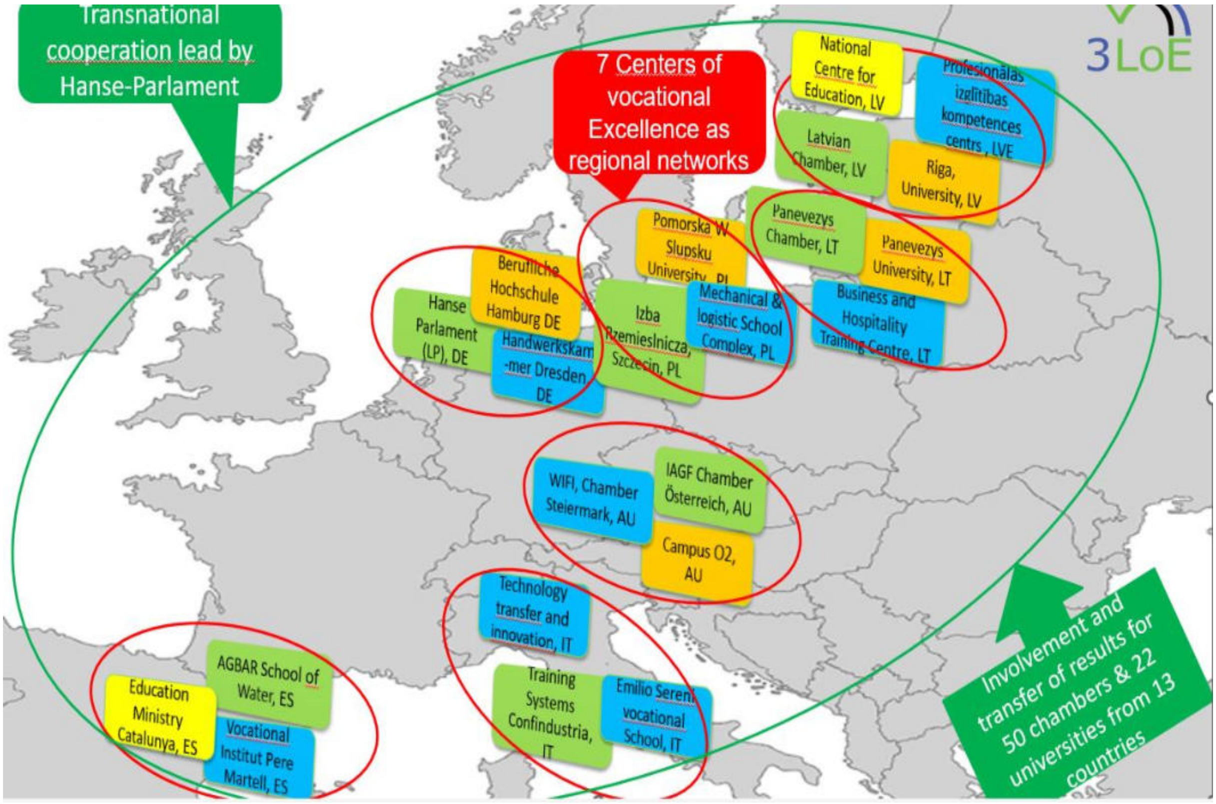
Result 4.3 Result
Green Economy training programs

PART A Curricula

Partner



Language

English

Content

Project Summary and Introduction

Curricula A Preparation and management of SMEs for work in the Green Economy

Curricula B Waste reduction and recycling management

Curricula C Wastewater treatment and recycling management

Curricula D Water supply and saving

Curricula E Cradle to Cradle in SMEs

Curricula F Energy generation from wastewater and waste

Project Summary and Introduction

About the 3LOE project

Around 99% of all EU businesses are SMEs, creating up to 70% of all jobs. In general, SMEs have good growth prospects for the future and are particularly well equipped to solve environmental problems and to enhance the green economy. However, in most of the project countries, SMEs are confronted with a shortage of skilled workers and young entrepreneurs. This shortage of skilled workers is even more alarming taking into account that due to aging of current entrepreneurs, a large and growing number of companies will have to be handed over to the next generation. Furthermore, young specialists and entrepreneurs often lack the qualifications and skills needed in order to respond to contemporary developments in the fields of energy, climate and environmental protection. The following problems have been identified in SMEs working in the fields of green economy, energy and environmental protection:

- Blatant and growing shortage of skilled workers.
- Large qualification deficits, especially in the Green Economy.
- Loss of attractiveness and low qualification of school-based VET.
- Low rates of further training and insufficient orientation of offers to SME needs.
- Ageing of entrepreneurs and increasing shortage of young people (demographic change).
- Failure of business transfers and low rates of business start-ups.
- Low innovation rates and insufficient productivity.
- Not enough cooperation between universities and SMEs and a lack of teaching geared to SME needs.
- Comparably low internationalization of SMEs and vocational training providers.
- Lack of national level support for SMEs".

To meet these challenges, work-based learning and new paths in vocational training must be provided through cooperation between educational institutions, economic chambers and SMEs. University graduates are often well-qualified in theory, but lack practical knowledge, skills and abilities that are crucial for SMEs. For this reason, VET reforms must also involve higher education, and should implement dual bachelor's degree programs that combine a bachelor's degree with vocational training and on-sight work in companies.

In the 3LOE project, an innovative and complex project structure with 22 project partners from 7 countries as well as 60 associated partners from 13 countries was designed. In each country, centers of vocational excellence (COVEs) in Green Economy will be established, managed and their permanent continuation ensured. A transnational cooperation of the centers will be developed, extended to 60 education stakeholders from 13 countries and operated permanently in an institutionalized form. The centers will offer a wide range of dual education measures in vocational training, further education and higher education, that are being developed, tested and evaluated in the project. These educational measures on EQF levels 3-7 focus on Green Economy, Digitalization and Entrepreneurship. Furthermore, vocational and educational consulting and innovation support for SMEs will be developed and implemented. In total, seven Train-the-Trainer programs will be developed and implemented permanently by the project partners. All results will be transferred to the 60 associated partners together with implementation advice.

The objectives and aimed outcomes of the 3LOE project can be summarized as following:

1. Foundation of a three-level Center in each project country

1.1 Building the "Green Economy" skills alliance for qualifications in SMEs with educational and economic actors from the 7 project countries; development of information and cooperation tools.

1.2 Expansion of the skills alliance to the 60 associated partners from 13 countries, comprising chambers of commerce, SME associations, as well as universities of applied sciences/colleges.

1.3 Development, testing and evaluation of a curriculum and teaching materials for Train the Trainer courses for personnel and center management (vocational schoolteachers, trainers in SMEs and lecturers in further and higher education institutions).

1.4 Evaluation of the construction and operation of the seven centers of Excellence and of the transnational cooperation.

1.5 Development of business and financing plans and ensuring the long-term continuation of the seven centres and transnational cooperation.

1.6 Development, consulting and introduction of political strategy program.

2. Implementation and realization vocational training

2.1 Development and implementation of a tool for vocational and qualification counselling as well as a training for consultants and teachers to use the tool.

2.2 Implementation of the dual system, so that work-based learning is put into practice in the project countries.

Preparation and transfer of curricula and examination regulations for dual vocational training for different professions and implementations in Poland, Lithuania, Latvia and Spain.

Development, test and implementation Trainings for teachers to conduct dual vocational training as well as Training of trainers in SMEs.

2.3 Development political concept for the training and integration of young people with learning difficulties for young people with learning difficulties (EQF level 3).

Development, test and implementation of a dual vocational training "Specialist for Building Insulation”.

2.4 Development, testing and evaluation of education programme, teaching materials and examination regulations for the provision of sector-specific qualifications already during the initial vocational training for stronger learners. Implementation in the dual system, so that work-based learning is put into practice in the project countries.

2.5 Development and implementation five-year technician training „Ecologic Solutions in Logistics”.

3. Implementation and realization of further vocational training

3.1 Development and implementation of concepts and instruments for the management of continuing vocational training.

3.2 Development, test and implementation of a Train-the-Trainer program for teachers to conduct further training.

3.3 Development and implementation of a concept "SME-fair digitalization" as well as development, test and implementation of two train the trainer programs "Basic and advanced digital skills".

3.4 Transfer and implementation of four further trainings Energy Saving and Renewable Energies.

3.5 Preparation, transfer and implementation of six further trainings in the Green Economy.

3.6 Development, testing and evaluation of different training programs and teaching material for owners, managers and qualified workers of SMEs (EQF level 5 and 6). The trainings are specifically tailored to SME needs and different qualification levels and combine the transfer of technical, professional and management know-how.

- Training Enterprise and Entrepreneurship in Green Economy
- Training Energy Service Manager
- Trainings vocational Master Carpenter and Electric
- Training Construction Technician
- Training Service Technician
- Training Sustainability in foodservice industry

3.7 Development of regulations for new continuing education occupational profiles with a focus on the green economy.

3.8 Development of an integration programme for the unemployed (EQF level 4) in order to be able to place the unemployed in permanent jobs through further training seminars and a further training qualification.

4. Implementation and realization of higher education

4.1 Preparation and transfer of curricula, evaluation and examination regulations for two existing dual Bachelor degree programmes "Management of Renewable Building Energy Technology" and "Business Administration for SMEs".

4.2 Development and beginning of implementation of new dual Bachelor degree programs

- Business Administration & Sustainable Management of SMEs
- Entrepreneurship and Innovation in Green Economy
- Logistics - Green Supply Chains
- Service technician
- Tutorial "Sustainable management Climate neutrality for companies"

4.3 Development, test and implementation of four study modules (EQF level 6) on SME management in the Green Economy sector, which will be carried out in the dual study system and integrated into existing Bachelor degree programmes.

4.4 Development and implementation of concept for innovation promotion Solutions for manageable R&D tasks of SMEs and conducting manageable R&D projects for SMEs-

4.5 Development, testing and implementation of Training program for university lecturers and SME advisors.

5. Dissemination, transfer and use of the project results

5.1 Development of a concept and summary evaluation of the dissemination results of all partners

5.2Transfer of all educational measures to 60 educational institutions in 13 countries and needs-oriented implementation consultations as well as realization of a bundle of measures for further dissemination of the project results.

5.3 Further dissemination activities such as presentations online, at third-party events, press releases and conferences.

5.4 Book with all results of the project and distribution via book trade.

For each of the three levels of educational measures there will be:

- Target-group-specific educational programs.
- Curricula, teaching materials, etc. developed in a leading role by the educational institutions of the respective level, whereby the educational institutions of the other levels (in particular universities) participate in an advisory and supportive manner.
- Representatives of the participant target groups involved in the development work.

All educational measures will be tested with the respective target groups under different national conditions in the countries, evaluated and completed on the basis of the evaluation results with application notes.

About the Green Economy training programs

Six different advanced training courses in green technologies will be offered to trainees with vocational training and several years of professional experience, to acquire skills in water, wastewater, waste and circular economy. Selective courses are specifically tailored to the needs of the target groups “SME-owners and managers” and “SME professionals”. The imparted learning content is cross-occupational, experts and interested companies from all lines of trades will be addressed. The learning results are rated at EQF level 5.

The offered advanced training courses may be supplemented by an integrative program for the unemployed with relevant pre-qualifications, thus, improving their chances on the lab our market.

A striking obstacle faced by SME is lack of time and permanent overburdening of their owners as well as their impossibility to release employees from work for a long-er scope of time to engage them in advanced trainings. There is also particular interest in ensuring that, as far as possible, qualifications offered should match individual skills needs of the employees and, at the same time, address specific SME issues. In re-sponse to such demands, a structural concept will be applied in the project, consisting of the following items:

- 2-3 learning phases with classroom teaching, delivered on two days per week, possibly Fridays and Saturdays,
- in between, longer on-the-job teaching periods at the trainees' workplace, cov-ering three to four months,
- Proposal for teaching periods at the trainees workplace:
  a) coaching by same trainers that are also delivering classroom teaching,
  b) optional and customized e-learning options,
  c) if possible, implementation of a specific development project within the com-pany, in the topic area of the respective advanced training (e.g. introduc-tion of Cradle-to-Cradle, recycling, etc.), involving as many employees as possible, thus, ensuring joint team learning.

An appropriate training method is, e.g., "Knowledge According to Individual Needs (KAIN)".

Following years of experience in advanced training of trainees in numerous European projects, the Hanse Parlament has developed and successfully tested the above-men-tioned "KAIN" three-part training method that is characterized by

a) achieving of a common knowledge base of participants with various pre-qualifica-tions

b) particular emphasis on individual experience of each course participant

c) demonstration of design possibilities for changing or mproving individual status of training participants in pursuing their project goals.

Under the project, the presented KAIN-method or any similar teaching and learning scheme shall be developed and applied, such as to match, to the greatest possible extent, specific SME demands as well as individual trainees` needs. Such approach also encourages readiness to further education, both among SME and among partici-pants, in as much as most of the countries involved in the project, should improve employee participation in professional development and upgrade trainings with respect to imparted skills and competencies. According to EU targets, at least 15 per cent of adults should participate in lifelong learning. This figure is significantly higher in the Scandinavian countries, ranging from 19.6 percentage points in Norway to 29.6% in Sweden, while in Lithuania and Latvia it is 6.0% and 7.3% respectively. In Poland, it was the lowest rate in the BSR - 3.7% and 8.4% respectively in Germany, below the EU-28 average at 10.8% (Eurostat). Practice in Scandinavian countries has shown that their highest advanced training rates are achievable thanks to e-learning, self-study and individual on-the-job coaching.

Under the project, six advanced training courses of each 30 to a maximum of 50 hours of classroom teaching will be implemented:

A Preparation and management of SMEs for work in the Green Economy

B Waste reduction and recycling management

C Wastewater treatment and recycling management

D Water supply and water saving

E Cradle-to-Cradle in SME

F Energy generation from wastewater and waste

The developed curricula and teaching materials will be tested and evaluated in different countries. Thus, different national conditions are included at the stage of development and project completion, thus significantly encouraging their use in different countries.

Result 4.3 Result Green Economy training programs is presented in two parts:

- Part A Curricula
- Part B Implementation and Evaluation

Part A is presented below.

Three-level Centers of Professional Excellence: Qualification, Entrepreneurship and Innovation in the Green Economy (3LoE)

Work Package 4: Second centre level "Continuing vocational training" (EQF Level 4-6)

Activity A6: Trainings in the Green Economy

Best Practice Curriculum

Training A – Preparation and management of SMEs for work in the Green Economy

Developed by:

Satakunta University of Applied Sciences (SAMK) in 2020 in the Project "Management and Technologies of Water, Waste Water, Waste and Circular Economy (WWW&CE)"

Prepared by:

Wirtschaftsförderungsinstitut (WIFI) Steiermark

August, 2021

Co-funded by the Erasmus+ Programme of the European Union

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Chapter 1: Executive Summary

The course "Preparation and management of SMEs for work in the Green Economy" was developed in the project "Management and Technologies of Water, Waste Water, Waste and Circular Economy – WWW&CE", which was funded by the Erasmus+ Programme of the European Union. Eleven partners from seven EU Member States developed tools according to work-based learning principles that are piloted and evaluated. For more information: https://www.sa-ce.eu

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The course is designed according to the qualifications on the European Framework Qualification Level 4 to 6. Furthermore, the six courses are primarily designed for young people with strong learning skills for vocational training. All courses of the WWW&CE project shall direct participants and in further sequence small and medium sized companies towards a more environmentally conscious approach to their personal and business objectives in order to generate a more sustainable world.

The main objective of the course "Preparation and management of SMEs for work in the Green Economy" is to equip employees or potential employees with fundamental knowledge and skills about Sustainability, Circular Economy and Green Innovation. The knowledge acquired will enable small and medium sized enterprises to respond quickly and sustainably to the challenges of our rapidly changing world.

Chapter 1.1: Name of the Course

"Preparation and management of SMEs for work in the Green Economy"

Chapter 1.2: Contact Details

WIFI Steiermark

Körblergasse 111-113

Co-funded by the Erasmus+ Programme of the European Union

A-8010 Graz

Tel.: +43 306 602 1234

Fax: +43 316 602 301

E-Mail: info@stmk.wifi.at

Web: https://www.stmk.wifi.at

To be adapted by each partner

Chapter 1.3: Type of Course

The goal of this course is to support employers and entrepreneurs of small and medium size enterprises to adapt to the changing world and to gain all the benefits of green economy.

The curriculum approaches the green economy on point of view of small and medium size enterprises (the SMEs). In the curriculum, the following issues should be taken into account:

1. The approach that is called "green economy" is holistic. It does not concentrate to only one or few of the challenges of sustainability but aims to see all the goals of sustainable development as valuable and desirable.

2. The business activities in green economy are not the evil itself, but their goal must be in line with the goals of sustainability. This means, that growth is a positive and desirable phenomenon, but only if it benefits societal and environmental goals of sustainable development, e.g. if it enables better education, encourages and helps the poor, disabled and women to improve their life and gives enterprises an opportunity to develop their capabilities and processes to meet the new environmental requirements.

3. The green economy is not a concept bought off the shelf, but a developing and modifiable draft, that is defined and realized by the work of the actors involved in the green economy.

4. In small and medium size enterprises, the resources needed to prepare and manage the transition to green economy are not unlimited. There are lack of personnel, insufficient skills and knowledge and limited financial resources.

5. Although the challenges are worldwide and the programme European union wide, each country has its own country-specific characteristics, like legislation and local regulation. Thus, the curriculum should be modifiable and applicable to each country.

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Chapter 1.4: Target Group

The training is directed to

- small and medium sized enterprises and their entrepreneurs and employers. It is recommended, that the participants have at least the basic vocational education.
- Students of further vocational education who are interested in green economy and / or green entrepreneurship.
- The training will also suit bachelor-level students who are interested in green economy and / or green entrepreneurship. However, the training is not intended to be approved as a part of bachelor's grade. Depending to the requirements and regulation of each country, further training and / or further assessments may raise the course to the level required in bachelor's grade.

Also, the others who are interested in green economy, for example those who are planning a business of their own, are welcome to participate to the training.

Chapter 1.5: Competences Obtained

The aim of the education is to give participants skills and knowledge required to manage the business toward green economy. The concrete competences are:

SENSE FOR ENVIRONMENTAL ASPECTS	To give participants an understanding of environmental issues that will affect our societies and businesses in the near future.
KNOWLEDGE IN SUSTAINABILITY	To give participants an understanding of sustainability and sustainable development and how these concepts can help to tackle the challenges caused by changing climate and other environmental and societal threats.
KNOWLEDGE ON LEGAL FRAMEWORK IN THE FIELD OF SUSTAINABILITY	To give participants a common information concerning the European and national policies concerning the environmental issues, sustainability and green economy.

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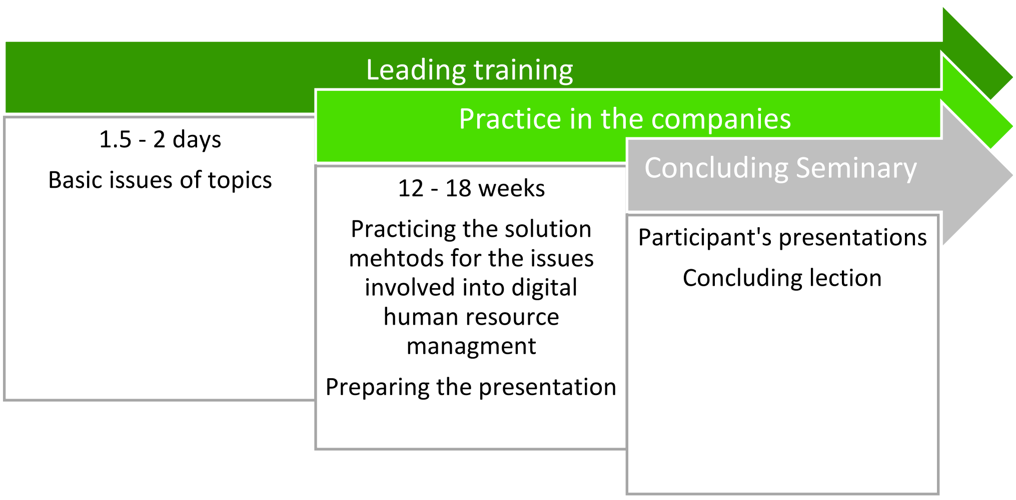
BASICS IN GREEN ECONOMY	To give participants a basic knowledge of green economy and its benefits and challenges for an enterprise and business.
INNOVATIVE THINKING	To help participants innovate new ideas how they and their companies will find the best ways to respond the challenges.

Chapter 1.6: Course Duration

The training process is composed of three phases:

- classroom teaching (21 – 20 hours)
- self-study with external support (150 – 200 hours)
- report and reflection. (15 -20 hours)

The training begins with a total of 3 -4 days theoretical part, during which the basic issues of each topic will be clarified by both lessons and group works. The leading part will be followed by 12 – 18 weeks practice in company, during with the participant gets known with the topics of the course in point of view of this company. During the practice a student will also prepare a presentation concerning the findings found and ideas got during the period in the company. After the practice is completed, a seminary of 1.5 – 2 days will be hold. In this seminary the participants will present their presentations, discuss their experiences and ideas, and finally, everything will be concluded with a lecture concerning the relationship between business management and HR-management.



Chapter 1.7: Required Prerequisites

The content of the course is designed as a training according to level four (4-6) of the European Qualifications Framework (EQF).

The participants entering the training programme shall meet at least one of the following requirements based on the content of the curriculum:

a) One has vocational qualification and several years of professional experience as a qualified worker/environmental specialist;
b) SMEs representatives.

Chapter 2: Introduction to the Topic

According to European parliament, Europe should take the leading role in fighting against climate change by using its unlimited creativity to achieve solutions for sustainable growth. This was one of the recurrent themes behind the founding of Horizon Europe, the EU's next research and innovation programme, due to start in 2021. The European Parliament and the Council agreed on Horizon Europe in April 2019. Based to this agreement the Commission has started to prepare the implementation of the programme, including the first 'Horizon Europe Strategic Plan 2021-24'. The plan, focused on Horizon Europe's second pillar: 'Global Challenges and European Industrial Competitiveness', will identify major policy drivers, strategic policy priorities, and targeted impacts to be achieved as well as identify missions and European Partnerships.

The pillars of the Horizon Europe (Figure 1) are Excellent Science, Global Challenges and European Industrial Competitiveness, and Innovative Europe. The pillars will be based to widening participation and strengthening the European Research Area.

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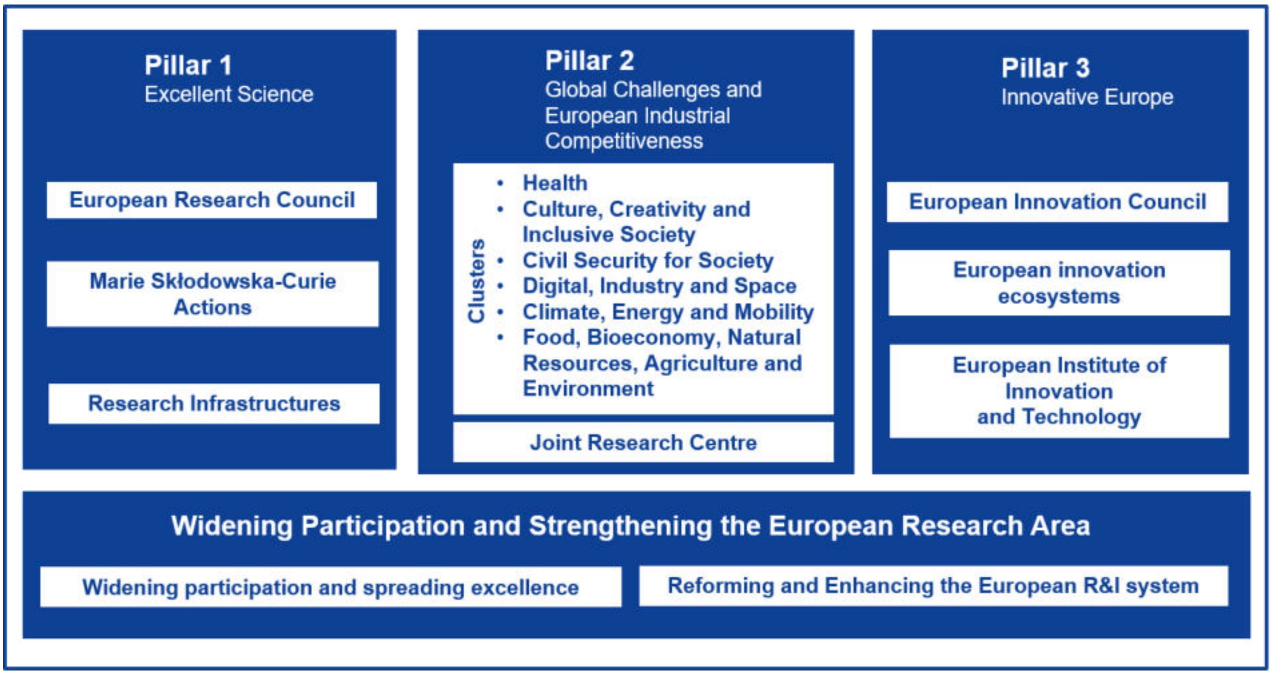

Figure 1: The pillars of the Horizon Europe (Source: https://ec.europa.eu/info/horizon-europe_en)

Horizon Europe will incorporate research and innovation missions to increase the effectiveness of funding by pursuing clearly defined targets. There has been identified 5 mission areas, each with a dedicated mission board and assembly. The areas are

- Adaptation to climate change including societal transformation
- Cancer
- Climate-neutral and smart cities
- Healthy oceans, seas, coastal and inland waters
- Soil health and food

The mission areas highlight the interdisciplinary approach to current and future challenges sooner than unbalanced fighting against single problem like climate change. The European parliament has emphasized the importance of taking also the societal and growth aspects into account as an important part of sustainability when aiming to the sustainable living, industry and business.

Green economy

The concept of the green economy has become topical mainly because it provides a response to the crises that the world has experienced during the bypassed years, in particular to the environmental and economic crises. It also offers an alternative approach to growth while aiming to protect the eco-systems and to decrease the impacts of poverty.

The United Nations facilitated an international conference on sustainable development ("Rio Convention") in Rio, Brazil, in June 2012. One of the main themes of the conference was a green economy in the context of sustainable development and decreasing of poverty. It was stated that " *a green economy in the context of sustainable development and poverty eradication should lead inter alia to meeting key global priorities such as food security, more effective water management and access to modern energy supply systems. And lead to improved resilience, public health and sustained, inclusive and equitable growth that generates employment, including for youth.*"

There is a growing policy focus on economic growth based on building a green economy in the European Union. The member states of the European Union and the European parliament are emphasizing the potential impact of an emerging green economy on the future of work. Attempts to tackle climate change can alternatively result in the creation of millions of new jobs within the next decades or cause a loss of millions of existing jobs – or both.

The changing climate will bring fundamental changes to economies and societies. The new skills will be needed to adapt the societies to these changes. To develop this adaptive capacity across society, research on what skills will be needed in the long term will be needed, and a response by schools, colleges, universities and professional associations, concerning the education and training, as well as governments, concerning the funding and new regulation, will be required.

When designing this curriculum, the diversity included into concept sustainability has been borne in mind. The green economy has been defined as low carbon, resource efficient and socially inclusive economy where growth in employment and income are driven by public and private investment into such economic activities, infrastructure and assets that allow reduced carbon emissions and pollution, enhanced energy and resource efficiency, and prevention of the loss of biodiversity and ecosystem services. Another definition of green economy states that the green economy is an economy that aims to reduce environmental risks and ecological scarcities. Green economy also aims for sustainable development without forgetting the environment. It is closely connected with ecological economics, but the approach is more politically focused. The UNEP Green Economy Report of 2011 states "that to be green, an economy must not only be efficient, but also fair. Fairness implies recognizing global and country level equity dimensions, particularly in assuring a Just Transition to an economy that is low-carbon, resource efficient, and socially inclusive." The feature that distinguishes it from prior economic regimes is that it recognizes that natural capital and ecological services have economic value and a full cost accounting system in

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which costs externalized onto society via ecosystems will be reliably tracked, and attributed to the entity that has caused damages or neglected its duty.

Chapter 3: Curriculum

Chapter 3.1: Content of the Curriculum

Part I: First Workshop (Totaling 3 - 4 days training)

Goals and tasks of the first workshop are

- to enable knowledge transfer about the KAIN-method, embedded in the contents of HR-policy and workplace innovation,
- to create a common basis of knowledge among the project participants concerning the management of change processes and employee participation,
- to encourage the exchange of experience about successful projects for work design and exploration of beneficial and hindering influencing factors and to
- form a preliminary orientation on topics for a change process in the own company.

During this 3 – 4 days' workshop the participants get to know models and instruments from project-related research for structuring and solving problems and learn to apply them. This is intended to create a common conceptual basis for the further procedure in the training.

The models and instruments presented as examples and design recommendations for practical use, ideally form a common framework in which, in particular, the existing experiences of the participants are to be integrated in order to pursue the training objectives. The experience of the participants should serve to supplement or modify the proposals for structuring and solving problems given by the research.

Thus, at an early stage of the training, a necessary adaptation of the proposed models and instruments to the individual needs and characteristics of the participants on site, usually with different frameworks and conditions, should take place.

Before the first workshop, a trainer designing the course should select and modify the models, instruments and other material applicable to just this country, area, branch and companies in question. The material presented in this curriculum consists of common examples and works as models and stimulus for trainers

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Preparation and management of SMEs for work in the Green Economy (45 h lessons + self-learning and project work)

Part 1: Classroom teaching (three – four days)

Note: Two shorter breaks (with coffee) and one longer break (Lunch) shall be held during the day.

Note 2: The material presented below are examples and stimulus, which should be applied and modified according to the country, area, background, level and needs of trainees, and according to knowledge areas of trainer. The times are suggestions and may vary depending to the weighting of topics (see above).

Time duration (in hours)	Topic	Content
0.5 – 1.0	**Welcome, registration, training arrangements and material**	Teacher motivates participants to making transition actions in their SMEs toward s a green economy. Participants present themselves and express their wishes for the VET training.
1.5 – 2.0	**Getting hold of the green economy. Green economy in SDGs.**	The objective of this lecture is to introduce the concept of green economy and how it is linked to the Sustainable Development Goals. Defining green economy. UN Environment Programme definition: https://www.unenvironment.org/regions/asia-and-pacific/regional-initiatives/supporting-resource-efficiency/green-economy European Environment definition: https://www.eea.europa.eu/publications/europes-environment-aoa/chapter3.xhtml Investopedia's definition: https://www.investopedia.com/terms/g/greeneconomics.asp.

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		The global green economy: a review of concepts, definitions, measurement methodologies and their interactions: https://rgs-ibg.onlinelibrary.wiley.com/doi/pdf/10.1002/geo2.36 Green growth and sustainable development: http://www.oecd.org/greengrowth/ Green economy principles: https://www.greeneconomycoalition.org/assets/reports/GEC-Reports/Principles-priorities-pathways-inclusive-green-economies-web.pdf Sustainable development goals: https://www.un.org/sustainabledevelopment/ Green SMEs in the European Union: https://kgk.uni-obuda.hu/sites/default/files/34_Szabo%20Antal.pdf
1.0 – 1.5 1.5 – 2.0	**Green economy: opportunities and challenges** **The topic includes group work and joint final discussions on green economy opportunities and challenges in SMES.**	The objective of this lecture is to explain why green economy is a relevant concept for SMEs. Inclusive solutions for the green transition: SMEs: Key Drivers of Green and Inclusive Growth https://www.oecd.org/greengrowth/GGSD_2018_SME%20Issue%20Paper_WEB.pdf
1.5 – 2.0	**The strategy and policy of the European Union: Green growth and circular economy. National and regional strategies.**	The objective of this lecture is to explain the European Union strategies related to green economy. The national and regional strategies

		provide application guidelines for local action at SMEs.
1.0 – 1.5	**The topic includes group work and joint final discussions on National and regional roadmaps and actions plans: Role of SMEs.**	Green growth and circular economy https://ec.europa.eu/environment/green-growth/index_en.htm Building capacity and supporting SMEs in their transition to sustainability https://ec.europa.eu/growth/smes/sme-strategy_en Unleashing the full potential of European SMEs https://ec.europa.eu/commission/presscorner/detail/en/fs_20_426 An Overview https://www.un-page.org/files/public/20170728_report-layout-online.pdf
1.0 – 1.5	**Financial possibilities for SMEs: European Union, national, regional and local finance**	The objective of this lecture is to explain national funding schemes according to the recipient country. Access to finance for SMEs https://ec.europa.eu/growth/access-to-finance_en
1.5 – 2.0 1.5 -2.0	**Capacity building: Green economy strategy, action plan and staff's skills and knowledge development at SMEs.** **The topic includes group work and joint final discussions on**	The objective of this lecture is to introduce capacity-building measures both in the company strategy level and in identification of the skills required for green jobs. Green action plan for SMEs – implementation report

	skills and knowledge demand in green economy at SMEs.	https://www.resourceefficient.eu/sites/easme/files/EREK_report_Implementation_of_SME_Green_Action_Plan.pdf How to measure and model social and employment outcomes of climate and sustainable development policies: https://www.un-page.org/files/public/green_jobs_training_guidebook_0.pdf Eco-innovation – An EU Action Plan https://www.switchtogreen.eu/?p=1166 Green Action Plan for SMEs https://www.oecd.org/environment/outreach/Laura-Giappichelli-EC-Green-Action-Plan-Kiev.pdf Circular Economy Action Plan The European Green Deal https://www.occe.eu/wp-content/uploads/2020/03/new_circular_economy_action_plan.pdf Skills for greener future: A global view https://www.ilo.org/wcmsp5/groups/public/---ed_emp/documents/publication/wcms_732214.pdf
1.5 – 2.0 1.5 – 2.0	**Green economy approaches at SMEs: technology, investments and finance. Role of eco-innovations at SMES. Best practices.**	The objective of this lecture is to introduce possible eco-innovations. Video: https://youtu.be/6L_ipFvVtWE

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	The topic includes group work and joint final discussions on green economy innovations in SMEs.	Inclusive solutions for the green transition: SMEs: Key Drivers of Green and Inclusive Growth https://www.oecd.org/greengrowth/GGSD_2018_SME%20Issue%20Paper_WEB.pdf ECO-INNOVATION at the heart of European policies https://ec.europa.eu/environment/ecoap/_en Policy and funding https://ec.europa.eu/environment/ecoap/about-action-plan_en A guide to eco-innovation for SMEs and business coaches https://www.eco-innovation.eu/index.php/guide-for-smes?download=24:eco-innovation-sme-guide-2nd-edition Eco innovation http://unep.ecoinnovation.org/ Inspiring circular economy solutions https://www.sitra.fi/en/projects/inspiring-solutions/
2.0 – 3.0	**Green economy tools and instruments**	The objective of this lecture is to introduce several tools available for green economy management. The Circular Economy tools and instruments https://ec.europa.eu/environment/green-growth/tools-instruments/index_en.htm ISO 14000 family: environmental management

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		https://www.iso.org/iso-14001-environmental-management.html ISO 14001:2015 - environmental management systems, a practical guide for SMEs https://www.iso.org/publication/PUB100411.html The EU Eco-Management and Audit Scheme (EMAS) https://ec.europa.eu/environment/emas/index_en.htm Environmental Policy Toolkit for Greening SMEs https://www.oecd.org/environment/outreach/Greening-SMEs-policy-manual-eng.pdf Cradle to Cradle https://www.c2ccertified.org/ Circular economy tools and instruments https://ec.europa.eu/environment/green-growth/tools-instruments/index_en.htm Circulytics - measuring circularity https://www.ellenmacarthurfoundation.org/resources/apply/circulytics-measuring-circularity EU Eco label https://ec.europa.eu/environment/ecolabel/ Green industrial policy and trade: A tool-box https://www.un-page.org/files/public/gita_manual_150ppi_full_3.pdf Practitioner’s Guide to Strategic Green Industrial Policy and the supplement

		https://www.un-page.org/files/public/practitioners_guide_to_green_industrial_policy.pdf and https://www.un-page.org/files/public/practitioners_guide_to_green_industrial_policy_supplement.pdf Green Industrial Policy: Concept, Policies, Country Experiences https://www.un-page.org/files/public/green_industrial_policy_book_aw_web.pdf Carbon footprint calculator http://carbonfootprintmanagement.com/free-co2-carbon-calculator/ Carbon handprint Guide https://cris.vtt.fi/ws/portalfiles/portal/22508565/Carbon_Handprint_Guide.pdf Water footprint https://waterfootprint.org/en/water-footprint/ Simple LCA for SMEs https://ec.europa.eu/environment/archives/emas/toolkit/downloads/5_1_lca.pdf
2.5 -3.0 1.5 – 2.0	**Green business models, including company presentations (real company cases on implemented green economy solutions, models, etc.).**	The objective of this lecture is to show business model opportunities with green economy practices.

	The topic includes group work and joint final discussions on business model development.	Green Business Model Innovation https://www.diva-portal.org/smash/get/diva2:707240/FULLTEXT01.pdf Building Blocks: Circular economy design, business models, reverse cycles and enabling conditions are essential https://www.ellenmacarthurfoundation.org/circular-economy/concept/building-blocks?gclid=CjwKCAiA-f78BRBbEiwATKRRBJ0FMAw4YKoBVztqytJxmUlRn0kT7kejPnpO16s-PTGT6Oqgbz6mDhoCHQAQAvD_BwE 23 Green Business Ideas for Eco-Minded Entrepreneurs https://www.businessnewsdaily.com/5102-green-business-ideas.html Green Business Models to Change the World: How Can Entrepreneurs Ride the Sustainability Wave? https://timreview.ca/sites/default/files/article_PDF/TIMLS_Westerlund_TIMReview_July2013.pdf The sustainable Business Model Canvas https://www.case-ka.eu/wp/wp-content/uploads/2017/05/SustainableBusinessModelCanvas_highresolution.jpg
1.5 -2.0	**Introduction to self-studies and project work**	Green SMEs contribute to the protection of the climate, environment, and biodiversity through their products, services, and business practices.

Self-studies and project work

Setting and explaining the assignment: The aim of the practice period is to help participants to establish an action plan through which their company can deliver services, products, etc. related to i.e. resource efficiency, green economy, staff development, and eco-innovation to SMEs'. During the self-study and project period the participants will deepen their knowledge on the green economy topic they have selected to be completed in their own SME. The background and reference material will be collected to meet the needs of the company, the industry sector and the local conditions. The documents and materials used in the first seminary days will be a good starting point to the task. Participants can also deepen their knowledge on the group work themes, which also serves to find the topic for their own SME. Participants will observe e.g. what kind of barriers and enablers they find in company, what kind of / which tools and applications would benefit the green economy management functions of the company best, how would they transfer the tools and technology into the organization, what kind of benefits they could give, or what kind of risks they might include. Write a brief report and prepare a presentation to be presented in the concluding seminary [Note to teachers: max length of a presentation depending to total number of presentations all should be presented within the time reserved for them. The time for project work presentations and discussion should not be forgotten].

Setting and agreeing the project work and how to report it in trilateral composition (Trainee, Trainer/Lecturer, Representative of an enterprise) either during the first seminary or in the beginning of the learning at the project work. In this phase, the needs of the enterprise, competencies of trainee and goals of the training should be taken into account. This is the only way to guarantee the commitment and motivation of all three parties in each project. It must also be borne in mind, that the project work and / or its results are not necessary public but may contain confidential business information. Thus, the form and content of publication, e.g. as a part of presentation in concluding seminary, must be agreed and defined individually.

Part II: Learning at the Work Place and Project Work

12 - 18 weeks self-study and practice in company

During the company-specific practice, students compile the assessments given during the training phase in the point of view of each company. This may include general overview of company, the attitudes of employees, entrepreneurs and company to the sustainability in common, ecologic and

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environmental issues, the ways they are approaching the green economy, and the opportunities by which a company can benefit the changes, some examples to be given. The results will be briefly presented in the concluding seminary, separate or together with the project work presentation.

Goals and tasks of the self-study-phase are

1. Accompaniment and support of change processes in enterprises, from the formulation of objectives, description of measures, conception of implementation to impact analysis by training and process-oriented, if necessary, also technical consulting,
2. Application and transfer of knowledge into the individual practice of the participants on site.

In this part, the participants have the task of applying the knowledge acquired in the first part and the knowledge of how to shape their own practice in the sense of the training idea in their companies / organizations. For a sustainable learning, it is necessary that they plan, implement, evaluate, critically reflect and document their own project or activities to improve a situation on site under their individual framework conditions in the "here and now".

This phase with the duration of approx. 12 – 18-weeks is accompanied and supported by professional advice and support given by the trainers / consultants. In principle, the participants should apply and implement the knowledge they have acquired in Part 1 themselves. As a rule, however, advice and support are often required in order to apply the process of adapting the knowledge acquired in Part 1 of the training appropriately under the real conditions on site and to lead one's own project to success.

<u>The role of the trainers/consultants</u>

The support given by the trainers can vary from a rather simple general consultation in the sense of passing on relevant information to an intensive accompaniment in the sense of coaching. In individual cases, it is usually necessary to find out, what kind of support it is needed to enable the individual participant to pursue his or her individual project goals.

In this phase, it is quite possible and even usual, that, when applying the models and instruments presented in the first phase in practice, the individual project proceeds differently than initially thought and planned by the participant. Even in such situations, the trainers of the project team can provide valuable support in pursuing the "actual" project goals.

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This second part of the training enables in particular the very welcome didactic aspect of working on concrete improvements in one's own company / at one's own workplace, which is associated with a high motivation to learn. In this learning process, the company management and other employees are usually intensively involved in what is actually done at the workplace, thus achieving joint learning and strong multiplication effects in the training.

Further advantages, i.e. what has been learnt, is directly implemented in everyday business life, or the innovations associated with project work are in the interest of company's management, quickly become visible and motivate managers to promote further training for the workforce and to use it as a strategic instrument of company management. The advantages also respond to the particular needs of small and medium-sized enterprises, which are constantly suffering from a lack of time as the biggest obstacle to training. In common, the KAIN Training Method eliminates absenteeism nearly totally.

Part III: Conclusion Workshop

1,5 – 2 days seminary

Goals and tasks of the conclusion workshop are

- Reflection (evaluation) about the success in the given task and the learning process
- Identify supportive and obstructive conditions of "changing to green"
- Derivation of "lessons learned" for further changes towards the green economy

In the third part of the training, the participants will present and discuss the experiences and the insights gained during the practice period), as well as their individual projects. Both the participants and the trainers have as their particular task to review the projects and to reflect on whether or respectively what contribution they make to the sustainable pursuit of the overarching training idea to strengthen the capacity and ability for HR-policy and workplace innovation. The exchange between the participants can provide them with very valuable impulses on how to make their own project even more successful. In this context, an important goal can also be to show which major obstacles are responsible for "not-yet-success" in order to work on this in the future.

<u>The role of the trainers/consultants is to</u>

- Enable constructive exchange between the participants,
- Focus on the common basis for the pursuit of (general) training objectives, and

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- Moderate an instructional discussion on the identification of supportive and obstructive conditions of change processes and present contributions for a possible reduction of resistance in the tracking of individual projects.

Schedule of the Workshop		
Day	**Content**	**Duration (in hours)**
1	• Welcome, registration and material • Presentation of students, discussion and feedback of the trainers – if needed continue the next day	7
2	• Key note on local actions on green economy management - Concept of green economy management at SMEs - 'Experiences from the local company, i.e. strategies, personnel, etc. • Wrap- up of the course content and achievements, feed-back survey, diplomas, etc.	7

Chapter 3.2: Conduction of the Training

Chapter 3.2.1: Part 1 - classroom teaching

Key objective: imparting knowledge - forming a common ground within the group.

This training module consists of altogether 3 – 4 days' workshop, during which participants learn about basic concepts and instruments available for structuring and solving problems. This is intended to form a common conceptual ground for further training steps. The module ideally forms a common framework, mainly to better integrate existing experience of participants in pursuing their training goals. The experience of participants may complete or modify the research proposals on structuring and solving problems.

Taking into account the individual needs of the participants in classroom training requires a high degree of expertise and experience by trainers, including their ability to use interactive and participant-oriented didactic methods.

Another addressed focus in the first part of the training is to highlight relevant issues with regard to planning, implementation and assessment of the projects that will be processed in the second part of the training. Thus, another key objective of this part of the training is to equip the trainee with skills and knowledge required to find, create and utilize the concepts and tools needed in his individual project. In a sense, application and implementation of the presented models and instruments by trainees at their work constitutes the primary focus of the second part of the training concept.

Chapter 3.2.2: Part 2 - Teacher-assisted self-study in the company or organization of trainee

Key objective: transfer and application of acquired knowledge in the trainees` individual job in practice.

In the second part of the training (duration approx.. 12 -18 weeks), trainees should apply the skills and knowledge acquired in the first part of the training with respect to their individual job practice at their company/organization, in line with the training idea. For a sustainable learning effect, it is crucial that trainees plan, implement, evaluate, document and critically reflect on their own project or their own activities with regard to improving their individual situation under their respective "here-and-now" conditions.

This course phase is accompanied and assisted by trainers and their technical advice and support. Principally, trainees are on their own with respect to applying and implementing knowledge acquired in Part 1. As a rule, however, advice and support are usually required in order to properly enjoy the benefits of adaptive process of newly acquired knowledge from the training Part 1, now under real-life conditions, and to turn the project into success. Support by trainers varies a lot. It is recommended to decide case by case, which type of support is best suited to enable each trainee achieving individual project goals.

At this stage, it is possible that, while processing the information gained during the Phase 1, the projects of the trainees may differ from their initial concepts and plans. In such case, trainers may lend a helping hand in bringing back on track "real" project goals.

The second part of the training allows fine-tuning improvements on the job or in one´s own company, thus, ensuring high learning motivation. As a rule, this type of learning, embedded in real job conditions, involves committed personal involvement of company management and other employees, and, by joint team learning, delivers expressive multiplier training effects.

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Further advantages are straight implementation of the acquired new knowledge in daily job operations; project-related innovations are in the interest of corporate management; they become quickly tangible, and managers feel encouraged to continue with advanced trainings for their employees, turning them into a strategic instrument of corporate management. Apart from this, this training approach responds to needs of SMEs, which biggest barrier to good training is their lack of time. Under KAIN training method, lost working hours and work absences are almost entirely avoided.

Chapter 3.2.3: Part 3 - Individual project presentation and reflection

In the third part of the training, experience and insight gained will be presented and exchanged in a joint event with focus on presenting the projects of individual participants. This training session takes approx.. 1.5 to 2 days. Both the trainees and the trainers will be asked to review and reflect on projects presented by the participants and to analyse answers with respect to a possible contribution to sustainable training target tracking. Moreover, a further key goal may help identifying major barriers to "not-yet-a-success" and fix them in the future.

The exchange of information amongst participants may provide valuable information on how to improve their own projects to be even more successful.

<u>The role of the trainers</u>

It is a task of the trainers to take into account the individual needs and particularities of the participants on site in a face-to-face training. This requires a high degree of knowledge and experience with the use of interactive and participant-centered didactic methods on the part of the trainers. A further focus of the first part of the training is to introduce the participants with the planning, implementation and critical evaluation of their own project work they are involved in the second part of the training. Thus, another central goal of this part of the training is to give the participants important impulses for the implementation of the presented models and instruments in their own project. The application and implementation of the presented models and instruments by the participants "at home" is, so to speak, the focus of the second part of the training concept.

At this stage, trainers have the following functions:

a) facilitating a constructive exchange amongst participants,
b) emphasizing the shared common idea with respect to the pursuit of the general training goals,
c) ideas on struggle-free implementation solutions for trainees` projects.

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Of course, upon completing third part, subsequent longer self-study phase may follow, combined with on-the-job implementation, followed again by classroom-teaching in form of a third workshop, etc.

At the end of the training, all participants should have sufficient information and idea on how to implement and pursue the basic training idea, mostly under different real-life conditions.

Content of the Curriculum

The variation in regulations and circumstances and qualification requirements are quite different in the BSR-countries, thus the material was written only as a form of framework inside which the local actors should modify the contents of modules according to their own regulations and national, regional and local requirements, without forgetting the needs of different study programmes. By using innovative, problem-based and experiential educational approaches, teacher will be able to help students to become experts who are able to create and implement the principles of green economy into their business.

The general objectives of the curriculum are to

- develop an overall image of the green economy and its activities at SMEs, and understand its basic principles,
- understand the problems related to sustainable and green business and how companies can resolve their activities to cope with the legal and regulatory, green economy and financial aspects,
- become familiar with approaches that could promote the green economy and
- create a vision of practical activities that could be undertaken by different sectors to promote green economy at SMEs.

The material listed in the curriculum is a collection that each teacher should complete with videos, articles and books approaching the topics in point of view of just the branch and region where the course is held. Each teacher should take into account the national, regional and local legislation and regulation, as well as the supportive and financial opportunities available by national, regional and local actors. The presentations enclosed are skeletons around which each teacher can and should build a localized and customized presentation that takes into account the needs of just this group of participants.

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Chapter 3.4: Teaching/Learning Equipment and Literature

Equipment:

Classroom equipped with school furniture, demonstration tools, and IT devices.

Literature/Sources:

Textbooks, methodical handout materials, national legal acts for waste management as well as material created by teachers/trainers.

Chapter 3.5: Further recommendations and Notes

Learning methods

In this course, the following techniques are recommended:

- Classroom teaching: Lectures, visiting lectures (local entrepreneurs), group works, videos, etc.
- Individual learning including
  - reading of given articles or any other assignments,
  - getting known with activities, responsibilities and rights of local, regional, country level EU-level authorities and given organizations by visiting their websites,
  - assessments, e.g. designing a business plan of own business or employer,
- Practical learning on the job and realization of a corresponding project in the company with consulting support by the teachers
- Learning diary or other form of reporting the learnt issues.
- Concluding presentations

Covid Situation

During the era of any pandemic such as Corona, it must be considered, that the teaching / learning in classrooms may not be recommendable, allowed or possible at all. In such cases, the course is easy to transfer to any distance learning platform. The following activities are recommended, but not obligatory:

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- The first session should be lectured online. In this session, the use of learning platform should be guided, and the schedule, rules and practices of the course should be presented
- The introduction sessions of each topic can be lectured online.
- Teacher records the introduction lectures and uses the suitable parts of PowerPoint presentation in each topic. If the session is lectured online, the recording is recommended to be recorded at the same time.
- The videos, presentations and links to further material needs to be available on the learning platform to be accessible for each participant.
- It is recommended, that teachers are available in online meetings with both groups and individual participants at least weekly to see how the learning is going, to answer the questions, and to support those who are not so accustomed to individual learning, and / or using the learning platforms. These meetings should be scheduled and informed to each participant.
- It is suggested, that during the practice period, each teacher and other expert agreed to be available as coach, trainer and support, informs a plan of times when he / she can be contacted if necessary.

The method used in the course - KAIN

This course is based to the KAIN-method (KAIN = Knowledge Acquisition according to Individual Needs). The KAIN-method creates a common knowledge base for participants with different backgrounds in training and consulting processes. It takes particular account of the individual experience of participants, shows possibilities to change/improve the situation of the participants on site for the pursuit of project goals and change measures, sharpens the knowledge of possible needs for change, and enables those involved participants to design the right measures and implement them correctly. The KAIN-method is characterized by

a. achieving of a common knowledge base of participants with various pre-qualifications
b. particular emphasis on individual experience of each course participant
c. demonstration of design possibilities for changing or improving individual status of training participants in pursuing their project goals.

The training process is composed of three phases:

1. classroom teaching

2. self-study with external support
3. report and reflection.

Chapter 3.6: Requirements for the trainer's qualification:

The trainer must meet the requirements for a VET trainer by the procedure established by national legal acts.

Chapter 4: Teaching Material

The material enclosed and the provided links in the curriculum (chapter 3) are examples showing how the topics of this course could be presented. Each teacher should adjust this to the circumstances of his own country, considering the local, regional and national regulation, and the background and interests of the students; are they studying or working in the branch of engineering, environmental topics, finance or marketing, or are they entrepreneurs or employees, some examples to be given. Each background and area of interests may require different weightings and highlights, and it is on the responsibility of each teacher to consider these special needs.

Presentation: The enclosed PowerPoint presentation should be adapted to local needs, requirements, regulation and legislation, and by weighting the local point of views.

Preparation and management of SMEs

A preparation and management of SME's for work in the green economy

European Environment Agency

Video of Circular economy 2:03

https://www.youtube.com/watch?v=_9mHi93n2AI

Ellen MacArthur Foundation

Multi-Lingual Content (Spanish, French, German & more)

https://www.youtube.com/playlist?list=PLXT_ozykGVakPSxaGUCwgDRKm-zy_s-uq

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EU climate action and the European Green Deal

https://ec.europa.eu/clima/policies/eu-climate-action_en

https://www.unep.org/

TOPIC: GREEN ECONOMY

Green Economy Policies and practice

The United Nations Environment Programme (UNEP) launched a Green Economy Initiative in 2008, which aimed at encouraging investment in improving the environment as a new engine for economic growth. The initiative resonated with policy makers such that "green economy" was adopted as a major agenda item for the 2012 United Nations Conference on Sustainable Development.

Governments and businesses are intuitively attracted to the notion that investing in clean technologies, clean water, and clean mobility, etc. can improve the environment while creating jobs and markets. Some of them acted upon this notion accordingly, such as in China and the United Arab Emirates. For the green economy model to sustain beyond anecdotal examples, however, it needs a systematic framework that speaks to policy advisers and business executives, as well as the graduate students who will step into those positions in the coming years.

This textbook attempts to offer that systematic framework for the green economy model. It builds on and extends from the traditional economic growth model by articulating the contributions to productivity from investing in natural capital, clean technologies, and green skills, enabled by fiscal, finance, trade, and labour policies. It also addresses the importance of institutions and progress measurement for ensuring that transition towards a green economy is pro-poor, inclusive, fair, and just. We hope that this textbook will inspire the students of today and prepare them to shape the Inclusive Green Economy of tomorrow.

https://greeneconomytextbook.org/

A guidance manual for green economy indicators

As part of the *Green Economy Toolkit for Policymakers* produced under PAGE, *The guidance manual for green economy indicators* explores the use of indicators to measure progress towards a more resource-efficient and inclusive economy. The report provides practical guidance on how to use indicators in specific national contexts.

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http://www.un-page.org/files/public/content-page/unep_indicators_ge_for_web.pdf

Using models for green economy policymaking

Using models for green economy policymaking concerns macroeconomic planning for both short and long term and provides countries with a range of modelling tools for formulating and evaluating the impacts of green economy policies. The report is part of the PAGE *Green Economy toolkit for policymakers*.

http://www.un-page.org/files/public/content-page/unep_models_ge_for_web.pdf

Riding towards green economy: Cycling and green jobs

A joint report by UN Environment-WHO-UNECE. A shift towards green economy is one of the key objectives of the 2030 Agenda for Sustainable Development. It was also one of the main themes addressed by the Eighth Environment for Europe Ministerial Conference, held in Batumi, Georgia, on 8–10 June 2016. The transport sector, which in all countries is one of the largest economic actors, can play a major role in promoting this transition, particularly in the urban environment, where 8 out of 10 Europeans are expected to live by 2030 (ST/ ESA/SER.A/352).

https://www.unep.org/resources/report/riding-towards-green-economy-cycling-and-green-jobs

The 5 Principles of Green Economy

*The Five Principles listed here are previewed from the forthcoming paper "**Principles, Priorities and Pathways for Inclusive Green Economies**", launched on July 16th 2019 at the UN High Level Forum on Sustainable Development in New York. Find out more about the launch of the full paper here.*

https://www.greeneconomycoalition.org/news-analysis/the-5-principles-of-green-economy

TOPIC: CLIMATE

European Climate Law

The Commission's proposal for the first European Climate Law aims to write into law the goal set out in the European Green Deal – for Europe's economy and society to become climate-neutral by 2050.

https://ec.europa.eu/clima/policies/eu-climate-action/law_en

Climate strategies & targets

The EU has set itself targets for reducing its greenhouse gas emissions progressively up to 2050.Key climate and energy targets are set in the:

- 2020 climate and energy package
- 2030 climate and energy framework

These targets are defined to put the EU on the way to achieve the transformation towards a low-carbon economy as detailed in the 2050 long-term strategy.

The EU tracks its progress on cutting emissions through regular monitoring and reporting.

Before proposing new policies, the Commission carefully assesses their potential impacts.

https://ec.europa.eu/clima/policies/strategies_en

2030 Climate Target Plan

Set a more ambitious and cost-effective path to achieving climate neutrality by 2050. Stimulate the creation of green jobs and continue the EU's track record of cutting greenhouse gas emissions whilst growing its economy

Encourage international partners to increase their ambition to limit the rise in global temperature to 1.5°C and avoid the most severe consequences of climate change.

https://ec.europa.eu/clima/policies/eu-climate-action/2030_ctp_en

What is Horizon 2020?

Horizon 2020 is the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract. It promises more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market.

https://ec.europa.eu/programmes/horizon2020/what-horizon-2020

Actions being taken by the EU

The EU will be climate neutral by 2050. To do this, it will carry out a series of initiatives that will protect the environment and boost the green economy.

https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu_en

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TOPIC: CIRCULAR ECONOMY

Financing the Circular Economy - Capturing the opportunity

This report offers new analysis that highlights rapid growth in circular economy financing and investment. It lays out the opportunities for investing, banking, and insurance - and calls on the financial sector to seize the full potential by scaling the circular economy in collaboration with governments and corporates.

https://www.ellenmacarthurfoundation.org/publications/financing-the-circular-economy-capturing-the-opportunity

Cradle to Cradle

Cradle to Cradle (C2C) is about seeing garbage as an eternal resource and doing the right thing from the beginning. It is about making community and product development function in the same way as a healthy ecological system where all resources are used effectively, and in a cyclical way (as opposed to the current linear system that can be better described as a Cradle to Grave system).

https://sustainabilityguide.eu/methods/cradle-to-cradle/

What is Cradle to Cradle Certified™?

Cradle to Cradle Certified™ is a globally recognized measure of safer, more sustainable products made for the circular economy.

Product designers, manufacturers and brands around the world rely on the Cradle to Cradle Certified Product Standard as a transformative pathway for designing and making products with a positive impact on people and planet. From fragrances to flooring, t-shirts and jeans to water bottles and window treatments, thousands of products are Cradle to Cradle Certified. What's more, a growing number of brands, organizations and standards also recognize Cradle to Cradle Certified as a preferred product standard for responsible purchasing decisions.

https://www.c2ccertified.org/get-certified/product-certification

Turning motivation into action: A strategic orientation model for green supply chain management

This study examines the key motivations for a firm to adopt a green supply chain management (GSCM) strategic orientation and the mechanisms that subsequently influence GSCM practices.

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Three components of GSCM orientation were examined, that is, strategic emphasis, management support and resource commitment. Data were collected from a sample of 296 manufacturing firms in China. The results indicate that the most important motivation is environmental concern, followed by customer requirements, cost saving, and competitive pressure, whereas legal requirements were not a significant factor. The results confirm that strategic orientation plays a mediating role between motivations and the actual practices. Within the three components of strategic orientation, resource commitment and strategic emphasis have a stronger direct impact on practices, whereas the effect of management support on GSCM practices is indirect through resource commitment. This study contributes to the literature by clarifying the key role of strategic orientation in turning GSCM motivations into actions.

https://onlinelibrary.wiley.com/doi/abs/10.1002/bse.2580

Videos:

Cradle2Cradle | Reggs 5:49

You may have heard of it. Cradle to cradle. Perhaps you're wondering what is that? Well, here's an explanation

https://www.youtube.com/watch?v=4jORau0V62c&feature=emb_logo

Explaining the Circular Economy and How Society Can Re-think Progress | Animated Video Essay 3:48

There's a world of opportunity to re-think and re-design the way we make stuff. 'Re-Thinking Progress' explores how through a change in perspective we can re-design the way our economy works - designing products that can be 'made to be made again' and powering the system with renewable energy. It questions whether with creativity and innovation we can build a restorative economy.

https://www.youtube.com/watch?v=zCRKvDyyHmI

Humans Changed the Face of the Earth, Now We Rethink Our Future | Ellen MacArthur Foundation 2:21

What is the circular economy? What does it look like in practice? Who's doing it now? And how can you get involved? This week, the Ellen MacArthur Foundation launches a three-part video

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series that explores what the circular economy really means for businesses, people and society, and some of the most innovative examples of it in action today.

https://www.youtube.com/watch?v=A5wn_iinbxw

The power of feedback mechanisms – Circular Design Guide 1:39

Tim Brown, IDEO's CEO on why embedding ways to gain feedback into your design is crucial for the circular economy and why it needs to be designed in from day one. Visit http://circulardesignguide.com to learn more.

https://www.youtube.com/watch?v=mrksUbAClgY

How Can We Make Policy Makers Realise & Understand the Potential of the Circular Economy? 16:17

How do you convince work colleagues that your bright idea isn't just another burden to their existing workload? Working with policymakers at the regional and city level in Italy, Luigi Acquaviva has had to learn a few tricks when it comes to turning environmental ideas into practice. Meanwhile in Scotland, Cheryl McCulloch had the job of exciting Glasgow businesses and policymakers about the circular economy. The circular city scan they produced managed to turn heads and opinions towards a new way of collaborating.

https://www.youtube.com/watch?v=bF19VIRUM7M

Cities Consume 75% of Natural Resource - How can a Circular Economy Tackle This? 3:04

As major engines for economic growth, cities can drive the circular economy agenda forward to unlock economic, environmental, and social benefits. Alongside Sustainable Development Goals and climate objectives, the transition to a circular economy will support city leaders as they deliver against their priorities, which include housing, mobility, and economic development. By 2050, two thirds of us will live in cities. However, our urban centres are grappling with the effects of our current take-make-waste economy. Under this 'linear system', cities consume over 75% of natural resources, produce over 50% of global waste, and emit between 60-80% of greenhouse gases. A circular economy provides the opportunity to rethink how we make and use the things we need, and allows us to explore new ways of ensuring long-term prosperity.

https://www.youtube.com/watch?v=o3ByrTTtx9M

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TOPIC: PLASTICS

Study confirms need for urgent transition to a circular economy for plastic

Breaking the Plastic Wave shows that plastic pollution is rapidly outpacing efforts to stop it. By 2040, if we fail to act, the volume of plastic on the market will double, the annual volume of plastic entering the ocean will almost triple, and ocean plastic stocks will quadruple. This is in line with our 2016 analysis, which revealed that in 2050 there could be more plastic than fish in the ocean.

https://www.newplasticseconomy.org/news/study-confirms-need-for-urgent-transition-to-a-circular-economy-for-plastic

New Plastics Economy: Reuse – Rethinking Packaging

This work provides a framework to understand reuse models, identifies six major benefits of reuse, and maps 69 reuse examples. Based on an evaluation of more than 100 initiatives and interviews with over 50 experts, it aims to inspire and help structure thinking. It provides a basic description of how different reuse models work as well as typical implementation challenges.

https://www.newplasticseconomy.org/about/publications/new-plastics-economy-reuse

Plastics and the circular economy

Our relationship with plastic needs rethinking. Plastics are versatile materials, but the way we use them is incredibly wasteful. We take oil and gas from the earth to make plastic products that are often designed to be used only once, and then we throw them away. This is what we call a linear *take-make-waste* model.

The use of plastics has increased twentyfold in the past 50 years. While the material has many benefits, we now know there are negative consequences if it becomes waste or pollution. Documentaries such as Blue Planet II, showing the impact of plastic pollution on wildlife around the world, have shocked and spurred a public backlash against the material.

In 2016, the Foundation published a report which showed that most plastic packaging is used only once, and only 14% is collected for recycling. 95% of the value of plastic packaging material, worth USD 80-120 billion annually, is lost to the economy.

In our second report on plastics, published in 2017 - with our partners, we showed that without fundamental redesign and innovation, about 30% of plastic packaging will never be reused or recycled.

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So how can we design a circular economy for plastic, in which it never becomes waste or pollution?

https://www.ellenmacarthurfoundation.org/explore/plastics-and-the-circular-economy

Videos:

Just 14% of Global Plastic Packaging is Recycled | A Circular Economy for Plastics. 1:36

The New Plastics Economy is an ambitious, three-year initiative that challenges and bring together a diverse range of stakeholders to rethink how we make, use and reuse plastics, building momentum towards a system that works.

https://www.youtube.com/watch?v=aqeulFxqT1Y

From Single-Use to Reuse: Rethinking Plastic Packaging | Summit 2019. 8:10

The problems with plastic start long before it reaches our oceans, rivers and beaches, and so must the solutions. We must tackle these problems at the source, and find solutions that stop plastic from ever becoming waste and pollution. By switching to reuse, businesses can eliminate unnecessary single-use packaging. The Foundation's Annette Lendal makes the case on the Summit 2019 stage that businesses around the world should be looking closely at reuse models as a way of investing in the shifting preferences of a generation, tapping into new opportunities offered by today's technologies, and fast tracking towards a circular economy.

https://www.youtube.com/watch?v=zjSfLzLQAoI

This company uses reusable packaging so you only pay for the product | Algramo Conversation. 8:45

Algramo's mission is to catalyse reusable packaging systems on a globally significant scale. With its network of 2,000+ convenience stores and packaging reuse rates over 80%, Algramo caught the attention of brands like Unilever, Nestle and others keen to explore reusable packaging. With their brand partners, they co-develop technology like Packaging as a Wallet (PaaW), that communicates with IoT connected vending machines. Through their distribution system, Unilever sells their laundry detergent for 30% below supermarket prices. Algramo's newest project is creating its flagship store that will be the logistics hub for a fleet of electric tricycles.

https://www.youtube.com/watch?v=jIizIVK8fUs

How Do We Stop Millions of Tonnes of Plastics Entering Our Oceans? | A Circular Economy for Plastics. 1:00

TOPIC: FOOD SYSTEMS

:80% of Food Will Be Consumed in Cities by 2050: Transforming City Food Systems | The Food Initiative. 1:50

Climate change. Biodiversity. Human health. What's the connection? Food. Changing our food system is the most impactful thing we can do to address climate change, create healthy cities and rebuild biodiversity You've probably been thinking about how you and your organisation can play your part

https://www.youtube.com/watch?v=fY8xqd3PedQ

Building a Food System That Can Work. 15:13

The world has 60 harvests left. 60 more years of food before our soil quality is diminished to the point of no return. In our zeal to produce more and more food at low cost, we are stripping nutrients from the soil, undermining our future capacity to grow food. We need a plan for a food system that works. Our guests in this show think that cities might hold the key.

https://www.youtube.com/watch?v=H3KBPhohhxg

Feeding One Fifth - Circular Food in China. 13:43

China accounts for one-fifth of the world's population and feeding that many people is everyone's matter. For the simple fact of its scale, China plays an important role in the global food system. What it eats and how it eats has far-reaching implications for everybody. During this DIF Studio session, we will discuss how entrepreneurial people in China are tackling the challenge of securing enough food for the many, while contributing to a more circular economy for food. The key to a better food future will be how we create resilient and circular companies and unite the efforts by the entrepreneurs in startups, corporates, and government organisations.

https://www.youtube.com/watch?v=LdaBofTi6Ww

3D Ocean Farming. 14:33

Co-funded by the Erasmus+ Programme of the European Union

How do we farm in a different way? How do we revive ecosystems through our farming methods? These are questions that Bren Smith, shellfish and seaweed farmer, asks himself. During 15 years of hard work, mistakes, and iteration, he created his business with 3D ocean farming.

https://www.youtube.com/watch?v=6GchLfXTgII

FURTHER MATERIAL

1. Technology Industries of Finland. Circular Economy business models in the manufacturing industries. https://teknologiateollisuus.fi/sites/default/files/file_attachments/circular_economy_playbook_for_manufacturing_executive_summary.pdf
2. United nations web page. Sustainable development goals knowledge platform. 2020. https://sustainabledevelopment.un.org/
3. European Comission web page. 2020. Green growth and circular economy. https://ec.europa.eu/environment/green-growth/index_en.htm
4. European Comission web page. 2020. EU approach to sustainable development. https://ec.europa.eu/info/strategy/international-strategies/sustainable-development-goals/eu-approach-sustainable-development-0_en
5. European Comission web page. 2020. A European Green Deal – Striving to be the first climate-neutral continent. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
6. European Union wep page.2020. Access to finance. https://europa.eu/youreurope/business/finance-funding/getting-funding/access-finance/index_en.htm#shortcut-0
7. European Union wep page.2020. Funding programmes. https://ec.europa.eu/environment/ecoap/about-action-plan/union-funding-programmes_en
8. European Union wep page.2020. Funding programmes. https://ec.europa.eu/environment/ecoap/about-action-plan/union-funding-programmes_en

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9. European Comission web page. Energy label and ecodesing. https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign_en

10. Global Footprint Network web page. 2020. https://www.footprintnetwork.org/our-work/ecological-footprint/

11. The Coalition for energy savings. 2013. Reaching the targets. eedguidebook.energycoalition.eu/images/PDF/energy-audits.pdf

12. Water footprint network web page. https://waterfootprint.org/en/

13. Technology Industries of Finland. Circular Economy business models in the manufacturing industries. https://teknologiateollisuus.fi/sites/default/files/file_attachments/circular_economy_playbook_for_manufacturing_executive_summary.pdf

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Appendix 1

Introduction to the Evaluation of the Training

Evaluating the training, teaching and learning has been an emerging issue in the 1980's when it was actively researched within several disciplines like education, pedagogics, psychology and organizational sciences. During the 1990's the enthusiasm flagged, but the interest woke up again in parallel with the waves of refugees and immigrants arriving to the Europe. The needs to include newcomers to the hosting society, to teach local culture, habits and language, and to train professional skills to comply with the local requirements have highlighted the importance of developing new teaching and training methods. These new methods and tools in teaching and training should be compatible with the requirements set by cultural diversity of both the refugees and immigrants, and the societies more or less voluntary receiving the incomers.

Furthermore, during the past two decades the western countries have met - in addition to enormous flood of settlers - another phenomenon that challenges the education system: The post-war baby boom generation reaches age of retirement. This has two consequences, both requiring the answers from school systems. Firstly, the western countries should have a capability and capacity to educate and train more and more nursing personnel to cover both the vacuum left by those retiring, and to answer to the needs of ageing population. Secondly, these countries should be capable to renew their education systems to be able to satisfy the needs of business, to be able to train skilled labor and to be able to educate more persons that are both capable and willing to create their career as entrepreneurs and to continue the work of retiring entrepreneurs. If this fails, the consequences for European economy might be fatal or even disastrous.

This challenges not only schools and universities or teachers and trainees, but also those developing the courses and teaching and training methods used in the courses. Evaluating the learning of trainees, used methods and the impact of these methods on the learning would help teachers, designers and analysts to improve the methods.

The aims and targets of the evaluation are context dependent issues. Thus, in ideal world, the courses, the methods used in the courses and the means to evaluate the outcome of the course, the learning of trainees and the efficacy and success of the methods should be designed together so that the whole course is seen as main process inside which the training and evaluation are parallel subprocesses. This would be the best way to ensure that exactly those goals set to this unique

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program are measured during the evaluation. In this case "Train the Trainer" and other education programs have been planned parallel with the planning of the evaluation.

The Education Program

Further vocational trainings programs (EQF level 4 and 5) for owners, managers and qualified workers of SMEs (WP5).

- Six courses on management and technologies in water, wastewater and waste management including cradle to cradle.
- The trainings are specifically tailored to SME needs and different qualification levels and combine the transfer of technical, professional and management know-how.
- Development of an integration program for the unemployed (EQF level 4) in order to be able to place the unemployed in permanent jobs through further training seminars and a further training qualification.
- Coordination of the program with training providers, SMEs and employment services.

This program has been developed to respond the challenges met by those aiming to strengthen the awareness and competences for target-oriented environmental policy and workplace innovations in SMEs via training and consulting the entrepreneurs and personnel of SMEs. The students should be able to support companies in the development of their environmental policy as well as in workplace innovations in the framework of the circular economy through consulting and qualifying support.

The following should be achieved:

a) Attraction of much needed junior staff for SMEs.
b) Development of capacities to increase awareness for Workplace Innovations.
c) Realization of individual Workplace Innovation projects, which the students carry out as employees of the participating SMEs with the support of professors of the respective university in connection with the dual studies in SMEs.

The target groups of the program are owners, managers and qualified workers of SMEs (WP5) with capabilities and interest to rise in their career.

The planned duration of course varies depending to the educational level and purposes. Each lesson lasts 45 minutes. Methods used in lessons will be lectures, teaching talks, working in small groups, case studies and examples from real world. Material used during the teaching consists of e.g. information material (basics & backgrounds, thematic introductions etc.), presentations, questionnaires, question guides, checklists, analysis results, good practice examples and so on. Course should contain at least following issues: Basics/overview of essential tasks and contents of business-oriented and productivity-enhancing measures in circular economy and workplace innovation (in each of the courses)

The SME-specific training course should contain following topics (overview):

a. One of the six courses on management and technologies in water, wastewater and waste management including cradle to cradle.

   A. Preparation and management of SMEs for work in the Green Economy
   B. Waste reduction and recycling management
   C. Wastewater, treatment and recycling management
   D. Water supply and saving
   E. Cradle to Cradle in SMEs
   F. Energy generation from wastewater and waste

b. Attitudes and behavior in consulting processes
c. Supporting activities by WWW&CE / Centres of Competence

Evaluation of courses including gained results and found problems is essential to be able to develop further the existing training programs as well as to consider the experiences gathered from these programs when building new curricula. The evaluation process has been designed hand in hand with the courses themselves. This concept presents an overview of evaluation process and questionnaire.

When evaluating course, the goals and real results should be compared. This is not always possible or fair and just. The evaluation should be targeted only to such measurable issues on which the designer, teacher, facilitator or student himself has an impact. Evaluating the impacts of training programs against the presented main goals would require large societal researches including the recording of the initial situation before starting the programs and the long-term follow-up research in which the conducted interventions and actions (In this case new forms of training and education) and their impacts on change of variables is followed (Figure 2). The final conclusions can be drawn just after some years or after decades. In this project this is not possible and the whole evaluation process must be rethought and simplified.

The most important variables, on point of view of achieving the goals set, are the motivation of student, the support he gets, the relevance of issues in curricula, the quality material and training and the ability of facilities to support training and learning. Although most of the variables presented above are so called soft variables, which can't be measured directly by targeting the measurement tool to some point or phase in the process, they can be assessed indirectly by assessing the feelings and comments of participants and other stakeholders.

Figure 2: Evaluation process

The assessment of feelings and comments can be done with many alternative tools, e.g. surveys, interviews and follow-up studies in which a researcher follows lessons and training in practice and observes the students and teachers collecting comments and registering e.g. the atmosphere in the classrooms and during the training in the workplaces.

In this case the experiences and comments of participants will be surveyed by simple questionnaire with questions approaching the common impressions, the applicability of facilities, the relevancy and importance of each issue and the experienced quality of each lesson and material used.

Evaluation concept

The objective of the evaluation is to determine whether the goals of the program will be achieved in the implementations evaluated, and how the program has impact on student's career and opportunities.

The type of the evaluation follows standard course evaluation methods, i.e. formative, process and outcome evaluation, the latter only partial:

- The formative evaluation will provide feedback to the curriculum designers, developers and implementers to ensure that designed and implemented courses really meets the needs of the intended audience, i.e. assure or improve the quality of program. Formative evaluation and analyses will answer to the following questions:

- Were the goals and objectives suitable for the audience?
- Were the training methods and course materials appropriate for the audience?
- Should the program or some part of it be developed further and if, how?
- Furthermore, formative evaluation also provides information that benefits the development of the program, facilities and timing.

- The process evaluation will provide information concerning the training and lectures, like asked questions and verbal feedbacks.
  - Process evaluation answers the question "What did you do?"
  - It focuses on procedures and actions used to produce results.
  - Process evaluation takes place during the training delivery and at the end of the training.
  - The co-organizer (Responsible for the course)
    - monitors the training,
    - describes the training process as a whole, and
    - records the findings into the written report.

- The outcome evaluation tries to find out how the knowledge, attitudes, and behaviors of the audience developed. It takes a long time to find out the outcomes of the education and training, so in this stage only the main topics participants are able to do at the end of training, will be assessed.

The evaluation process will be as follows:

1. **a.)** Semi-structured questionnaires will be created for the participants (Appendix A): The topics (topic 1, topic 2…) **should be renamed to match to the parts of the course. It is also recommended** that co-organizer (Responsible for the course) writes the name of the school / institution, the name of the evaluated course and the number of the workshop (1st / 2nd) in the beginning of the questionnaire before printing it to make sure that the identification data needed in the evaluation is correct. If the questionnaire needs to be compiled to e.g. German, the co-organizer takes care of this.

   b.) Semi-structured questionnaires will be created for the trainers / lecturers / teachers

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(Appendix B): **It is recommended** that co-organizer (Responsible for the course) writes the name of the school / institution, the name of the evaluated course and the number of the workshop (1st / 2nd) in the beginning of the questionnaire before printing it to make sure that the identification data needed in the evaluation is correct.

2. Time for the survey (approx. 15 minutes) will be allocated in the end of each workshop
3. In the beginning of the course the co-organizer (Responsible for the course) will inform participants about the evaluation and its importance for further development actions
4. The co-organizer (Responsible for the course) distributes the questionnaires to the participants to be filled in before leaving the workshop. The purposes of the questionnaire and how the data will be used should be explained clearly to the participants. This will help to improve the response rate and encourage them to make comments that can be useful to improve future programs.

   Note: Survey for participants will be conducted twice, in the end of both workshops!
5. The participants complete the questionnaires and return them to the co-organizer.
6. The co-organizer distributes the lecturer's questionnaire to each lecturer to be compiled immediately after his / her part of the course has been finished.

   Note: If the lecturer teaches in both workshops, he / she completes the questionnaire twice!
7. In the end of the learning on the job -phase, representant of each enterprise involved in the training will be interviewed by the co-organizer. Guidelines for the interview will be found in appendix C. Interviews can be conducted face to face or via Skype, Microsoft Teams or e-mail, some examples to be given.
8. The co-organizer collects the questionnaires and answers of interviews and deliver them to the evaluator. If there are free speech answers in some other language than English, it is recommendable that the co-organizer translates them to English.
9. The evaluator compiles all feedbacks and summarizes written analysis on the evaluations.

The evaluation approach will be based on a combination of qualitative and quantitative methods. The Microsoft Excel package will be used to transcribe the feedbacks and interviews. Open questions will be categorized, and qualitative analysis of the groups will be done.

The final evaluation report will discuss the following issues:

- Did the curriculum reach the targets?
- How well was the knowledge creation and sharing realized?

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- Did the participants assimilate knowledge and tools?
- Was the venue and equipment appropriate for the training course?
- What kind of further development will be needed, if any?

Schedule of the evaluations

The schedule of the evaluation should be matched to the phases of the curriculum. There is no sense to evaluate the course before the students have a true and fair view of the course, its phases and contents. A closer schedule of each evaluation will be agreed later.

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Appendix 2

Questionnaire for participants of the ___________-course

Please circle the scale that applies to your opinion on the following aspects of the education you participated.

Scale: 1= Strongly disagree, 2=Disagree, 3=Neither disagree or agree, 4=Agree, 5=Strongly agree

In common						
The facilitation (location, room etc.) was suitable for training		1	2	3	4	5
The topics and issues were relevant and responded to the goals of training		1	2	3	4	5
The lecturers explained topics of the lessons, additional questions, experiences, and topical issues arisen during the course well		1	2	3	4	5
There were enough time scheduled for each issue.		1	2	3	4	5
I got valuable knowledge from lessons and examples presented by lecturers.		1	2	3	4	5
I believe that can utilize the knowledge gained from lessons in my future career.		1	2	3	4	5
I can utilize the skills trained and knowledge gained in my future career, e.g. when consulting my clients.		1	2	3	4	5
Comments concerning the common issues						
Lessons and Topics						
Topic 1	The presentation was clear and understandable	1	2	3	4	5

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	The issues were relevant and topical	1	2	3	4	5
	The information presented were up-to-date	1	2	3	4	5
Topic 2	The presentation was clear and understandable	1	2	3	4	5
	The issues were relevant and topical	1	2	3	4	5
	The information presented were up-to-date	1	2	3	4	5
Topic 3	The presentation was clear and understandable	1	2	3	4	5
	The issues were relevant and topical	1	2	3	4	5
	The information presented were up-to-date	1	2	3	4	5
Topic 4	The presentation was clear and understandable	1	2	3	4	5
	The issues were relevant and topical	1	2	3	4	5
	The information presented were up-to-date	1	2	3	4	5
Topic 5	The presentation was clear and understandable	1	2	3	4	5
	The issues were relevant and topical	1	2	3	4	5
	The information presented were up-to-date	1	2	3	4	5
Topic 6	The presentation was clear and understandable	1	2	3	4	5
	The issues were relevant and topical	1	2	3	4	5

	The information presented were up-to-date	1	2	3	4	5
Topic 7	The presentation was clear and understandable The issues were relevant and topical The information presented were up-to-date	1 1 1	2 2 2	3 3 3	4 4 4	5 5 5
Topic 8	The presentation was clear and understandable The issues were relevant and topical The information presented were up-to-date	1 1 1	2 2 2	3 3 3	4 4 4	5 5 5
Topic 9	The presentation was clear and understandable The issues were relevant and topical The information presented were up-to-date	1 1 1	2 2 2	3 3 3	4 4 4	5 5 5
Free speech						
What was good?						
What could have been done better? (E.g. was some topic missing or unnecessary)						
Would you recommend the course to someone you know? If not, why not?						
Was anything missing that you might need in your future profession / occupation / job?						

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Was the proportion of topics and issues inside each topic suitable or should something be increased / decreased?
Other comments

Thank you for your answer

Questionnaire for lecturers of the _____________ - course

TRAINING / EDUCATION EVALUATION: LECTURERS' OPINION COLLECTED BY THE CO-ORGANIZER

The lecturer should evaluate the course with overall grade (poor, fair, good, very good, excellent). Written comments are appreciated. Thank you for your co-operation!

Course / Subjects / Issues you were teaching: ____

Experience in teaching: _____ years

1. Overall content of course topics

1 = Poor		Comments:
2= Satisfactory		
3= Good		
4= Very good		
5= Excellent		

2. How well the topics in curricula match to the needs and goals of the students (average)?

1 = Poor		Comments:
2= Satisfactory		
3= Good		
4= Very good		
5= Excellent		

3. Schedule compared to the contents and goals of the programme

1 = Poor		Comments:
2= Satisfactory		
3= Good		
4= Very good		
5= Excellent		

4. Level of the students

1 = Poor		Comments:

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2= Satisfactory		
3= Good		
4= Very good		
5= Excellent		

5. Motivation of the students

1 = Poor		Comments:
2= Satisfactory		
3= Good		
4= Very good		
5= Excellent		

6. How do the contents of the education match to the requirements of the qualification

1 = Poor		Comments:
2= Satisfactory		
3= Good		
4= Very good		
5= Excellent		

Thank you for your answer

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Guidelines for interviews of enterprises involved in the ___________ - course.

TRAINING / EDUCATION EVALUATION: FEEDBACK FROM ENTERPRISES COLLECTED BY THE CO-ORGANIZER

Date ___/___/20___ Course_____________ Enterprise ______________________

The interviewer will ask the following questions from each enterprises' representant.

1. Schedule: Was the schedule of theory and practice in line with company's needs? How about the schedule and order of topics?

2. Content: Did the training contain issues and topics needed in your business? Was something missing? If, what?

3. Realized Project: Did the project realized during the learning on the job -phase achieve the goals set to it? If not, what remained undone?

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4. What could have been done differently? What should have been done differently? What should not be changed?

Thank you for your answer

WWW&CE
Preparation and management of SMEs for work in the Green Economy

Satakunta University of Applied Sciences (SAMK), project partner number 11

Compiled by Dr Sirpa Sandelin and Dr Kari Lilja and Sanna Lindgren

HANSE-PARLAMENT E.V.

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Introduction

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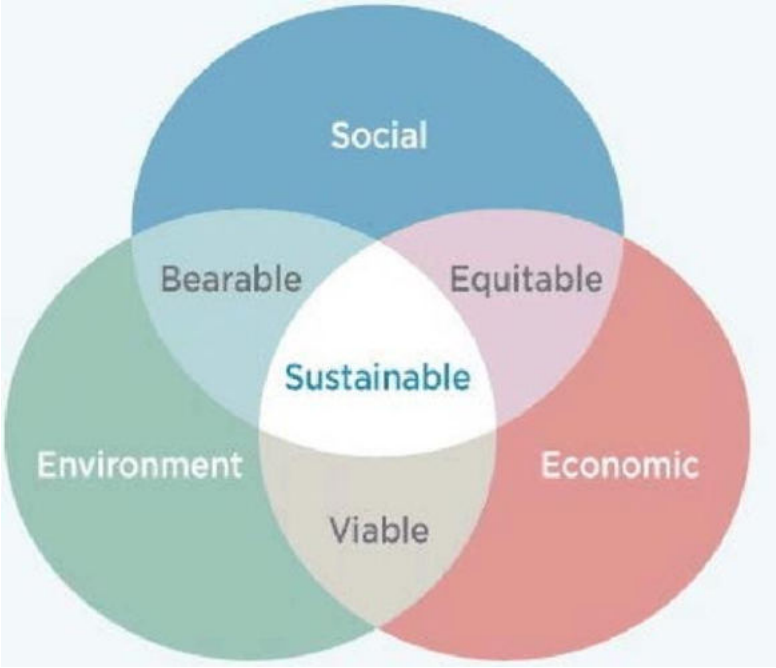
WWW&CE Water, Waste Water, Waste & Circular Economy

Sustainable development according to Elkington: triple bottom line



- Triple Bottom Line (TBL) states the success of a company. This goes together with term P3, which stands for people, planet and profits. C**ompanies have to measure their impacts with profits, community (people) and the environment (planet).**

Why commit to sustainable action?

Why circular economy? Why now?

- Circular economy is relevant as it offers companies the opportunity to turn inefficiencies in linear value chains into business value
- Utilizing underutilized capacities, premature product lives, unsustainable materials, wasted end-of-life value and unexploited customer engagements
- Sales organisation focus on selling functionality of product rather than the customer problem – engage customers throughout the product life-cycle to offer services and add-on sales [8]

Video: Jenny Davis-Peccoud: Transforming Business for a Sustainable Economy

Picture by Alexas_Fotos from Pixabay.

Technology Industries of Finland. Circular Economy business models in the manufacturing industries. https://teknologiateollisuus.fi/sites/default/files/file_attachments/circular_economy_playbook_for_manufacturing_executive_summary.pdf

Getting hold of the green economy. Green economy in SDGs.

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WWW&CE Water, Waste Water, Waste & Circular Economy

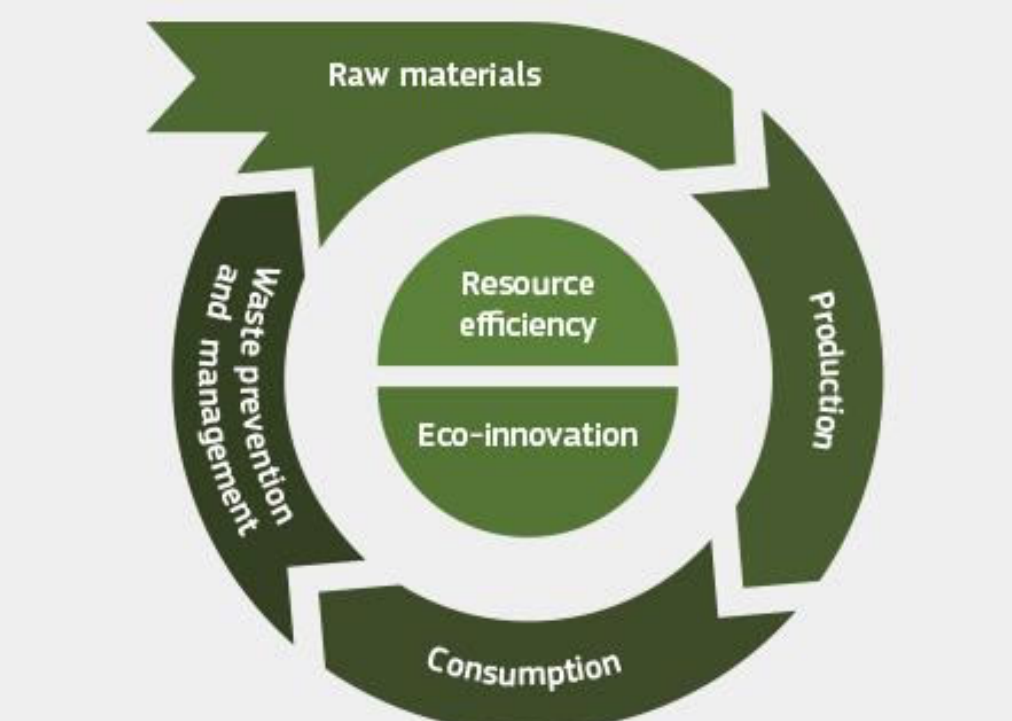
17 Sustainable development goals, SDG

Source: Unicef.org webpage

- 17 goals, 169 targets.
- Ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth
  - All while tackling climate change and working to preserve our oceans and forests.
- The circular economy is relevant to all sectors of the economy.
  - It has gained increasing prominence as a tool which presents solutions to some of the world's most pressing sustainable development challenges. [3]

United nations web page. Sustainable development goals knowledge platform. 2020.
https://sustainabledevelopment.un.org/

Green growth and circular economy in EU



Source: ec.europa.eu webpage

- Raw materials
  - Natural resources should be used in the most efficient way and without depleting the planet's resources.
- Production
  - Transform environmental challenges into economic opportunities and provide a better deal for consumers.
- Consumption
  - The European Commission has developed policies and tools to help identify green products and reward sustainable production practices.
- Waste prevention and management
  - To become successful, circular economy requires a consistent implementation and enforcement of existing waste legislation across the EU.
- Resource efficiency
  - The Commission also aims to improve resource efficiency in more specific areas, such as in the building and food sectors, as well as in SMEs, and to turn waste into a resource.
- Eco-innovation
  - Investing in eco-innovation is essential to ensure Europe's global leadership in creating a resource efficient society. [2]

European Commission web page. 2020. Green growth and circular economy.
https://ec.europa.eu/environment/green-growth/index_en.htm

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Green economy: opportunities and challenges

- Increased market share and new markets
  - eco-innovation, eco-entrepreneurship, and eco-adoption among SMEs.
- Greening-related cost reductions for SMEs generally arise from efficiency gains since less inputs are required to produce the same output.

Process efficiency:

- *By optimizing current processes or introducing new more efficient ones, SMEs minimize the required inputs and waste production.*

• Product design:

- *SMEs can re-design their products to reduce the required inputs without sacrificing the product's utility.*

• Waste disposal:

- *In addition to reducing waste by improving process efficiency, SMEs can reuse already-generate waste or pass it along to other companies. This reduces cost of waste disposal.*

• Source of raw material:

- *SMEs can reduce cost of raw materials by switching to re-cycled materials.*

• Infrastructure efficiency:

- *SMEs can generate savings associated with energy-efficiency lighting, building insulation, and heating systems efficiency.*

• Packaging and transport:

- *By reducing the volume of packaging and switching to local suppliers to decreasing shipping distances, SMEs can further reduce costs*

SMEs:
Key Drivers of Green and Inclusive Growth
Shashwat Koirala Environment Directorate, OECD
https://www.oecd.org/greengrowth/GGSD_2018_SME%20Issue%20Paper_WEB.pdf

Green economy: opportunities and challenges

There is evidence that through cost reductions and increased sales and market share, greening SMEs enables inclusive growth.	•Conversely, the market uncertainty and resource burden of greening can hinder SMEs' ability to deliver inclusive growth. •SMEs may not also be fully informed about the relevant greening measures and their costs and benefits, thus making it difficult for them to deliver both green and inclusive growth.
There is evidence that the business benefits of greening SMEs leads to job creation but estimates of job destruction are missing.	•Impacts in developing countries is also under-researched, which is problematic because their labour markets and factor prices are often different from developed countries, so results from one don't necessarily translate to the other •In addition to creating and destroying jobs, greening can transform jobs.
SMEs need to provide upskilling opportunities for their employees.	•If done effectively, this is a major opportunity to deliver inclusive growth; •if not, it could exacerbate the differences in career development opportunities between large firms and SMEs.
SMEs can integrate green and inclusive business models. However, they do face a host of external and internal barriers.	•Companies experience a range of internal barriers such as a lack of financial and human resources to develop new products and processes, as well as a lack of awareness amongst both management and employees. •Lack of resources is probably one of the most important barriers, since the resources must compete with other priorities in the company.

SMEs: Key Drivers of Green and Inclusive Growth
Shashwat Koirala Environment Directorate, OECD
https://www.oecd.org/greengrowth/GGSD_2018_SME%20Issue%20Paper_WEB.pdf
Green Business Model Innovation: Policy report

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The strategy and policy of the European Union:

Green growth and circular economy. National and regional strategies.

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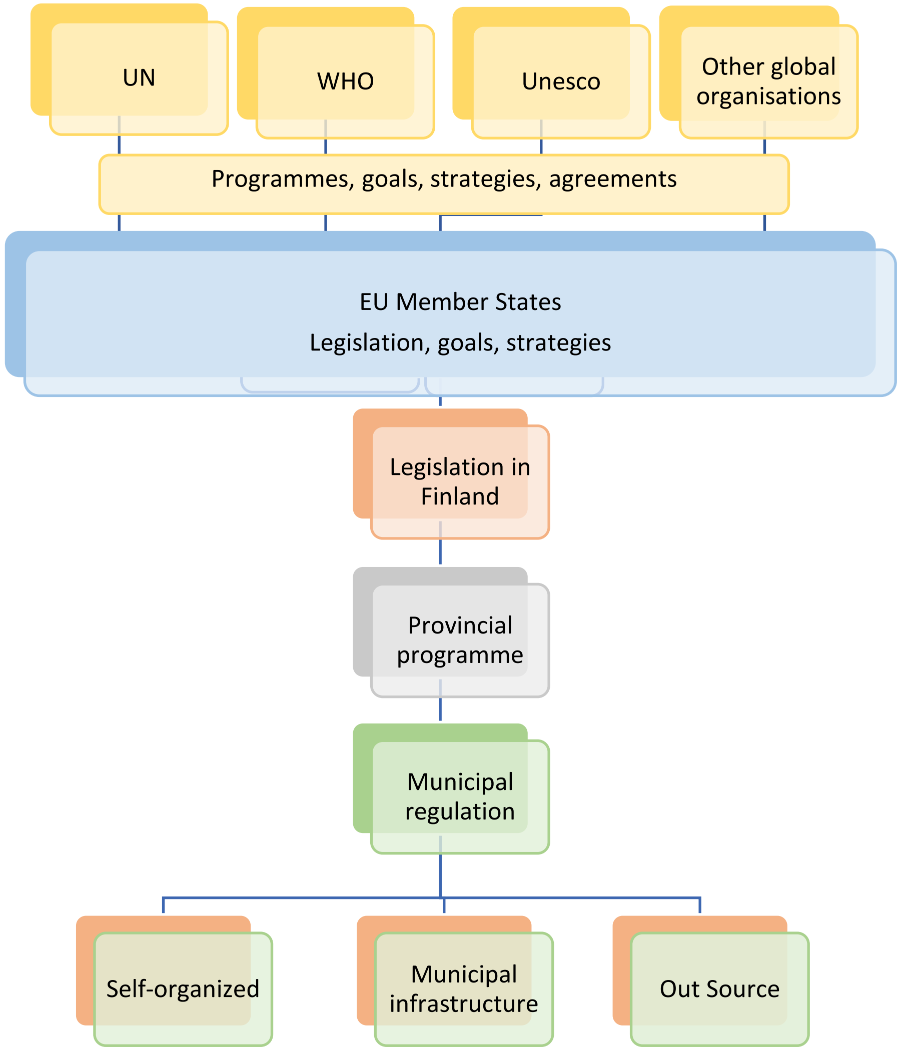
From international goals to local regulations

Sustainable development Continuous and guided social change, globally, regionally and locally, aimed at securing good living opportunities for current and future generations.

- **Ecological sustainability**
  - Preserving biodiversity and ecosystems functionality, as well as adapting human economic and material activities to natural sustainability in the long term.
- **Economic sustainability**
  - Economic sustainability is a measure of balanced growth in content and quality that is not based on long-term indebtedness or reserve disposal.
- **Social and cultural sustainability**
  - To guarantee the passage of conditions for prosperity from generation to generation.
  - Population growth, poverty, food and health care, gender equality, and the organization of education are global social sustainability challenges with implications for ecological and economic sustainability. [4]



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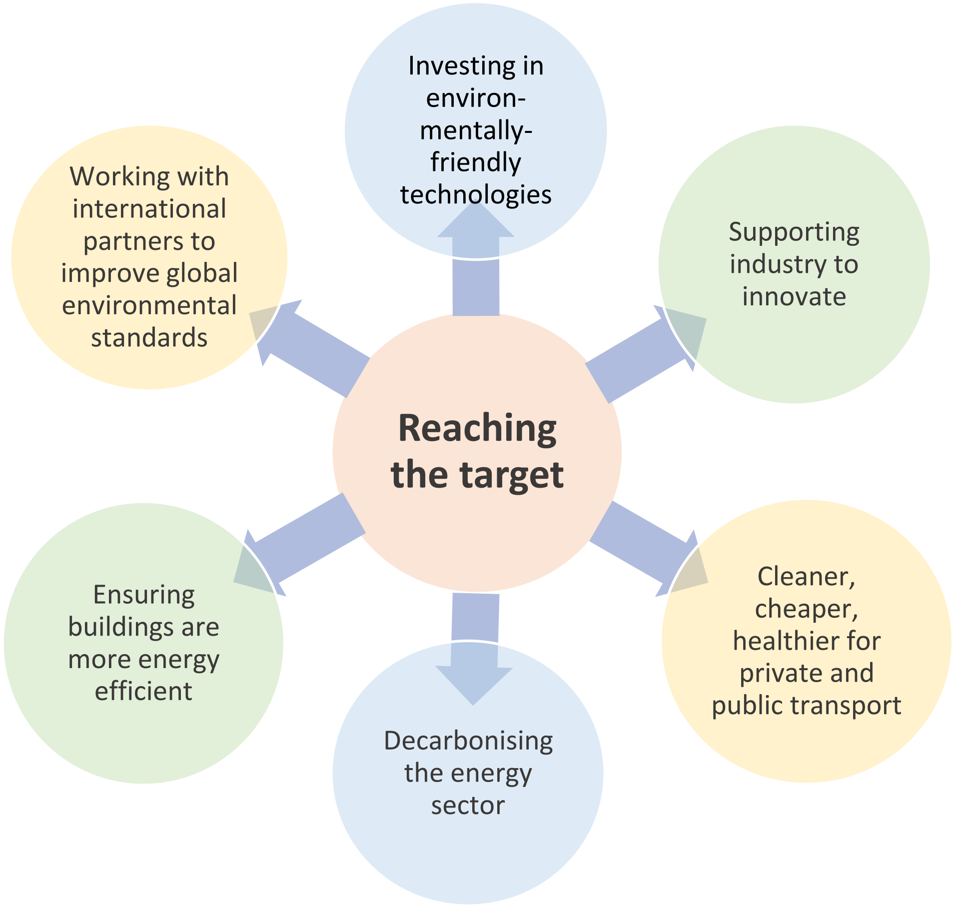
European Commission web page. 2020. EU approach to sustainable development.
https://ec.europa.eu/info/strategy/international-strategies/sustainable-development-goals/eu-approach-sustainable-development-0_en

EU contribution to international goals

- The EU has committed to implement the Sustainable Development Goals both in its internal and external policies. The SDGs feature in all the
  - European Commission's 10 priorities.
- Sustainable development has been mainstreamed into EU policies and legislation
  - EU Sustainable Development Strategy
- The European Green Deal
  - provides a roadmap with actions
  - ➢ boost the efficient use of resources by moving to a clean, circular economy
  - ➢ restore biodiversity and cut pollution.
- The EU will be climate neutral in 2050. [3]



European Commission web page. 2020. A European Green Deal – Striving to be the first climate-neutral continent. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

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Financial possibilities for SMEs:

European Union, national, regional and local finance

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Who is eligible for EU funding?

- EU Funding is available for all types of companies of any size and sector including entrepreneurs, start-ups, micro companies, small and medium-sized enterprises, and larger businesses. A wide range of financing is available: business loans, microfinance, guarantees and venture capital. [6]

Direct funding

Grants

- Grants are given to specific projects that relate to EU policies, usually following a public announcement known as a **call for proposals**.

Contracts

- Contracts are issued by EU institutions to buy services, goods or works that they need for their operations – such as studies, training, conference organisation or IT equipment.

Indirect funding

Funds

- Indirect funding is managed by national and regional authorities and comprises of nearly 80% of the EU budget, mainly through 5 big funds that come under the umbrella of the European Structural and Investment Funds.

EU funds

- **COSME Programme**
- **InnovFin Programme (Horizon 2020)**
- **Creative Europe**
- **Programme for Employment and Social Innovation (EaSI)**
- **European Structural and Investment Funds (ESI funds)**
- **European Investment Bank**
- **European Investment Fund**

European Union web page.2020. Access to finance. Referred 31.5.2020.
https://europa.eu/youreurope/business/finance-funding/getting-funding/access-finance/index_en.htm#shortcut-0

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EU funding for ECO-innovation

Horizon 2020

To who
- resource efficiency
- water
- waste
- key enabling technologies
- SMEs

What for
- innovation action
- SME instrument
- public procurement of innovation
- pre-commercial procurement

LIFE

To who
- environmental technologies
- resource efficiency
- industry & production
- waste
- water

What for
- demonstration & pilot
- capacity building
- best practice
- information, awareness & dissemination

COSME

To who
- improving access to finance and markets
- improving conditions for competitiveness & sustainability
- promoting entrepreneurship

What for
- Loan Guarantee Facility (LGF)
- Equity Facility for Growth (EFG)
- access to finance for SMEs

ESIF

To who
- regional development
- research & innovation
- SME competitiveness
- low carbon economy
- environment & resource efficiency

What for
- EU Regional Development Fund
- EU Social Fund
- Cohesion Fund
- EU Agricultural Fund for Rural Development
- EU Maritime and Fisheries Fund

[4]

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European Union web page.2020. Funding programmes.
https://ec.europa.eu/environment/ecoap/about-action-plan/union-funding-programmes_en

Capacity building:

Green economy strategy, action plan and staff’s skills and knowledge development at SMEs.

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The sustainable business models

Key partners	Key Activities/Resources	Value Propositions	Customer relationships	Channels	Customer segments
Partners	Value propositions required	Value delivered to the customer	Type of relationship	Channels want to be reached/already reached	For whom are values created?
Suppliers	Distribution channels	Customer's problems helped to solve	Segments expected to establish/are already established	Integration of the channels/which work best	
Resources aquired	Customer Relationships	Bundles of products and services offered each customer segment	Integration to the rest of business model	Most cost-efficient Channels	Who are the most important customers
Activities performed	Revenue streams	Which customer needs are satisfied	Costs	Channels integration with customer routines	

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www.businessmodelgeneration.com

The sustainable business models

Cost Structure	The most important costs inherent in the business model	The most expensive key resources	The most expensive key activities	Cost driven/Value driven
Eco-Social Costs	Ecological or social costs business model is causing	Non-renewable key resources	Key activities needing a lot of resources	
Revenue Streams	Values customers are willing to play	What customers are currently paying	How would they prefer to pay	Revenue stream contributing to overall revenues
Eco-Social Benefits	Ecological and social benefits business models are generating	Beneficiaries ->Potential customers?	Transforming the benefits into a value preposition	

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Eco-innovation – An EU Action Plan

Integrate eco-innovation in environmental and industrial policies

- By focusing on its contribution to economic growth, job creation and EU industry competitiveness;

Ensure appropriate funding

- For market replication and demonstration projects, clusters and public-private partnerships, and networks implementing innovative public procurement;

Identify **standards and performance targets**

- In which areas they could have the biggest impact and to propose their development;

Trigger **support to SMEs**

- From the public sector and financial intermediaries and accelerate the take-up of eco-innovation in the private sector, with measures such as the establishment of a European network of eco-innovation financiers, new funding instruments that offer targeted debt and equity facilities, and expansion of other services to SMEs, to help find and exploit eco-innovation opportunities;

Promote global **sustainability**

- Consumption and production patterns, technology transfer and exchange of best practices with developing and emerging economies to help European eco-innovators access international markets;

Ensure the skills of **labour force**

- Are equipped with the appropriate skills and knowledge to drive forward the green economy transition

Bring together public and private actors

- To promote breakthrough innovations with big market potential in key sectors that could contribute to greater resource efficiency.

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https://www.switchtogreen.eu/?p=1166

Green economy approaches at SMEs:

Technology, investments and finance. Role of eco-innovations at SMES. Best practices.

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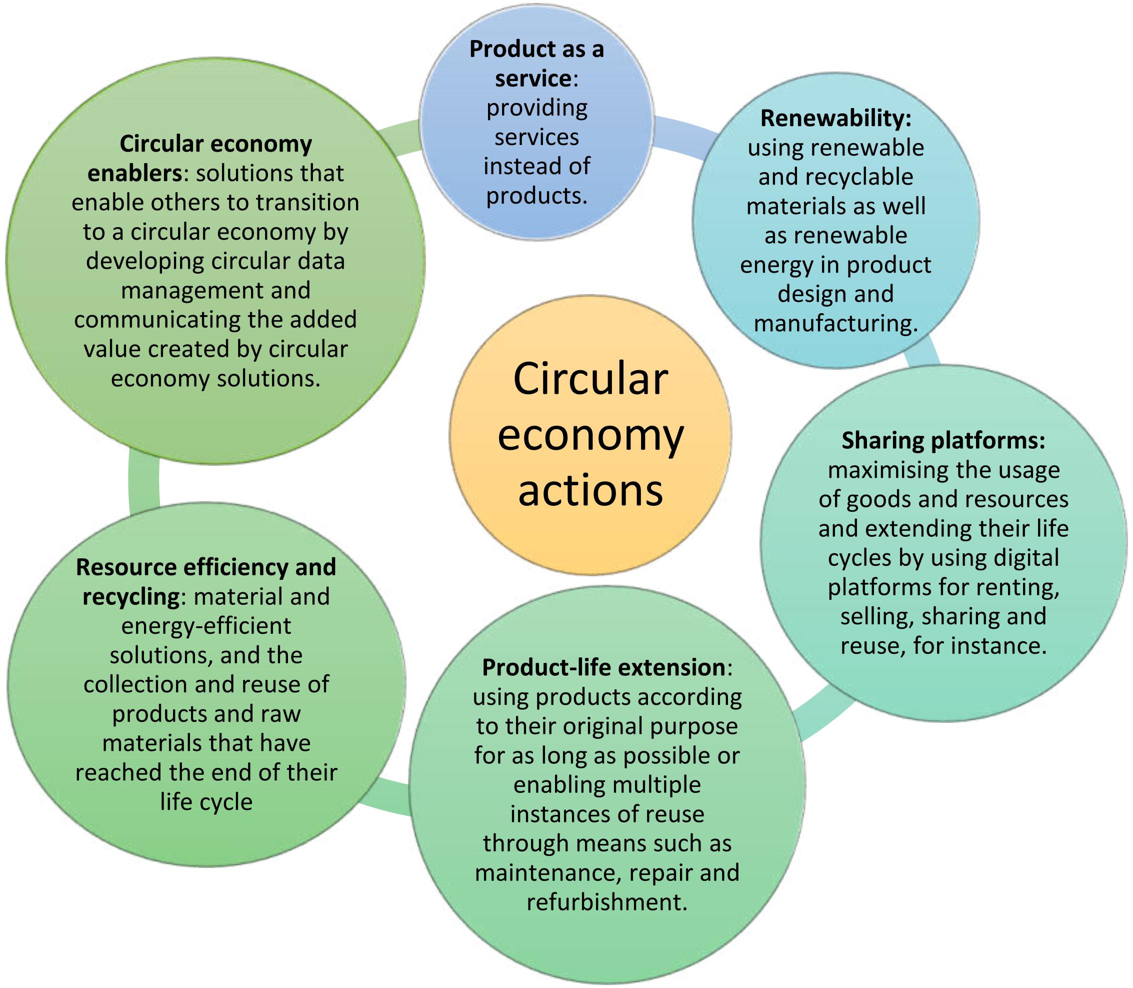
Role of eco-innovations at SMES. Best practices.



- Resilient business models
  - Companies can revisit their business models and value propositions by reconsidering novel ways of delivering value to their customers
  - Shifting from products to services (e.g. functional sales) can reduce resource intensity, bring about new market opportunities and make business more resilient
- New markets and customers
  - Companies developing and selling new eco-innovative products, services and technologies are motivated by the opportunity to access new markets and customer segments.
- Cost saving
  - Eco-innovations resulting in improved resource productivity save money by reducing costs of material and energy.
  - This type of "savings opportunity" is especially associated with process innovation and grounded in initiatives like "cleaner and leaner" production.
- Complying with regulations
  - Growing environmental and social standards applied by their strategic partners and clients (e.g. retailers).

Sitra
https://www.sitra.fi/en/projects/inspiring-solutions/#what-is-it-about
EU Eco-innovation
https://www.eco-innovation.eu/index.php/guide-for-smes?download=24:eco-innovation-sme-guide-2nd-edition

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Eco-innovation

- Eco-innovation and green technologies are key to Europe's future and at the heart of the European Union's policies.
    - Eco-innovation is a new business model which promotes sustainability throughout the entire life cycle of a product
- The EU's economic prosperity and well being is intrinsically linked to its natural environment, and the global demand for renewable energy and resource-efficient solutions will be a source of jobs and economic growth in the years to come.
- Smart, sustainable and inclusive growth is the focus of the Europe 2020 Strategy.
- The EU's 7th Environment Action Programme (7EAP) set out a vision of "living well within the limits of the planet", including the need to "turn the Union into a resource-efficient, green, and competitive low-carbon economy", by 2050.
- The EcoAP is therefore an important element of the European policy framework for sustainable consumption and production.
    - It reinforces initiatives such as, the Eco-Management and Audit Scheme (EMAS), the EU Ecolabel, the Environmental Technology Verification (ETV) scheme as well as the Product Environmental Footprint pilot.
    - The EcoAP has been targeting innovative SMEs. In fact, it recognises innovative front-runner businesses with the European Business Awards for the Environment (EBAE)
    - it opens up funding opportunities under COSME, Horizon 2020, and the LIFE programme and builds on the Enterprise Europe Network (EEN) for business matchmaking. Recently, EcoAP efforts have been strengthened by the Green Action Plan for SMEs.

Eco-innovation, SMEs and the Circular Economy - UN Environment's Eco-innovation Manual:

https://www.youtube.com/watch?v=6L_ipFvVtWE&feature=youtu.be

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https://ec.europa.eu/environment/ecoap/about-action-plan/objectives-methodology

Green economy tools and instruments

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Systems and tools

ISO 14000
Standard Tools and techniques of environmental management

ISO 14001
ISO 14004
Environmental systems
Comprehensive management of environmental impacts

ISO 14031
Evaluation the levels of the environmental protection
Evaluation the levels of the environmental protection and informing of it

ISO 14006
ISO 14062
Planning that takes environmental aspects into consideration
Combining environmental aspects to the planning and development

ISO 14064 part 1 – 3
ISO 14065
Calculation and reporting of greenhouse gas emissions
Reducing greenhouse gas emissions

ISO 14051
Cost analysis of material flows
To make the use of the material and energy more effective

ISO 14040
ISO 14044
Life cycle analysis
Illustration and comparison of the environmental impact of products and services

ISO 14064
Water footprint
Reducing the environmental impact to the water

ISO 14020
ISO 14021
ISO 14024 ISO 14025
Ecolabel and specifications
Increasing supply and demand for products and services that are less than the environment

ISO 14063
Environmental communications
Developing the environmental communications strategy and processes

ISO 14067
The carbon footprint of a product
Reducing greenhouse gas emissions

- The CEN Technical Committee, the European Organisation for Standardization, has created a broad collection of standards on sustainable development
- For all types of and size organizations in different industries
- Both private and public sector. [7]

European Union web page.2020. Funding programmes.
https://ec.europa.eu/environment/ecoap/about-action-plan/union-funding-programmes_en

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Energy label and ecodesign

Energy savings

The EU energy labels provide a clear and simple indication of the energy efficiency of products at the point of purchase.

- Reducing greenhouse gas emissions across the EU.
- A yearly energy saving of around 150 Mtoe (million tonnes of oil equivalent) by 2020, roughly equivalent to the annual primary energy consumption of Italy.
- For consumers, an average saving of up to hundreds of euros per year
- EU has put in place regulations and directives, particularly for energy labelling and ecodesign for products.

- washing machines and washer-driers
- dishwashers
- electronic displays
- household refrigerators
- light sources
- refrigerators with a direct sales function
- external power supplies
- electric motors
- power transformers
- welding equipment

Ecodesign

- The EU legislation on ecodesign is an effective tool for improving the environmental performance of products by setting mandatory minimum standards for their energy efficiency.
- The inclusion of elements to further enhance the reparability and recyclability of appliances.
- Several of the new measures include requirements, such as ensuring the availability of spare parts - making key parts more easily replaceable - and access to repair and maintenance information for professional repairers. [3]

European Commission web page. Energy label and ecodesign.
https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign_en

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Cradle to Cradle Certified™

A globally recognized measure of safer, more sustainable products made for the circular economy.

Key Steps for certification

1. Determine if your product is appropriate for certification
2. Select an Accreditet Assessment Body for testing, analysis, and evaluation of your product
3. Work with your assessor to compile and evaluate data and documentation
4. Receive certification for your product
5. Work with Institute and your marketing teams
6. Report your progress

Assessment Ctegories

- Material Health
- Material Reutilization
- Renewable Energy & Carbon Management
- Water Stewardship
- Social Fairness

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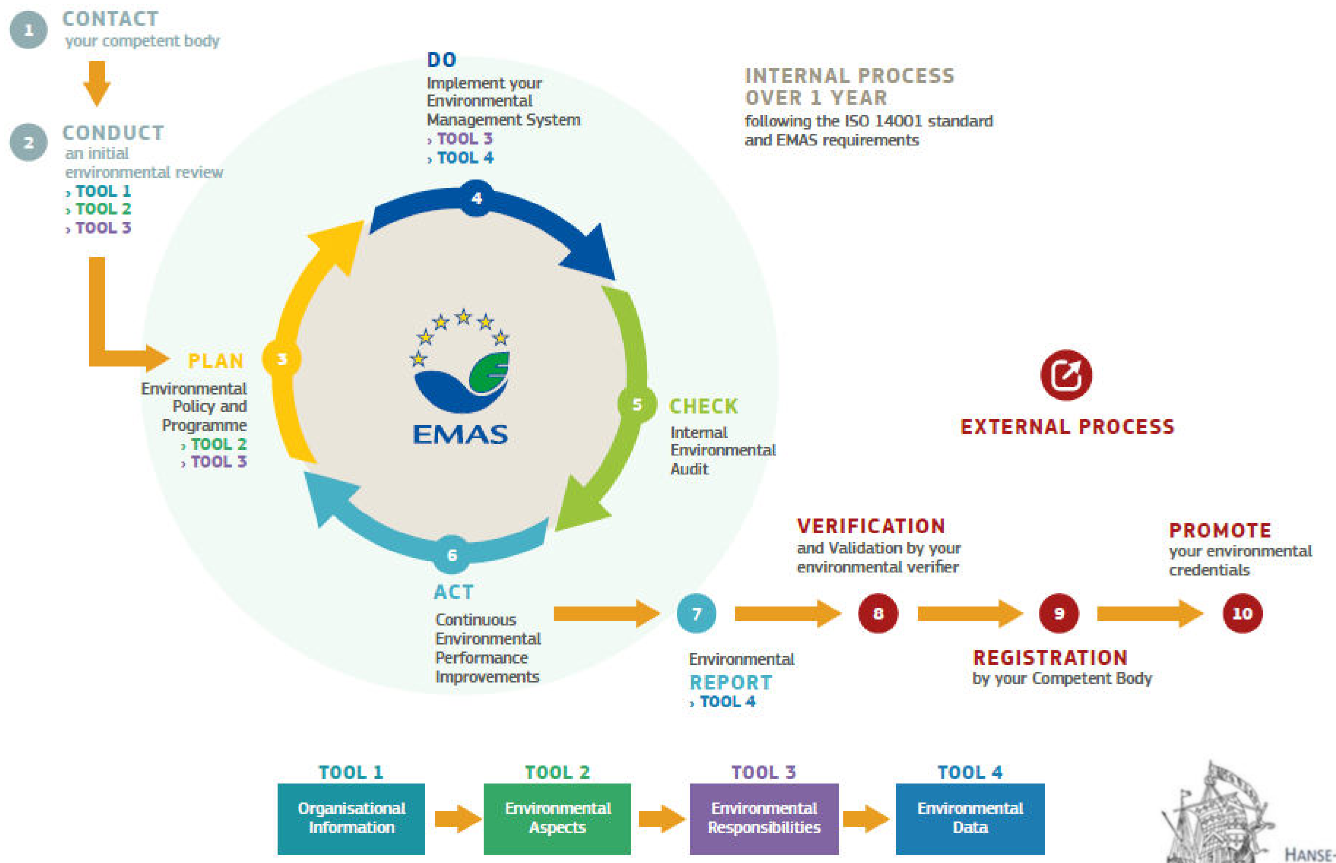
https://www.c2ccertified.org/

Eco-Management and Audit Scheme (EMAS)

Source:
https://ec.europa.eu/environment/emas/pdf/other/Emas%20toolkit_instruction%20manual.pdf



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Other systems and tools

Picture by Oimheidi from Pixabay.

European Energy Efficiency Directive (EED)	• Gives energy audits and energy management schemes a substantial role to play in improving energy efficiency in the end-use sectors.
PEF (Product Environmental Footprint)	• A multi-criteria measure of the environmental performance of a good or service throughout its life cycle.
OEF (Organisation Environmental Footprint)	• A multi-criteria measure of the environmental performance of a goods/services-providing by organisation from a life cycle perspective.
REACH	• Stands for the Registration, Evaluation, Authorisation and Restriction of Chemicals.
Ecological Footprint	• Ecological Footprint accounting measures the *demand* on and *supply* of nature.
Water footprint	• Provide powerful insights for businesses to understand their water-related business risk, for governments to understand the role of water in their economy and water dependency, and for consumers to know how much water is hidden in the products they use. • Help drive strategic action toward sustainable, efficient and equitable water use.
Carbon footprint	• The effects of man-made greenhouse gas emissions on the climate can be measured and compared in the form of carbon footprints.
Carbon handprint	• The carbon handprint is a concept, which describes the emission reduction effect that the solutions produced by companies have for the user. The focus is on what can be done and how others can be helped to prevent climate change. In contrast, a carbon footprint describes the harmful effects of our activities that contribute to climate change.

[13, 11, 5]

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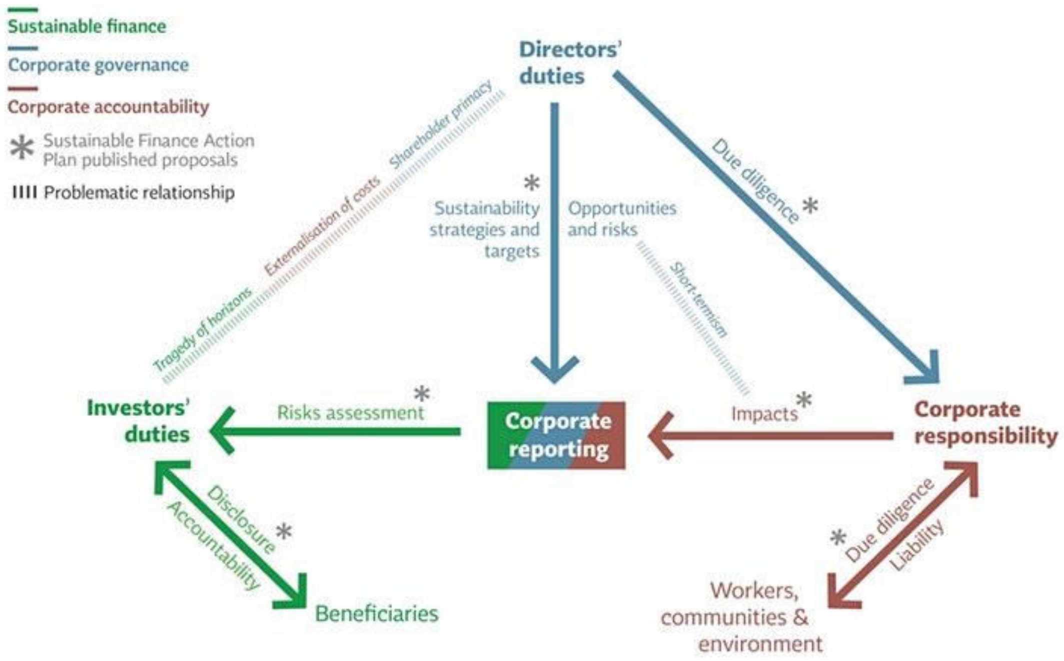
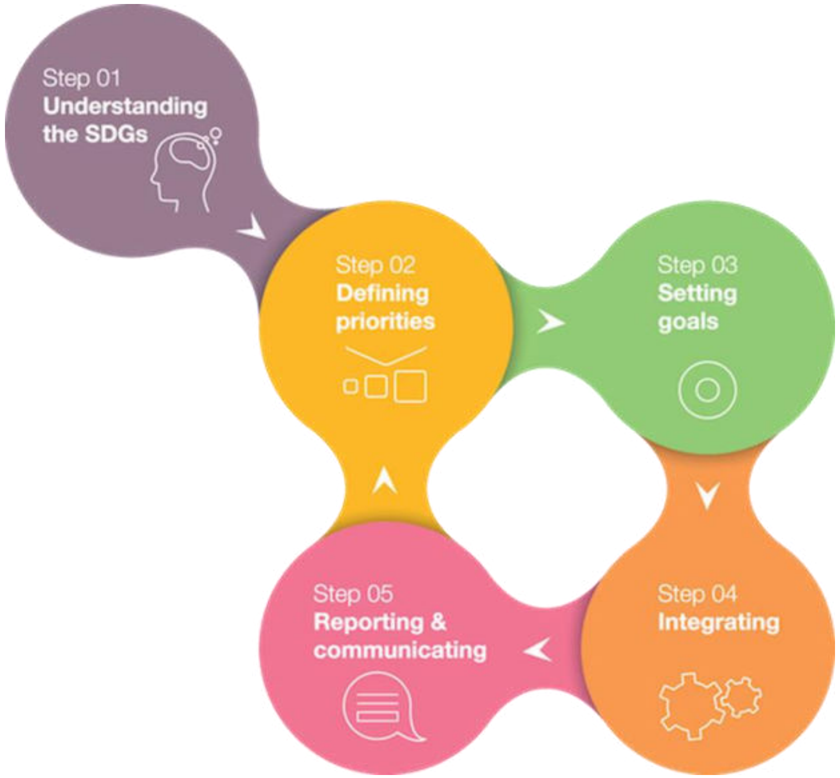
Global Footprint Network web page. 2020. https://www.footprintnetwork.org/our-work/ecological-footprint/
The Coalition for energy savings. 2013. Reaching the targets. eedguidebook.energycoalition.eu/images/PDF/energy-audits.pdf
Water footprint network web page. https://waterfootprint.org/en/

Corporate sustainability reporting and SDG

https://www.eventbrite.com/e/the-state-of-corporate-sustainability-reporting-in-the-eu-tickets-86331839857# & https://sdgcompass.org/wp-content/uploads/2016/05/019104_SDG_Compass_Guide_2015_v29.pdf





Green business models

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Green business models

Circular economy design	New business models	Reverse cycles	Enablers and favourable system conditions
• Companies need to build core competencies in circular design to facilitate product reuse, recycling and cascading. Circular product (and process) design requires advanced skills, information sets, and working methods.	• The shift to a circular economy requires innovative business models that either replace existing ones or seize new opportunities.	• New and additional skills are needed for cascades and the final return of materials to the soil or back into the industrial production system. This includes delivery chain logistics, sorting, warehousing, risk management, power generation, and even molecular biology and polymer chemistry.	• Collaboration • Rethinking incentives • Providing a suitable set of international environmental rules • Leading by example and driving up scale fast • Access to financing

https://www.ellenmacarthurfoundation.org/circular-economy/concept/building-blocks

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Technological innovations

Unsustainable materials:

- Volvo uses **one third recycled materials** in new trucks and designs them for recycling so that 90% can be recycled
- Wärtsilä applies a **modular engine design** to enable increased commonality and backward compatibility of parts

Underutilised capacities:

- Caterpillar acquired Yardclub, a **platform facilitating equipment sharing .**

Premature product lives:

- Bosch operates **remanufacturing chains** for high-quality components to ensure a high fraction stay in its loops
- The Schneider Electric Circuit Breaker Retrofit-program **modernises and updates** electrical distribution centers
- Konecranes provides a Lifecycle Care-program that includes consultation services, **modernisation & maintenance**

Wasted end-of-life value:

- GM recycles 84% of its worldwide manufacturing waste and has **111 landfill-free facilities**
- Maersk introduced a Cradle-to-Cradle Passport for vessels, a **database listing the material composition** of the main parts of the ship enabling better recycling of materials and parts

Unexploited customer engagements:

- Michelin offers **tire as a service** (pay per mile) and sensor-based data analytics for predictive maintenance
- Philips has several contracts signed for providing **light as a service** on a pay-per-lux basis or monthly subscription

[8]

Technology Industries of Finland. Circular Economy business models in the manufacturing industries.
https://teknologiateollisuus.fi/sites/default/files/file_attachments/circular_economy_playbook_for_manufacturing_executive_summary.pdf

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Biolan Ltd.

Source: https://www.biolan.com/

- Established in 1974, Belongs to the Biolan Group
- Employees (2018): 62, Net sales (2018): EUR 23 million
- Sustainable developments proofed by the ISO 9001 compliant quality assurance system and the ISO 14001 compliant environmental system.
- Biolan's main business is fertilizers, nitrogen compounds and products for ecological gardening. They also manufacture products for ecological living. The company has own production facilities in Finland, Estonia and China. The Finnish family business company Biolan was established in 1974, which is the starting point toward circular economy solutions. First product was dried and granule chicken manure for gardens. Composters came into markets in 1978 and in 1980s Biolan developed growing substrate business. Since that, Biolans's business had expanded into peat substrates, nutrients and conditioners, greenhouse technology, dry toilets and wastewater treatment solutions. Biolan also participates in development projects around the world.

Biolan Ltd. Corporate responsibility

Source: https://www.biolan.com/biolan/corporate-responsibility.html

- "**Biolan is deeply committed to corporate accountability and the values of sustainability**.
- Biolan lives and breathes responsibility. Since its establishment, Biolan has always based its operations on **sustainable development**. We are constantly developing new consumer products and solutions to help everyone participate in the recycling of natural resources and reducing our environmental impact.
- We are fully **compliant with laws and regulations in all our actions**. We are aware of the environmental impact of our operations and have set ambitious goals and targets for ourselves in environmental protection. We always look into solutions and raw-materials with the best possible lifecycle, consumer and usability as well as environmental performance.
- **Recycling i**s a driving force in our production. Biolan Group's environmental business unit utilises various **side-streams and by-products of agriculture and industry**. This allows the reuse of nutrients and energy incorporated in the waste. This also reduces the demand for primary nutrients and energy sources.
- Biolan also takes its responsibilities as an employer seriously. We are a **reliable, fair and inclusive employer** who looks after the **wellbeing of its staff and their opportunities for self-development**.
- In 2012, Biolan was the first manufacturer in Finland to analyse the **carbon footprint** of its growing mediums and fertiliser products. The results showed that our products have a very low environmental impact because we utilise industrial and agricultural sidestreams as raw-materials. For example, the packaging of soil products accounts for up to 80 percent of the products' carbon footprint."

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Biolan Ltd.

- Based on ISO 9001 and ISO 14001 the company should be able to compact with SDGs 1, 2, 3, 4, **6**, 7, **8**, **9**, **12**, **13**, 14 and 15.
  - Indirect link: SDG 1, 2 (composting toilets for sustainable agriculture), 3 (composting toilets for better sanitation), 4 (internal education), 7 (renewable energy), 14 (sanitation systems), 15 (humus)
- The most beneficials SDGs are 6: water and sanitation, 8: decent work and economic growth, 9: infrastructure, industrialization (foster innovation), 12: sustainable consumption and production, 13: combat climate change, 17: global partnerships.
  - Those goals have positive shaping impact on Biolan's business, and at the same time they can reduce negative environmental impacts such as emissions to air, soil and waterbodies. These goals and Biolan's strategic actions in them should be in their strategy. Some of the targets are already incorporated in their values, but the company strategy is not available for review. Anyway, strategy should highlight Biolan's long-term impacts.

Biolan Ltd.

- Goal 17 stresses more systematic partnership creation, which is directly linked to the strategy. Biolan should concentrate more on the international projects, which build up into their own strategic needs, i.e. developing products for target markets instead of just transferring existing products without modifications.
- In addition, development cooperation projects with i.e. UNICEF are valuable to show Biolan's social responsibility globally.
- In goal 8 Biolan should emphasize not only their Finnish employees knowledge and skills, but the knowledge increase in local development projects and people working in their local development units. Offering employment possibilities for local people increases their ability to support the whole community.

Biolan Ltd.

- The key action Biolan should focus deals with transparent communication and re-porting of SDGs. Biolan should report clearly their sustainable development performance. The company has ISO 14001 Environmental Management System, but no data is currently available on the website.
- Biolan should also follow core subjects of the ISO 26000 Social Responsibility, and create and publish their Code of Conduct to engage their suppliers in their philosophy.
- Annually, Biolan should announce the key sustainable development performance indicators, and report achievements regarding the Global Conduct principles.
- For private consumers Biolan should open clearly their products sustainability for the whole lifecycle.
- For their own employees Biolan should organize training for SDGs and their applicability in the company and its’ operations.

Introduction to self-studies and project work

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Introduction to self-studies and project work

- To help to establish an action plan through which your company can deliver services, products, etc. related to i.e. resource efficiency, green economy, and eco-innovation to SMEs'.
- Deepen the knowledge on the green economy topic they have selected to be completed in their own SME.
- The documents and materials used in the first seminary days will be a good starting point to the task.
- Participants will observe e.g.
    - what kind of barriers and enablers they find in company,
    - what kind of / which tools and applications would benefit the green economy management functions of the company best,
    - how would you transfer the tools and technology into the organization,
    - what kind of benefits they could give, or
    - what kind of risks they might include
- A brief report and prepare a presentation to be presented in the concluding seminary

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WWW&CE Water, Waste Water, Waste & Circular Economy

WWW&CE project staff hope you will have fruitful and innovative study moments

Picture by markmags from Pixabay.

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WWW&CE

Work Package 4: Second centre level "Continuing vocational training" (EQF Level 4-6)

Activity A6: Trainings in the Green Economy

Best Practice Curriculum

Training B – Waste reduction &recycling management

Developed by:

VILNIAUS STATYBININKŲ RENGIMO CENTRAS in 2020 in the Project "Management and Technologies of Water, Waste Water, Waste and Circular Economy (WWW&CE)"

Prepared by:

Wirtschaftsförderungsinstitut (WIFI) Steiermark

August, 2021

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Chapter 1: Executive Summary

The course "Water Supply Technologies" was developed in the project "Management and Technologies of Water, Waste Water, Waste and Circular Economy – WWW&CE", which was funded by the Erasmus+ Programme of the European Union. Eleven partners from seven EU Member States developed tools according to work-based learning principles that are piloted and evaluated. For more information: https://www.sa-ce.eu

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The course is designed according to the qualifications on the European Framework Qualification Level 4 to 6. Furthermore, the six courses are primarily designed for young people with strong learning skills for vocational training. All courses of the WWW&CE project are targeted to support participants and further on small and medium sized companies towards a more environmentally conscious approach to their personal and business objectives in order to generate a more sustainable world.

The course "Waste reduction & recycling management" focuses on waste mitigation as well as waste treatment and recycling methods. The overall aim is for employees and potential employees to acquire useful expertise in the areas of waste reduction and recycling. By raising the participants' awareness of the waste issues that we are facing today, not only can their private behaviour be positively affected. Participants also have the chance to bring about a positive change in the waste management of SMEs.

Chapter 1.1: Name of the Course

"Waste reduction & recycling management"

Chapter 1.2: Contact Details

WIFI Steiermark

Körblergasse 111-113

A-8010 Graz

Tel.: +43 306 602 1234

Co-funded by the Erasmus+ Programme of the European Union

Fax: +43 316 602 301

E-Mail: info@stmk.wifi.at

Web: https://www.stmk.wifi.at

To be adapted by each partner

Chapter 1.3: Type of Course

To upskill a qualified worker with the knowledge and principles of waste reduction and recycling management to be applied in the daily operation of an SME. After completion of the course, the learners will be equipped with all needed skills, knowledge, and competence to manage and minimize waste as well as to apply the most suitable recycling technologies.

Chapter 1.4: Target Group

The training program is intended for learners having a vocational qualification and several years of professional experience, mainly SME representatives or unemployed people.

Chapter 1.5: Competences Obtained

COMPLEX PROBLEM SOLVING SKILLS	Use of research results to solve waste reduction and recycling problems that have not yet been encountered, in an environment that is continuously changing and presents even more new challenges, ability to see the big picture, the whole problem.
CRITICAL THINKING	Ability to use logic and argumentation in solving various types of waste management problems, analysis of various problem-solving methods, assessment of positive and negative aspects for the environment.
COGNITIVE FLEXIBILITY	The competency to control several different processes in the field of waste management simultaneously. .
DECISION MAKING	The ability to make decisions based on research results. Furthermore, to be able to manage different types of waste in a suitable way in order to select the most appropriate technology.

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COORDINATION WITH OTHERS	Cooperation and involvement of stakeholders in planning specific actions in the fields of waste management, technology selection, enforcement of the aspects of purpose-oriented water use and water saving and support of it with recommended technical solutions.
LEGAL	Knowing of the content of National regulatory requirements applicable to the different waste management.
RSPONSIBILITY	Identifying, evaluating and comparing one's own and other's behaviours, thoughts, values and emotions in the preservation of materials and resources proper hazardous waste management.
ENVIRONMENTAL MOTIVATION	Acting and behaving according to a set of reasons and facts to preserve materials, resources and products, proper waste management.

Chapter 1.6: Course Duration

The course comprises of

- Part I - 34 contact hours of contact lessons,
- Part II - 170 hours of individual learning as well as project work (includes 12 hours of coaching) and
- Part III - 8 hours of Workshop and the
- Assessment

Overall, the total duration of this course amounts to 212 hours.

Based on ECVET principles, the duration of a course counted by accumulating the following:

- Contact hours (Theory): the amount of expected timetabled hours of trainer-trainee contact, including lectures, seminars, and workshops for delivering the theoretical part.
- Self-learning hours (Individual work): the study of something by oneself without direct supervision or attendance in a class.
- Project work.

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- Assessment hours: the time needed to prepare an assignment, including the time allocated to the exam.

Chapter 1.7: Required Prerequisites

The content of the course is designed as a training according to level four to six (4 to 6) of the European Qualifications Framework (EQF).

The participants entering the training programme shall meet at least one of the following requirements based on the content of the curriculum:

a) One has vocational qualification and several years of professional experience as a qualified worker/environmental specialist;
b) SMEs representatives.

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Chapter 2: Curriculum

Chapter 2.1: Content of the Curriculum

Number	Module Name	Content	Training Time	
			Contact Hours	Self-Study Time
I	Waste quantification and monitoring	Waste streams, quantification of solid waste, e-waste quantification, the quantification of hazardous waste and its impact on the environment are part of this module. Furthermore production calculations, mass balance and environmental impact evaluations are made within this module.	6	22
II	Waste process studies	Includes an analysation of the composition of municipal waste generated in the country. Besides that also the life cycle assessment ,material/substance flows, resource utilisation and the sustainable product design are part of the module.	6	36
III	Waste management systems	Determination of the legal framework and requirements on the waste management process. The Principles of Waste management and solid waste management, indeed the collection systems, segregation procedures, waste cycle management, 3R implementation, hazardous waste management, landfill requirements as well as communication and	8	6

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		implementation campaigns. Moreover, good practise examples are included in this module.		
IV	**Waste minimization**	Management strategies to reduce waste amount, industrial symbiosis and the integration of process waste. Additionally, good practise examples of waste reuse.	**4**	**30**
V	**Waste reduction and recycling technologies**		**12**	**46**
	Technologies in waste management	Improvement procedures of recycling rates and optimization of waste collection. Route modernization and landfill modernization possibilities. Safety and turnaround times.		
	Waste segregation and sorting	Manual sorting procedures, multi-compartment bins, automatic sorting systems, mechanical biological treatment (MTB), optical sorting, Eddy current sorting, and optical sensor based sorting technologies.		
	Collection and transportation of waste	Underground collection system, Web-based GIS technology, Waste bin monitoring system using GSM, waste compactors.		
	Recycling	De-Inking technology for paper recycling, biodegradeable and degradeable plastic, cullet remanufacturing (for glass).		

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	Processing	Autoclaving, Fluffing, Melting technology, Incineration, Vermicomposting,		
	Turning waste into energy	Thermal Conversion, advance thermal treatment technologies (pyrolysis, gasification), plasma gasification and plasma pyrolysis, refuse-derived fuel (RDF), fluidized bed technology, bio-conversion, dry anaerobic composting.		
	Disposal	Bioreactor technology, landfill gas recovery technologies (microturine technology, fuel cell technology)		
	Digital technologies	NCC(mobile), BIM (Building imitation modelling), apple (robotics), gCycle (bio-based materials), Rubicon Global (cloud, big data)		
	Technology innovations and waste reduction	Virtual Reality/augmented reality, artificial intelligence (AI), machine learning, prefabrication, predictive analytics.		
	Benefits of using digital technologies for waste management	Analysation and performance evaluation of digital technologies to determine advantages of digital solutions for waste management.		
		Total	**34**	**170**

Project work: Using the acquired knowledge to create and develop a strategy for a company on how to reduce the amount of waste and which possibilities are given to recycle waste.

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Chapter 2.2: Content of the knowledge acquired by learning the modules

Learning outcomes	Recommended content to achieve the learning outcomes
Evaluation and Awareness of waste streams and environmental impacts	1. Topic: Waste quantitfication and monitoring Tasks: 1.1 know different types of waste 1.2 Calculate production 1.3 Perform a quantitative assessment hazardous waste
Ability to analyse survey results	2. Topic: Waste process studies Tasks: 2.1.Perform material/substance flow analysis 2.2 Assess the life-cycle of a different material
Knows principles of waste management	Topic: Waste management systems Tasks: 3.1 Legal requirements applicable for waste management 3.2. Treatment of different types of waste
Ability to develop a waste-reduction strategy for a company	4. Topic: Waste minimization Tasks: 4.1 How to integrate waste management processes 4.2 Application of good practise examples in planning and reduction of waste
Knows the current technologies on waste reduction and recycling procedures and is able to select the best option for a company.	5. Topic: Waste reduction and recycling technologies Tasks: 5.1 Knows how to improve recycling rates, waste collection, route modernization, landfill modernization and safety. 5.2 One is familiar with the different technologies and digital solutions in the field of waste management. 5.3. The participant is able to determine the advantages and disadvantages of waste management technologies.

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Chapter 2.3: Conduction of the Training

Part I

Seven days of training, to transfer knowledge and to provide best practise examples. The training, according to the drawn up schedule, will start every day at 4 pm and end at 9 pm. Theory lessons took place at the premises of the Vilnius Builders Training Centre.

Part II

Time of 3 - 4 months for self-learning and completing the project work
with accompanying coaching. Participants receive coaching from their trainers. Coaching will take place three times at least 3 hours each:

- First time - in the beginning, to determine and agree on the topic of the written exercise; as a workshop or individual coaching;
- Second time - in the middle of the independent study period (discussion, draft, and model); as a workshop or individual coaching‘;
- Third time - after handing in the written exercise to evaluate the results of the independent study; as a workshop or individual coaching.

Participants should have the opportunity to meet with other participants to exchange their acquired experiences, e.g., provision of materials, contacts, or electronic exchange.

Part III

1-day seminar/workshop for analysing project work, the distillation of advantages and opportunities for companies, further knowledge sharing, and proceedings. The purpose of this part is primarily to reflect and exchange experiences. In this context, the participants should have the opportunity to share experiences gained during the training and project work.

Workshop agenda	
9.00am-11.00am	**Exchange and reflection:** • Introduction

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	• Presentation of the projects realized in the company • Discussion and exchange of good practice methods
	Break
11.30am – 12.30pm	**Clarification of questions** • Question & answer session
	Break
1.30pm – 3.30pm	**Outlining the steps for the implementation:** **Step 1** Have a look at the situation in your company **Step 2** Find out what's already there to build upon **Step 3** Identify what is needed to be even more helpful to employees and customers **Step 4** Find indicators of achievement **Step 5** Make a plan on how to implement activities **Step 6** Check the outcomes and adapt activities if nessecary
	Break
4 pm -5pm	**Steps ahead and Evaluation** • Long-term strategy for waste reduction and recycling • Plans for the future: What do the participants want to realize in the company? • Discussion

Chapter 2.4: Teaching/Learning Equipment and Literature

Equipment:

Classroom equipped with school furniture, demonstration tools, and IT devices.

Literature/Sources:

Textbooks, methodical handout materials, national legal acts for waste management as well as material created by teachers/trainers.

Chapter 2.5: Further recommendations

Learning methods: lecture, presentations, disscussions, group work, projects, hands-on activities, company visits.

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Chapter 2.6: Requirements for the trainer's qualification:

The trainer must meet the requirements for a VET trainer by the procedure established by national legal acts.

Chapter 2.7: Testing of the Competence Level

- The whole training consist of three parts and comprises of 210 to 240 hours.
- The training is concluded with an examination.
- Upon passing the examination, the further training qualification "Specialists for Waste Management" is achieved.
- Each participant, who passes the exam, will receive the Certificate.

Chapter 3: Teaching Material

The teaching material can be found on the following pages.

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EXAMPLE OF TEACHING MATERIAL

EXISTING TECHNOLOGIES FOR DEALING WITH WASTE

WHAT WILL YOU LEARN ABOUT IT?

- What are advantages and disadvantages of waste recycling?
- What are the existing technologies for dealing with waste?
- What are the best practices to re-use or recycle C&D waste?

ADVANTAGES OF RECYCLING

ADVANTAGES
1. Minimizes pollution.
2. Protects the environment.
3. Minimizes global warming.
4. Conserves natural resources.
5. Reduces the amount of waste in landfill sites.
6. Ensures sustainable use of resources
7. Contributes to creation of jobs.
8. Reduces energy consumption

DISADVANTAGES OF RECYCLING

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DISADVANTAGES
1. High initial or upfront capital costs.
2. Recycling facilities can be unsightly, noisy and odorous.
3. Products from recycled waste may not be as durable or suitable everywhere
4. Recycling processes may be expensive.
5. Recycling is not widespread on large scale, therefore there may be high transport costs and CO_2 impacts.

ADVANTAGES OF RECYCLING

1. Recycling minimizes pollution

Recycling of wastes such as concrete, timber, plastics, metals, and chemicals (eg plasterboards) considerably reduce levels of pollution because these waste products are reused rather than being transported to landfill or worse dumped recklessly. (fly tipping)

2. Protects the environment

The great benefit of recycling waste material is that it protects the natural environment. While many trees are felled every day, recycled paper is utilized to reduce deforestation. Deforestation leads to $C0_2$ released to the atmosphere and soil erosion. This simple example demonstrates that natural resources can be recycled to conserve and benefit the environment.

ADVANTAGES OF RECYCLING

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3. Recycling minimizes global warming

Recycling minimizes global warming and its impacts. During some waste disposal processes huge amounts of waste are burned, in some cases to generate electricity. This leads to the emission of greenhouse gases such as carbon dioxide, sulfur, and nitrogen, which contribute to climate change and global warming.

4. Conserves natural resources

If recycling of waste material was not undertaken it would mean that new products would need to be manufactured, which would necessitate the extraction of raw materials from mining/dredging, oil refining and deforestation. Recycling is a responsible way of conserving existing raw materials. Taking steps to conserve natural resources like minerals, water and wood by recycling and using recycled materials ensures that construction activities minimize their environmental impact.

ADVANTAGES OF RECYCLING

5. Recycling cuts down amount of waste in landfill sites

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Recycling construction materials into reusable products reduces the amount of material sent to landfill sites. This is beneficial because it helps minimize land use and potential water pollution. Landfill sites need to compact the waste, then contain it in waterproof 'cells' and finally monitor and manage waste gas generated (methane). If water leaches out from the landfill it can be polluting and could contribute to environmental problems. By reducing the quantity of material sent to a landfill site these issues are minimized.

6. Recycling ensures sustainable use of resources

Recycling contributes to the sustainable use of raw materials, in particular when these natural materials are scarce or difficult to acquire. Governments have stepped in to encourage recycling at all levels, from schools and institutions, companies and industries and also by setting global targets. This means that we can leave existing natural resources for future generations.

ADVANTAGES OF RECYCLING

7. Recycling contributes to creation of jobs

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Recycling can create job opportunities. More recycling plants will be set up, leading to a process of collection and delivery, waste processing and redistribution. All these activities will trigger an increase in job opportunities and also entrepreneurs creating innovative materials produced from recycled materials could create new industries.

8. Reduces energy consumption

A lot of energy is used to process raw materials. By recycling materials the energy consumption, which is vital for large-scale production, for instance, mining and refining, will be reduced.

DISADVANTAGES OF RECYCLING

1. High upfront capital costs

Recycling is not always cost-effective. Building a new waste recycling facility requires a lot of capital. The cost includes purchasing vehicles, upgrading or installing new recycling units, waste

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holding areas, and chemical disposal if appropriate. A key element is also encouraging and educating all stakeholders through communication programmes and advertisements, eg posters, as to why recycling is required and what they have to do.

2. Recycling facilities can be unsightly, noisy and odorous

Any waste recycling site, by its very nature, will have mounds of waste material, either waiting to be sorted and at the end of the process piles or bales of recyclable material. This can appear unsightly and may, due to degradation of the material, smell. There will also be a lot of vehicles moving around the facility, creating noise and fumes.

DISADVANTAGES OF RECYCLING

3. Products from recycled waste may not be durable

The quality of products manufactured from recycled waste may not be of the same quality as raw material. Before any recycled material that is used it should be tested and checked to ensure it meets the legal specification, usually undertaken by government or an accrediting department.

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4. Recycling might not be inexpensive

Sometimes, recycled materials may not be as economical as most people think. This may be due to the processing and transport costs, however generally recycled material is more cost effective than transporting raw materials to site. Consider also the corporate social responsibility and sustainability impact which is difficult to cost in monetary terms.

DISADVANTAGES OF RECYCLING

5. Recycling is not widespread on large scale

Although recycling plays a role in reducing the rate of pollution and sustainability, the process has not been widely embraced and developed therefore transport to recycling facilities can be difficult. Recycling has not been fully embedded in most industries, in particular construction. The ultimate problem that most sites encounter is what to do with the recycled material. A holistic approach to create markets for the recycled material is an important goal for recycling to be effective.

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CIRCULAR ECONOMY MODEL OF C&D WASTE:

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The traditional linear economy allows valuable C&D waste to end up in landfill and negatively impact on the environment.

The circular economy approach is to reuse/recycle products and materials wherever possible and minimize the residual C&D waste sent to landfill.

This involves the entire construction supply chain. The materials from demolished buildings should be reprocessed on site or reused in other sectors without creating any waste that goes to landfill.

Therefore architects, engineers and contractors must ensure they minimise the use and maximise the reuse of building materials at the very start of the construction process.

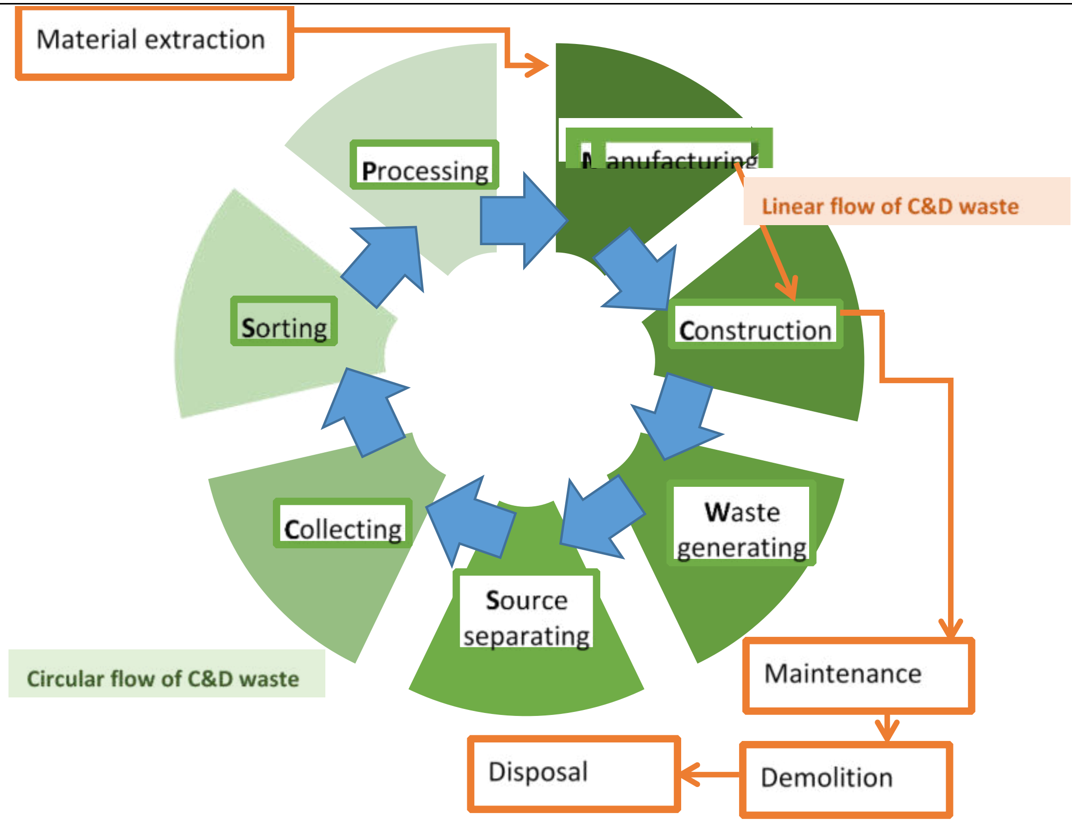

Figure 1 – Linear and circular economy model of C&D waste

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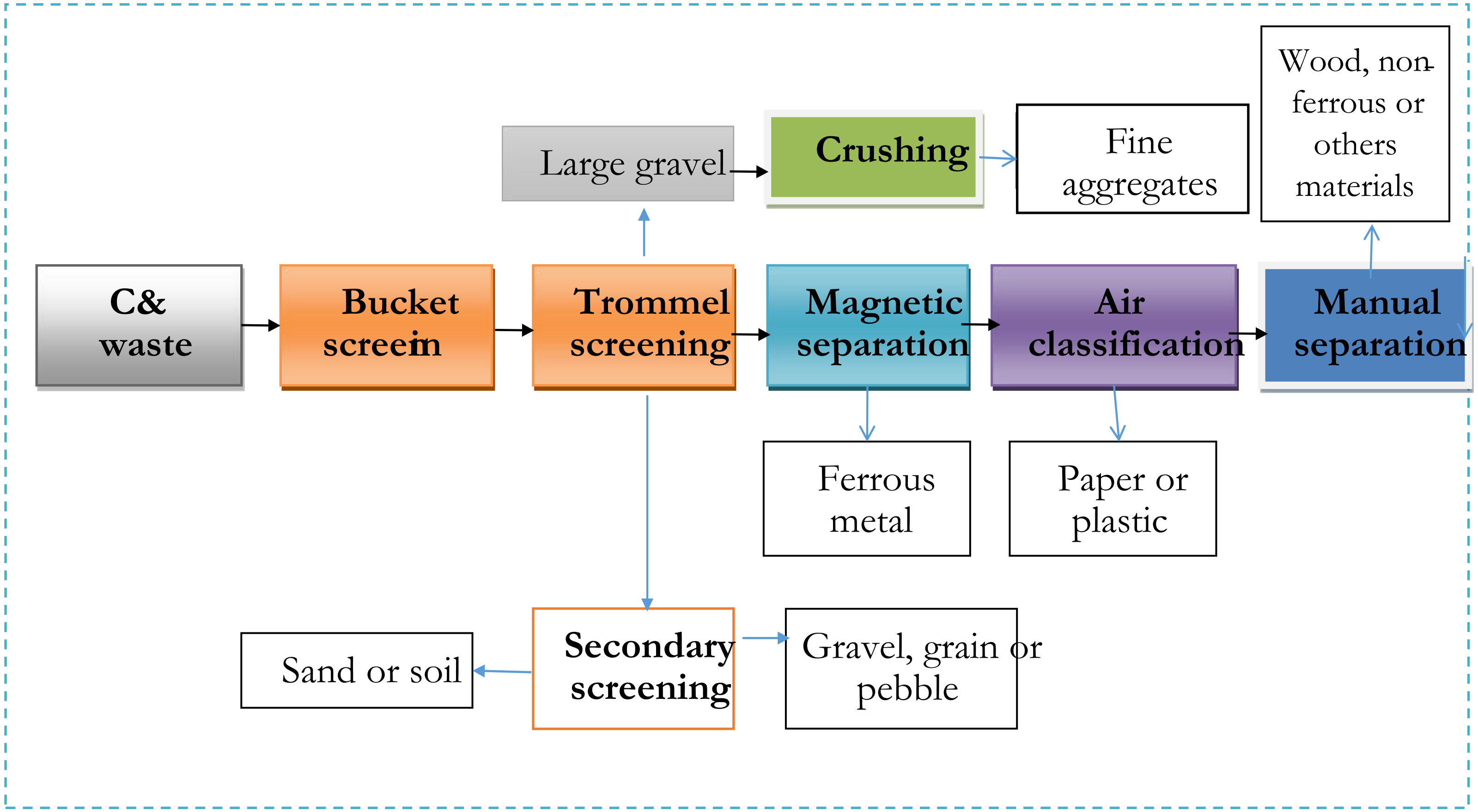
EXISTING TECHNOLOGIES

BUCKET SCREENING



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Watch this video to see waste facility in action

It is used to select material before or after the crushing phase.
Material is sorted by screen it is stored for reuse or recycling.
Some screen rotate to sift material before sorting.

https://www.youtube.com/watch?v=x_dzOnpf9zo

TROMMEL SCREENING

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This technology is named after the cylinder shaped screen used to separate materials by size. It is efficient in the separation and processing of wood chip, soil, compost, light demolition waste and aggregate. The Trommel width, rotational speed, the size of the screen openings, the type and number of baffles and the inclination of the cylinder are factors which influence how waste material is separated
This method of screening enables fast and massive volume processing.

https://www.youtube.com/watch?v=kk4DJeDOqjs

MAGNETIC SEPARATION

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This system uses a magnet to extract ferrous material from the waste stream and convey it to a separate storage area.

https://www.youtube.com/watch?v=c_AUIqLPmZk&feature=youtu.be

AIR CLASSIFICATION

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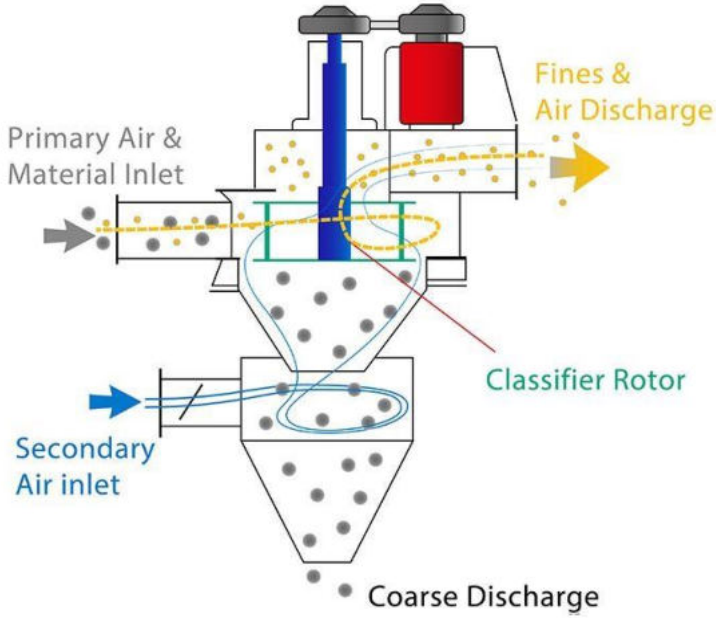
The rotary air classifier consists of three major components: a rotating drum, a screened settling chamber and a compressed air system.

Compressed air is injected so the lightweight material becomes airborne and it is blown down toward the settling chamber.

The larger particles are further transported and dropped at the lower end.

To minimise emissions, the majority of the air can be recirculated.



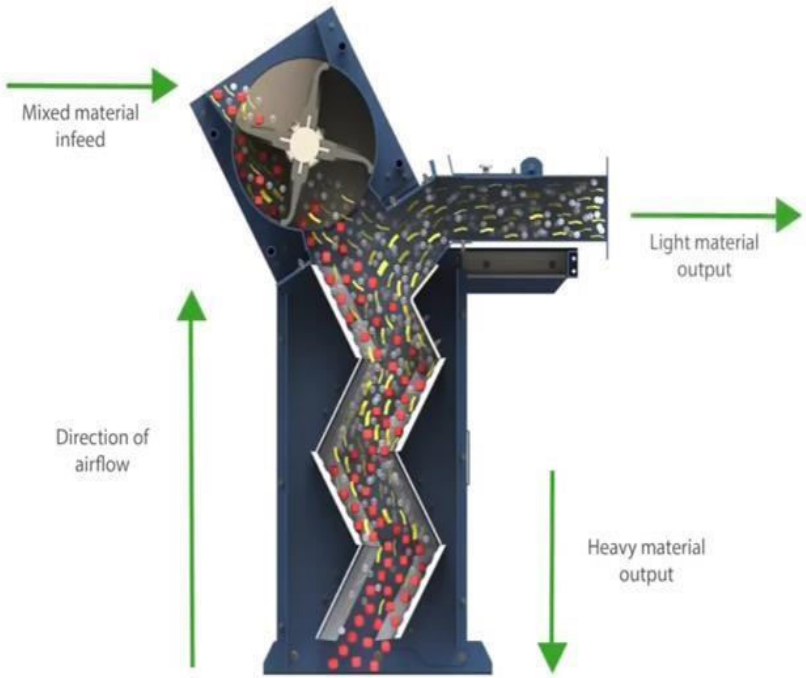
https://www.youtube.com/watch?v=wLi0gm-nh_c

AIR CLASSIFICATION

A zig-zag air classifier

The waste is fed into a zig-zag shaped vertical column while a stream of air is injected from the bottom.

The waste is sorted into heavy and light elements.



https://www.youtube.com/watch?v=_vL3qSC4NHY

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CRUSHING TECHNOLOGY

The most commonly used technology for dealing with C&D waste is crushing.
Mobile crushing stations are used to crush rock, concrete, brick and blocks that could be reused on site, for example as road base or backfill operations, without the material leaving the site.
The mobile crushers can be different sizes, depending on the requirement, they can undertake primary crushing, secondary crushing and alternative screening with belt conveyors to move the crushed material to a storage point.
More information: - www.xkjgroup.com

https://www.youtube.com/watch?v=IQ41yP7LMII

MANUAL SORTING AND SEPARATION

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On-site Waste Sorting – This involves everyone on site placing recyclable or reusable material into appropriate containers or storage areas. This primary sorting is efficient and cost effective. Use small 'wheelly bins' near to where people are working to make transport of the material easier.

Manual separation – This can take place at a waste facility to sort different qualities of wastepaper, colour specific glass, clear and coloured polyethene foil or remove contaminating materials out of waste streams.

Manual separation is both expensive and timeconsuming when handling large volumes of materials. It is preferable to maximize the use of mechanical sorting.

EXAMPLES OF BEST PRACTICES

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Experience of LafargeHolcim - How to recycle C&D waste into new sustainable building materials

720 tonnes of recycled aggregates have been used to produce new concrete for the project and **3,280 tonnes of recycled gravels** have been produced for road use.

- All inert material have been recycled into new aggregates: 18% of them to produce new concrete products and 82% to produce road gravels.
- Avoided using 4,000 tonnes of natural resources from quarries.
- The carbon assessment of a traditional construction project is around 6.2 kg of CO_2/tonne of aggregate versus 5.2 kg of CO_2/tonne for this circular economy project

By 2020, LafargeHolcim Group wants to re-use 80 million metric tonnes of waste derived resource per year.

http://www.circulary.eu/project/lafargeholcim-demolition-waste/

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EXAMPLES OF BEST PRACTICES

Experience of ACCIONA’s

Recycling and reusing excavation materials:

Reusing material in other construction processes; such as viaduct piles protection embankment filling, access roads filling and restoration, river course protection, laying and compacting material on the esplanade.

In 2016, reused materials:-

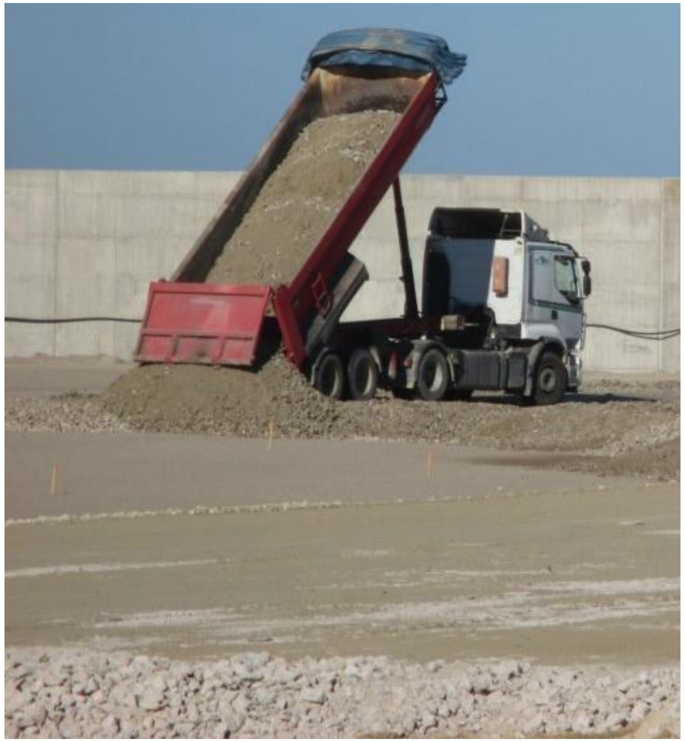
1,067,200 m^3 of excavation materials.

17,000 m^3 of topsoil

1,000 m^3 of concrete waste.

26,400 m^3 of bituminous mixtures waste (bituminous mixture is asphalt which is mixed with different aggregates to create asphalt concrete).

In the last 3 years, ACCIONA Construction has avoided more than 10,000 t of CO_2 considering all implemented measures.



http://www.circulary.eu/project/acciona-procurement/

FACTORS TO CONSIDER BEFORE IMPLEMENTIG WASTE MANAGEMENT TECHNOLOGIES ON SITE

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1. The quality of the waste;
2. The volume of waste to be treated;
3. Technological processes available to use on site;
4. Environmental impact and Safety impact;
5. Storage location on site
6. Information relating to the site, water course, geology etc.
7. Legal requirements/specification relating to reuse and recycling

BENEFITS OF USING C&D WASTE MANAGEMENT TECHNOLOGIES

- Optimization of natural resources (by substitution with recycled products);
- Minimize energy and water consumption (processing, dust suppression, etc.);
- Minimize production of residual waste products (sent to landfill, pollution);

- Minimize transport activity;
- Minimize impact from dust-, vibrations-, CO2,-, noise emissions;
- Maximize the value of recycled products (material, energy)

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EXISTING TECHNOLOGIES FOR DEALING WITH WASTE

Well done! You have reached the end of this Topic
Now complete the following questions to check your understanding

Good Luck!

CASE STUDY BASED ON THE INFORMATION PROVIDED, ANALYSE CDW MANAGEMENT PRACTICES IN LT

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1. Answer the question below:
   - What are the main activities to deal with C&D waste in Lithuania?
   - How many per cent of C&D waste were recovered and disposed to landfill in Lithuania?
   - How many per cent of hazardous C&D waste were recovered in LT, 2017?
2. Create the diagram of C&D waste treatment data in LT, 2017 (how many per cent of C&D waste were recovered, incinerated, exported, backfilled and sent to landfill).

EVALUATION OF OPPORTUNITIES OF EXISTING SECTOR TECHNOLOGIES OF WASTE

CDW management practices in LT

In 2017, 1070,562 tons of construction and demolition waste were generated in Lithuania, which was 12% more than in 2016 (957,059 tons), and 63% more than in 2014 (658,416 tons), resulting from the intensification of construction in the country during this period.

The Government of the Republic of Lithuania has approved the National Waste Management Plan for 2014–2020 to reduce the impact of waste pollution, ensure a waste management system and establish waste management objectives. The waste management system should address issues of the population, provide the quality of the environment, comply with the market economy standards; meanwhile, the share of recycled waste in 2020 should be at least 50%. **Table 1 CDW treatment data in LT, 2017**

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Data source: The Environmental Protection Agency under the Minister of the Environment of the Republic of Lithuania (EPA), 2014-2017.

CDW destination (2017)	Waste total quantity (t)	Material recovery		Incineration		Export (S4)		Backfilling (R10, R11)		Landfill (D1, D5)		Total	
		Re-use, recycling, recovering on another site, including by another company (R2-R9), (D8, D9, D14, R12, S5)		using waste as fuel (R1)						t	%	t	%
		t	%	t	%	t	%	t	%				
Nonhazardous waste	1028.830	722.247	70.20	0.164	0.16	165.2	16.05	113.696	11.1	27.523	2.7	1028.830	100
Hazardous waste	41.731	25.452	60.99	1.055	2.53	0.1	0.16	0	0	15.125	36.24	41.731	100
Total	1070.562	747.699	69.84	1.219	0.11	165.3	15.44	113.696	10.62	42.648	3.99	1070.562	100

Table 1 shows that in 2017, the LT generated 1028.83 tonnes of nonhazardous C&D waste, of which 722.247 tonnes was recovered. This represents a recovery rate of 70.20 per cent, which is above the target of 70 per cent which the LT must meet in 2020.

In the EU Waste Framework Directive 2008/98 waste related activities classified as recovery (R) or disposal (D).

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DISPOSAL OPERATIONS	
D1	Deposit into or on to land (e.g. landfill, etc.)
D2	Land treatment (e.g. biodegradation of liquid or sludgy discards in soils, etc.)
D3	Deep injection (e.g. injection of pumpable discards into wells, salt domes or naturally occurring repositories, etc.
D4	Surface impoundment (e.g. placement of liquid or sludgy discards into pits, ponds or lagoons, etc.)
D5	Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)
D6	Release into a water body except seas/oceans
D7	Release to seas/oceans including sea-bed insertion

RECOVERY OPERATIONS	
R1	Use principally as a fuel or other means to generate energy
R2	Solvent reclamation/regeneration
R3	Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes)
R4	Recycling/reclamation of metals and metal compounds
R5	Recycling/reclamation of other inorganic materials
R6	Regeneration of acids or bases

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D8	Biological treatment which results in final compounds or mixtures which are discarded by means of any of the operations numbered D 1 to D 12
D9	Physico-chemical treatment which results in final compounds or mixtures which are discarded by means of any of the operations numbered D 1 to D 12 (e.g. evaporation, drying, calcination, etc.)
D10	Incineration on land
D11	Incineration at sea
D12	Permanent storage (e.g. emplacement of containers in a mine, etc.)
D13	Blending or mixing prior to submission to any of the operations numbered D 1 to D 12
D14	Repackaging prior to submission to any of the operations numbered D 1 to D 13

R7	Recovery of components used for pollution abatement
R8	Recovery of components from catalysts
R9	Oil re-refining or other reuses of oil
R10	Land treatment resulting in benefit to agriculture or ecological improvement
R11	Use of waste obtained from any of the operations numbered R 1 to R 10
R12	Exchange of waste for submission to any of the operations numbered R 1 to R 11
R13	

D15	Storage pending any of the operations numbered D 1 to D 14 (excluding temporary storage, pending collection, on the site where the waste is produced)		Storage of waste pending any of the operations numbered R 1 to R 12 (excluding temporary storage, pending collection, on the site where the waste is produced)

ANSWERS OF CASE STUDY, C&D WASTE MANAGEMENT PRACTICES IN LT ANALYSIS

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1. Answer the questions:
   a. What are the main activities to deal with C&D waste in Lithuania?

      Reuse, recycling, recovering on another site, including by another company

   b. Ho many per cents of C&D waste were recovered and disposed in Lituania?

      69.84% export

   c. How many per cents of hazardous C&D waste were backfilling recovered in LT, 2017?

      60.99%
2. Create the diagram of C&D waste treatment data in LT, 2017 (how many per cents of C&D waste recovered , incinerated, exported backfilled and landfilled)

EXERCISE

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Link each technology to the correct discription

Trommel screening

Magnetic Separation

Manual separation

This technology is efficient in the separation and processing of wood chip, soil, compost, light demolition waste, aggregates and yard waste.

Involves hand removal of the recyclables from the waste stream and placement into appropriate containers.

This system attracts ferrous material from the waste stream and conveys it away.

ANSWER OF EXERCISE

This technology is used for separation of waste. The wste is fed into azig zag shaped vertical column wile being subjected to a astream of air introduced from the bottom.

Crushing

Air classification

This technology is mainly used for metallurgical, chemical, building materials, hydropower, and other materials processing that often require relocation operations

Air classification

Trommel screening

Magnetic Separation

Manual separation

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This technology is efficient in the separation and processing of wood chip, soil, compost, light demolition waste, aggregates and yard waste.

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This technology is used for the separation of wastes. The waste is fed into a zig -zag shaped vertical column while being subjected to a stream of air introduced from the bottom.

This technology is mainly used for metallurgical, chemical, building materials, hydropower, and other materials processing that often require relocation operations

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Work Package 4: Second center level "Continuing vocational training"

Activity A6: Additional Qualification Trainings

Best Practice Curriculum

Training C – Wastewater treatment and recycling management

Developed by:

SAMK in 2021 in the Project "Management and Technologies of Water, Waste Water, Waste and Circular Economy (WWW&CE)"

Prepared by:

Wirtschaftsförderungsinstitut (WIFI) Steiermark

November, 2021

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Chapter 1: Executive Summary

The course "Technologies decentralized wastewater treatment" was developed in the project "Management and Technologies of Water, Waste Water, Waste and Circular Economy – WWW&CE", which was funded by the Erasmus+ Programme of the European Union. Eleven partners from seven EU Member States developed tools according to work-based learning principles that are piloted and evaluated. For more information: https://www.sa-ce.eu

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The course "Wastewater treatment and recycling management" promotes sustainability by teaching important environmental topics such as wastewater treatment and recycling management. The participants are attaining knowledge about legal frameworks, current technologies and common practices, maintenance and renovation concepts, as well as financing methods. Overall, the course aims to equip participants with the necessary knowledge and skills to design wastewater treatment and recycling options in an efficient and sustainable manner. Furthermore, the course aims to support participants in finding innovative solutions on how they and their companies can best respond to the current challenges in this field.

Chapter 1.1: Introduction

According to European parliament, Europe should take the leading role in fighting against climate change by using its unlimited creativity to achieve solutions for sustainable growth. This was one of the recurrent themes behind the founding of Horizon Europe, the EU's next research and innovation programme, due to start in 2021. The European Parliament and the Council agreed on Horizon Europe in April 2019. Based to this agreement the Commission has started to prepare the implementation of the programme, including the first 'Horizon Europe Strategic Plan 2021-24'. The plan, focused on Horizon Europe's second pillar: 'Global Challenges and European Industrial Competitiveness', will identify major policy drivers, strategic policy priorities, and targeted impacts to be achieved as well as identify missions and European Partnerships.

The pillars of the Horizon Europe (Figure 1) are Excellent Science, Global Challenges and European Industrial Competitiveness, and Innovative Europe. The pillars will be based to widening participation and strengthening the European Research Area.

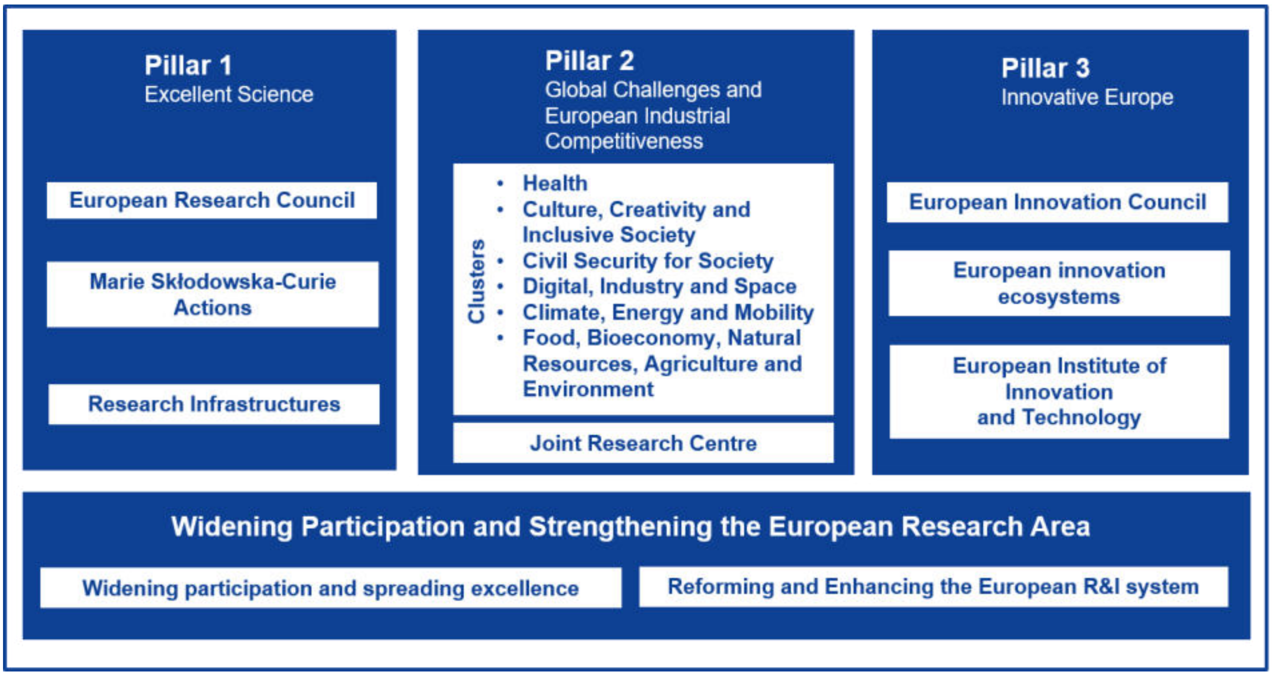

Figure 1: The pillars of the Horizon Europe (Source: https://ec.europa.eu/info/horizon-europe_en)

Horizon Europe will incorporate research and innovation missions to increase the effectiveness of funding by pursuing clearly defined targets. Five mission areas have been identified, each with a dedicated mission board and assembly. The areas are…

- Adaptation to climate change including societal transformation
- Cancer
- Climate-neutral and smart cities
- Healthy oceans, seas, coastal and inland waters
- Soil health and food

The mission areas highlight the interdisciplinary approach to current and future challenges sooner than unbalanced fighting against single problem like climate change. The European parliament has emphasized the importance of taking also the societal and growth aspects into account as an important part of sustainability when aiming to the sustainable living, industry and business.

Wastewater treatment and recycling management

Water is vital for a healthy ecosystem, socio-economic development and for human survival. *The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests.*[1] Water issues are directly targeted at SDG goals number six, titled "Clean Water and Sanitation", which aims at ensuring availability and sustainable management of water and sanitation for all by 2030. The target 6.3 focuses on the following: *improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.*[2] The SMEs are in a key position to improve wastewater treatment and recycling management, thus promoting not only their own sustainability and competitiveness but also ecosystems well-being.

The concept of wastewater treatment and recycling management is a vast, multidiscipline and challenging topic, which needs prompt attention also in SMEs. In Europe, the treatment of wastewater is regulated by the Urban Waste Water Treatment Directive (UWWTD)[3], which steers the EU towards the zero pollution ambitions proclaimed in the European Green Deal. Member states have to collect and treat wastewaters to protect environment, water ecosystems, human health and biodiversity. Treating, recycling and reusing wastewater and sewage sludge have an import link to circular economy: renewable energy production and recycled nutrients save natural resources and help SMEs to achieve cost-effectiveness. Another important perspective in a wider scale is the creation of sustainable growth and jobs.

In 2019, the European Commission evaluated whether the UWWTD has reached its objectives. It was shown that increasing collection of wastewater and treatment has been successful, hence led to improvements in water quality.[4] However, there is need for additional improvements. Special attention and actions should be addressed to pharmaceutical residues and micro plastics as well as

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[1] United Nations. Sustainable Development Goals, https://sdgs.un.org/goals
[2] United Nations. Targets and Indicators, https://sdgs.un.org/goals/goal6
[3] European Commission. Urban Waste Water Directive Overview, https://ec.europa.eu/environment/water/water-urbanwaste/index_en.html
[4] European Commission. 2020. Tenth report on the implementation status and programmes for implementation (as required by Article 17 of Council Directive 91/271/EEC, concerning urban waste water treatment), https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0492&from=EN

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pollutions through storm water overflows, small agglomerations, non-connected dwellings etc. These must also include technological developments and be adapted to societal issues resulted from climate change[5]. Industrial wastewaters are very complex to be treated, especially in cases where the wastewater contains various physical and chemical compounds. Numerous legislative norms, national and local regulations and guidelines make wastewater treatment and recycling management a complex challenge.

Wastewater treatment and recycling systems in SMEs have to be sustainable, and energy optimization and nutrient recycling have to be included in the management boundaries. This, together with improving the efficiency of industrial water use and treatment of the wastewater, will unlock the potential for saving water and safeguarding the environment. The adoption of innovative solutions, like digitalization, smart metering and efficient operation of treatment processes, is vital. Stakeholder discussions guide business operations and e.g. reliance on legal obligations. Increase in new knowledge and skills of rapidly advancing technology are urgently required in SMEs.

Chapter 1.2: Name of the Course

"Wastewater treatment and recycling management"

Chapter 1.3: Contact Details

WIFI Steiermark

Körblergasse 111-113

A-8010 Graz

Tel.: +43 306 602 1234

Fax: +43 316 602 301

E-Mail: info@stmk.wifi.at

Web: https://www.stmk.wifi.at

To be adapted by each partner

[5] European Commission. Inception impact assessment, https://ec.europa.eu/info/law/better-regulation/

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Chapter 1.4: Target Group

The training is directed to…

- the small and medium sized enterprises and their entrepreneurs and employers. It is recommended, that the participants have at least the basic vocational education.
- students of further vocational education who are interested in wastewater treatment and recycling option in company action.
- the training will suit also bachelor-level students who are interested in wastewater treatment and recycling management. However, the training is not intended to be approved as a part of bachelor's grade. Depending to the requirements and regulation of each country, further training and / or further assessments may raise the course to the level required in bachelor's grade.

In addition, the others who are interested in wastewater treatment and recycling management options, for example those who are planning a business of their own, are welcome to participate to the training.

Chapter 1.5: Course Duration

The average course duration consist of 30 to 45 hours classroom teaching and 150 - 200 hours of individual learning during the second phase of the training.

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Chapter 2: Curriculum

The goal of this part of the project is to develop a further vocational training that would help the employers and entrepreneurs of small and medium size enterprises to adapt to the changing world and to gain all the benefits of new trends in wastewater treatment and recycling management. To reach this goal, a curriculum, that will be applicable in each country participating the project, has been designed.

The curriculum approaches the wastewater treatment and recycling management on point of view of small and medium size enterprises (the SMEs). In the curriculum, the following issues has been taken into account:

1. The approach "Wastewater treatment and recycling management" is multidiscipline and holistic. Sustainable treatment of wastewater and proper recycling practices play a major role in allowing SMEs to meet cost-effective treatment and stakeholders expectations.
2. The management and recycling of wastewater have to be in line with the goals of sustainability and responsibility in SMEs. Thus, companies have to develop their capabilities and processes to meet the constantly tightening environmental requirements as well as the other applicable goals of sustainability.
3. In small and medium size enterprises, the resources required to manage wastewater treatment and recycling are very limited. There are lack of personnel, insufficient skills and knowledge, and limited financial resources.
4. Although the challenges are common, each country has its own country-specific characteristics, like legislation and local regulation. Thus, the curriculum should be modifiable and applicable to each country.

Chapter 2.1: Objectives of the training

The aim of the education is to give participants skills and knowledge required to manage wastewater treatment and recycling management in the company. The concrete goal is to give the participants'

- Knowledge of the operating environment of wastewater treatment and recycling management promoting sustainability and responsibility.
- A common information concerning the European and national legislation and regional regulations concerning the wastewater treatment and recycling management in SMEs.
- Ability to develop wastewater treatment and recycling management processes, to manage wastewater treatment and recycling processes, to execute renovations and develop information systems so that are in line with the requirements and company strategies.
- Skills to design appropriate wastewater treatment and recycling options in sparsely populated areas.

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- Ability to develop working in a wastewater and recycling work community in SMEs and with stakeholders.
- Ability to help participants innovate solutions how they and their companies will find the best ways to respond the challenges.

Chapter 2.2: First Workshop

Duration: 3 - 4 days

Goals and tasks of the first workshop are

- to enable knowledge transfer about the KAIN-method, embedded in the contents of wastewater treatment and recycling management,
- to create a common basis of knowledge among the project participants concerning the management of wastewater treatment and recycling management and the role of employees,
- to encourage the exchange of experience about successful projects for designing wastewater treatment and recycling systems, including managing the systems and to
- form a preliminary orientation on topics for effective wastewater treatment and recycling management in the own company.

During this 3 – 4 days' workshop the participants get to know models and instruments from project-related research for structuring and solving problems and learn to apply them. The goal is to create a common conceptual basis for the further procedure in the training.

The models and instruments presented as examples and design recommendations for practical use, ideally form a common framework in which, in particular, the existing experiences of the participants are to be integrated in order to pursue the training objectives. The experience of the participants should serve to supplement or modify the proposals for structuring and solving problems given by the research.

Thus, at an early stage of the training, a necessary adaptation of the proposed models and instruments to the individual needs and characteristics of the participants on site, usually with different frameworks and conditions, should take place.

Before the first workshop, a trainer designing the course should select and modify the models, instruments and other material applicable to just this country, area, branch and companies in question. The material presented in this curriculum consists of common examples and works as models and stimulus for trainers.

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Preparation and management of SMEs for work in the wastewater treatment and recycling management (45 h lessons + self-learning and project work)

Note 1: Two shorter breaks (with coffee) and one longer break (Lunch) will be held during the day.

Note 2: The material presented below are examples and stimulus, which should be applied and modified according to the country, area, background, level and needs of trainees, and also according to knowledge areas of trainer. The times are suggestions and may vary depending to the weighting of topics (see above).

Topic	Duration (hours)	Notes and materials
1. Welcome, registration, training arrangements and materials	0.5 – 1.0	Teacher motivates participants to making transition actions in their SMEs in managing wastewater treatment and recycling. Participants present themselves and express their wishes for the training
2. Review of the wastewater treatment and recycling management. How the topic is related to SDGs.	1.0 – 1.5	The objective of this lecture is to review the concepts related to wastewater treatment and recycling management and how it is linked to the Sustainable Development Goals. Water Quality and Wastewater https://www.unwater.org/water-facts/quality-and-wastewater/ Water and sanitation https://sdgs.un.org/topics/water-and-sanitation Water Europe https://watereurope.eu/ & https://watereurope.eu/wp-content/uploads/UWWTD-position-paper-1-1.pdf Definitions and terminology https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781118731741.oth Sustainable development goals https://www.un.org/sustainabledevelopment/ & https://sdgs.un.org/goals/goal6

		Indicator 6.3.1 – Wastewater treatment https://www.sdg6data.org/indicator/6.3.1 SDG 6 - Clean water and sanitation (statistical annex) https://ec.europa.eu/eurostat/statistics-explained/index.php?title=SDG_6_-_Clean_water_and_sanitation_(statistical_annex) Interactive game http://wwtpgame.iwama.eu/
3. European Union water policy, directives, national legislation and local regulations.	1.0 – 1.5	The objective of this lecture is to explain the European Union strategy and legislation related to wastewater treatment and recycling management. The national and regional strategies, legislation and regulations provide application guidelines for local action at SMEs.
The topic includes group work and final discussions on national and regional legislation and regulations/requirements.	1.0 - 1.5	Urban Waste Water Directive https://ec.europa.eu/environment/water/water-urbanwaste/index_en.html & https://watereurope.eu/wp-content/uploads/WE-Position-Paper-on-the-Urban-Wastewater-Treatment-Directive-final-v2.pdf Sewage sludge https://ec.europa.eu/environment/topics/waste-and-recycling/sewage-sludge_en Water reuse https://ec.europa.eu/environment/water/reuse.htm Regulation on minimum requirements for water reuse https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R0741&from=EN Position papers:

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		https://watereurope.eu/wp-content/uploads/UWWTD-position-paper-1-1.pdf & https://watereurope.eu/wp-content/uploads/WE-Position-Paper-Sewage-Sludge-Directive.pdf ISO standards https://www.iso.org/ics/13.060.30/x/ Finnish industrial wastewater guide (material also for other topics) https://www.vvy.fi/site/assets/files/1110/finnish_industrial_wastewater_guide.pdf Other material compatible with the local conditions
4. Wastewater treatment methods for municipal and industrial wastewater. Different network for run-off water and nature based solutions. Wastewater treatment plants outside the municipal network. **The topic includes group work and final discussions on wastewater management and best practices.**	4.0 – 5.0 1.5 – 2.0	The objective of this lecture is to expand the participants' expertise on current developments of wastewater conveying and treatment. Special attention is given on wastewater treatment and recycling in sparsely populated areas. Resource center: Water & Wastewater Treatment Education https://www.suez-na.com/en-us/our-offering/resources (select appropriate material) Wastewater treatment https://courses.edx.org/c4x/DelftX/CTB3365STx/asset/Wastewater_Lecture_Note.pdf Industrial waste water treatment – pressures on Europe's environment https://www.eea.europa.eu/publications/industrial-waste-water-treatment-pressures European Wastewater Sector Foresighting https://www.nweurope.eu/media/13111/wtn-wastewater-foresighting-report-final.pdf

		Wastewater https://www.kemira.com/water/wastewater/ Other material compatible with the local conditions
5. Sludge treatment and utilization **The topic includes group work and final discussions on sludge management and best practices**	1.0 – 1.5 1.0 – 1.5	The objective of this topic is to gain a deeper understanding of all of the required aspects for the design and operation of a comprehensive sludge management system. Waste water treatment – sludge management https://www.eureau.org/resources/briefing-notes/5629-briefing-note-on-sludge-management/file Key figure data for sludge benchmark http://www.iwama.eu/output/key-figure-data-energy-and-sludge-benchmark, or direct link https://www.iwama.eu/sites/iwama/files/outputs/files/key_figure_data_for_sludge_benchmark_0.pdf Audit concept for smart energy and sludge management http://www.iwama.eu/output/audit-concept-smart-energy-and-sludge-management (select materials related to sludge) Sludge https://www.kemira.com/water/sludge/ Sludge treatment and disposal https://www.iwapublishing.com/sites/default/files/ebooks/9781780402130.pdf How is Wastewater Sludge Treated for Disposal? https://www.suez-na.com/en-us/our-offering/resources/wastewater-sludge-treatment-process Project BEST – Better Efficiency for Industrial Sewage Treatment https://bestbalticproject.eu/

		Other material compatible with the local conditions.
6. Wastewater reuse, energy recovery and energy efficiency	2.0 – 3.0	The objective of this topic is to demonstrate innovative technical and digital solutions that optimize water reuse, resource recovery and energy utilisation in SME settings. Key figure data for energy efficiency http://www.iwama.eu/output/key-figure-data-energy-and-sludge-benchmark or direct link https://www.iwama.eu/sites/iwama/files/key_figure_data_for_energy_benchmark_0.pdf Opportunities to improve energy use in urban wastewater treatment: a European-scale analysis https://iopscience.iop.org/article/10.1088/1748-9326/ab0b54/meta Audit concept for smart energy and sludge management http://www.iwama.eu/output/audit-concept-smart-energy-and-sludge-management (select materials related to energy efficiency) Policy brief: The potential of the wastewater sector in the energy transition http://powerstep.eu/system/files/generated/files/resource/policy-brief.pdf From wastewater to fertilizers https://run4life-project.eu/ Sewage treatment plants: Economic Evaluation of Innovative Technologies for Energy Efficiency https://iwaponline.com/ebooks/book/246/Sewage-Treatment-Plants The role of biogas production from industrial wastewaters in reaching

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		climate neutrality by 2050 https://www.europeanbiogas.eu/wp-content/uploads/2021/04/Paper-The-role-of-biogas-production-from-wastewater-in-reaching-climate-neutrality-by-2050.pdf Powerstep materials selected from http://powerstep.eu/resources/ Other material compatible with the local conditions.
7. Operating wastewater treatment plants and pipelines. Monitoring parameters. Maintenance and renovation works. Inspection methods for sewer pipes. **The topic includes group work and final discussions on the challenges faced in operating the plants and sewers.**	2.0 – 2.5 1.0 – 1.5	The objective of this lecture is to deepen the operation, control and maintenance service knowledge at wastewater treatment plants and sewers to meet the set performance requirements. Selected parts from the publication F.R. Spellman. (2020). Handbook of Water and Wastewater Treatment Plant Operations https://www.routledge.com/Handbook-of-Water-and-Wastewater-Treatment-Plant-Operations/Spellman/p/book/9780367485559?gclid=CjwKCAjw64eJBhAGEiwABr9o2LdjMBKZlzIp9NF3KmZR1fbqnYbEtayidSVG7fnu44fcSIrFvnVejxoCdEgQAvD_BwE#. The older version is available https://www.academia.edu/27033992/Handbook_of_Water_and_Wastewater_Treatment_Plant_Operations_pdf Inspection methods for sewer pipes https://www.fistt.net/wp-content/uploads/2019/09/CASI-Methods.pdf Occupational Hazard Datasheets - Wastewater Treatment Plant Operator https://www.ilo.org/wcmsp5/groups/public/---

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		ed_protect/---protrav/---safework/documents/publication/wcms_192394.pdf Other material compatible with the local conditions.
8. Financial possibilities for SMEs: European Union, national, regional and local finance	1.0 – 1.5	The objective of this lecture is to explain European Union and national funding schemes according to the recipient country. Access to finance for SMEs https://ec.europa.eu/growth/access-to-finance_en COSME - Europe's programme for small and medium-sized enterprises https://ec.europa.eu/growth/smes/cosme Other material compatible with the local conditions.
9. Capacity building: strategy, action plan and staff's skills and knowledge development. **The topic includes group work and final discussions on skills and knowledge demand in wastewater treatment and recycling in SMEs.**	1.5 – 2.0 1.0 – 1.5	The objective of this lecture is to introduce capacity building measures both in the SME strategy level and in identification of the skills required for working at wastewater treatment and recycling operations. Lifelong Learning and Wastewater Treatment in the Baltic Sea Region http://www.iwama.eu/output/tested-training-materials-smart-energy-and-sludge-management or direct link http://www.iwama.eu/sites/iwama/files/outputs/files/lifelong_learning_and_wastewater_treatment_in_the_baltic_sea_region.pdf Evaluation of Capacity Development Activities http://www.iwama.eu/sites/iwama/files/cd_evaluation_lq.pdf Other material compatible with the local conditions.

10. Introduction to self-studies and project work	1.5 – 2.0	SMEs contribute to the protection of the climate, environment, and biodiversity through their wastewater treatment and recycling practices.

End part (length 21.0 – 29.5 hours + breaks)

Self study and project work:

Setting and explaining the assignment: The aim of the practice period is to help participants to establish an action plan through which their company can manage wastewater treatment and recycling operations. During the self-study and project period, the participants will deepen their knowledge on the wastewater and recycling topic they have selected to be completed in their own SME. The background and reference material will be collected to meet the needs of the company, the industry sector and the local conditions. The documents and materials used in the first seminary days will be a good starting point to the task. Participants can also deepen their knowledge on the group work themes, which also serves to find the topic for their own SME. Participants will find out the answers for e.g. following questions:

- What kind of wastewater treatment and recycling management operations existing in company,
- What kind of wastewater treatment and recycling processes or digital tools and applications would benefit the company best,
- How would they transfer these operations and tools into the organization, and
- Benefits and risks they might include.

Each participant writes a brief report and prepare a presentation to be presented in the concluding seminary [Note to teachers: max length of a presentation depending to total number of presentations all should be presented within the time reserved for them. The time for project work presentations and discussion should not be forgotten].

Setting and agreeing the content of the project work, and agreeing how to report the project in trilateral composition (trainee, trainer / lecturer, representative of an enterprise), should be done either during the first seminary or in the beginning of the learning at the project work. In this phase, the needs of the enterprise, competencies of trainee and goals of the training should be taken into account. This is the only way to guarantee the commitment and motivation of all three parties in each project. It must also be borne in mind, that the project work and / or its results are not necessary public, but may contain confidential business information. Thus, the form and content

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of publication, e.g., as a part of presentation in concluding seminary, must be agreed and defined individually.

Chapter 2.3: Learning at the Work Place and Project Work

Duration: 12 – 18 weeks self-study and practice in company.

During the company-specific practice, students compile the assessments given during the training phase in the point of view of each company. This may include general overview of company, the attitudes of employees, entrepreneurs and company to the treatment requirements or recycling of wastewater in common, ecologic and environmental issues, the ways they are approaching the wastewater and recycling management, and the opportunities by which a company can benefit the changes, some examples to be given. The results will be briefly presented in the concluding seminary, separate or together with the project work presentation.

Goals and tasks of the self-study-phase are

1. Accompaniment and support of change processes in enterprises, from the formulation of objectives, description of process parameters, plan of construction or renewal of the existing process, if necessary also technical consulting.
2. Application and transfer of knowledge to other personnel.

In this part, the participants have the task of applying the knowledge acquired in the first part and the knowledge of how to shape their own practice in the sense of the training idea in their companies / organizations. For a sustainable learning, it is necessary that they plan, implement, evaluate, critically reflect and document their own project or activities to improve a situation on site under their individual framework conditions in the "here and now".

This phase with the duration of approx. 12 – 18 weeks is accompanied and supported by professional advice and support is given by the trainers / consultants. In principle, the participants should apply and implement the knowledge they have acquired in Part 1 themselves. As a rule, however, advice and support are often required in order to apply the process of adapting the knowledge acquired in Part 1 of the training appropriately under the real conditions on site and to lead one's own project to success.

The role of the trainers/consultants

The support given by the trainers can vary from a rather simple general consultation in the sense of passing on relevant information to an intensive accompaniment in the sense of coaching. In

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individual cases, it is usually necessary to find out, what kind of support it is needed to enable the individual participant to pursue his or her individual project goals.

In this phase, it is quite possible and even usual, that, when applying the treatment and recycling processes and tools presented in the first phase in practice, the individual project proceeds differently than initially thought and planned by the participant. Even in such situations, the trainers of the project team can provide valuable support in pursuing the "actual" project goals.

This second part of the training enables in particular the very welcome didactic aspect of working on concrete improvements in one's own company / at one's own workplace, which is associated with a high motivation to learn. In this learning process, the company management and other employees are usually intensively involved in what is actually done at the workplace, thus achieving joint learning and strong multiplication effects in the training.

Further advantages, i.e. what has been learnt, is directly implemented in everyday business life, or the innovations associated with project work are in the interest of company's management, quickly become visible and motivate managers to promote further training for the workforce and to use it as a strategic instrument of company management. The advantages also respond to the particular needs of small and medium-sized enterprises, which are constantly suffering from a lack of time as the biggest obstacle to training. In common, the KAIN training method eliminates the absenteeism close to wholly.

Chapter 2.4: Conclusion Workshop

Duration: 1.5 – 2 days seminary

Goals and tasks of the conclusion workshop are

- Reflection (evaluation) about the success in the given task and the learning process
- Identify supportive and obstructive conditions of "managing wastewater treatment and recycling"
- Derivation of "lessons learned" for further changes towards the efficient wastewater treatment and recycling operations

In the third part of the training, the participants will present and discuss the experiences and the insights gained during the practice period), as well as their individual projects. Both the participants and the trainers have as their particular task to review the projects and to reflect on whether or respectively what contribution they make to the sustainable pursuit of the overarching training idea

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to strengthen the wastewater treatment and recycling management actions. The exchange between the participants can provide them with very valuable impulses on how to make their own project even more successful. In this context, an important goal can also be to show which major obstacles are responsible for "not-yet-success" in order to work on this in the future.

The role of the trainers/consultants is to

- Enable constructive exchange between the participants,
- Focus on the common basis for the pursuit of (general) training objectives, and
- Moderate an instructional discussion on the identification of supportive and obstructive conditions of change processes and present contributions for a possible reduction of resistance in the tracking of individual projects.

Schedule of the workshop

Note: Two shorter breaks (with coffee) and one longer break (Lunch) will be held during each day.

First day (Time reservation about 7 hours)

1. Welcome, registration and material
2. Presentations of students, discussion and the feedback of the trainers – continues, if needed, in the second day

Second day (Time reservation about 7 hours, depending to the time allocated for student's presentations)

3. Key-note on new trends in wastewater treatment and recycling in SMEs
    a. The future of wastewater treatment and recycling
    b. New trends affect to the competitiveness and imago of the company.
4. Wrap-up of the course contents and achievements, feedback survey, diplomas, etc.

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Chapter 2.5: Additional Literature

In addition to the links in the curricula, the following material is available and recommended:

Construction blueprint: Management and Technologies of Water, Waste Water, Waste and Circular Economy – WWW&CE https://constructionblueprint.eu/initiative/management-and-technologies-of-water-waste-water-waste-and-circular-economy-wwwce/

DWA https://webshop.dwa.de/en/publikationen.html. Some publications available in several languages.

European Commission: Final Implementation Report for Directive 86/278/EEC on Sewage Sludge: 2013 – 2015. https://ec.europa.eu/environment/archives/waste/reporting/pdf/Final_Implementation_Report_2013_2015_Sewage_Sludge.pdf

EurEau https://www.eureau.org/resources/publications/eureau-publications

European Environment Agency: Urban waste water treatment for 21st century challenges https://www.eea.europa.eu/publications/urban-waste-water-treatment-for

European Water Association https://www.ewa-online.eu/

Fit in wastewater technology (6/2021) https://webshop.dwa.de/de/fit-in-wastewater-technology-6-2021.html/

Institute for Underground Infrastructure https://www.ikt-online.org/

IWA Circular Economy: Tapping the power of wastewater https://iwa-network.org/learn/circular-economy-tapping-the-power-of-wastewater/

Kemira: Water https://www.kemira.com/water/

Kemira: How water treatment contributes to the circular economy https://www.kemira.com/insights/how-water-treatment-contributes-to-the-circular-economy/

World Business Council for Sustainable Development https://www.wbcsd.org/, good materials, like World Water Week 2021 in review: opportunities for business to support water, climate and nature https://www.wbcsd.org/Overview/News-Insights/Insider-perspective/World-Water-Week-2021-in-review-opportunities-for-business-to-support-water-climate-and-nature

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Guidelines for management of industrial wastewaters: Documents, information and recommendations for Management of Industrial Wastewaters in Baltic Sea Region. The guidelines document also includes specific national key recommendations separately for Russia, Estoina, Latvia, Lithuania, Poland and Finland. The guidelines document is found in English, Polish and Russian (summary) and key guidances are found in the concerned national languages separately. https://bestbalticproject.eu/about/guidelines-for-industrial-waste-water-management-wp5/

Toolbox of best practices in industrial wastewater management, https://bestbalticproject.eu/outputs/toolbox/

Investments and pilots at WWTPs and industries, https://bestbalticproject.eu/outputs/investments-and-pilots/

Cooperation between different stakeholders https://bestbalticproject.eu/wp-content/uploads/2020/08/Cooperation-infographic-1.png

Co-treatment of domestic and industrial wastewaters at municipal treatment plants -Training models and materials for increasing capacity and knowledge of stakeholders https://bestbalticproject.eu/wp-content/uploads/2020/09/Training-Concept_FINAL-with-tools.pdf

Developing local management models for improved treatment of industrial effluents https://bestbalticproject.eu/wp-content/uploads/2021/04/BEST-Developing_local_management_models.pdf

Chapter 2.6: Methods recommended

In this course, the following methods are recommended:

- Lectures including lections, videos and discussions concerning the topics of videos and / or lections
- Individual learning including
  - reading of given articles,
  - getting known with activities, responsibilities and rights of local, regional, country level EU-level authorities and given organizations by visiting their web-sites,
  - assessments, e.g. designing a business plan of own business or employer,
- Practical learning on the job and realization of a corresponding project in the company with consulting support by the teachers
- Learning diary or other form of reporting the learnt issues.

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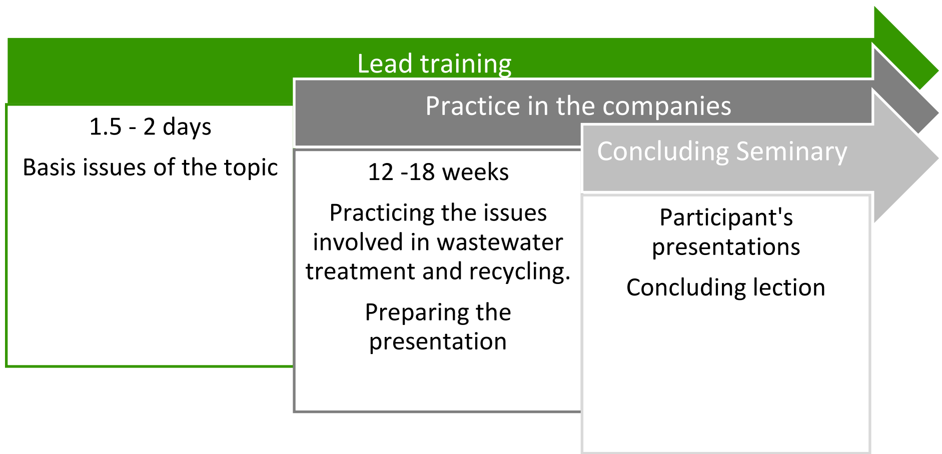
- Concluding presentations

Chapter 2.7: Schedule

This course is divided into three parts. Training begins with a 3 - 4 days theoretical part, during which the basic issues of each topic will be clarified by both lessons and group works. The leading part will be followed by 12 – 18 weeks practice in company, during which the participant will become known with the topics of the course in point of view of this company. During the practice, a student will also prepare a presentation concerning the findings found and ideas got during the period in the company. After the practice is completed, a seminary of 1.5 – 2 days will be hold. In this seminary the participants will present their presentations, discuss their experiences and ideas. Finally, everything will be concluded with a lecture regarding new trends in wastewater treatment and recycling and how the adoption of innovations will affect the company competitiveness and image.



Compiled by Dr Karl Lilja & Dr Sirpa Sandelin

Chapter 2.8: Testing of the competence Level

The course will be evaluated according to the procedure agreed in the project meeting. This means that teacher responsible for the course shall inform the evaluation to the participants in the beginning of the course and conducts the parts of the evaluation process he is responsible for according to evaluation concept (Appendix 2).

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Chapter 3: Course Method - KAIN

This course is based to the KAIN-method (KAIN = Knowledge Acquisition according to Individual Needs). The KAIN-method creates a common knowledge base for participants with different backgrounds in training and consulting processes. It takes particular account of the individual experience of participants, shows possibilities to change/improve the situation of the participants on site for the pursuit of project goals and change measures, sharpens the knowledge of possible needs for change, and enables those involved participants to design the right measures and implement them correctly. The KAIN-method is characterized by

a. achieving of a common knowledge base of participants with various pre-qualifications
b. particular emphasis on individual experience of each participant
c. design variations for improving the opportunities to achieve their project goals.

The training process is composed of three phases:

1. classroom teaching
2. self-study with external support
3. report and reflection.

Chapter 3.1: Part One - Classroom Teaching:

Duration: 3 - 4 days

Key objective: imparting knowledge - forming a common ground within the group.

This training module consists of altogether 3 – 4 days' workshop, during which participants learn about basic concepts and instruments available for structuring and solving problems. This is intended to form a common conceptual ground for further training steps. The module ideally form a common framework, mainly to better integrate existing experience of participants in pursuing their training goals. The experience of participants may complete or modify the research proposals on structuring and solving problems.

Taking into account the individual needs of the participants in classroom training requires a high degree of expertise and experience by trainers, including their ability to use interactive and participant-oriented didactic methods.

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Another addressed focus in the first part of the training is to highlight relevant issues with regard to planning, implementation and assessment of the projects that will be processed in the second part of the training. Thus, another key objective of this part of the training is to equip the trainee with skills and knowledge required to find, create and utilize the concepts and tools needed in his individual project. In a sense, application and implementation of the presented models and instruments by trainees at their work constitutes the primary focus of the second part of the training concept.

Chapter 3.2: Part Two - Teacher-assisted self-study in the company or organization of trainee

Duration: approx. 12 - 18 weeks

Key objective: transfer and application of acquired knowledge in the trainees` individual job in practice.

In the second part of the training, trainees should apply the skills and knowledge acquired in the first part of the training with respect to their on-the-job training at their company/organization, in line with the training idea. For a sustainable learning effect, it is crucial that trainees plan, implement, evaluate, document and critically reflect on their own project or their own activities.

This phase of the course is accompanied and assisted by trainer. The trainer may also provide technical advice and support. Principally, trainees are on their own with respect to applying and implementing knowledge acquired in Part 1. As a rule, however, advice and support is usually required in order to properly enjoy the benefits of adaptive process of newly acquired knowledge from the training Part 1, now under real-life conditions, and to turn the project into success. Support by trainers varies a lot, and so does the trainees need for support, too.

At this stage, it is possible that during the processing of the information gained within the Phase 1 the projects of the trainees may differ from their initial concepts and plans. In such case, trainers may give a helping hand in bringing back on track "real" project goals.

The second part of the training allows fine-tuning improvements on the job or in one´s own company to ensure high learning motivation. As a rule, this type of learning, embedded in real job conditions, involves committed personal involvement of company management and other employees, and, by joint team learning, delivers expressive multiplier training effects.

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Further advantages are straight implementation of the acquired new knowledge in daily job operations; project-related innovations are in the interest of corporate management; they become quickly tangible and managers feel encouraged to continue with advanced trainings for their employees, turning them into a strategic instrument of corporate management. Apart from this, this training approach responds to particular needs of SMEs, which biggest barrier to good training is their lack of time. Under KAIN training method, lost working hours and work absences are almost entirely avoided.

Chapter 3.3: Part Three - Individual project presentation and reflection

Duration: approx. 1.5 - 2 days.

In the third part of the training, the experiences and insights gained will be presented and exchanged in the seminary of 1.5 – 2 days. This concluding session focuses on presenting the projects of individual participants. Both the trainees and the trainers should review and reflect on projects presented by the participants, and analyze answers with respect to a possible contribution to sustainable training target tracking. Moreover, a further key goal may help identifying major barriers to "not-yet-a-success" and fix them in the future.

The exchange of information amongst participants may provide valuable information on how to improve their own projects to be even more successful.

Chapter 3.4: The role of the trainers

It is a task of the trainers to take into account the individual needs and particularities of the participants on site in a face-to-face training. This requires a high degree of knowledge and experience with the use of interactive and participant-centered didactic methods on the part of the trainers. A further focus of the first part of the training is to introduce the participants with the planning, implementation and critical evaluation of their own project work they are involved in the second part of the training. Thus, another central goal of this part of the training is to give the participants important impulses for the implementation of the presented models and instruments in their own project. The application and implementation of the presented models and instruments by the participants "at home" is, so to speak, the focus of the second part of the training concept.

At this stage, trainers have the following functions:

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a) Facilitating a constructive exchange amongst participants,
b) Emphasizing the shared common idea with respect to the pursuit of the general training goals, and
c) Having ideas on struggle-free implementation solutions for trainees` projects.

Of course, upon completing third part, subsequent longer self-study phase may follow, combined with on-the-job implementation, followed again by classroom-teaching in form of a third workshop, etc.

At the end of the training, all participants should have sufficient information and idea on how to implement and pursue the basic training idea, mostly under different real-life conditions.

Chapter 4: Teaching Material

The teaching material can be found in the file "3LoE_WP4_CC_Wastewater treatment and recycling management_Teaching Material.pptx". The PowerPoint Presentation should be updated to local needs, requirements, regulation and legislation, and by weighting the local point of views.

Appendix 1 - Notes for the teachers and facilitators

The material enclosed is an example showing how the topics of this course could be presented. Each teacher should adjust this to the circumstances of his own country, considering the local, regional and national regulation, and the background and interests of the students; are they studying or working in the branch of engineering, environmental topics, finance or marketing, or are they entrepreneurs or employees, some examples to be given. Each background and area of interests may require different weightings and highlights, and it is on the responsibility of each teacher to consider these special needs.

Target group

The main target groups of curriculum are employees and entrepreneurs of SME-enterprises. The course can be offered also to others interested in the topics, e.g. those planning to become entrepreneurs.

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Work required

The average work required by course is: classroom teaching in the first and third phase together a minimum of 30 to a maximum of 45 hours, and individual learning during the second phase (practicing period) 150 - 200 hours.

Dividing the class teaching phase

The curriculum has now been designed with the idea of 3 or 4 + 2 days class teaching. However, the first three or four days can also be held in different schedules, e.g. 2 + 2 or 1 + 1 + 1 + 1 days within the first weeks of the course period.

Applicable methods

Teachers are encouraged to use varying methods containing e.g.:

- Lectures,
- Visiting lecturers, particularly local entrepreneurs,
- Group works,
- Videos approaching the topics (Reliability of the source must be evaluated),
- Individual studies and
- Assignments.

Cooperation with the local experienced industry practitioners and municipal or governmental operators (where applicable) is highly recommended. The module can be taught and studied individually thus, the module can be included into open studies offered to individuals, companies and organizations, who intend to implement or develop green economy.

Contents of the curriculum

The variation in regulations and circumstances and qualification requirements are quite different in the BSR-countries, thus the material was written only as a form of framework inside which the local actors should modify the contents of modules according to their own regulations and national, regional and local requirements, without forgetting the needs of different study programmes. By using innovative, problem-based and experiential educational approaches, teacher will be able to help students to become experts who are able to create and implement the principles of green economy into their business.

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The concrete goals are

- To give participants knowledge of the operating environment of wastewater treatment and recycling management promoting sustainability and responsibility.
- To give participants a common information concerning the European and national legislation and regional regulations concerning the wastewater treatment and recycling management in SMEs.
- To develop wastewater treatment and recycling management processes, manage wastewater treatment and recycling processes, to execute renovations and develop information systems so that are in line with the requirements and company strategies.
- To design appropriate wastewater treatment and recycling options in sparsely populated areas.
- To develop working in a wastewater and recycling work community in SMEs and with stakeholders.
- To help participants innovate solutions how they and their companies will find the best ways to respond the challenges.

The material listed in the curriculum is a collection that each teacher should complete with videos, articles and books approaching the topics in point of view of just the branch and region where the course is held. Each teacher should take into account the national, regional and local legislation and regulation, as well as the supportive and financial opportunities available by national, regional and local actors. The presentations enclosed are skeletons around which each teacher can and should build a localized and customized presentation that takes into account the needs of just this group of participants.

Teaching Material

The PowerPoint presentation included is a skeleton around which each teacher should build a presentation of his / her own, taking into account the local circumstance (requirements, legislation, local challenges etc.), the needs of local business, and the needs and ambitions of participants.

Taking Corona (Covid19) into account

During the era of Corona, it must be considered, that the teaching / learning in classrooms may not be recommendable, allowed or possible at all. In such cases, the course is easy to transfer to any distance learning platform. The following activities are recommended, but not obligatory:

- The first session should be lectured online. In this session, the use of learning platform should be guided, and the schedule, rules and practices of the course should be presented

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- The introduction sessions of each topic can be lectured online.
- Teacher records the introduction lectures and uses the suitable parts of PowerPoint presentation in each topic. If the session is lectured online, the recording is recommended to be recorded at the same time.
- The videos, presentations and links to further material are put into the learning platform to be available for each participant.
- It is recommended, that teachers are available in online meetings with both groups and individual participants at least weekly to see how the learning is going, to answer the questions, and to support those who are not so accustomed to individual learning, and / or using the learning platforms. These meetings should be scheduled and informed to each participant.
- It is recommended, that during the practice period, each teacher and other expert agreed to be available as coach, trainer and support, informs a plan of times when he / she can be contacted if necessary.

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Appendix 2 – Evaluation Concept

Compiled by Dr. Kari Lilja and Dr Sirpa Sandelin .

Introduction

Evaluating the training, teaching and learning has been an emerging issue in the 1980's when it was actively researched within several disciplines like education, pedagogics, psychology and organizational sciences. During the 1990's the enthusiasm flagged, but the interest woke up again in parallel with the waves of refugees and immigrants arriving to the Europe. The needs to include newcomers to the hosting society, to teach local culture, habits and language, and to train professional skills to comply with the local requirements have highlighted the importance of developing new teaching and training methods. These new methods and tools in teaching and training should be compatible with the requirements set by cultural diversity of both the refugees and immigrants, and the societies more or less voluntary receiving the incomers.

Furthermore, during the past two decades the western countries have met - in addition to enormous flood of settlers - another phenomenon that challenges the education system: The post-war baby boom generation reaches age of retirement. This has two consequences, both requiring the answers from school systems. Firstly, the western countries should have a capability and capacity to educate and train more and more nursing personnel to cover both the vacuum left by those retiring, and to answer to the needs of ageing population. Secondly, these countries should be capable to renew their education systems to be able to satisfy the needs of business, to be able to train skilled labor and to be able to educate more persons that are both capable and willing to create their career as entrepreneurs and to continue the work of retiring entrepreneurs. If this fails, the consequences for European economy might be fatal or even disastrous.

This challenges not only schools and universities or teachers and trainees, but also those developing the courses and teaching and training methods used in the courses. Evaluating the learning of trainees, used methods and the impact of these methods on the learning would help teachers, designers and analysts to improve the methods.

The aims and targets of the evaluation are context dependent issues. Thus, in ideal world, the courses, the methods used in the courses and the means to evaluate the outcome of the course, the learning of trainees and the efficacy and success of the methods should be designed together so

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that the whole course is seen as main process inside which the training and evaluation are parallel subprocesses. This would be the best way to ensure that exactly those goals set to this unique program are measured during the evaluation. In this case "Train the Trainer" and other education programs have been planned parallel with the planning of the evaluation.

Education Program

Further vocational trainings programs (EQF level 4 and 5) for owners, managers and qualified workers of SMEs (WP5).

- Six courses on management and technologies in water, wastewater and waste management including cradle to cradle.
- The trainings are specifically tailored to SME needs and different qualification levels and combine the transfer of technical, professional and management know-how.
- Development of an integration program for the unemployed (EQF level 4) in order to be able to place the unemployed in permanent jobs through further training seminars and a further training qualification.
- Coordination of the program with training providers, SMEs and employment services.

This program has been developed to respond the challenges met by those aiming to strengthen the awareness and competences for target-oriented environmental policy and workplace innovations in SMEs via training and consulting the entrepreneurs and personnel of SMEs. The students should be able to support companies in the development of their environmental policy as well as in workplace innovations in the framework of the circular economy through consulting and qualifying support.

The following should be achieved:

a.) Attraction of much needed junior staff for SMEs.
b.) Development of capacities to increase awareness for Workplace Innovations.
c.) Realization of individual Workplace Innovation projects, which the students carry out as employees of the participating SMEs with the support of professors of the respective university in connection with the dual studies in SMEs.

The target groups of the program are owners, managers and qualified workers of SMEs (WP5) with capabilities and interest to rise in their career.

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The planned duration of course varies depending to the educational level and purposes. Each lesson lasts 45 minutes. Methods used in lessons will be lectures, teaching talks, working in small groups, case studies and examples from real world. Material used during the teaching consists of e.g. information material (basics & backgrounds, thematic introductions etc.), presentations, questionnaires, question guides, checklists, analysis results, good practice examples and so on. Course should contain at least following issues: Basics/overview of essential tasks and contents of business-oriented and productivity-enhancing measures in circular economy and workplace innovation (in each of the courses)

The SME-specific training course should contain following topics (overview):

a.) One of the six courses on management and technologies in water, wastewater and waste management including cradle to cradle.

  A. Preparation and management of SMEs for work in the Green Economy

  B. Waste reduction and recycling management

  C. Wastewater, treatment and recycling management

  D. Water supply and saving

  E. Cradle to Cradle in SMEs

  F. Energy generation from wastewater and waste

b.) Attitudes and behavior in consulting processes

c.) Supporting activities by WWW&CE / Centres of Competence

Evaluation of courses including gained results and found problems is essential to be able to develop further the existing training programs as well as to consider the experiences gathered from these programs when building new curricula. The evaluation process has been designed hand in hand with the courses themselves. This concept presents an overview of evaluation process and questionnaire.

When evaluating course, the goals and real results should be compared. This is not always possible or fair and just. The evaluation should be targeted only to such measurable issues on which the designer, teacher, facilitator or student himself has an impact. Evaluating the impacts of training programs against the presented main goals would require large societal researches including the recording of the initial situation before starting the programs and the long-term follow-up research in which the conducted interventions and actions (In this case new forms of training and education)

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and their impacts on change of variables is followed (Figure 1). The final conclusions can be drawn just after some years or after decades. In this project, this is not possible and the whole evaluation process must be rethought and simplified.

The most important variables, on point of view of achieving the goals set, are the motivation of student, the support he gets, the relevance of issues in curricula, the quality material and training and the ability of facilities to support training and learning. Although most of the variables presented above are so called soft variables, which can't be measured directly by targeting the measurement tool to some point or phase in the process, they can be assessed indirectly by assessing the feelings and comments of participants and other stakeholders.

The assessment of feelings and comments can be done with many alternative tools, e.g. surveys, interviews and follow-up studies in which a researcher follows lessons and training in practice and observes the students and teachers collecting comments and registering e.g. the atmosphere in the classrooms and during the training in the workplaces.

In this case the experiences and comments of participants will be surveyed by simple questionnaire with questions approaching the common impressions, the applicability of facilities, the relevancy and importance of each issue and the experienced quality of each lesson and material used.

Evaluation concept

The objective of the evaluation is to determine whether the goals of the program will be achieved in the implementations evaluated, and how the program has impact on student's career and opportunities.

The type of the evaluation follows standard course evaluation methods, i.e. formative, process and outcome evaluation, the latter only partial:

- The formative evaluation will provide feedback to the curriculum designers, developers and implementers to ensure that designed and implemented courses really meets the needs of the intended audience, i.e. assure or improve the quality of program. Formative evaluation and analyses will answer to the following questions:
    - Were the goals and objectives suitable for the audience?
    - Were the training methods and course materials appropriate for the audience?
    - Should the program or some part of it be developed further and if, how?

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  - Furthermore, formative evaluation also provides information that benefits the development of the program, facilities and timing.
- The process evaluation will provide information concerning the training and lectures, like asked questions and verbal feedbacks.
  - Process evaluation answers the question "What did you do?"
  - It focuses on procedures and actions used to produce results.
  - Process evaluation takes place during the training delivery and at the end of the training.
  - The co-organizer (Responsible for the course)
    - monitors the training,
    - describes the training process as a whole, and
    - records the findings into the written report.
- The outcome evaluation tries to find out how the knowledge, attitudes, and behaviors of the audience developed. It takes a long time to find out the outcomes of the education and training, so in this stage only the main topics participants are able to do at the end of training, will be assessed.

The evaluation process will be as follows:

1. a.) Semi-structured questionnaires will be created for the participants (Appendix A): The topics (topic 1, topic 2…) should be renamed to match to the parts of the course. It is also recommended that co-organizer (Responsible for the course) writes the name of the school / institution, the name of the evaluated course and the number of the workshop (1st / 2nd) in the beginning of the questionnaire before printing it to make sure that the identification data needed in the evaluation is correct. If the questionnaire needs to be compiled to e.g. German, the co-organizer takes care of this.

   b.) Semi-structured questionnaires will be created for the trainers / lecturers / teachers

   (Appendix B): It is recommended that co-organizer (Responsible for the course) writes the name of the school / institution, the name of the evaluated course and the number of the workshop (1st / 2nd) in the beginning of the questionnaire before printing it to make sure that the identification data needed in the evaluation is correct.

2. Time for the survey (approx. 15 minutes) will be allocated in the end of each workshop

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3. In the beginning of the course the co-organizer (Responsible for the course) will inform participants about the evaluation and its importance for further development actions
4. The co-organizer (Responsible for the course) distributes the questionnaires to the participants to be filled in before leaving the workshop. The purposes of the questionnaire and how the data will be used should be explained clearly to the participants. This will help to improve the response rate and encourage them to make comments that can be useful to improve future programs.
   Note: Survey for participants will be conducted twice, in the end of both workshops!
5. The participants complete the questionnaires and return them to the co-organizer.
6. The co-organizer distributes the lecturer's questionnaire to each lecturer to be compiled immediately after his / her part of the course has been finished.
   Note: If the lecturer teaches in both workshops, he / she completes the questionnaire twice!
7. In the end of the learning on the job -phase, representant of each enterprise involved in the training will be interviewed by the co-organizer. Guidelines for the interview will be found in appendix C. Interviews can be conducted face to face or via Skype, Microsoft Teams or e-mail, some examples to be given.
8. The co-organizer collects the questionnaires and answers of interviews and deliver them to the evaluator. If there are free speech answers in some other language than English, it is recommendable that the co-organizer translates them to English.
9. The evaluator compiles all feedbacks and summarizes written analysis on the evaluations.

The evaluation approach will be based on a combination of qualitative and quantitative methods. The Microsoft Excel package will be used to transcribe the feedbacks and interviews. Open questions will be categorized, and qualitative analysis of the groups will be done.

The final evaluation report will discuss the following issues:

- Did the curriculum reach the targets?
- How well was the knowledge creation and sharing realized?
- Did the participants assimilate knowledge and tools?
- Was the venue and equipment appropriate for the training course?
- What kind of further development will be needed, if any?

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Schedule of the evaluations

The schedule of the evaluation should be matched to the phases of the curriculum. There is no sense to evaluate the course before the students have a true and fair view of the course, its phases and contents. A closer schedule of each evaluation will be agreed later.

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Questionnaire

A: Questionnaire for participants of the ____________-course

Please circle the scale that applies to your opinion on the following aspects of the education you participated.

Scale: 1= Strongly disagree, 2=Disagree, 3=Neither disagree or agree, 4=Agree, 5=Strongly agree

In common					
The facilitation (location, room etc.) was suitable for training	1	2	3	4	5
The topics and issues were relevant and responded to the goals of training	1	2	3	4	5
The lecturers explained topics of the lessons, additional questions, experiences, and topical issues arisen during the course well	1	2	3	4	5
There were enough time scheduled for each issue.	1	2	3	4	5
I got valuable knowledge from lessons and examples presented by lecturers.	1	2	3	4	5
I believe that can utilize the knowledge gained from lessons in my future career.	1	2	3	4	5
I can utilize the skills trained and knowledge gained in my future career, e.g. when consulting my clients.	1	2	3	4	5
Comments concerning the common issues					
Lessons and Topics					

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Topic 1	The presentation was clear and understandable The issues were relevant and topical The information presented were up-to-date	1 1 1	2 2 2	3 3 3	4 4 4	5 5 5
Topic 2	The presentation was clear and understandable The issues were relevant and topical The information presented were up-to-date	1 1 1	2 2 2	3 3 3	4 4 4	5 5 5
Topic 3	The presentation was clear and understandable The issues were relevant and topical The information presented were up-to-date	1 1 1	2 2 2	3 3 3	4 4 4	5 5 5
Topic 4	The presentation was clear and understandable The issues were relevant and topical The information presented were up-to-date	1 1 1	2 2 2	3 3 3	4 4 4	5 5 5
Topic 5	The presentation was clear and understandable The issues were relevant and topical The information presented were up-to-date	1 1 1	2 2 2	3 3 3	4 4 4	5 5 5
Topic 6	The presentation was clear and understandable The issues were relevant and topical	1	2	3	4	5

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	The information presented were up-to-date	1 1	2 2	3 3	4 4	5 5
Topic 7	The presentation was clear and understandable The issues were relevant and topical The information presented were up-to-date	1 1 1	2 2 2	3 3 3	4 4 4	5 5 5
Topic 8	The presentation was clear and understandable The issues were relevant and topical The information presented were up-to-date	1 1 1	2 2 2	3 3 3	4 4 4	5 5 5
Topic 9	The presentation was clear and understandable The issues were relevant and topical The information presented were up-to-date	1 1 1	2 2 2	3 3 3	4 4 4	5 5 5
Topic 10	The presentation was clear and understandable The issues were relevant and topical The information presented were up-to-date	1 1 1	2 2 2	3 3 3	4 4 4	5 5 5
Free speech						
What was good?						
What could have been done better? (E.g. was some topic missing or unnecessary)						

Would you recommend the course to someone you know? If not, why not?
Was anything missing that you might need in your future profession / occupation / job?
Was the proportion of topics and issues inside each topic suitable or should something be increased / decreased?
Other comments

Thank you for your answer

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Wastewater, treatment and recycling

Satakunta University of Applied Sciences (SAMK), project partner number 11

Compiled by Dr Sirpa Sandelin, Dr Kari Lilja and Petra Janhunen

Picture from webpage Pixabay.

Introduction

Introduction

Target group

- The small and medium sized enterprises and their entrepreneurs and employers, students of further vocational education and the others who are interested in wastewater treatment and recycling
- Bachelor-level students who are interested in wastewater treatment and recycling, but the training is not directly accepted as a part of bachelor's grade
- Recommended, that the participants have at least the basic vocational education.

Work required

- Part 1 - Classroom teaching: duration 3 - 4 days
- Part 2 - Teacher-assisted self-study in the company or organization of trainee: 12-18 weeks
- Part 3 - Individual project presentation and reflection: 1.5 - 2 days

Contents of the curriculum

- Should be possible to be modified according to countries own regulations and local requirements.
- Training is based to the KAIN-method (KAIN = Knowledge Acquisition according to Individual Needs). The aim is to create a common knowledge base taking into account students different educational backgrounds and to show participants opportunities to make transition actions in their SMEs in managing wastewater treatment and recycling. The teacher motivates and sharpens information about potential change needs and guides participants to plan the right actions and implement them correctly.

Co-founded by the Erasmus+ program of the European Union: "Management and technologies of Water, Wastewater, Waste & Circular Economy -WWW & CE"

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Introduction

Schedule of the course

Leading training

3 - 4 days

Basic issues of the topic

Practice in the companies

12-18 weeks

Practicing the issues involved in wastewater treatment and recycling

Preparing the presentation

Concluding Seminary

1.5 – 2 days

Participant's presentation

Concluding lection

The goals of the education

- Create knowledge of the operating environment of wastewater treatment and recycling management promoting sustainability and responsibility.
- Give a common information concerning the European and national legislation and regional regulations concerning the wastewater treatment and recycling management in SMEs.
- Build an ability to develop wastewater treatment and recycling management processes, to manage wastewater treatment and recycling processes, to execute renovations and develop information systems so that are in line with the requirements and company strategies.
- Train skills to design appropriate wastewater treatment and recycling options in sparsely populated areas.
- Create an ability to develop working in a wastewater and recycling work community in SMEs and with stakeholders.
- To help participants to find innovative solutions to how they and their companies will find the best ways to respond the challenges.

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Terminology

- ***Black water:*** Wastewater and sewage from toilets.
- ***Circular economy:*** An economy in which the value of products, materials and resources is maintained in the economy for as long as possible with help of e.g. reuse and recycling, and the amount of waste is minimized.
- ***Climate change:*** A long-term change in the average weather patterns of local, regional and global climates. The changes have caused a broad range of observable effects that in common are considered as synonymous with the term.
- ***Grey water:*** The wastewater from sinks, baths, washbasins, showers, washing machines, etc. (not from toilets).
- ***Industrial Wastewater*** Water or liquid-carried waste from an industrial process resulting from industry, manufacture, trade, automotive repair, vehicle wash, business, or medical activity; this wastewater may contain toxic or hazardous constituents.
- ***Nitrogen, N:*** Nutritient that comes to wastewater mainly from excrement and urine. When nitrogen leaves the settling well it is in ammonium form. Nitrogen is also a plant nutrient, and it appears as a minimum nutrient in most of the European water systems. Organic or ammonium-formed nitrogen uses the oxygen supplies of the water system when oxidized to nitrate.
- ***Phosphorus, P:*** Phosphorus appears as soluble phosphate in wastewater, and it is a nutrient that increases the forming of organic matter in nature. This causes eutrophication. The formed matter uses the oxygen supplies of water.
- ***Sludge:*** The accumulated suspended solids of sewage deposited in tanks or basins. A mixture of solids and water produced during the treatment of wastewater. Biosolids remaining after secondary or tertiary treatment. Sludge may be applied to agricultural fields as a soil amendment, composted, or palletized. Or the settleable solids separated from liquids during processing or the deposits of foreign materials on the bottoms of streams or other bodies of water.
- ***Sustainability:*** The term sustainability refers to meeting the needs of the present without compromising the ability of future generations to meet their needs.

Source:
https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781118731741.oth

Terminology

- **Sustainable development:** Development that provides economic, social and environmental benefits in the long-term, having focus on the needs of both current and future generations. Defined by the World Commission on Environment and Development (Brundtland Committee) in 1987 as: *Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*
- ***Urban wastewater:*** Domestic wastewater or the mixture of domestic wastewater with industrial wastewater and/or run-off rainwater
- **Wastewater Treatment Plant** An arrangement of pipes, equipment, devices, tanks, and structures for treating wastewater and industrial wastes. A water pollution control plant
- **Wastewater Recycling** Reclamation process of collection and treatment of wastewater on-site for return and use back into the same site; for example, collection and reclamation of gray water from an establishment for subsequent toilet flushing in that same establishment.
- **Wastewater Reuse** Reclamation process of collection and treatment of wastewater in a certain way to enable the usage of the treated wastewater in e.g. irrigation.
- **Wastewater Treatment System** Assembly of systems for collection, treatment, and dispersal of sewage or effluent.
- **Wastewater Treatment System, Municipals** Wastewater treatment system, owned by municipal and / or other public entity, for the collection, treatment, and dispersal of wastewater from two or more lots, or two or more equivalent dwelling units.
- **Wastewater Treatment System, Decentralized** Wastewater treatment system for collection, treatment, and dispersal/reuse of wastewater from individual homes, clusters of homes, isolated communities, industries, or institutional facilities, at or near the point of waste generation.
- **Water Pollution** A general term signifying the introduction into water of micro-org or sewage which renders the water unfit for its intended use.

Source and more definitions and terminology:
https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781118731741.oth

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Review of the wastewater treatment and recycling management. How the topic is related to SDGs.

Water facts (UN) and wastewater reuse

Water is linked to almost everything in the world:

- Climate change
- Disasters
- Ecosystems
- Financing Water and Sanitation
- Gender
- Human Rights to Water and Sanitation and hand hygiene
- ***Quality and wastewater***
- Water scarity
- Transboundary waters
- Urbanization
- Water, food and energy

The challenge can also be seen as an opportunity:

- Globally, it is evaluated that over 80% of wastewater is released to the environment without adequate treatment (UN WWDR, 2017).
- The potential for wastewater recovery is huge - Safely managed wastewater is an affordable and sustainable source of water, energy, nutrients and other recoverable materials. (UN WWDR, 2017).
- Globally almost three out of four jobs that make up the entire global workforce are water-dependent, thus, investments in water infrastructure and 'water jobs' make positive returns and have a multiple effect on job creation across all economic sectors (WWAP Presentation: Launch of the UN World Water Development Report 2016)
- European Commission, Water reuse check out Water reuse factsheet Water reuse factsheet

Source:
United Nations Water facts https://www.unwater.org/water-facts/

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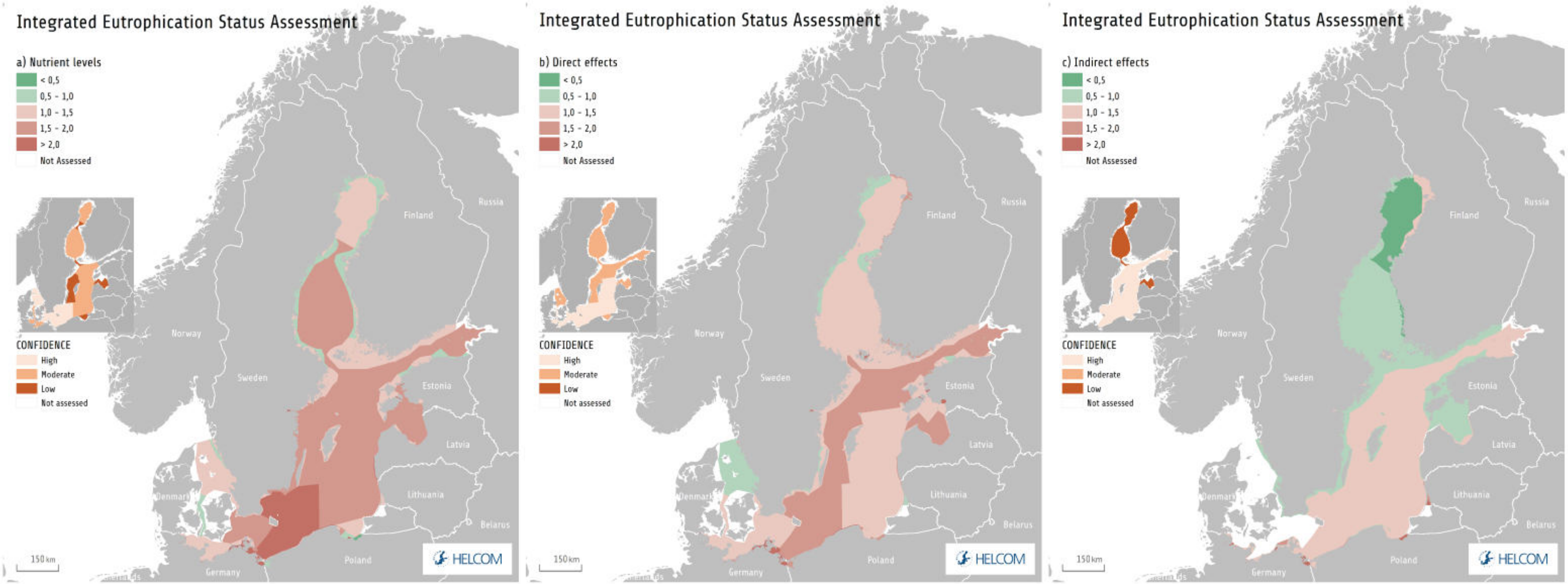
Wastewater

Domestic and industrial wastewater represents a significant stress on the aquatic environment due to the loads of organic matter nutrients and hazardous substances

- The treatment of urban wastewater is essential for many reasons, e.g. ***ensuring health and the environmental protection*.**
- The quantity and quality of industrial wastewater differs from domestic wastewater and so the treatment processes of municipal wastewater treatment plants can be disrupted by industrial wastewaters.
- The quality of industrial wastewater varies significantly depending on the industry
- Large amounts of material, such as dairy products with high organic content, released suddenly into sewerage systems or even small amounts of wastewater from fabricated metal or chemical industry, can cause harm due to residues of hazardous substances.
- Industrial plants may be required to pre-treat wastewater before it is discharged into the sewer, and/or industrial plants can also have their own wastewater treatment system.
- Effluent discharge of inadequately treated industrial wastewater and sewage endangers receiving aquatic system.
- The eutrophication of the Baltic Sea is the consequence of nutrients, particularly phosphorus and nitrogen, having ended up to the sea during past decades. Domestic and industrial wastewaters are remarkable sources of nutrients.

Source:
https://bestbalticproject.eu/wp-content/uploads/2020/09/Training-Concept_FINAL-with-tools.pdf

HELCOM - Integrated Eutrophication Status Assessment



Integrated assessment results for eutrophication by criteria groups 2011-2016: left: nutrient levels, middle: direct effects, right: indirect effects. In coastal areas HELCOM utilizes national indicators to assess the eutrophication status. White denotes areas that were not assessed due to the lack of indicators. The inserted maps in each lower corner show the confidence assessment result, with darker colours indicating lower confidence.

Source:
http://stateofthebalticsea.helcom.fi/pressures-and-their-status/eutrophication/#indicators-included-in-the-assessment

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17 Sustainable Development Goals, SDG

In 2015, the United Nations member states approved the Agenda to achieve the 17 Sustainable Development Goals (SDGs) with the purpose of building a better and more sustainable future for all by the 2030.

17 goals containing 169 targets.

Ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth

- All tackling climate change and working to preserve oceans and forests.

The circular economy is relevant to all sectors of the economy.

- It has gained increasing prominence as a tool which presents solutions to some of the world's most pressing sustainable development challenges. [3]

Source: https://sdgs.un.org/goals

Water and Sustainable Development Goal 6

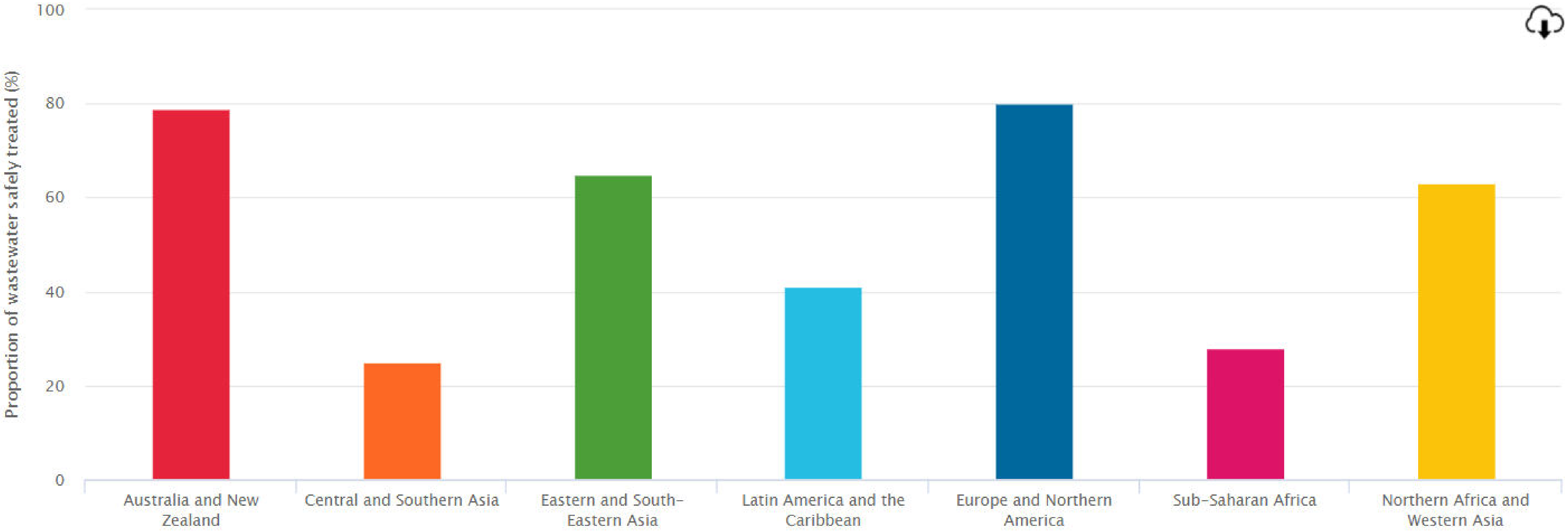
Aims to work on issues related to clean water and sanitation, but also the sustainability of the hygiene of water resources worldwide. Some of the relevant targets expected to be reached by 2030 are:

- Implement integrated water resources management
- Protect and restore water-related ecosystems
- Support activities to developing countries for water and sanitation as wastewater treatment , recycling and reuse technologies

Some of the most important challenges are:

- Every third people – 2.3 billion people – around the world lack basic handwashing facilities at home. (WHO/UNICEF 2021)
- Today, every fourth people – 2 billion people – around the world lack safe drinking water. (WHO/UNICEF 2021)
- Almost half of the global population – 3.6 billion people – lack safe sanitation. (WHO/UNICEF 2021)

Status in different SDG regions on Indicator 6.3.1 Proportion of wastewater safely treated (%) (2020)



Regional data are estimates based on country data. Currently, not enough country data are available to produce a statistically sound regional estimate.

Source
https://www.sdg6data.org/indicator/6.3.1

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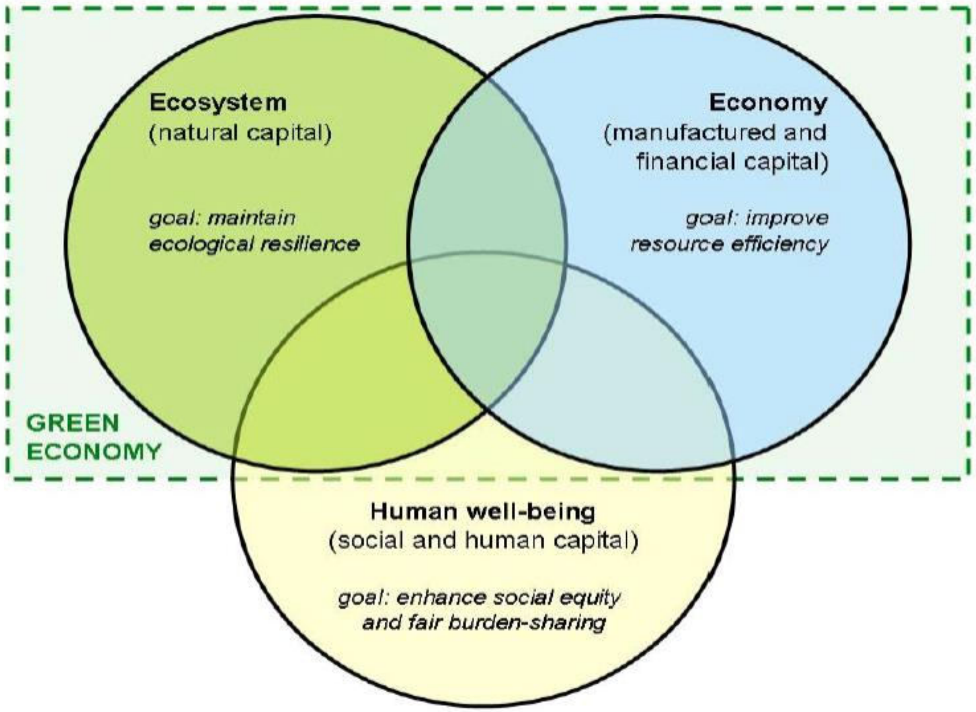
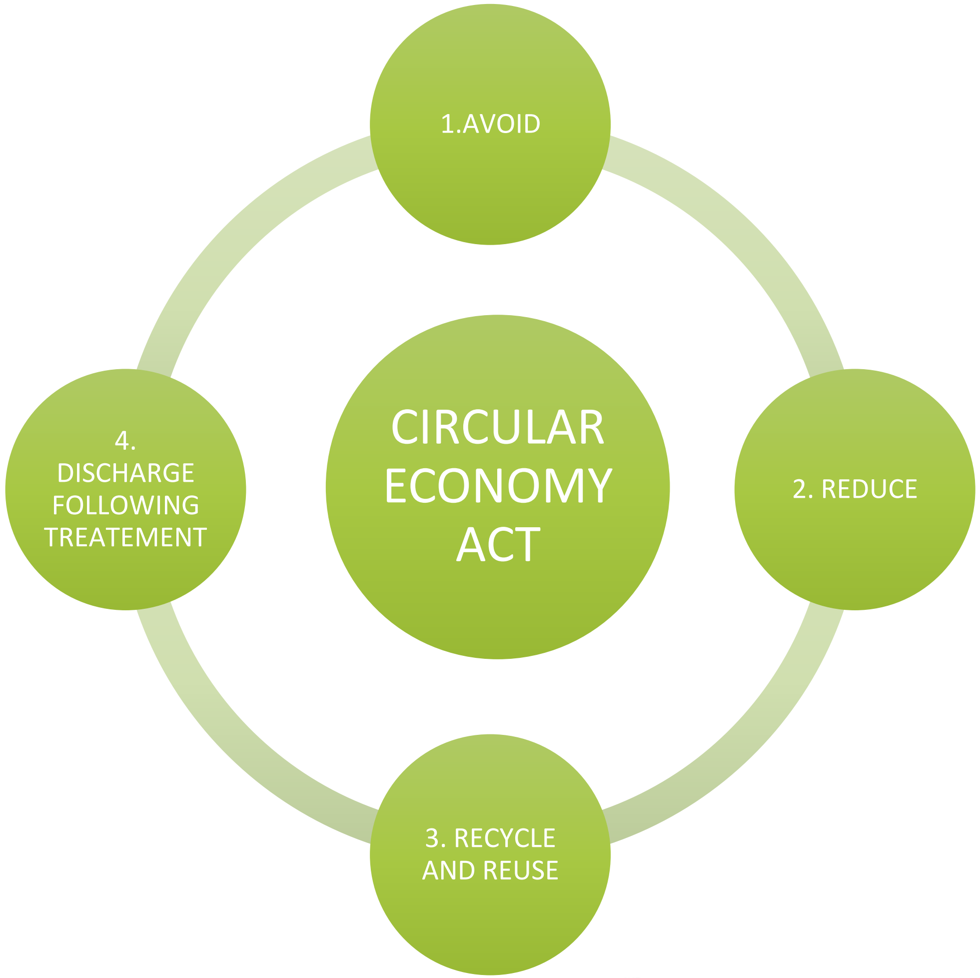
Green growth and circular economy in EU

The green economy according to the EEA



Source: European Environment Agency

Target hierarchy of wastewater treatment according to circular economy



Source:
https://www.eea.europa.eu/ &
https://www.interreg-central.eu/Content.Node/Digital-Learning-Resources/01-Greywater.pdf

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European Union water policy, directives, national legislation and local regulations.

European legal framework related to water

"The main overall objective of EU water policy is to ensure access to good quality water in sufficient quantity for all Europeans, and to ensure the good status of all water bodies across Europe." (European Commission)

Laws governing water protection and wastewater treatment (e.g.):

- *EU Water Framework Directive 2000/60/EC (WFD)*
- EU Urban Wastewater Directive 91/271/EEC (UWD)
- Sewage sludge
- Regulation on minimum requirements for water reuse

Furthermore, there are various strategies, plans and recommendations that support international and transboundary water cooperation (e.g., ISO standards (13.060.30), European Green Deal, EU Water Strategy (Blueprint), The HELCOM Baltic Sea Action Plan, River Basin Management Plan (RBMP), SDGs.)

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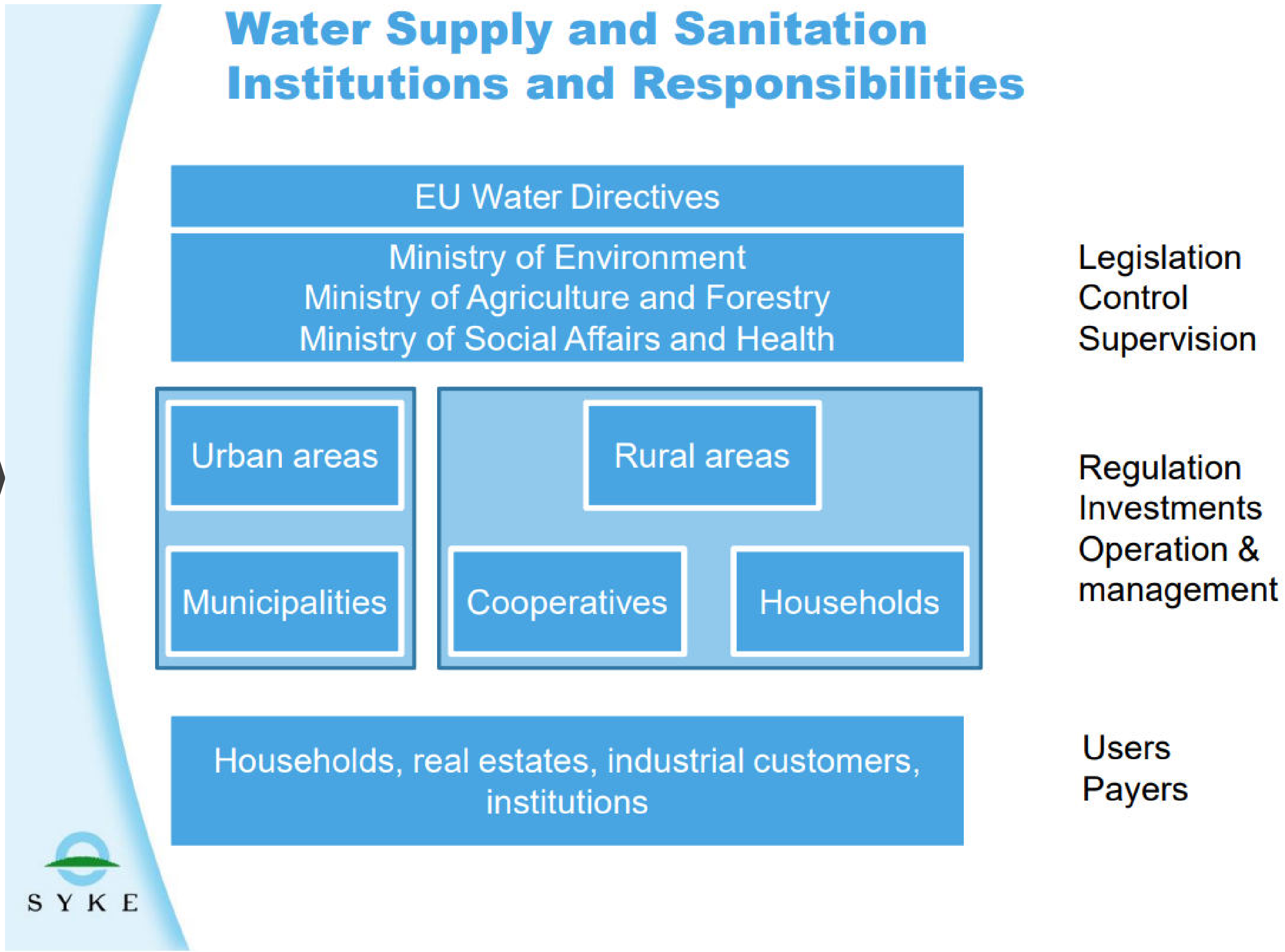
National legislation: Example of Finland Water supply and Sanitation Institutions and Responsibilities



Source and more about water services in Finland:
https://mmm.fi/en/water/water-services-and-groundwater
https://www.ymparisto.fi/en-US

Case example from Finland

Example of regulations and agreements on industrial wastewater in Finland: Conveying non-domestic wastewater to sewers

Regulations and delivery terms and conditions concerning water services

- Water Services Act 119/2001
- General delivery terms and conditions of water services

Regulations on environmental protection

- Environmental Protection Act 527/2014 and Environmental Protection Decree 713/2014
- Government Decree on Urban wastewater treatment 888/2006
- Government Decree on Substances dangerous and hazardous to the aquatic environment 1022/2006, Decree Amendments 868/2010 and 1308/2015
- BAT reference documents (BREFs)
- Sanitation Safety Plan

Regulations and agreements on chemicals

- Chemicals Act 599/2013/ and Chemicals Decree 675/1993
- E-PRTR Regulation 166/2006
- The 2001 Stockholm Convention on POPs
- Government Decree on the Monitoring of the handling and storage of dangerous chemicals 685/2015
- HELCOM list of substances of special concern
- REACH and CLP

Source:
https://www.vvy.fi/site/assets/files/1110/finnish_industrial_wastewater_guide.pdf

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Case example from Finland

Example of regulations and agreements on industrial wastewater in Finland: Conveying non-domestic wastewater to sewers

Regulations on treatment plant sludge, waste and health protection

- Fertiliser Product Act 539/2006
- Decree of the Ministry of Agriculture and Forestry on Fertiliser products 24/11
- Decree of the Ministry of Agriculture and Forestry on the Exercise and supervision of activities regarding fertiliser products 11/12
- Waste Act 646/2011 and Waste Decree 179/2012
- Regulation on by-products 1069/2009 and its implementing regulation 142/2011
- Health Protection Act 763/1994

Regulations and standards regarding certain industries

- Government Decision on Amalgam-containing wastewater and waste resulting from dental care 112/1997
- Government Decree on the Environmental protection requirements of energy production units with a rated thermal input below 50 megawatts 750/2013
- Government Decree on Limiting emissions from large combustion plants 936/2014
- Government Decree on Environmental protection regulations of liquid fuel distribution stations 444/2010
- Decree of the Ministry of the Environment on Water supply and sewer systems of properties 1047/2017
- Government Decree on Waste incineration 151/2013
- The Finnish Standard SFS 3352 for distribution stations of combustible liquids

Source:
https://www.vvy.fi/site/assets/files/1110/finnish_industrial_wastewater_guide.pdf

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Wastewater treatment methods for municipal and industrial wastewater.

Urban wastewater treatment in Europe

- Urban wastewater treatment has improved across Europe over the last 30-40 years.
- In 2017, most European countries collected and treated wastewater to tertiary stage. In EU-27 countries (EEA 2020), 69% of the population were connected in tertiary treatment and 13% in secondary treatment.
- Less than 80 % of the population were connected to public urban wastewater treatment systems in Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Ireland, Italy, Lithuania, Poland, Romania, Serbia, Slovakia and Slovenia.

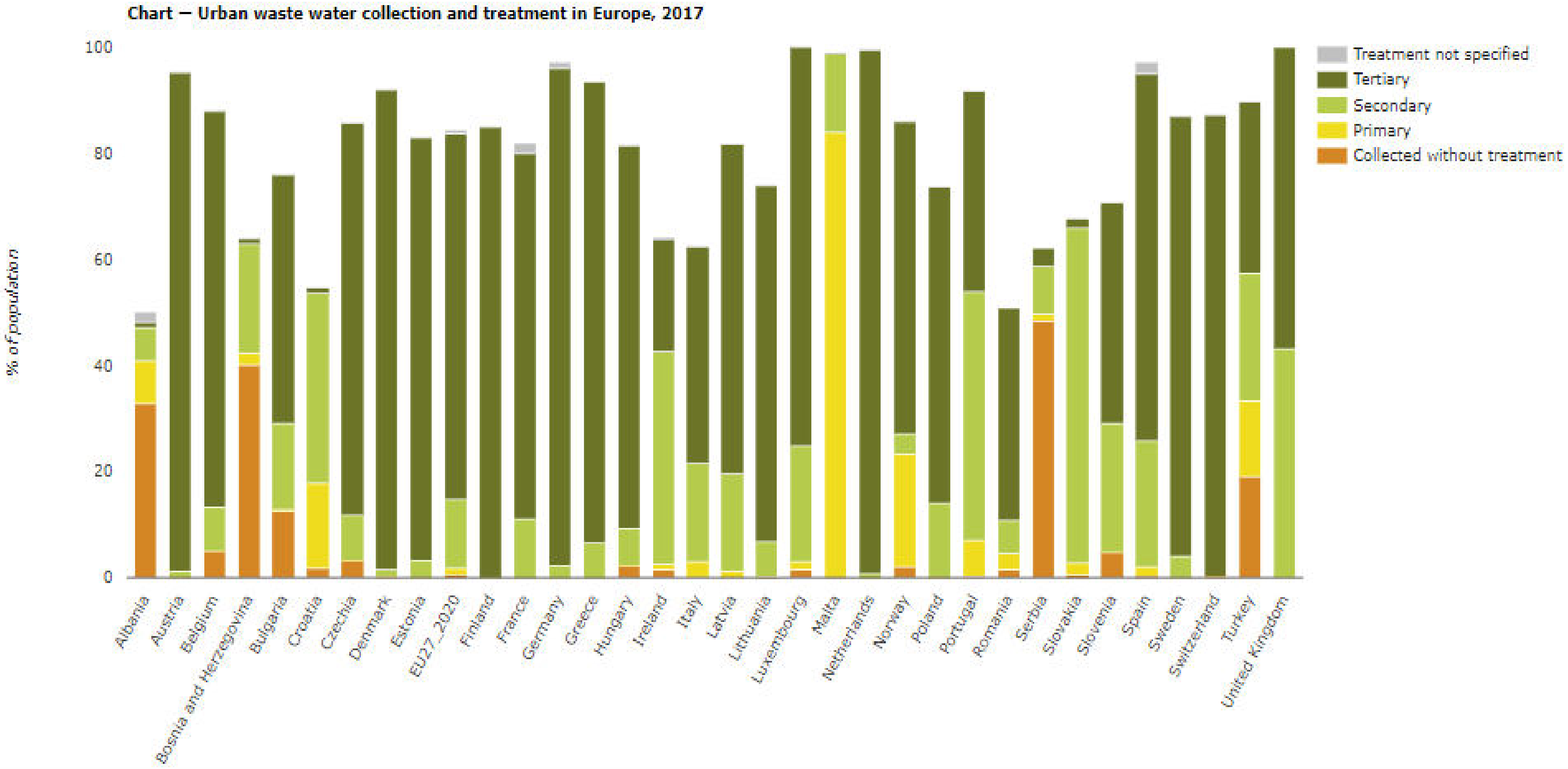

Figure shows the proportion of urban waste water collected and the level of treatment applied as a percentage of the population. Orange bars represent sewage collected but not treated before discharge; yellow bars represent primary treatment, such as settling; light green bars represent secondary treatment to reduce dissolved and suspended organic compounds, such as those using biological methods; dark green bars represent more stringent 'tertiary' treatment, mainly to reduce nutrients.

Source: https://www.eea.europa.eu/data-and-maps/indicators/urban-waste-water-treatment/urban-waste-water-treatment-assessment-5

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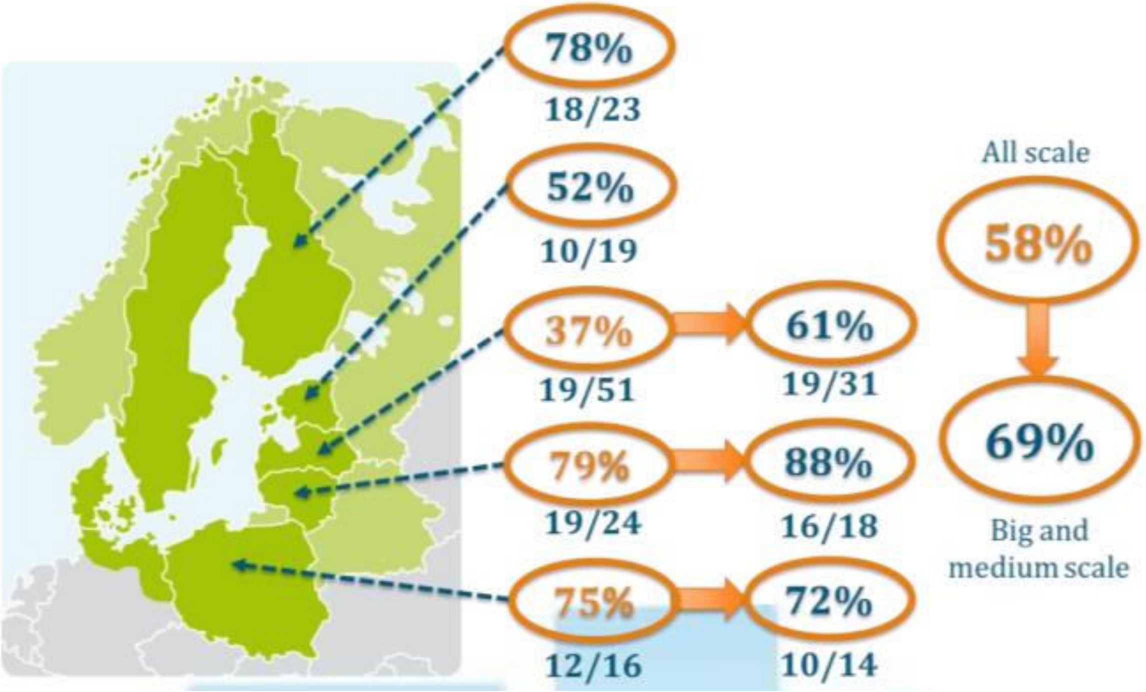
Current situation in industrial wastewater treatment in Baltic Sea Region

The main findings (Project BEST)

- The legislation in the EU, national and regional levels in most of the BSR countries is in order, but the implementation is insufficient in many countries.
- The main sectors of specific concern in the BRS region that can cause disturbances in operation and treatment efficiency at municipal WWTP are Processing and preserving of meat and production of meat products, Manufacture of dairy products and Manufacture of beverages.
- In many countries as Estonia, Latvia, Lithuania, Poland and Russia the priority and hazardous substances are mainly not listed in contracts or integrated permits, and therefore, they are out of the scope of both water utility and Environmental authority.
- The overall knowledge of industrial wastewater characteristics, treatment technologies and impact on municipal wastewater systems is rather limited in both industrial organization and water utility sides.

Industrial organisations with a contract regarding industrial wastewater discharge into municipal wastewater systems



Final report (Project BEST): [Assessment of the current situation concering industrial wastewater discharge into municipal wastewater systems in the Baltic Sea region]

Source:
https://bestbalticproject.eu/about/assessing-the-current-situation-managment-of-industrial-waste-waters-in-bsr-wp2/

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Wastewater treatment plant basics

- In most situations the required wastewater treatment is carried out at wastewater treatment plants.
- A sewage treatment plant must:
    - Treat the wastewater to such an extent that meets the effluent requirements.
    - be able to handle the inherent variations that are in the wastewater as well as variations in the amount of wastewater.
    - Be sustainable constructed
    - Be able to treat the wastewater at a minimum annual cost
    - Cause minimum amount of disturbance to the surrounding areas.
- General design principals and components of wastewater treatment Plant
    - Design Loads (hydraulic load and biologigal load)
    - Treatment Process Components (e.g. different types of wastewater contaminations and chosed treatment steps)
    - Data from Wastewater treatment plants
    - Amount of sludge and method of treatment

IWAMA interactive Ware Management,
Interactive “Day at the WWTP” –game

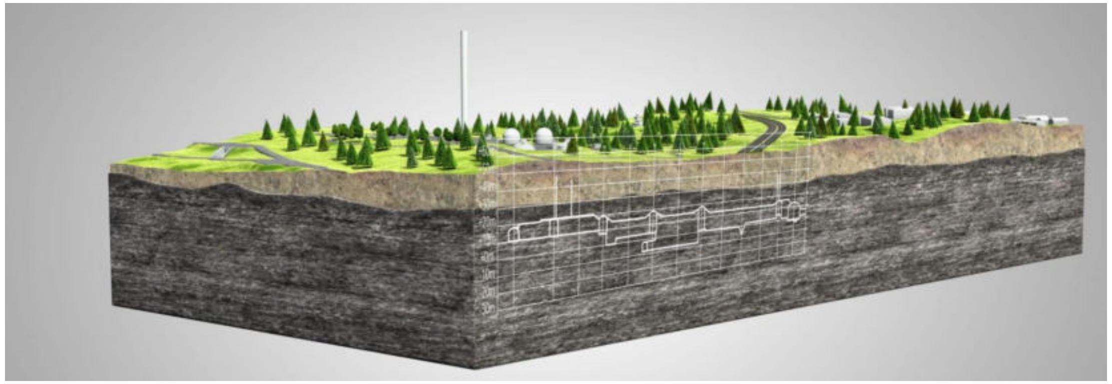
Source:

https://courses.edx.org/c4x/DelftX/CTB3365STx/asset/Wastewater_Lecture_Note.pdf

Good practices:

-New modern wastewater treatment plant to Espoo’s Blominmäki will be completed in 2022

- The treatment plant will process the wastewater of 400,000 residents from Espoo and Kauniainen, Kirkkonummi, Siuntio and Western Vantaa.
- Treats wastewater better, operates reliably and safely, uses its own energy and blends in with the surroundings
- The treatment goals are clearly stricter than the EU requirements and the recommendations of HELCOM (Helsinki Commission)
    - The aim of the Blominmäki treatment plant is to remove from wastewater over 96% of the phosphorus and organic matter as well as over 90% of the nitrogen it contains. Even if the population and volume of wastewater to be treated increase, the resident-specific nutrient load on the Baltic Sea will decrease from the current level.
- Experiences, for example, from the Helsinki Viikinmäki treatment plant will help in reaching the challenging treatment goals cost-efficiently.
- Video (4:36): Blominmäen jätevedenpuhdistamon 3D-animaatio



Picture: https://www.hsy.fi/en/blominmaki/

Source/ Learn more: https://www.hsy.fi/en/blominmaki/ &
https://www.balticwaterhub.net/good-practice/centralized-wastewater-treatment-wwtp-helsinki

Steps in the treatment of wastewater

Pre-treatment

- dedicated to removing coarse material and sand; these particles can cause difficulties further along in the treatment process (blockages, damage to the components, etc.) if they are not removed.

Mechanical treatment

- The settleable substances are separated (mechanical treatment) which is referred to as primary treatment or clarification, however this step can also be omitted in some treatment configurations

Biologigal treatment

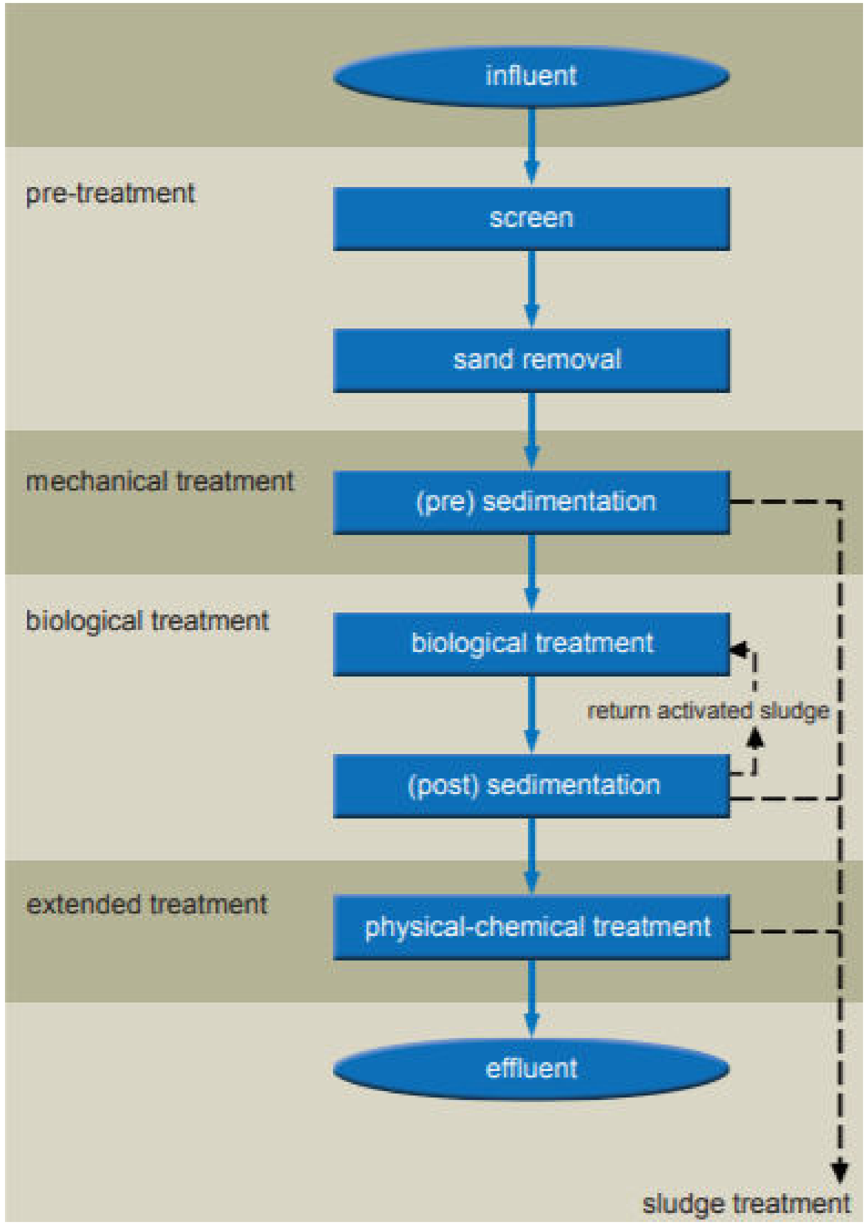
- Secondary treatment which encompasses the removal of the dissolved and suspended organic contaminants through a biological process; nitrogen and phosphorus compounds can also be removed in the secondary process. Then the biological (or activated) solids produced by the secondary process are separated in a secondary clarifier.

Extended treatment

- The effluent is either discharged into the surface water or an extended or physical-chemical purification process can be deployed as the last phase prior to discharge. The extended treatment often focuses less on the oxygen demanding substances, but more on other components (e.g., micro pollutants, heavy metals, pathogens, etc.).

Sludge treatment

- During the treatment of wastewater sludge is produced. This consists mainly of water (typically >95%). The sludge can go through multiple treatments, from which one of the most important is the thickening process



Possible steps in the treatment of wastewater

Source:
https://courses.edx.org/c4x/DelftX/CTB3365STx/asset/Wastewater_Lecture_Note.pdf

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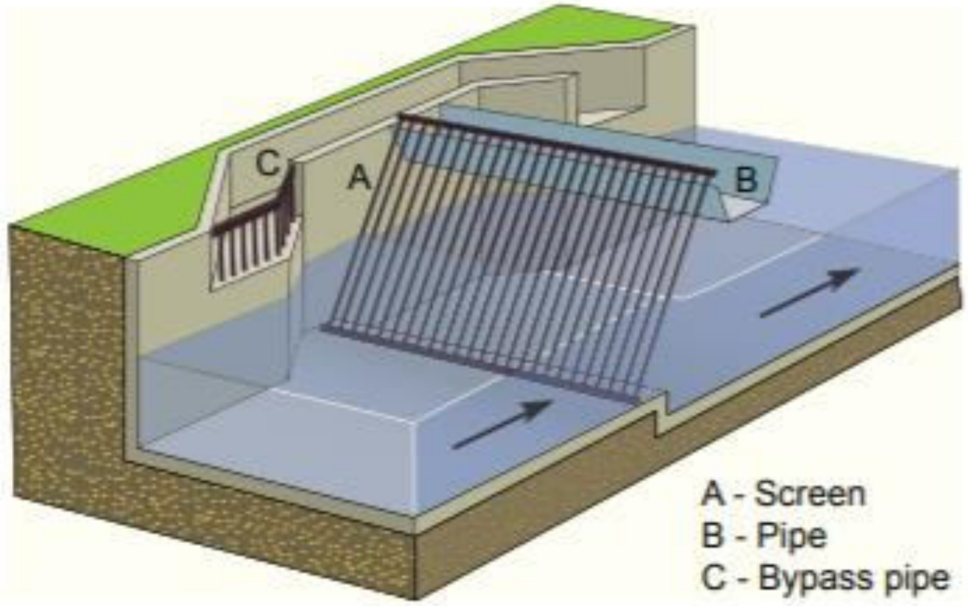
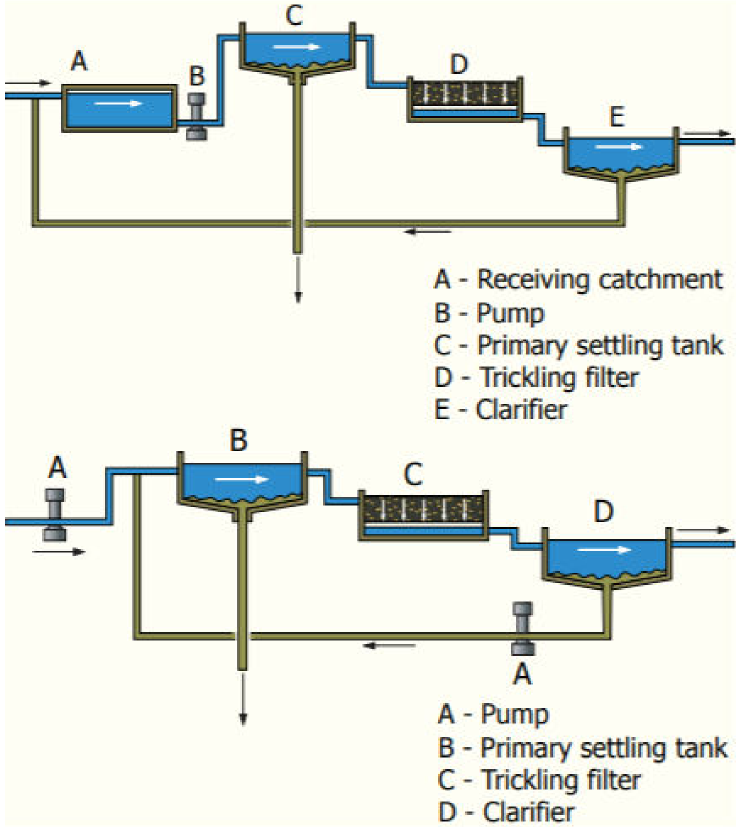
Stages and technology of wastewater treatment

- **Primary Treatment**
  - Screens
  - Grit Chambers
  - Primary Sedimentation
- **Secondary Treatment**
  - Trickling Filters
  - Activated Sludge Process
- **Additional Treatment**
  - Nitrogen Removal
  - Phosphate Removal
  - Extended Treatment
    - Deep Bed Filter
    - Chlorination



Bar screen with bypass pipe



Recirculation with influent supply through gravity sewer or pressure main

Source text and pictures:
https://courses.edx.org/c4x/DelftX/CTB3365STx/asset/Wastewater_Lecture_Note.pdf

Pretreatment of Industrial Wastewater

- Companies can produce wastewater that does not meet the requirements for wastewater discharged into the public sewer. In this case, wastewater must be pre-treated before discharging it to the company's sewer.
- The most typical pretreatment equipment is oil, sand and grease separators.
- Maintenance should be performed according to the equipment manufacturer's instructions
- Waste produced during maintenance must be treated in accordance with waste management regulations.

Source:
https://lahtiaqua.fi/yritykset-tai-yhteisot/yrityksille/poikkeavat-jatevedet/

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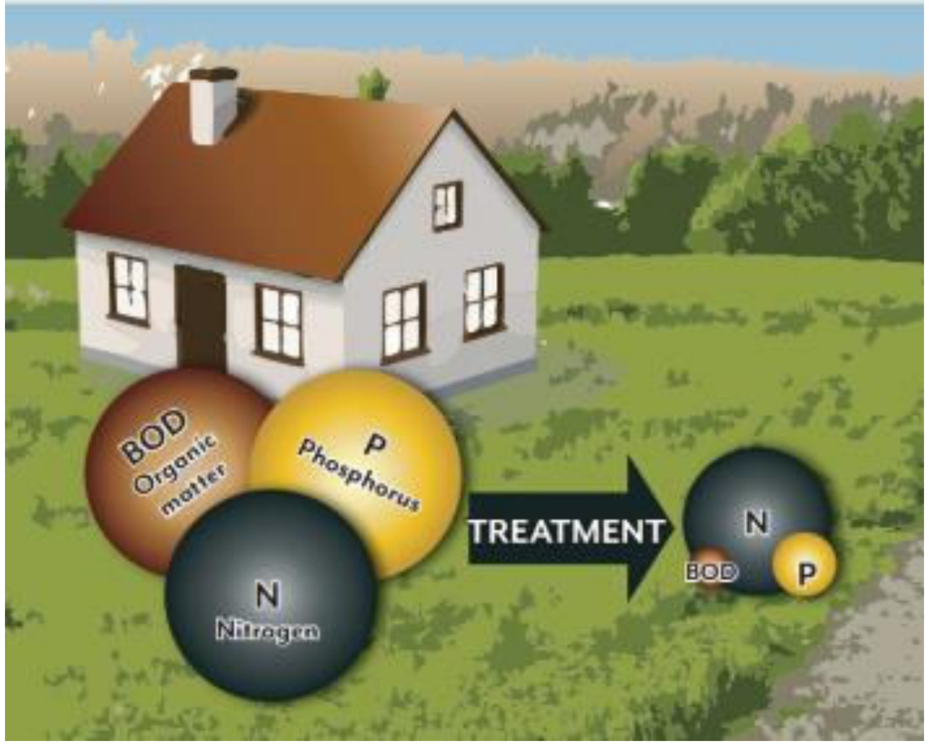
The BEST practices – Pretreatment

- Pre-treatment practices and methods for industries
- Efficient and responsible pretreatment of industrial wastewaters, good examples in videos
    - Pretreatment at Valio dairy
    - Pretreatment at Orion pharmaceutical plant
    - Pretreatment at Kalevela Koru jewelry factory
    - Pretreatment at Kalatukku E. Eriksson fish processing plant
    - Pretreatment at Fortum Recycle and Waste, waste and environmental services company
    - Better regulation for wastewater pre-treatment in E-Piim dairy in Estonia (Regulation tank)

Case example from Finland

Example of Regulations and agreements on wastewater in Finland in sparsely populated areas (outside of the municipal sewage networks)

- Wastewater from sparsely populated areas (non-connected dwellings) pollutes water bodies more than the approximately four million people who are connected to the sewer network (Jätevesien käsittely haja-asutusalueella, 2018).
- According to the Finnish Environmental Law: If the property is not part of a centralized sewage network and the activity does not require an environmental permit, sewage waters need to be directed and treated in such a way that does not cause danger of contamination
- The property owner ensures that the wastewater treatment system meets the treatment requirements
- The treatment requirements concern three compounds (organic matter, phosphorus and nitrogen) causing euthrophication, and the aim is to reduce environmental impacts
- Municipalities may have stricter regulations
- If the treatment requirements are not met, the system needs to be refurbished
  - By 31.10.2019 in groundwater areas and within 100 m from surface waters
  - In other areas when there are larger, permit requiring construction on going, a water system is established, or specific renovation or changes are made on the property
  - immediately, if a new construction takes place
  - Treatment requirements do not concern: −Properties which have no water toilet and wash water use is low (e.g. cottages and saunas where water is carried): small amounts of wash water can be directed to the ground without treatment in a controlled manner
  - Permanently inhabited properties owned by persons turning 68 by 9.3.2011 (so called age specific exemption)



A guide to waste water:

- Environmental impacts of wastewater
- What does the legislation say?
- On-site wastewater treatment alternatives

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Case example from Finland

Phases of wastewater system renovation in sparsely populated areas outside municipal sewerage networks

Contacting to the municipality and asking if property can be connected to the municipal sewer. If it is possible now or in the near future, the property must be connected to a municipal sewer

If it is not possible to connect to the municipal sewer, the property must have its own wastewater treatment system.

Selecting a competent wastewater designer (engineer) who will draw up a wastewater plan, find out the municipal regulations and assist in the selection and dimensioning of the wastewater system.

Submitting the Permit Application for Construction Supervision

Invitation to tender and selecting construction contractor

Construction supervision (recording and documentation of construction phases and materials)

Changes must be accepted with Construction Supervision and documented.

Documents (System description, Maintenance instructions and operational log book) regarding the wastewater system required on property. An example of document can be found here.

Source:
https://valonia.fi/materiaali/jatevesi/

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Sludge treatment and utilization

Sludge - no longer seen as a waste product but as a bioresource

- **The raw sewage sludge** is a by-product of the treatment of wastewater, and it consists of water, organic matter and nutrients.
  - It contains valuable resources:
    - Carbon (25–35% in dry solids)
    - Nitrogen (4– 5% in dry solids)
    - Phosphorus (P: 2-3% in dry solids)
    - Oxygen (O: 20-25% in dry solids)
    - Residuals (trace elements, metals, etc)
- **Types of sludge**
  - **Primary sludge** results from a first mechanical settlement of the raw waste water or rain water entering the wastewater treatment plant. It mainly contains organic matter. This type of sludge has a high energy content that can be used, for example, to produce biogas. Primary sludge is only produced by a wastewater treatment plant equipped with a primary settler.
  - **Secondary sludge (or biological sludge**), results from the biological treatment of waste water. During this treatment, micro-organisms grow and multiply through the degradation of organic matter by different biological processes. The excess of the biological sludge has to be removed during the treatment process to maintain the stability of the cycle.
  - **Chemical sludge** comes from the addition of some chemicals to bring about a specific treatment (e.g. the addition of $FeCl_3$ - ferric chloride - to enhance phosphorus removal). It contains both biological sludge and some residual chemical products. It usually represents a very small part of sludge production.

Source:
https://www.eureau.org/resources/briefing-notes/5629-briefing-note-on-sludge-management/file

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Sludge - no longer seen as a waste product but as a bioresource

- **Treated sludge** has undergone processes to prepared for use.
- **Dry solids** is what is leftover when all the water is removed from raw sludge. It is the metric to compare quantities produced.
- A wastewater treatment plant produces approximately two litres of raw sludge per person per day at all Wastewater treatment plants across Europe.
- Sludge management and treatment in videos:
  - Sludge management
  - Automated sludge treatment with Kemira Kemconnect

Source:
https://www.eureau.org/resources/briefing-notes/5629-briefing-note-on-sludge-management/file

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Sludge destinations

Each country manages their sludge according to their own priorities, local needs and opportunities

- ***Agricultural recycling*** are the main options in Cyprus, Denmark, France, Ireland, Norway, Portugal, Slovakia, Spain and the UK.
- ***Incineration*** is the only option in Flanders and the Netherlands.
- ***Land reclamation*** is a very important solution in Finland and Sweden.
- Germany, Wallonia, Czech Republic, Poland use a ***mix of options***.
- ***Landfill*** remains the principal option in Malta and Romania.

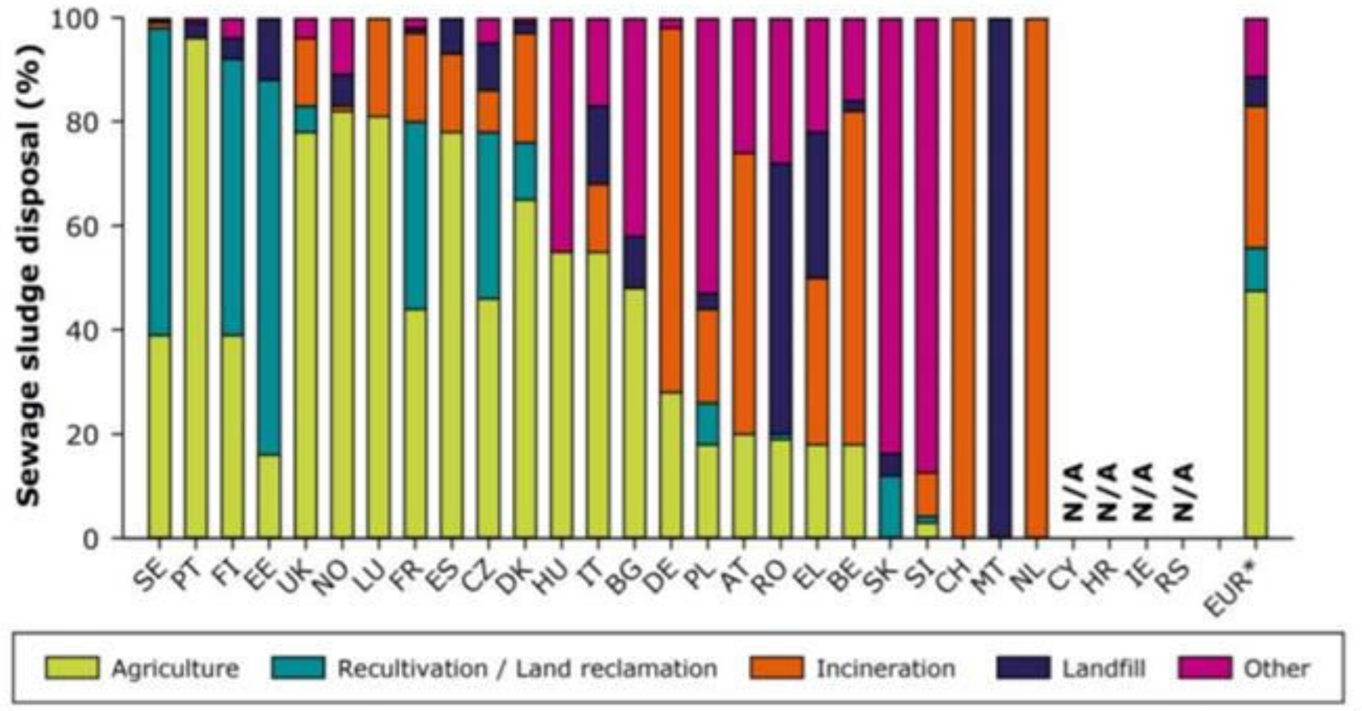
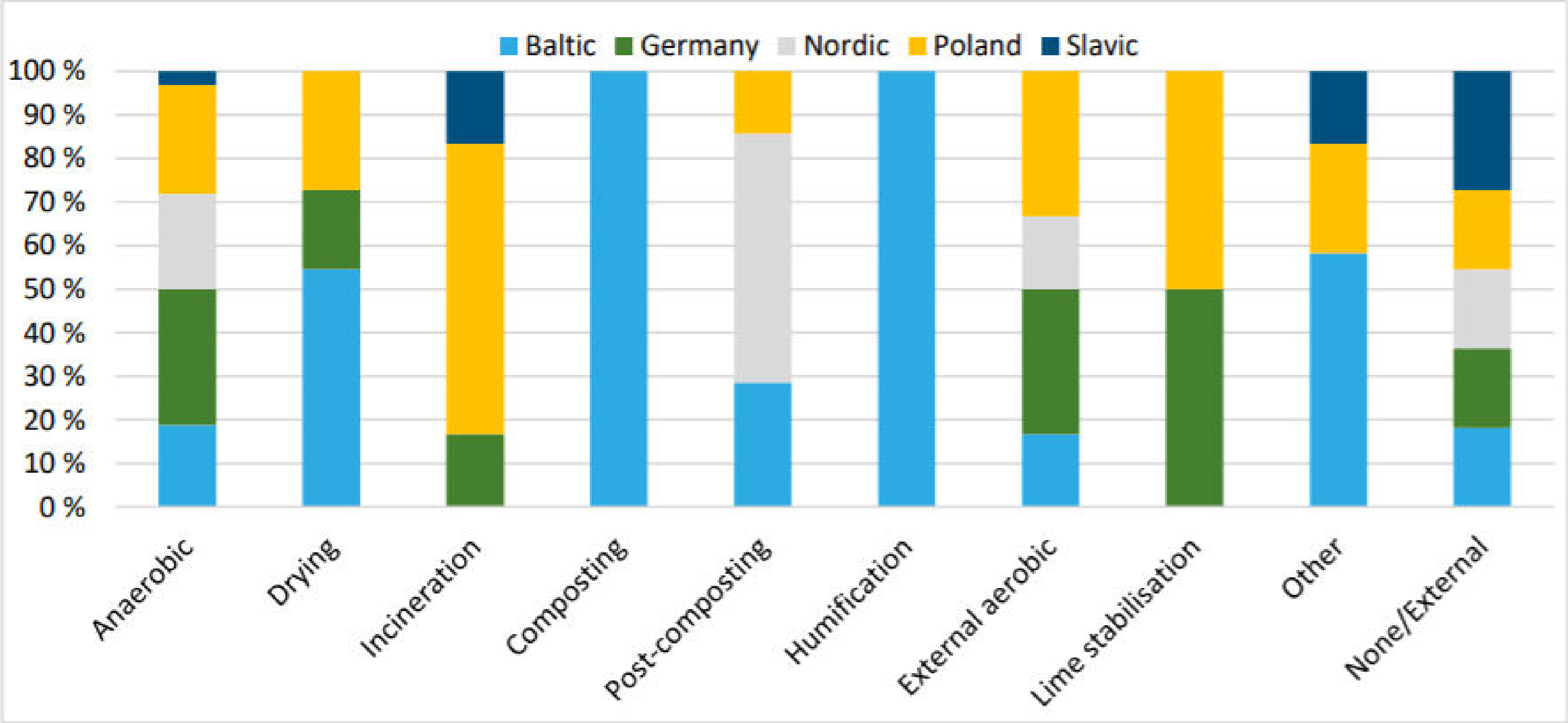


Figure 2: Sludge destination per country in % according to EurEau Survey (2017)
N.A.: No answer available from that member country at the time of the survey.

Source:
https://www.eureau.org/resources/briefing-notes/5629-briefing-note-on-sludge-management/file

Regional use of sludge treatment technologies

- It is important that sludge volumes are kept at a minimum with a high dry-solids content to reduce disposal costs.

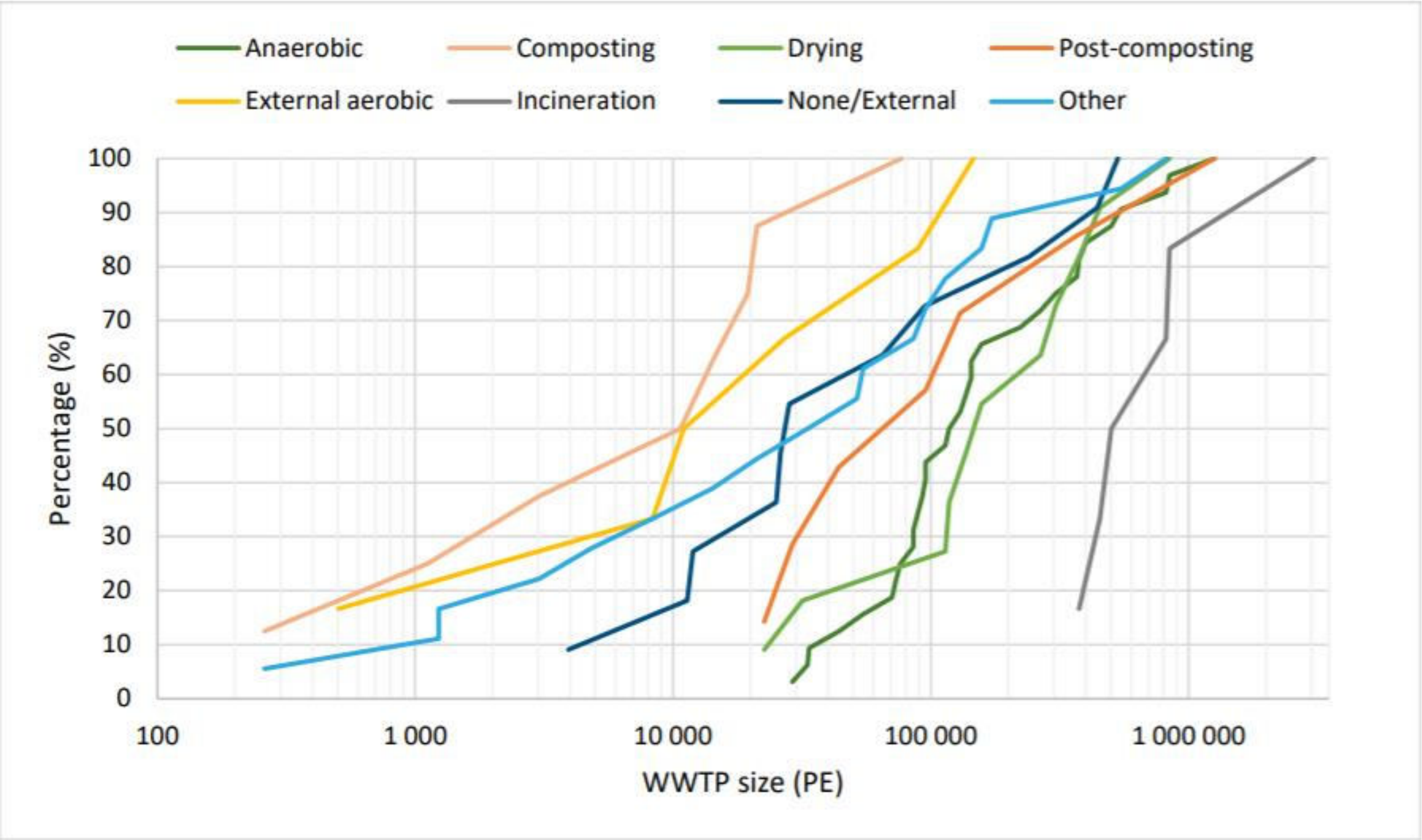


Absolute regional use by technologies (66 WWTPs, 99 technological steps).

Source:
https://www.iwama.eu/sites/iwama/files/outputs/files/key_figure_data_for_sludge_benchmark_0.pdf

Sludge treatment technologies by wastewater treatment plant size

- Even though sludge treatment technologies used partially depend on the country or sub-region of their location, most influencing dependency is the size of wastewater treatment plant



Correlation between sludge treatment technologies and WWTP sizes in PE (66 WWTPs, 99 technological steps).

Source:
https://www.iwama.eu/sites/iwama/files/outputs/files/key_figure_data_for_sludge_benchmark_0.pdf

Utilization of sludge – BEST practice

- Biogas production from food industry sludge and waste
  - Benefits of co-digestion
    - Potential increase in biogas production.
    - Appropriate use of biodegradable industrial waste resources.
    - Waste recovery in the form of energy or heat.
    - Properly conducted pre-treatment processes on the industrial plant premises secures the wastewater treatment line against overloading.
- Video (2:08): Pilot-scale fermentation unit to utilize industrial sewage for biogas production in Leszno, Poland

Good practices for sludge management

The best managements from the EurEau perspective

Control at source	• By implementing control at source, we can reduce the amount of contaminants that end up in sludge thus improving its recyclability and reuse potential
Biosolids	• Exploring the potential for additional use of biosolids on land will not only improve soil quality but help mitigate climate change
Assurance schemes	• certification to assure quality standards will help protect May 2021 Wastewater treatment – sludge management ~ 11/32 ~ human and environment health– details
Risk Assessment	• Risk assessment and risk management can be legislated at national level to further protect human and environmental health
Energy production	• Switching to sustainable energy such as biogas will encourage investment in biogas production from Wastewater treatment plant.
Incineration	• Sludge incineration (either mono- or co-inceneration) is another means to generate energy if land application is not feasible
Resource recovery	• Recovering phosphorus and nitrogen from sludge makes a significant contribution to the circular economy
Innovation	• innovation will drive new possibilities. New technologies such as pyrolysis (the burning of sludge without oxygen to preserve the carbon) and gasification have proven to be environmentally safe and economically feasible solutions for sewage sludge treatment. Furthermore, trials with ozonolysis demonstrated its effectiveness in reducing and stabilising sludge. Hydrothermal liquefaction technology (HTL), mineralisation and Gas-to-liquid technology (GTL) are also being used.

Source and more details: https://www.eureau.org/resources/briefing-notes/5629-briefing-note-on-sludge-management/file

"Operators are choosing their preferred management options according to their local needs to comply with local environmental regulations, available markets and opportunities and the requirements to keep the water tariff affordable."

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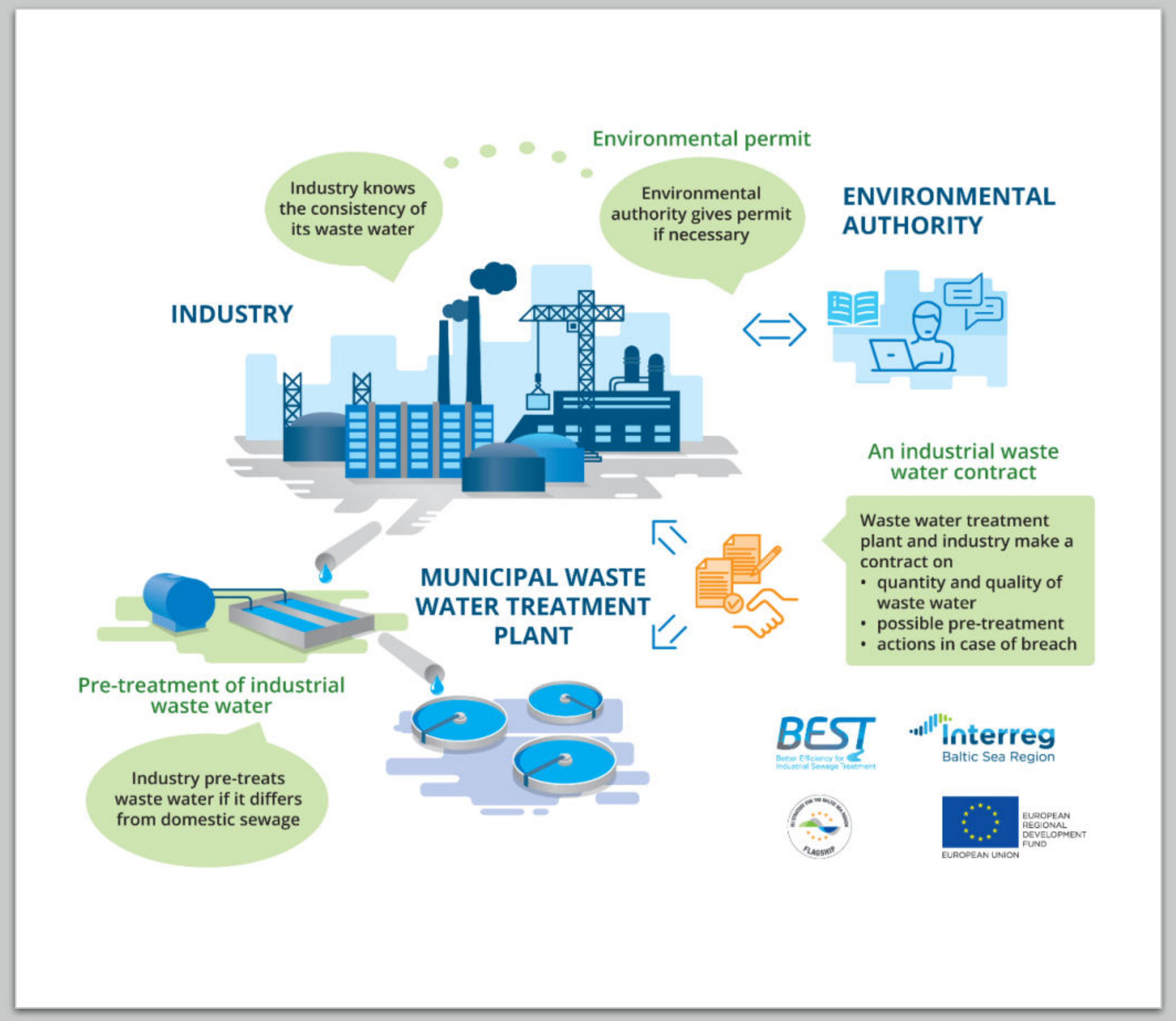
Maintenance and renovation works. Inspection methods for sewer pipes.

Cooperation between different stakeholders

- Along with technological developments, the challenges in co-treatment of industrial effluents can be solved by improving practices such as joint planning, communication and cooperation between water utilities, industrial operators, and environmental authorities.
- Effective cooperation ensures timely exchange of information and quick response to malfunction situations



Source
https://bestbalticproject.eu/wp-content/uploads/2020/08/Cooperation-infographic-1.png

Developing local management models for improved treatment of industrial effluents

- Recommended models for testing
  - Organizing educational visits to the Wastewater treatment plant
  - Collecting information (“a cadaster”) of industrial wastewaters
  - Using an excel tool for instructions in emergency situations
  - Organizing regular meetings with industries
  - Organizing regular meetings with environmental authorities
  - Publishing of an annual report on industrial wastewaters .

Source and pilot testing examples:
https://bestbalticproject.eu/wp-content/uploads/2021/04/BEST-Developing_local_management_models.pdf

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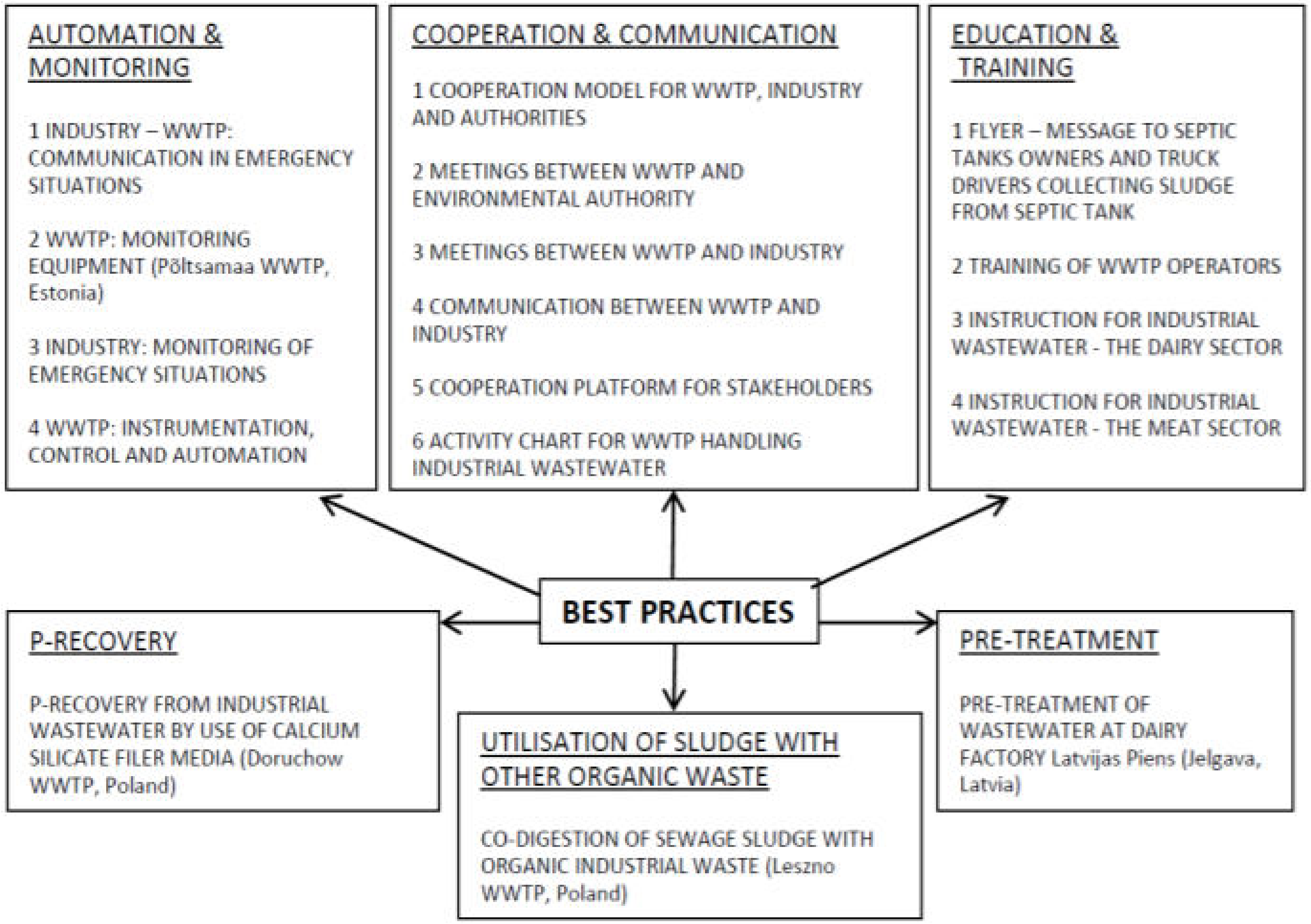
Toolset of entire toolbox of best practices



Source:
https://bestbalticproject.eu/wp-content/uploads/2020/09/Training-Concept_FINAL-with-tools.pdf

Process assessment for pipeline inspections

Process assessment for pipeline inspections (CEN, 2008).

Source:
https://www.fistt.net/wp-content/uploads/2019/09/CASI-Methods.pdf

New pipe: sewer inspection time intervals

Time stamp, years	Explanation Significance	Significance
0	Inspection of commissioning and acceptance	Subsequent inspections can be compared to this point. Data is saved, documented, and managed.
+2	Inspection after the period of guarantee is done.	Make sure that the pipeline is still in good (newly built) condition. If this is not the case, reparation is to be made and documented. Data is saved, documented, and managed.
+10	The first systematic inspection.	Data is saved, documented and managed. Analysis based on comparison of the earlier inspections.
Either: + 2 + 5 + 10	The second systematic inspection is made based on the earlier observations.	Data is saved, documented and managed. Analysis based on comparison of the earlier inspections.
Same as above. Continued until the service life is over	Further inspections. Data updates, increases, and will be analyzed.	Data is saved, documented and managed. Analysis based on comparison of the earlier inspections.
End of service life.		Data is saved, documented and managed. Analysis based on comparison of the earlier inspections. Data and information is analyzed to improve asset management actions in other pipelines

Source:
https://www.fistt.net/wp-content/uploads/2019/09/CASI-Methods.pdf

Old pipelines: Sewer inspection time intervals with no prior-inspections

Time stamp, years	Explanation	Significance
NOW	The first inspection of the pipeline.	Initial data of the pipeline's condition. The latter inspections can be compared to this point. Data is saved, documented, and managed.
Either: + 2 + 5 + 10	The second systematic inspection is made based on the earlier observations.	Data is saved, documented and managed. Analysis based on comparison of the earlier inspections
Same as above. Continued until the service life is over	Further inspections. Data updates, increases, and will be analyzed.	Data is saved, documented and managed. Analysis based on comparison of the earlier inspections.
End of service life		Data is saved, documented and managed. Analysis based on comparison of the earlier inspections. Data and information is analyzed to improve asset management actions in other pipelines.

Source:
https://www.fistt.net/wp-content/uploads/2019/09/CASI-Methods.pdf

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Condition assessment and sewer inspection (CASI) methods

- Pre-screening methods for CASI
  - Data analyses and other computational methods
  - CASI with zoom-camera
- CCTV in THE CASI process
  - Digital CCTV
- Laser scanning and echo-location CASI methods
  - Laser scanning
  - Ground penetrating radars
- Acoustic CASI methods
- Electrical and electromagnetic CASI methods
- House connections and their inspections

Source:
https://www.fistt.net/wp-content/uploads/2019/09/CASI-Methods.pdf

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Other methods linked to pipelines CASI

- Manhole inspection methods (MIM)
- Tunnels and their inspection methods
- Information available from pumping stations
- Flow measurements
- Measurements of water quality
- Samples taken from a pipe
- Pressure testing, smoke testing, color testing

Source:
https://www.fistt.net/wp-content/uploads/2019/09/CASI-Methods.pdf

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Financial possibilities for SMEs: European Union

Who is eligible for EU funding

- EU Funding is available for all types of companies of any size and sector including entrepreneurs, start-ups, micro companies, small and medium-sized enterprises, and larger businesses. A wide range of financing is available: business loans, microfinance, guarantees and venture capital.
- Main funding opportunies
  - Improving SMEs' access to finance and markets
  - SMEs supporting the EU's energy, transport and digital networks
  - SMEs in the field of research and innovation
  - SMEs in the European regions
  - Other funding opportunities for SMEs
- COSME - Europe’s programme for small and medium-sized enterprises

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Capacity building: strategy, action plan and staff's skills and knowledge development.

EQF and wastewater sector

- European Qualifications Framework (EQF)
  - “The EQF seeks to support cross-border mobility of learners and workers, promote lifelong learning and professional development across Europe.”
  - 8 EQF levels

The eight education levels from the EQF can also be applied in the wastewater sector, according to the German Qualification Framework (DQR):

- **Level 1-2:** Sewer and Wastewater Treatment Plant Helper
  (e.g. 1 week theoretical and 2 weeks practical qualification)
- **Level 3:** Certified Sewer Operator
  (e.g. 3-5 weeks training and 3 years experiences)
- **Level 4:** Water/Wastewater Technician (e.g. 3 years dual education)
- **Level 5:** Foreman
- **Level 6:** Bachelors, Senior Master Technician
- **Level 7:** Master, Scientist, Head of Water Utilities
- **Level 8:** Prof., Dr.-Eng., PhD

Source:
https://europa.eu/europass/en/european-qualifications-framework-eqf
http://www.iwama.eu/sites/iwama/files/outputs/files/lifelong_learning_and_wastewater_treatment_in_the_baltic_sea_region.pdf

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Skills development - Non-formal educations

- Training days/seminars/conferences
- Workshops/development groups
- Dialogical and interactive way of working
- On-the-job training
- Coaching/Mentoring
- Short courses
- Visits to other
- Peer learning
- Benchmarking
- Technical applications
- Social media
- Intranet
- Work shadowing
- Self-study
- E-training packages
- Task/job rotations

Picture from Pixabay

Water utilities and wastewater treatment professionals in the Baltic Sea Region - Recognized challenges in daily work

- Municipal wastewater treatment plants are primarily designed to treat wastewater from households and these treatment processes can easily be disrupted by industrial wastewater differing in its quantity and quality compared to domestic wastewater.
- Challenges in the treatment of industrial wastewaters
  - Water utilities need knowledge about potential treatment solutions as well as improved cooperation between the water utilities, industrial companies and authorities responsible for permits and monitoring, to better plan, further develop and monitor the treatment processes.
  - Industrial companies need new knowledge and understanding about impacts of their effluents on municipal wastewater treatment process.
  - Authorities on local and regional level need knowledge about wastewater treatment process challenges at the water utilities.

Source:
https://bestbalticproject.eu/wp-content/uploads/2020/09/Training-Concept_FINAL-with-tools.pdf

Training models and materials for increasing capacity and knowledge of stakeholders

- This document presents training models and material that can be used to:
  - Training forms
    - Train the experts in-depth knowledge and capacity for everyday work
  - Interactive and participatory tools for events
    - Target very specific issues in wastewater treatment related to specific industry;
  - Challenge/Solution based tool sheets – Toolbox of best practices
    - Enhance cooperation and communication between water utilities, industrial companies and authorities.

Source:
https://bestbalticproject.eu/wp-content/uploads/2020/09/Training-Concept_FINAL-with-tools.pdf

Sources

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- Wastewater treatment https://courses.edx.org/c4x/DelftX/CTB3365STx/asset/Wastewater_Lecture_Note.pdf
- Interactive game http://wwtpgame.iwama.eu/
- Blominmäki & Viikinmäki WWTP (Good practices) https://www.hsy.fi/en/blominmaki/ & https://www.balticwaterhub.net/good-practice/centralized-wastewater-treatment-wwtp-helsinki
- Pre-treatment of Industrial Wastewater https://lahtiaqua.fi/yritykset-tai-yhteisot/yrityksille/poikkeavat-jatevedet/
- Project BEST – Better Efficiency for Industrial Sewage Treatment https://bestbalticproject.eu/
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- Developing local management models for improved treatment of industrial effluents https://bestbalticproject.eu/wp-content/uploads/2021/04/BEST-Developing_local_management_models.pdf

Work Package 4: Second centre level "Continuing vocational training" (EQF Level 4-6)

Activity A6: Trainings in the Green Economy

Best Practice Curriculum

Training D – Water supply and savings

Developed by:

WIFI WKO in 2020 in the Project “Management and Technologies of Water, Waste Water, Waste and Circular Economy (WWW&CE)”

Prepared by:

Wirtschaftsförderungsinstitut (WIFI) Steiermark

August, 2021

Co-funded by the Erasmus+ Programme of the European Union

TABLE OF CONTENTS

Co-funded by the Erasmus+ Programme of the European Union

Chapter 1: Executive Summary

The course "Water Supply and Saving" was developed in the project "Management and Technologies of Water, Waste Water, Waste and Circular Economy – WWW&CE", which was funded by the Erasmus+ Programme of the European Union. Eleven partners from seven EU Member States developed tools according to work-based learning principles that are piloted and evaluated. For more information: https://www.sa-ce.eu

The course is designed according to the qualifications on the European Framework Qualification Level 4 to 6. Furthermore, the six courses are primarily designed for young people with strong learning skills for vocational training. All courses of the WWW&CE project shall direct participants and in further sequence small and medium sized companies towards a more environmentally conscious approach to their personal and business objectives in order to generate a more sustainable world.

The main objective of the course "Water Supply and Saving" is to provide information on water management, water supply and saving technologies as well as standards and regulations within this field. The participants are going to study different water supply options in order to be able to implement water management measures within their company. Furthermore, after successful completion they are aware of various water saving technologies and are able to prepare concepts to reduce the water footprint of a company. The acquired knowledge of the participates promotes a careful use of water in the company and thus contributes towards a positive environmental development of enterprises.

The course "Water Supply and Saving" (4 ECTS) is divided into the following modules:

- Module I – "Introduction to Water Supply and Saving" (0.5 ECTS)
- Module II – "Water Supply" (1 ECTS)
- Module III – "Water Saving" (1 ECTS)
- Module IV – "Practical Application and Utilization" (1.5 ECTS)

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The modules are offered in the form of classroom training with integrated home-based learning. The course is concluded with a seminar paper based on use cases and an analysis of the respective company of the course participant. The modules are described in the following.

Chapter 1.1: Name of the Course

"Water Supply and Saving"

Chapter 1.2: Contact Details

WIFI Steiermark

Körblergasse 111-113

A-8010 Graz

Tel.: +43 306 602 1234

Fax: +43 316 602 301

E-Mail: info@stmk.wifi.at

Web: https://www.stmk.wifi.at

To be adapted by each partner

Chapter 1.3: Type of Course

Training course for further education.

Chapter 1.4: Demand and Acceptance

As a result of anthropogenic climate change, certain sectors will need more and more qualifications in the future and will have to cope with increasingly complex tasks in order to meet the demands of the times. The proper management of water, especially drinking water, plays a major role in this context. Water supply is essential for a functioning society, health of the population and a working economy at every level. At the same time, in the context of anthropogenic climate change, water conservation is a challenge that will occupy not only the present, but also the future generations to come. It can be highly relevant for small and medium sized enterprises (SMEs) to be able to manage their own water needs and to guarantee the best possible self-sufficiency in the private and commercial sectors. Every company should not only build-up, educate and train employees in the field of water management, so that these employees can take over environmentally relevant work

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and activities in the company, but should also devote themselves to this topic for general cost and environmental reasons. Even for companies with few employees, such trainings can offer many advantages. Furthermore, private persons should also apply themselves with these topics as they are also highly relevant for private households and can play, where applicable, a significant cost reduction factor.

Especially companies in the water, wastewater, waste management, recycling, circular economy, recycling management, etc. sectors will not only be affected by this change due to climate change but will also be able to benefit from it. In order to meet these requirements, it is essential that small and medium-sized enterprises (SMEs) adapt their business models and receive training in the relevant areas at all levels of the company. As SMEs in particular suffer from strong competition and therefore the available time is a scarce commodity, further training courses are being developed to meet future requirements on the one hand and to take account of the lack of time of decision-makers, managers, owners, experts and other employees of SMEs on the other.

The WIFI Steiermark has set itself the goal of initiating an innovative further education course

"Water Supply and Water Saving", which offers further education at the level of the European Qualification Framework (EQF) 5 (in Austria this corresponds to a completed

"Meisterabschluss") for the following target groups:

- The first target group are decision makers (i.e. owners, managers and experts) in the field of "installation and building technology", which would like to follow-up with a further education in this relevant field.
- The second target group comprises people in the environmentally related occupations, who want to broaden their knowledge. This includes people working in the field of environmental and also quality management.
- The third group comprises of industry employees, who want to further educate themselves, in order to gain applicable knowledge in their field of work. This group is not limited by any factor, as environmentally related educations will gain in importance in many, if not all sectors. Thus, spreading information and applying future trends can benefit all types of companies.

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The main objective of this curriculum is the further education of specialists, managers and entrepreneurs in the professions and industries of water supply and water conservation, e.g. installation and building technicians.

The objective is to impart knowledge in the field of water management with a focus on water supply and water saving, as well as to learn, test and discuss future challenges and sustainable solutions. This curriculum is part of a training programme for decision-makers (owners, managers), quality and environmental managers and professionals from SMEs.

Six different training courses in green technologies are included in the whole programme and are offered to trainees with vocational training and several years of professional experience to acquire skills in water, wastewater, waste and circular economy. The learning content thought are cross professional and are addressed at experts and interested companies from all sectors. The training of the individual courses is specially tailored to the needs of SMEs and different qualification levels. Furthermore, it combines the transfer of technical and professional expertise.

Decision makers (owners and managers) of SMEs are struggling with the task of combining training and work under great lack of time. Employees as well are exposed to the same situation, which prevents them from leaving their work for a longer period of time to attend trainings or further educations measures. Thus, this course is designed in a way so that employers and employees of SMEs have the opportunity to participate in this course without great loss of time or resources, but with a maximum in learning success. Furthermore, an additional benefit for SMEs is created by the fact that the teaching contents and qualifications offered, meet the qualification needs of the employees of SMEs and simultaneously take into account the specific requirements of the SMEs.

To better illustrate the potential of the target groups, current figures from the Austrian Federal Economic Chamber and Statistics Austria were used as sources.

In 2019, around 34,400 employees were working in the field of sanitary, heating and ventilation technology. The annual turnover was about 5,001 million euros. The production value was about 4,965 million euros. In 2018 there were 10,281 salaried employees, 20,562 workers and 3,554 apprentices working in this sector.[1]

1 http://wko.at/statistik/BranchenFV/B_111.pdf

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In 2017, 1,674,234 persons aged between 25 and 64 years out of a total of 4,903,139 persons in Austria completed an apprenticeship (this corresponds to EQF level 4).[2] In 2018, 14,272 people completed a master craftsman training course in Austria.[3]

A statistic that shows how many out of every thousand people participate in continuing education programs on an annual average.[4] 330 out of 1000 wage earners and 288.8 out of 1000 workers participated in training courses. In 2018, 15.1% of the population aged between 24 and 64 years participated in further training programmes.

These figures once again underline how people in Austria who are available and willing to participate in courses like the one described in this curriculum.

There are currently several university courses as well as other training opportunities in Austria and many more at European level that offer similar theoretical content to this course. However, as the entire study programme is a combination of theoretical and practical experience, only the training course for installation and building services technicians and sanitary, heating and ventilation technicians can be considered similar within Austria. However, these differ in that these training courses usually comprise entire courses of study and not individual qualifications, although the environmental aspect as offered in the overall programme is usually not offered in such a holistic way.

Chapter 1.5: Target Group

The first priority belongs to owners, management personnel and employees of small and medium-sized enterprises – basically from all branches. Generally, Business founders and potential business founders from all branches. Scientists and consultants dealing with economic questions and furtherance of SMEs during research and consulting. In addition, Students who are interested in preparing seminar and bachelor works related to C2C in SMEs or would like to work in SMEs after

2 http://statistik.at/web_de/statistiken/menschen_und_gesellschaft/bildung/schulen/reife-_und_diplompruefungen/index.html

3 http://wko.at/statistik/Meisterpruefung/Meisterpruefung2018.pdf

4 http://statistik.at/web_de/statistiken/menschen_und_gesellschaft/bildung/index.html

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completing their studies. People, who are temporarily unemployed and would like to improve their chance for employment through visiting the seminar.

Chapter 1.6: Competences Obtained

AWARENESS OF THE IMPORTANCE OF WATER SUPPLY	The candidate has an understanding of the importance of water supply and water conservation as well as their relevance to anthropogenic climate change and increasing their own competitive advantage in the market.
KNOWLEDGE OF TECHNOLOGIES AND LEGAL REQUIREMENTS IN WATER SUPPLY	The candidate has knowledge of measures and technologies for water supply and water saving as well as the international and national legal situation.
INDUSTRY KNOWLEDGE	The candidate has industry knowledge and future developments and requirements.
AWARENESS OF SOURCES WITHIN THE FIELD OF WATER SUPPLY	To give participants a basic knowledge of green economy and its benefits and challenges for an enterprise and business.
ABILITY TO DO RESEARCH WITHIN THIS FIELD	Candidates can update their expertise through literature, websites, courses, seminars and specialist literature as reports and mentors to organizations and agencies and through interaction with industry.
CONSCIOUSNESS OF THE RELEVANCE OF SUSTAINABLE WATER MANAGEMENT	Candidates understand the role of their own industry and the importance of working towards a sustainable water management.
COMPETENCES IN DESINGING/PLANNING SUSTAINABEL WATER MANAGMENT	The candidate can use his or her specialist knowledge to plan and design sustainable water management measures tailored to his or her sector.

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SOLUTION-ORIENTED SKILLS	The candidate will be able to design and describe sustainable water management measures with appropriate professional tools and to supervise technical solutions and methods in work related to water management and circular water use technologies

After successful completion the participants are able to carry out environmental relevant work and activities in the company relating to water management, wastewater, water supply and water conservation. The graduates can carry out evaluations and potentials of the company with regard to water supply and water saving. The course also serves as an introduction to other courses in the field of environmental management. Through further training, graduates can acquire the qualifications of waste management officer, environmental officer, internal and internal environmental management, quality management, environmental consulting and become active in these areas.

Chapter 1.7: Field of application

Typical Organization

Every company in the fields of water management, wastewater, water supply and water conservation as well as every company in the building and installation technology or sanitary sector.

Any company that wants to develop and train employees in these areas, so that these employees can take over the environmentally relevant work and activities in the company.

Typical Industries

At a global or European (Union) level: in addition to public institutions, typical industries dealing with water supply and saving as well as wastewater management are represented in all industrial sectors, such as construction, building services, installation engineering, sanitary services, etc.. In addition, the entire private and public water and wastewater management sector must be considered as a target group. Moreover, a considerable number of small and medium-sized enterprises of all types and forms of sectors and industries are in some way connected with water supply, water and wastewater management or water saving. However, typical branches of industry are all industries

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and company sizes as well as private households that want to optimize their water supply and water saving potentials.

Chapter 1.8: Course Duration

The duration of this course is measured in ECTS. One ECTS corresponds to 25 hours of work. In this course, the amount of work required is measured in lessons - one lesson corresponds to 50 minutes.

The entire course comprises 4 ECTS, which corresponds to a total of 100 hours or 120 lessons of workload. These 4 ECTS (or 100 hours) include every activity that needs to be undergone to finish the course, i.e. classroom-setting lessons, studying the content at home (self-study), preparing a seminar paper and presenting this paper to fellow peers.

In the case of an extra-occupational course of study, an annual load of 45 ECTS is assumed as the minimum duration of the study. This results in approximately 3.75 ECTS per month. As this course includes a case study in the form of a seminar paper, which is based on real-life working experience, the total duration of this course was set at three months.

The course is divided into three phases:

- The first phase will comprise of frontal teaching in a classroom setting, which takes place at the course venue and includes home-based e-learning of the presented content by the participants. The total amount for this phase is 60 lessons (i.e. 50 hours or 2 ECTS).
- The second phase comprises of executing a case study and writing a seminar paper about the company of the participant. This work or phase is supported by a trainer. This task will account for approximately 51 lessons (i.e. 42.5 hours or 1.7 ECTS).
- The third phase is again at the course venue, where the participants present their projects and exchange experiences and learned lessons. This will be about 9 lessons (i.e. 7.5 hours or 0.3 ETC) long.

Summarized, the total workload for this curriculum including classroom participation, selfstudy and the preparation and presentation of a seminar paper is 120 lessons, each corresponding to 50 minutes, which equals 100 hours or 4 ECTS.

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Chapter 1.9: Required Prerequisites

The access and admission requirements for this course are not as stringent as for other courses in the sector of further education. This is due to the fact that this course addresses a large target group and the imparted knowledge is very fundamentally oriented.

For this course "Water Supply and Water Saving" recommended previous knowledge, if available, includes knowledge of water management and wastewater. This also includes job-related experience or training-related experience in these areas.

Nevertheless, the following qualifications, among others, are required for the course and the associated subsequent activities:

- The course itself is classified on an EQF level 5. Therefore, a relevant education/qualification on EQF level 4 or 5 in a related field (e.g. building technology, sanitary management) is required.
- Several years of working experience in the field.
- Basic understanding of environmental issues and its impacts.

After completing this course and completing other related courses, participants will be able to apply the acquired knowledge in their companies. Skills include the creation of an operational water concept according to national and international regulations. Knowledge and tasks in the water sector will be just as familiar as the basics of wastewater management.

Chapter 2: Curriculum

The four modules of the course …

- Module I – "Introduction to Water Supply and Saving"
- Module II – "Water Supply"
- Module III – "Water Saving"
- Module IV – " Practical application and use cases"

…are taught in the form of classroom teaching and self-study. In the theoretical modules, consisting of the thirst three modules, the knowledge foundation for the seminar work to be written by the participants is established. All modules are characterized by theoretical lecture contents and tasks

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for independent self-study work. In this way, the practical relevance is placed in the foreground and an immanent examination of the teaching content can be guaranteed. Students acquire the 0.5 ECTS for the first module and 1 ECTS for the second and third module by attending the lectures and active participation, as well as by independently preparing and subsequently presenting the seminar, i.e. the project work.

Basic knowledge in the fields of natural sciences and water and wastewater as well as related topics, such as anthropogenic climate change, are integrated in modules I to III.

Module IV essentially consists of the preparation and execution of a case study in the participant's company. It is written by the participants in independent work and supported by the trainer via online tools. This module requires the most amount of work and is therefore worth 1.5 ECTS.

Module Number & Name	Content of the Curriculum		
I Introduction to Water Supply and Saving	In this module the basics of water management are taught. The different types of water and types of water extraction, different pumping systems, water in the context of climate change, etc. will be covered in this module in addition to the operational implications of water management. This module gives participants a general overview of the topic of water supply and water saving, including national, European and global challenges. In addition, national and international standards and regulations are dealt with and the relationship to the environment is addressed. Another issue addressed is the relevance for SMEs and, in a wider context, the challenges and opportunities of water management. The participants will integrate the contents into their seminar work.		
	ECTS: 0.5 Hours: 12.5 Lessons: 15	<u>Type of the course:</u> Integrated course consisting of lecture and self-study parts	<u>Type of Examination:</u> Seminar Paper (about the overall course and the contents of all modules)

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Course targets	The participants know the basic concepts of water supply and water saving on national and international as well as European level. Furthermore, the students know general measures for water supply in companies and especially in small and medium-sized enterprises.		
Recommended literature	European Commission on Water: https://ec.europa.eu/environment/water/index_en.htm European Commision Long Term Strategy 2050: https://ec.europa.eu/clima/sites/lts/lts_at_de.pdf European Commission on Drinking Water: https://ec.europa.eu/environment/water/water-drink/index_en.html European Commission Drinking Water Directive: https://ec.europa.eu/environment/water/waterdrink/legislation_en.html Prescott Folwell, A: Water-Supply Engineering: The Designing and Constructing of Water-Supply Systems / Amory Prescott Folwell - Palala Press; ISBN: 978-1357131302 Ludwig, A: Water Storage: Tanks, Cisterns, Aquifers, and Ponds for Domestic Supply, Fire and Emergency Use / Art Ludwig - Oasis Design; ISBN: 978-0964343368 Haidenbauer, H; Winkelbauer, G: Gas- und Sanitärtechnik: Installations- und Gebäudetechnik / Jugend & Volk, 2010; ISBN: 978-3-7100-3233-2 Albers, K-J: Recknagel - Taschenbuch für Heizung und Klimatechnik / ITM InnoTech Medien, 79. Auflage, 2019/2020; ISBN: 978-3-96143-077-2		
II Water Supply	In this module the area of national and European water supply is taught. In addition to the operational effects of water supply, the different types of water and wastewater as well as different pumping systems are dealt with. The water supply in an SME environment is dealt with and the possibilities of what can be used in the field of water technology are taught. This module gives participants a general overview of water supply, including national, European and global challenges and regulations. In addition, the topic of drinking and hot water, as well as the relationship to the environment, will be covered. Another topic addressed is the relevance and positions for SMEs and the relationship of water management to the environment. The contents will be integrated by the participants in their seminar work.		
	ECTS: 1	Type of the course:	Type of Examination:

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	Hours: 25 Lessons: 30	Integrated course consisting of lecture and self-study parts	Seminar paper (about the overall course and the contents of all modules)
Course targets	The participants know the basic concepts of water supply on a national and international as well as on a European level. This includes the different types and types of water, pumps and supply options as well as their potentials. In addition, the participants know measures for water management in companies and especially in small and medium-sized enterprises with an applicable approach.		
Recommended Literature	European Commission on Water: https://ec.europa.eu/environment/water/index_en.htm European Commision Long Term Strategy 2050: https://ec.europa.eu/clima/sites/lts/lts_at_de.pdf European Commission on Drinking Water: https://ec.europa.eu/environment/water/water-drink/index_en.html European Commission Drinking Water Directive: https://ec.europa.eu/environment/water/waterdrink/legislation_en.html Prescott Folwell, A: Water-Supply Engineering: The Designing and Constructing of Water-Supply Systems / Amory Prescott Folwell - Palala Press; ISBN: 978-1357131302 Ludwig, A: Water Storage: Tanks, Cisterns, Aquifers, and Ponds for Domestic Supply, Fire and Emergency Use / Art Ludwig - Oasis Design; ISBN: 978-0964343368 Haidenbauer, H; Winkelbauer, G: Gas- und Sanitärtechnik: Installations- und Gebäudetechnik / Jugend & Volk, 2010; ISBN: 978-3-7100-3233-2 Albers, K-J: Recknagel - Taschenbuch für Heizung und Klimatechnik / ITM InnoTech Medien, 79. Auflage, 2019/2020; ISBN: 978-3-96143-077-2		
III Water Saving	In this module the area of national and European water saving is taught. In addition to the operational effects of water supply and water saving, the different types of water and wastewater as well as different pumping systems are dealt with. Water saving in an SME environment will be dealt with and the possibilities of what can be used in the field of water technology will be		

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<table>
<tr><td></td><td colspan="3">communicated. This module gives participants a general overview of water saving, including national, European and global challenges and regulations. In addition, the topic of drinking and hot water, as well as the relationship of water saving to the environment, will be covered. Another topic addressed is the relevance and positions for SMEs and the relationship of water management to the environment. The participants will integrate the contents into their seminar work. The contents of the first module will be extended and used. This includes both theoretical and operational water management at national and European level. Different technologies and their potentials are addressed with the focus on water saving. The contents are oriented towards the applicable use in the operational and medium-sized environment and the possibilities are conveyed which technologies and potentials can be used. Furthermore, real use cases are demonstrated in order to prepare the participants for their own seminar work with practical examples. Another topic is the relevance, opportunities and positions for SMEs and, in a wider context, the challenges and opportunities of water saving for the environment and the economy. The participants will integrate the contents into their seminar work.</td></tr>
<tr><td></td><td>ECTS: 1
Hours: 25
Lessons: 30</td><td><u>Type of the course:</u>
Integrated course consisting of lecture and self-study parts</td><td><u>Type of Examination:</u>
Seminar paper (about the overall course and the contents of all modules)</td></tr>
<tr><td>Course targets</td><td colspan="3">The participants are familiar with different technologies and concepts of water saving at national and international as well as European level. Special emphasis is placed on different technologies. The different types and modes of water saving and their potential for SMEs and enterprises will be discussed. In addition, the participants are able to create concepts for their own company (by examining use cases) and can evaluate their own water management in the company.</td></tr>
<tr><td>Recommended Literature</td><td colspan="3">European Commission on Water:
https://ec.europa.eu/environment/water/index_en.htm</td></tr>
</table>

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	European Commision Long Term Strategy 2050: https://ec.europa.eu/clima/sites/lts/lts_at_de.pdf Prescott Folwell, A: Water-Supply Engineering: The Designing and Constructing of Water-Supply Systems / Amory Prescott Folwell - Palala Press; ISBN: 978-1357131302 Ludwig, A: Water Storage: Tanks, Cisterns, Aquifers, and Ponds for Domestic Supply, Fire and Emergency Use / Art Ludwig - Oasis Design; ISBN: 978-0964343368 Jean Olien, R: Saving Water (Water in Our World) / Rebecca Jean Olien - CAPSTONE PR; ISBN: 9781491482834 Haidenbauer, H; Winkelbauer, G: Gas- und Sanitärtechnik: Installations- und Gebäudetechnik / Jugend & Volk, 2010; ISBN: 978-3-7100-3233-2 Albers, K-J: Recknagel - Taschenbuch für Heizung und Klimatechnik / ITM InnoTech Medien, 79. Auflage, 2019/2020; ISBN: 978-3-96143-077-2		
IV Practical Application and Utilization	This module gives the participant the final instruction for their own seminar paper. The contents of the first three modules are revised and enhanced by using specific use cases. The contents are oriented on applicable utilization in a company and SME setting and the opportunities of which technologies and potentials can be used in the companies of the participants. This module gives the participants all required information for the preparation of their seminar paper.		
	ECTS: 2 Hours: 50 Lessons: 60	Type of the course: Integrated course consisting of lecture and self-study parts	Type of Examination: Seminar paper (about the overall course and the contents of all modules)
Course targets	The participants have the necessary knowledge and skills to write a seminar paper on the potentials of water supply and water saving in their own company or on an illustrative example. This seminar paper is at the same time the final paper of the course and is presented by the participant to the other participants in a classroom session.		

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Recommended Literature	See "Recommended Literature" of Module I, Module II and Module III

Chapter 2.1 Speakers & Trainers

This part is filled out by the performing institute.

Name:	
Title:	
E-Mail Address:	
Telephone:	

Training and additional qualifications:

Current professional activity:

Previous teaching activities:

Publications (if applicable):

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Chapter 2.2.: Requirements for the trainer's qualification:

The competences of the trainers are broadly diversified and cover the fields of water, installation technology, building services engineering, energy, environment, legal areas such as environmental law, plant and commercial law, employee protection as well as quality and environmental management and communication.

As the further training course "Water Supply and Water Saving" is to be very company-related and implementation-oriented, lecturers with high practical relevance and lecturers with high scientific competence will be used.

Areas such as legal compliance, costs, energy, environmental indicators, handling of wastewater, water and sewage use, internal communication, etc. convey the scientific basics and are presented by qualified persons from the further education sector.

Chapter 2.3: Testing of the competence Level

The course and examination regulations of the applicable institution apply.

The performance assessment in the classroom courses is based on the attendance of modules I, II and III, while module IV concludes with a project work (seminar paper) of the students. In this project work (seminar paper), the application of the learned concepts and methods to cases from the professional practice of the students is in the foreground.

The composition of examination commissions as well as repetition possibilities are regulated in the course and examination regulations of the applicable institution.

Chapter 2.4: Access Requirements and Admission

The access and admission requirements for this course are not as stringent as for other courses in the sector of further education. This is due to the fact that this course addresses a large target group and the imparted knowledge is very fundamentally oriented.

For this course "Water Supply and Water Saving" recommended previous knowledge, if available, includes knowledge of water management and wastewater. This also includes jobrelated experience or training-related experience in these areas.

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After completing this course and completing other related courses, participants will be able to apply the acquired knowledge in their companies. Skills include the creation of an operational water concept according to national and international regulations. Knowledge and tasks in the water sector will be just as familiar as the basics of wastewater management.

Chapter 2.5 Quality assurance

The quality assurance of the course "Water supply and water saving" will be integrated into the existing quality assurance system of WIFI Styria. In addition, extensive tests and evaluations by third parties will be carried out before the official start of the course. Furthermore, the management will attend the courses at random.

Finally, each classroom course is evaluated by the course participants with the help of anonymous evaluation sheets with regard to content and communication of the course contents. These evaluations are continuously incorporated into the improvement of the course.

Chapter 3: Teaching Material

1 Water collection

There is enough water on earth. However, only 1% to 2% can be used as drinking water supply. The EU ensures that tap water is safe to drink throughout the Union.

There are also regional differences in the size of the deposits. As in many other regions of the world, concerns about water scarcity and shortages are increasing in Europe as the risk of droughts due to climate change is rising. About 80% of Europe's freshwater use (for drinking water and other uses) comes from rivers and groundwater, making these sources extremely vulnerable to risks from overuse, pollution and climate change.

For some countries, like Austria, there is no (drinking) water shortage. Fifty percent of drinking water is obtained from spring water, 49% from groundwater and only 1% from surface water.

1.1 Groundwater collection systems (wells)

It is differentiated between:

- Pile-Driven well

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- Shallow, Dug or Shaft well
- Drilled well (Vertical well)
- Horizontal well

Pile-Driven Well can only be driven in sandy, loose soils, for shallow depths (up to approx. 7 m) and low delivery rates, e.g. in allotment gardens. A finely slotted pipe section with a ram tip is screwed onto the lower part of the suction pipe.

A driven well is constructed by placing the tip of the well in the ground. This is filled with salt to prevent soiling of the pores by penetrating soil. Then a 5/4" threaded pipe is galvanized, seamlessly screwed on and the top of the well, together with the threaded pipe, is knocked into the ground while rotating.

The hammering is done with a 10 kg hammer or a device with weight mounted on the pipe. Once the water-bearing soil layer has been reached, a hand pump is attached, and the well is "ringed out". The surrounding sand of the soil is pumped up by the ringing and a hollow space is created at the top of the well. Afterwards a head water-domestic waterworks can be built. A sand filter is necessary in the suction line.

The use of such well systems is usually only appropriate for allotment gardens, garden irrigation etc. Single-family houses should not be connected to such systems, as the amount of water is too small, or the water level can fluctuate strongly according to the season.

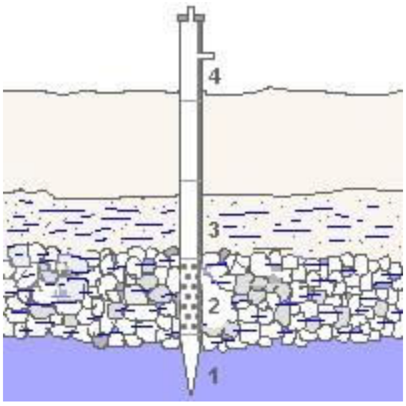

Figure 1: Pile-driving well tip; Picture by: Roland Bergmann

Shallow, Dug or Shaft well used to be dug (substructure method) or laboriously driven into rocky ground and then covered with bricks or stones as required. Today they are erected using the lowering method (precast concrete rings). They can be found with diameters from about 80 cm to a maximum of 250 cm. The concrete rings are placed on the ground and then the underlying soil is dug up. The weight of the concrete ring causes it to sink into the ground. At ground level the next ring is put on.

Figure 2: Walled shaft well; Picture by ThomasWolter at Pixabay.com

Figure 3: Shaft well; Picture by RitaE at Pixabay.com

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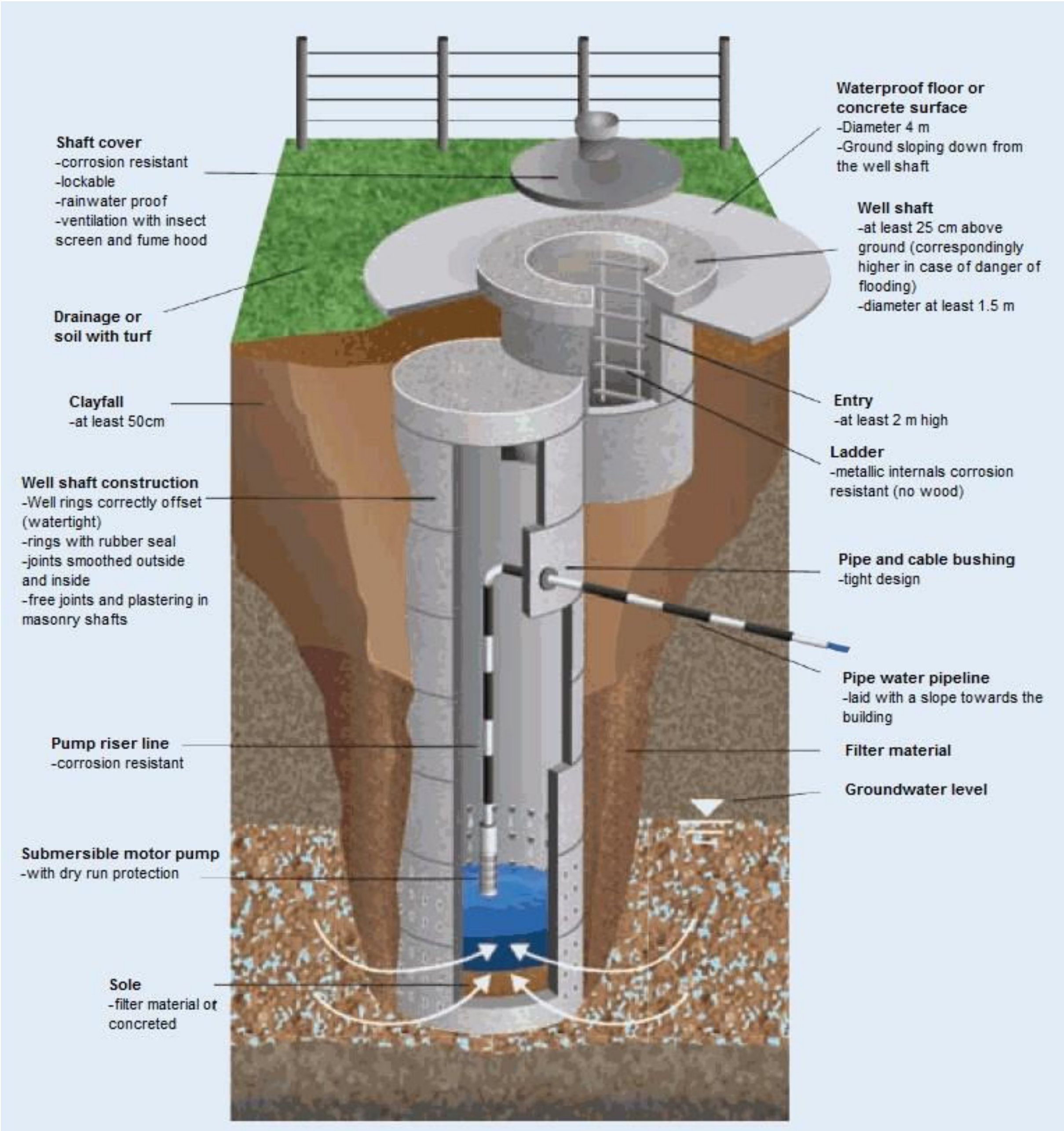

Figure 4: Shaft well; Source: Umweltbundesamt.de

Drilled wells can be drilled to great depths in any soil type. In loose soils, the drill pipe is left in the well. Below the groundwater-level, the borehole or production pipe is slit in each groundwater-level floor, if necessary. A gravel pack is usually placed around this filter pipe.

With today's drilling technology, drilled wells can be drilled not only vertically (vertical), but also laterally (horizontal) at greater depth.

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In horizontal wells, from a larger shaft, seepage and filter pipes are driven horizontally in a star shape up to 100 m into the water-bearing layer. During operation, the well shaft serves as a collection shaft for the ground water.

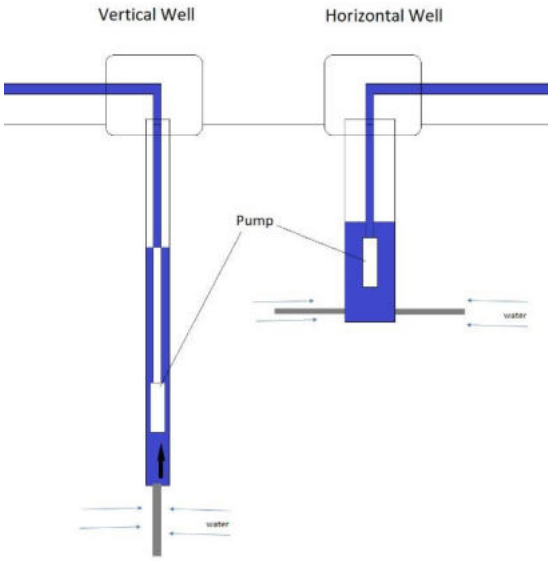

Figure 5: Drilled well / Vertical- & Horizontal filter well; Source: self-drawn

Drill-pipe Diameter

The total clear diameter of the hole. This must be larger than the filter tube diameter. Since the drill pipe must be lowered into the hole, the hole should be a few centimeters larger.

- DN 80 = 88mm outer diameter of the pump + 2x50mm Gravel pack =188mm Drill pipe diameter: Here better 200mm drill diameter
- DN 115 = 125mm outer diameter of the pump + 2x50mm Gravel pack =225mm Drill pipe diameter: Here better 250mm drill diameter

Groundwater Level

The filter tube area must be installed so deep that the stagnant groundwater level is about 23 meters above the upper end of the filter tube area. During pump operation, the groundwater level drops so that the filter tube area can run dry. This is prevented by a sufficiently high groundwater cover. For safe operation, the filter tube area should be located as deep as possible below the groundwater surface in suitable soil conditions.

The fluctuating groundwater level should also be taken into account when calculating the drilling depth, because in spring the groundwater level can be about 2 meters higher than in summer.

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Well Pump

The pump should be installed approx. 0.5 meters above the filter tube area. The pump must not be installed in the filter tube area, as the filter tube area is clogged by the punctual suction of the pump.

The rising water from the filter pipe area to the pump also cools the motor located under the inlet part of the pump. The pump should have a groundwater cover of at least 1 meter in each operating area (lowered groundwater level).

Dummy Tube

The dummy tube consists of an approximately 0.5-1-meter-long solid tube, which is closed at the bottom with a cap. Fine sand components accumulate in the dummy pipe during the course of operation; therefore, it should be rinsed out once a year.

1.2 Use of well systems

Shaft wells are built almost exclusively for private purposes. A too small well depth (shallower than 8 m) should be avoided because of the fluctuating water quality.
The sole of the shaft, where the water flows in, should be provided with a layer of gravel to ensure filtration. The well shaft should be covered so that no surface water can penetrate. An aeration and ventilation hood must be provided.

Driven wells can only be used for secondary purposes (garden irrigation etc.). Water is pumped from a depth of 5-7 m, usually by means of a hand pump.

Drilled well are used both for private purposes and for water supply companies. Drill diameters depending on requirements and use from 200 mm to 2000 mm.

Horizontal filter wells are used by water supply companies and industry.
The well shaft is used for storage and is sealed at the sole. The water enters the well shaft through the horizontal perforated pipes arranged in a star shape around the shaft.

1.3 Spring tapping

The spring tapping has the task of catching the water of the spring, delivering it to a water reservoir and subsequently to a supply line.

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A spring tapping consist of:

- Spring tapping
- Spring chamber

One or more pipes, which must hold the maximum bulk quantity in order to avoid backwater, lead from the spring tapping to the spring chamber.

The spring chamber should be equipped with the following facilities:

- **Extraction line**: should not be installed at the lowest point because of the alluvial sand and should be equipped with an inlet screen.
- **Overflow:** must be designed for the max. bulk quantity to prevent overflow or backwater. The overflow ends in the emptying pipe.
- **Emptying:** is pulled together with the overflow and has a frog flap at the end to prevent small animals from entering.

If a source is to be used for a central drinking water supply, it must be provisionally set so that preliminary investigations can be carried out.

These consist of:

- Measurement of the spring bulk density (l/s)
- Measurement of the water temperature
- Unadulterated taking of water samples for chemical and bacteriological water tests.

The measurements must be carried out regularly over a longer period (at least 1 year), and the precipitation must be recorded at the same time.

If, based on the preliminary investigations, a spring is suitable as drinking water supply; it must be dug out for hygienic reasons to such an extent that the catchment has an overburden of more than 3 m. During the excavation work, the spring exit points are dug out. Injury to impermeable bottom layers must be avoided at all costs (no blasting).

The capture system of a spring consists of:

- water catchment (spring tapping) and
- collecting shaft (spring chamber)

The water catchment of a strata spring is carried out in such a way that filter pipes with a gravel pack are placed in front of a retaining wall (concrete or clay). All excavations must be covered with loam or clay and securely protected against the penetration of surface water.

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The collection shaft serves to accommodate the necessary armatures and operating equipment. It must be erected at an appropriate distance from the spring intake so that the spring intake is not affected by the construction work and no backwater enters the spring intake.

1.4 Summary

Water resources should be selected so that they naturally meet the requirements in terms of quantity and quality. For drinking water purposes, the hygienic quality is always decisive and not the costs for the construction and operation of the plant.

Depending on the intended use, a distinction is made between drinking water and process water.

Drinking Water: Water that is directly suitable for human consumption for hygienic and aesthetic reasons.

Process Water: This refers to water that must meet different minimum requirements depending on its intended use (depending on whether it serves as a raw material or is needed for production, cleaning, washing or cooling).

Water extraction: Depending on occurrence, water demand and intended use via well systems (driven wells, shaft wells, drilled wells, horizontal filter wells) Spring catchments of (stratified, dammed, discharged) surface water from reservoirs, rivers and streams.

Water treatment: Depending on the nature of the water (hard water, acidic water, contamination, etc.)

- Filter systems (dirt filtering, suspended particles)
- Softening plants (lime)
- Purification of manganese, iron, sulphates etc.
- De-acidification
- Disinfection (chlorine, ozone, UV radiation)

Water demand:

- Current water demand
- Future water demand (assessment period, service life)
- Fluctuations in water demand (seasonal, changes in living standards)

2 Pump Systems

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2.1 Physical basics for water extraction with pumps

Groundwater and surface water from the depths are extracted by means of pumps. When water is sucked in by pumps, the air pressure plays a major role.

It weighs on the water level with about 1 bar = 10 N/cm2.

This pressure keeps a water column of about 10 m in height in equilibrium.

This results in a theoretical suction height of approx. 10 meters. This is reduced by the pump design, the friction losses and the temperature of the fluid to be sucked. This results in a practical pumping height of approx. 7.5 meters.

Pumps can be classified or assigned to each other according to various aspects:

- According to the fluid to be pumped (water, oil, steam, gases, etc.)
- According to the working principle (displacement, suction)

2.2 Parameter of the pumps

Volume flow $\dot{\boldsymbol{V}}$

In pump systems, in most practical cases the flow can be regarded as incompressible, i.e. the density as constant. Instead of mass flow, the term volume flow is therefore usually used in practice.

The symbol used is $\dot{\boldsymbol{V}}$, the unit used is m^3/h or l/s.

$$Volume\ flow = \frac{Volume}{time} \quad \frac{Mass\ flow}{time} =$$

At a density of 1 kg/dm^3 the volume flow can be equated with the mass flow.

Delivery head H

The delivery head H of a pump is the difference in pressure between the pressure side and suction side of a pump. In practice, the delivery head for pump diagrams is given in meters (m).

Performance P

The power of a pump is the power absorbed at the impeller shaft. This is comprised of the volume flow, the delivery head, the total efficiency, the density of water and the acceleration due to gravity. or:

$$P = \frac{Q * \rho * g * H}{\eta}$$

$$Q * \rho * g * H \quad \left[\frac{m^3}{s} * \frac{kg}{m^3} * \frac{m}{s^2} * m = \frac{kgm^2}{s^3} = W\right]$$

$$1N = \frac{kgm}{s^2} * m = 1Nm \rightarrow \frac{kgm}{s^2} * \frac{1}{s} = \frac{kgm^2}{s^3} \rightarrow 1\frac{Nm}{s} = 1W$$

Q ❼ Volume flow

□❼ Density

g ❼ Acceleration of gravity

H ❼ Drop height

□❼ Efficiency

Example:

Volume flow 4.5 m^3/h at 4 bar pressure, efficiency 75

Wanted: electrical connection

(Solution: P = 6,667 Watt)

2.3 Classification of pumps

Centrifugal Pump

Centrifugal pumps are used in the installation sector:

- in the public water supply for the extraction and transport of water, even over long distances,
- for own water supply and pressure boosting systems,
- as circulation pumps for hot water systems,
- as circulation or storage charging pumps in heating systems

Centrifugal pumps have an impeller and, depending on the design, a vane-wheel or a starwheel. Pressure within pump is generated, when at large revolutions, water is hurled outward based on centrifugal forces. The advantage of centrifugal pumps is that they provide steady water flows.

The following is important for the function of centrifugal pumps:

- All centrifugal pumps must be filled with water before initial operation.
- With all headwater pumps, a foot valve must be installed at the foot of the suction pipe so that no water from the pump flows back into the well.

The function of the **foot valve** is to keep the water in the suction pipe when the pump is stopped. Its sieve keeps coarse sand away from the suction line and acts as a backflow preventer. At the lowest water level, it should still be 30 cm in the water in order to make it impossible for air to penetrate.

Centrifugal pumps are differentiated according to:

The Suction	**the number of wheels**	**according to the installation situation**
- Normal-suction pump	- single-stage	- Headwater pumps
- Self-suction pumps	- multi-stage	- Underwater Pumps

Furthermore: Wet and dry runners (glandless and gland)

Self-suction pumps have a star wheel, which is arranged eccentrically (outside the center) in the circular housing. When the impeller turns, a water ring is created at the housing wall, between the vanes at first ever larger cavities are formed, so that suction is created there and liquids, gases, or their mixtures are sucked in. When the gaps are reduced, pressure is created which forces the medium out of the pressure joint.

Self-suction pumps achieve high heads, but only low flow rates. Their efficiency is lower than that of normal-suction pumps.

Single-stage pumps (spiral housing pumps) have one impeller.

They convey large water flows and reach pressure heads of up to 100 m.

Multi-stage pumps have several impellers connected in series and separated by fixed guide walls; they could be regarded as several pumps connected in series on a one drive shaft. Their channels direct the water flow from the outside to the inside in order to lead it to the next stage.

Depending on the number of stages, very high delivery heads can be achieved. With multistage pumps, only the first stage at most is self-suctioning.

Headwater pumps are mounted up to about seven meters above the water level.

Underwater motor pumps are installed below the water level in the well. Motor and pump sit on a wave one above the other in a housing. The pump is suspended from the pressure pipe and lowered into the well pipe. The motor must not sit on the sole of the well. The lowest water level of the well must be 20 cm above the inlet of the pump. The electrical supply line is attached to the pressure pipe. No drag may be exerted on it.

Underwater motor pumps can be discharged into drilled wells with diameters from 80 mm.

They work very economically and replace the deep-suction devices used in the past for great water depths. They are used:

- always for suction heights greater than 7 m
- at suction heights < 7 m due to their good efficiency and quiet running

The water-cooled motor is located underneath the actual pump. There is also a membrane tank underneath, which absorbs the cooling water that expands when heated during operation.

The individual impellers are mounted on the extended motor shaft in their step housing. Water flows through a sieve of the inlet openings into the pump. Each impeller feeds it with pressure to the impeller above. This increases the pressure from stage to stage.

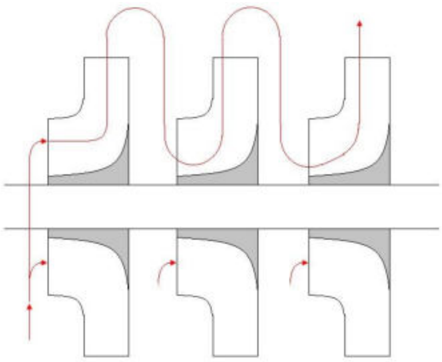


Figure 6: Stages of an underwater pump; (self-drawn) **Impeller form:**

Depending on the size of the flow rate and the rotation speed, a characteristic impeller shape results when striving for optimum efficiency.

There are various impeller shapes of centrifugal pumps:

- High pressure impeller
- Medium pressure impeller
- Low pressure impeller
- Helical impeller
- Propeller impeller

Depending on the shape of the pump impeller, an additional distinction is made:

- Radial pump
- Axial pump

With **radial pumps,** the water is flung outwards.

In **axial pumps** (propeller pumps), the water is pumped through the impeller in axial direction, similar to the air in aircraft propellers. They have the highest speed and are suitable for high flow rates at low head.

Today, centrifugal pumps, especially radial pumps, represent the predominant number of pump designs for pumping liquids. Besides cold and hot aqueous liquids, centrifugal pumps also pump viscous media.

Special designs are suitable for conveying aggressive substances.

Advantages:

- Almost uniform delivery without periodic fluctuations in flow rate and head
- high reliability, as there are no oscillating components and valves
- high rotational speeds allow direct coupling with electric motors
- the high rotational speed results in small machine dimensions
- low operating and maintenance costs

A characteristic feature of **centrifugal pumps** is the relationship between:

- Flow rate $\dot{V}$
- Delivery pressure Δp
- Motor performance P

If the flow rate changes, the delivery pressure also changes.

This relationship is shown in the **pump characteristic curve (throttle characteristic curve)**. They can be used to determine the respective operating point of a pump. They can be used to determine the respective operating point of a pump. The operating point is a point on the characteristic curve that indicates the delivery pressure at a given flow rate and vice versa.

The pump characteristic curve is determined by the pump manufacturer by means of tests.

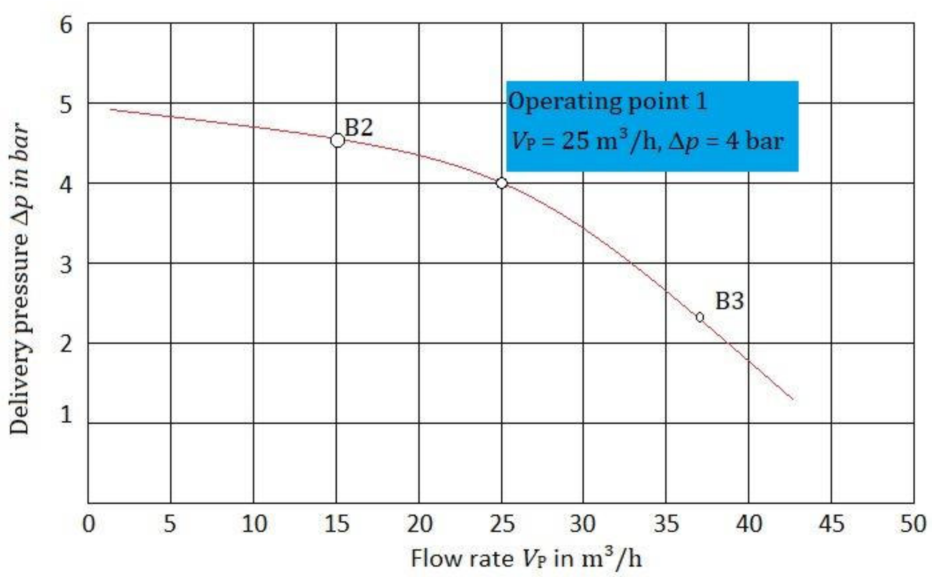


Figure 7: Pump characteristic curve; (self-drawn)

The **system curve** can also be referred to as the pipe curve. It shows the relationship between flow rate V and pressure head loss of a system.

The system curve is different for each system. It depends on the pipe material, on the most unfavorable pipe length, on the flow rate depending on the dimensioning and on the geodetic height.

Since the resistances in a pipe network increase fourfold with double the flow rate, the system curve is a parabolic curve.

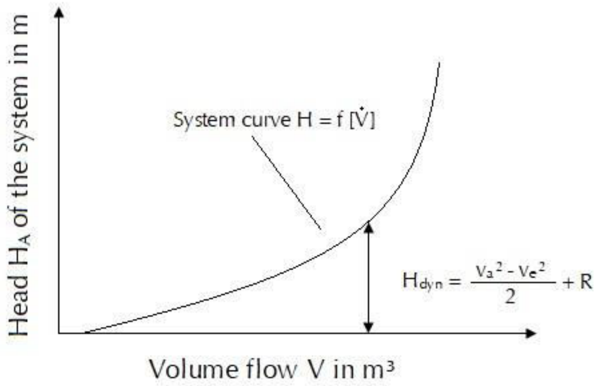


Figure 8: System curve; (self-drawn)

The **operating point** is determined by superimposing a system curve and a suitable throttling curve. The point of intersection of both curves is called operating point. If the resistance or the flow rate in the system changes, the operating point also changes. This means that the system curve moves along the throttle curve.

To determine the operating point, the volume flow and the pressure loss of the system must therefore be calculated. Only with this information can a suitable pump system be selected.

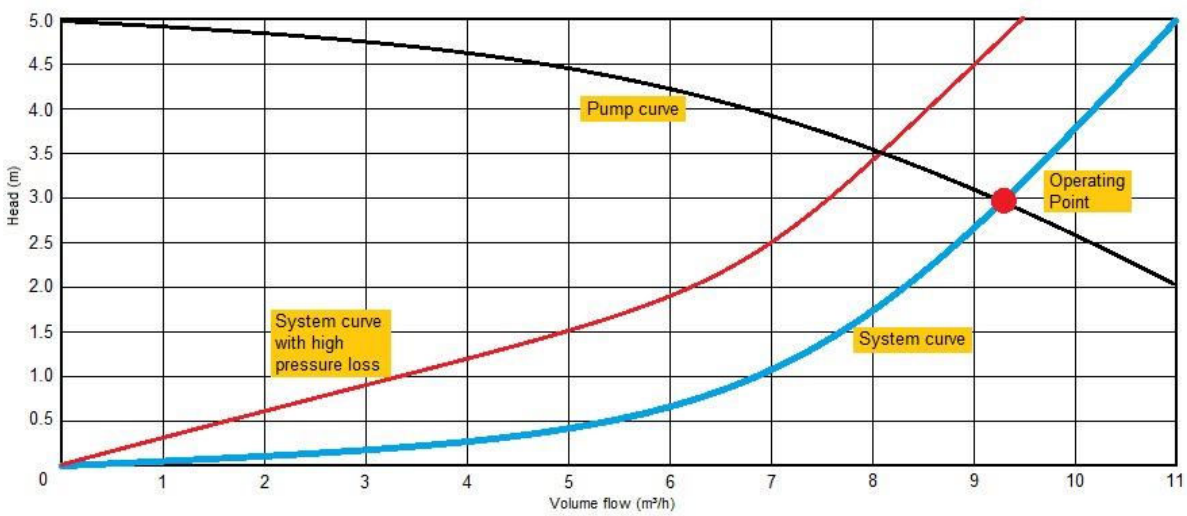


Figure 9: Determination of the operating point; (self-drawn)

2.4 Combination of pumps

If necessary, pumps can also be interconnected in a combination.

Depending on whether the delivery head or the flow rate is to be increased, water pumps can be connected in parallel or serially.

Analogous to the battery combination in electrical engineering, the pressures add up when connected in series and the volume flows when connected in parallel.

SERIES CONNECTION ❼ PREASURE INCREASE

PARALLEL CONNECTION ❼ VOLUME FLOW INCREASE

Connecting one behind the other (series connection)

Every multistage centrifugal pump consists of individual stages connected in series, which are combined in a shared housing.

They could therefore be replaced by series connection of several individual centrifugal pumps.

As with multi-stage designs, when individual pumps are connected in series, the pressure heads belonging to the same flow rate add up.

The total throttle curve of the series connection is therefore obtained by additive superposition of the throttle curves of connected individual machines in ordinate direction

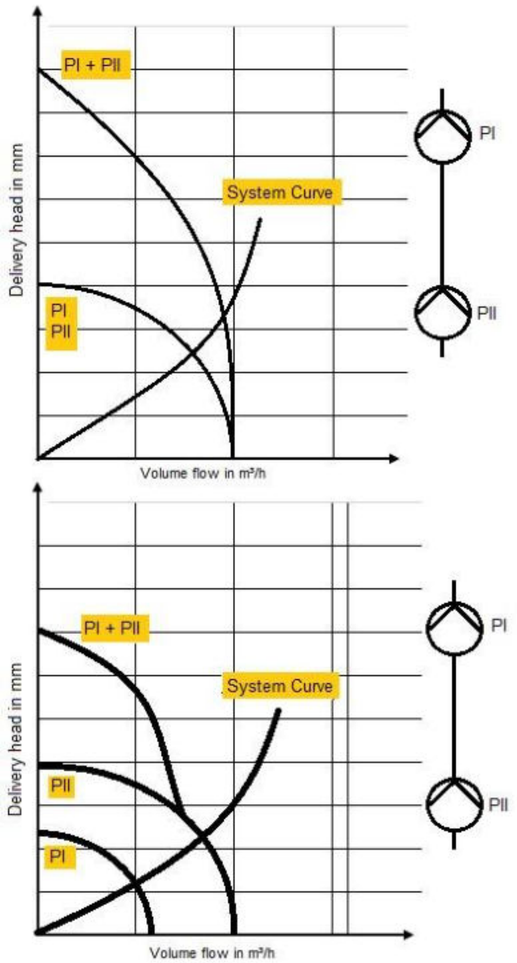


Figure 10: Series connection, (self-drawn)

The picture shows the series connection of two pumps, both identical (picture above) and different pumps (picture below). The pictures confirm that it is advantageous to connect only the same pumps in series. At one point, pump PI acts as flow resistance (negative head); pump PI must be overcome by pump PII.

Connecting next to each other (parallel connection)

For pump systems with highly fluctuating flow rates, it is advisable to arrange several pumps connected in parallel. While only one pump operates at low flow rates, additional pumps are switched on as the flow rate increases. All pumps feed into a common discharge line, but each of them has its own suction line.

The characteristic curves of the individual pumps can be quite different, but cooperation is only problem-free if all pumps have a stable characteristic curve with the same zero delivery head. If several pumps deliver into a common discharge line, they must apply the same pressure and the sum of the individual flow rates results in the total flow.

The total throttle curve of the parallel connection is therefore obtained by additive superposition of the cooperating individual pumps. This means that the volume flows belonging to the same head must be added together.

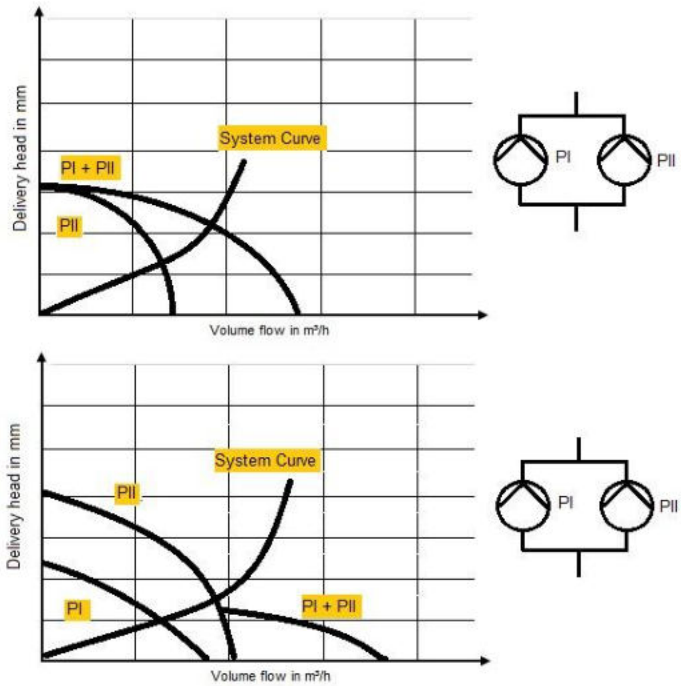


Figure 11: Parallel connection, (self-drawn)

The picture shows the principle of parallel connection of two pumps. For pumps with different throttle curves, the total throttle curve shows a kink.

If not secured by non-return valves, the weaker pump, in this case PII, even flows backwards, i.e. against its delivery direction. Therefore, as required for series connection, only identical pumps should operate in parallel if possible.

Parallel connection produces more flow, but this must be purchased with a higher power requirement.

Glandless pumps: Rotor and stator windings are separated by a motor can. This design results in very small pump dimensions. The pumps are maintenance-free and glandless. The most common applications of these pumps are circulation pumps for heating systems (single-stage radial pumps) and underwater pumps.

The motor of these pumps is cooled by the medium to be pumped. They generally consist of a pump housing, impeller, rotor, motor shaft, electric motor, terminal box, and a ventilation screw.

Gland pumps or process pumps:

These are larger pump systems, in which the motor and pump are no longer placed in one housing. The motor is connected to the pump via a shaft. The individual parts are mounted on a base plate, whereby the shaft is interrupted with a coupling. The shaft is sealed by the pump housing with gland packing or with a mechanical seal.

The fields of application of such pumps are e.g. industrial water, cooling water, fire extinguishing systems and many more. The motor is cooled by air-cooling.

Cavitation:

Cavitation can cause major problems with centrifugal pumps. This means the sudden appearance of steam bubbles on the suction side of the rotor blade.

If the static pressure of a flowing liquid is lowered below the vapor pressure (dependence of the evaporation temperature on the air pressure), vapor bubbles form. These implode on the pressure side of the rotor blade (sudden pressure increase) and can thus considerably disturb a continuous flow. Damage to the rotor blade also occurs.

The lower the pressure in the system, the lower the temperature of the pumped medium.

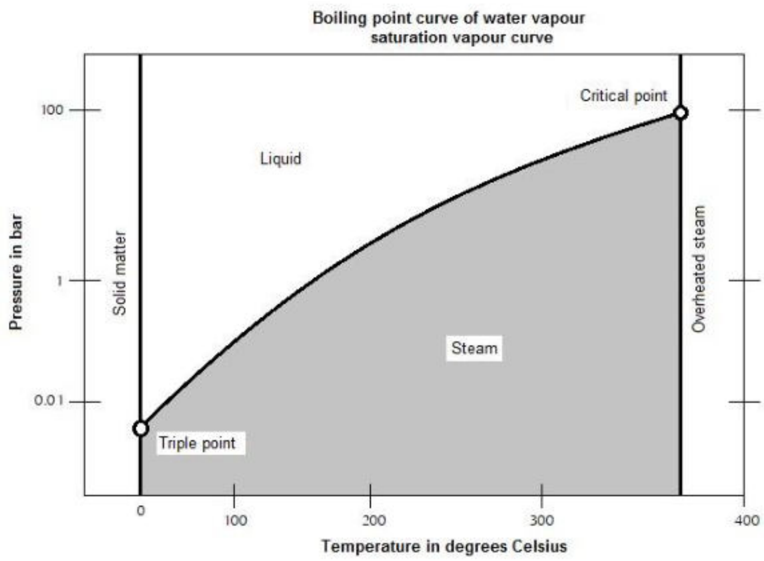


Figure 12: Vapor pressure curve **N**et

Positive **S**uction **H**eat **(NPSH) Value:**

In addition to the main selection criteria for pump selection (flow rate and head), the NPSH value specified by the manufacturer should not be ignored. It indicates the pressure level, which must not fall below on the suction side.

2.5 Displacement pumps

Classification:	**Most frequent use for:**
Piston pumps	Domestic waterworks
Semi-rotary pumps	Hand pumps directly mounted on driven wells, Fuel pumps
Membrane pumps	Sewage pumps
Gear pumps	Oil pumps (oil burners)
Jet pumps	Jet pumps as deep suction device Injectors (for pumping in e.g. gravity heating) Ejectors (for sucking out e.g. thermal water)

Since these types of pumps do not play a role in public water supply, they will not be discussed further.

3 Applicable Standards and Regulations

The following shows excerpts of standards and regulations that must be observed when planning water-heating systems. *Note*: Some Austrian Standards (ÖNORM) are based on European Norms (EN). A DIN standard is a voluntary standard developed under the direction of the German Institute for Standardization. The ÖNORMS, which do not include an "EN", are Austrian national standards. For other (EU)-countries, other standards may apply. If not, the Austrian standards can be seen as illustrative example.

EN 806 and ÖNORM B5019	Hygiene-relevant planning, execution, operation, maintenance, monitoring and rehabilitation of central drinking water heating systems
ÖNORM H5151	Planning of central hot water heating systems with or without hot water preparation
ÖNORM EN12828	Heating systems in buildings - Design of hot water heating systems
ÖNORM EN12831-3	Energy performance of buildings - Part 3 Dimensioning of domestic hot water systems
ÖNORM EN12977	Solar thermal systems and their components
ÖNORM EN13203	Solar assisted gas-fired appliances for domestic hot water supply - appliances not exceeding a nominal heat load of 70 kW and a storage capacity of 500 litres of water
ÖNORM H7701	Solar thermal systems - Approximation method for the design of flat plate collectors in hot water installations
DIN EN15332	Boilers - Energetic evaluation of hot water storage systems
ÖNORM EN12897	Water supply - Determination of indirect heated, non-ventilated storage water heaters

DIN 1988	Technical rules for drinking water installations
DVGW W 553	Dimensioning of circulation systems in central drinking water heating systems
DIN EN 1717	Protection of drinking water against contamination in drinking water installations and general requirements for safety devices for the prevention of drinking water contamination by back tiling
DIN 4708	Central water heating systems
EU Drinking Water Directive	The Drinking Water Directive (Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption) concerns the quality of water intended for human consumption. Its objective is to protect human health from adverse effects of any contamination of water intended for human consumption by ensuring that it is wholesome and clean.

4 General Information on Drinking/Domestic Water Heating

Nowadays, hot water for showering and bathing has become a standard feature, especially in the private households. However, the relative share for domestic hot water heating is constantly increasing due to the legally decreasing building heat demand. Under further consideration of the legitimate comfort requirements of the users, careful planning and design of a drinking water heating system that satisfies economic and hygienic aspects is therefore of particular importance.

The user of a system expects hot water

- anytime,
- in sufficient quantities and
- with desired temperature,
- hygienically perfect water is available.

In addition to these requirements, there are further demands on the water heating system:

- Economic efficiency
- Environmentally friendly operation
- Low cost operation
- Safe and secure operation
- Permanent operation

Drinking water heating systems can be divided into **centralized** and **decentralized** systems according to the type of supply and divided into **open** and **closed** systems.

4.1 Central Systems

In centralized systems, all tapping points of a building are supplied with hot water via a common pipe network (possibly unfavorable consumers are connected decentrally).

Open systems:
These systems are no longer used for centralized systems.

Closed system:
These systems are under the pressure of the public or private supply network and are protected with a safety valve against unintentionally high overpressure.
The general trend is towards centralized domestic hot water heating, as these systems usually have favorable investment, operating and maintenance costs.

4.2 Decentral Systems

In such systems, the water is heated directly or near the tapping points. This usually concerns devices either for the individual supply of distant tapping points or for systems with only low hot water demand.

4.3 Open Systems

For open systems, small storage units are generally used, which are mainly electrically heated and are intended for wall mounting. They are connected to the atmosphere and are operated without pressure. These devices are for individual supply only.

4.4 Closed Systems (group supply)

A group supply is when several draw-off points, e.g. in an apartment, are supplied together by one domestic hot water heater. The domestic hot water heater should be installed close to the tapping point where most of the heated domestic hot water is drawn. Due to the short pipe routes, the installation work and the heat losses of the pipes in the group supply are low. Such supply types are often used in social housing (suspended electric storage or gas-flowwater-heater, gas combination heater).

5 Circulation Line

A branch back to the storage water heater is installed in the hot water pipe as close as possible to the tapping points. The hot water circulates via this circuit. When opening a hot water tap, hot water is immediately available for the user. In larger buildings (apartment blocks, hotels, etc.) the installation of circulation pipes is also interesting from the aspect of water loss. At more remote taps, it not only takes a very long time for hot water to arrive without a circulation pipe, but a great deal of water also flows away unused.

The following chapters (5.1 and 5.2) are referring to the Austrian Standard ÖNORM B5019, which deals with hygiene-relevant planning, execution, operation, maintenance, monitoring and rehabilitation of central drinking water heating systems. This standard is applicable for Austria. Other EU Member States may have their own standards and norms in place. If not, the Austrian norm can be seen as an illustrative example.

5.1 Time control for systems that do not fall within the scope of ÖNORM B5019

The EU Directive "Energy Performance of Buildings EPB" led to the adoption of the Energy Saving Ordinance (ESO) in Germany and the Energy Performance Certificate Presentation Act in Austria at the beginning of 2007. This chapter is based on the German ESO. The ESO defines the basic efficiency level and is regularly updated on the basis of EU legislation. It lays down guidelines on the basis of which the transmission heat loss and the annual primary energy requirement of a so-called reference house are calculated for each construction or renovation project.

According to the German Energy Saving Ordinance (ESO), circulation systems must be equipped with self-acting devices to switch off the circulation pumps and insulated against heat loss in accordance with the recognized rules of technology. The temperature difference between hot water outlet and circulation inlet must not exceed 5 K.

With the help of circulation lines, a large part of the hot water network can be brought to higher temperatures and thus "thermally disinfected" to kill bacteria (e.g. legionella). For thermal disinfection, the installation of thermostatically controlled tap fittings is recommended.

5.2 Circulation line for systems according to ÖNORM B5019

Each circulation line must be equipped with a regulating valve at the point of entry into the circulation manifold. This regulating valve can be set to a fixed hydraulic resistance or thermostatically controlled.

Control valves with a fixed hydraulic resistance must be set so that the water temperature at the control valve and in the circulation manifold at the inlet to the drinking water heating systems is at least 55 °C each and never falls below this temperature at any point in the distribution system. The thermostatically controlled valves must allow flushing with water temperatures of at least 70 °C.

By installing thermostatic control valves, a significant reduction of the volume flow can be achieved when the preset required circulation temperature is reached. The monitoring of operating parameters according to building-specific requirements (e.g. hospitals, nursing homes) using central control technology is recommended. Hereby, at least the outlet temperature from the storage tank and the return temperature of the circulation system shall be measured and documented.

It is not permitted to switch off the circulation pump.

Circulation lines should be brought as close as possible to the tapping points. The length of the line from the branch of the circulation line to the most distant tapping point must not exceed 6 m.

Gravity circulation is not suitable from a hygienic point of view.

The circulation line must be routed directly to the charging converter of the storage charging system or to the flow-through drinking water heating system.

6 Hot Water Demand

Different temperatures are required for different applications, but the demand in liters varies considerably.

Standard values for the daily hot water requirement of a person are divided into three categories according to the standard of the equipment:

- Simple equipment - as a minimum standard in publicly funded housing.
- Superior equipment - as a normal, predominantly applied standard for rental and owner-occupied dwellings.
- Comfortable furnishing - highest standard that responds to individual wishes, e.g. condominiums and private homes.

Different data is available in the literature, as these values vary considerably depending on individual behavior.

	Hot water demand	Temperature
Simple equipment	ca. 30 l	55°C
Superior equipment	ca. 50 l	55°C
Comfortable furnishing	ca. 100 l	55°C

Table 1: Hot water demand standard values in the household

Furnishings	Per use	Water temperature

Hand wash basin	ca. 5 l	40°C
Wash basin	ca. 20 l	40°C
Bidet	ca. 30 l	40°C
Shower bath	ca. 50 l	40°C
Bathtub	ca. 170 l	40°C
Kitchen sink	ca. 50 l	55°C

Table 2: Hot water requirements standard values for individual purposes

6.1 Energy requirement for the water heater

$$E = \frac{m \times c \times \Delta\vartheta}{\eta}$$

$$Wh = \frac{kg \times Wh \times K}{kg \times K}$$

6.2 Fuel requirements for the water heater

$$B = \frac{m \times c \times \Delta\vartheta}{\eta \times H_{u(B)}} \ldots B = E/H_{u(B)}$$

$$kg = \frac{kg \times kJ \times K \times kg}{kg \times K \times kJ}$$

6.3 Power requirements of water heaters

$$P = \frac{m \times c \times \Delta\vartheta}{t_A \times \eta \times 3600} \quad P = E/t_A$$

$$Power = \frac{mass \times spec.\, warmth\ capacity \times temperature\ difference}{heating\ time \times efficiency \times conversion\ factor}$$

Efficiencies:

These efficiencies take into account the boiler, appliance and distribution efficiency.

Device	Efficiency	Central Systems	Efficiency

E-flowmeter	0.9	Oil firing	0.75
Gas-flow	0.85	Gas firing	0.75
Water heater	0.85	Solid fuels	0.45
Boiler	0.85		

Table 3: Efficiencies for hot water preparation

Heating time t_A:

Common heat-up times for a small to medium sized systems are:

Individual devices: ca. 3 – 6 hours

Central water heating: ca. 0.5 – 1.5 hours

6.4 Heating surface determination (rough estimate)

The determination of heating surfaces for hot water preparation requires precise knowledge, which usually only the manufacturers know about heat transfer, flow conditions etc. The formula for calculation below is only for a simple and approximate determination of the heating surface.

$$P = A \times k \times \Delta\vartheta_m$$

Average excess temperature:

$$\Delta\vartheta_m = \frac{\vartheta_{VL} + \vartheta_{RL}}{2} - \frac{\vartheta_{WW} + \vartheta_{KW}}{2}$$

Logarithmic excess temperature:

$$\Delta\vartheta_{m(ln)} = \frac{\Delta\vartheta_{Gr} - \Delta\vartheta_{Kl}}{ln \frac{\Delta\vartheta_{Gr}}{\Delta\vartheta_{Kl}}}$$

Example:

A 300-liter hot water heater should be heated from 12°C to 68°C in 2 hours. The system is operated with an oil central heating system. The pipe register should have a flow temperature of 75°C and a return temperature of 60°C.

- What amount of heat in kJ and kWh is required for heating?
- What is the fuel requirement per hour and in total? □ = 0.75
- What power must the pipe register have? □$_{WT}$ = 0.95
- What area in m² must the register have, if it is made of copper?
- How long must the pipe register be if it is to be made from a 28 x 1 copper pipe? (k=400 W/m²K)

(Solution: Q = 70.560kJ = 19.6kWh; Fuel demand 1.3l/h; 2.6l; P = 10.32KW; A = 0.938m²; l=10.7m)

Example:

What length must the pipe register have (steel pipe D 33.70mm; d 27.2mm DN 25) if the register is to have a capacity of 18 kW?

Flow temperature 75 °C, return temperature 65 °C, cold-water temperature 11 °C, hot water temperature 60 °C.

What heating time does the system require with a storage tank capacity of 500 l?

How many m³ of natural gas does the gas boiler need for a one-time heating and per hour if we assume H_{iB} = 34 MJ/m³ and η = 0.80 for gas? (k=350 W/m²K)

(Solution: l=14.1m; t (Heat-up test) = 1.58h, Gas consumption = 3.8m³ and 2.40m³/h)

7 Dimensioning of Water Heaters

Warm water for every comfort requirement is a justified wish, but the way to get there is often difficult. Depending on the type of installation, different factors are important. A residential building is to be regarded differently than a gymnasium or a hospital. The situation is aggravated by the fact that there are almost no legal regulations or guidelines.

In Austria, hot water heating was only defined more precisely in ÖNORM H 5151-1 (Cf. method for determining the size of storage tanks according to DIN 4708). For other (EU)-countries, other standards may apply. The Austrian ÖNORM H 5151-1 must always be applied in conjunction with EN 12828, therefore, if no national standard is available, refer to EN 12828. If any Austrian Standards (ÖNORM) are referred to, it shall be seen as an illustrative example.

7.1 Calculation according to the performance indicator (ÖNORM H51511)

When dimensioning water heaters, the applicable standards and guidelines must be observed, especially ÖNORM B 5019.

This procedure applies to both storage and flow-through water heaters of central drinking water heating systems.

The calculation is based on DIN 4708-1 and -2. This is valid for residential construction and residential-like character, as long as no peak demand time below 10 minutes is required. The difference lies in the fact that the number of rooms and occupancy rates are not taken into account, but only the relevant sanitary facilities.

Central water heating systems that cannot be calculated according to this system should be calculated using the sum-line-method.

The calculation is made as follows:

1. Determination of the demand key figure *N* for the hot water demand
2. Calculation of the design values and dimensioning of the water heater Serving

as a unit Wh – c_W = 1,163 Wh/kg x K !

Determination of the demand key figure N

The hot water demand in residential buildings depends mainly on bathtubs and showers. Therefore, only these sanitary fixtures and fittings are taken into account in the calculation of *N*.

Single-family homes and hotels with residential use (e.g. apartment hotels) also show similar hot water consumption behavior.

If rarely used sanitary facilities (shower in the guest room) are available in residential units, the “specific demand indicator N_S” can be reduced by 10 - 50% (reduction factor $R_F \leq 0.5$).

Relevant Sanitary Equipment	Spec. Demand Key Figure N_S
Shower Bath (Normal)	0.7
Bathtub (up to 160 liters)	1.0
Special shower bath (several outlets)	1.4
Large capacity bathtub	1.7

Table 4: Specific Demand Key Figure N_S

For the calculation, the number of apartments and the relevant sanitary fixtures and fittings must therefore be known.

Demand Key Figure N

The demand key figure N is determined using the following equation:

$$N_e = \sum_k (R_{F,k} \times N_{S,k})$$

$$N = \sum_i (n_i \times N_{e,i})$$

The results are rounded to the nearest whole number.

Dimensioning of the water heater

The size of the water heater must be adapted to the need for hot water

However, it must be ensured that the heat output can cover at least the hourly heat demand $Q_{1,0}$ as well as the 10-minute peak demand Q_{10}.

The values for the calculation are summarized in Table 7 "Calculation values for calculating water heaters” in Chapter 7.4.

Determination of storage water heaters without performance indicator NL

If we have determined the demand key figure *N* and do not have or know the storage performance indicator N_L, we can calculate the storage volume.

$$V_{Sp} = f_{Sp} \times \left(\frac{Q_{1,0} - \Phi_{DWH} * 1}{\varrho \times c_W \times (\theta_{Sp} - \theta_{KW})} \right)$$

The storage factor f_{Sp} is as follows:

Case	Description	Storage Factor
1	Storage tank with external heat exchanger and charge pump	1.0
2	Storage tank with internal heat exchanger without dead space	1.15
3	Storage tank with internal horizontally installed heat exchanger (up to max. 1/3 of the height); only single-family homes	1.5
4	Like case 3 but with hight to max. ½ - only single-family homes	2.0

Table 5: Storage Factor f_{Sp}

If the tank is designed according to Table 7 "Calculation values for the calculation of water heaters" in Chapter 7.4, the following points must be considered:

Dimensioning of the storage volume

- If the storage tank temperature equals 60°C, the storage tank volume V_{th} for the demand key figure N = 10 to N = 300 can be taken directly from the table.
- For N = 1 to 9 standardized storage volumes are given in the table - these also apply to internal heat exchangers.
- The storage volumes listed otherwise apply to the charge storage system

Calculation of the minimum heat output

- If a storage tank already exists for an object, the minimum transfer heat quantity Q_W is calculated as follows:

$$Q_W = Q_{1,0} - Q_C$$

- The storage capacity Q_C

$$Q_C = V_{Sp} \times \varrho \times c_W \times (\theta_{Sp} - \theta_{KW}) \times \frac{1}{f_{SP}} \times \frac{1}{1000}$$

- The minimum heat output Φ_{DHW}

$$\Phi_{DHW} = \frac{Q_W}{1}$$

The division by 1000 includes the conversion from Wh to kWh.

Dimensioning of storage water heaters according to the performance indicator NL

For an object, which has a demand key figure N, the required memory can be selected.

$$N_L \geq N$$

When determining N_L where the flow temperature is 70°C higher than the cold-water temperature and the hot water temperature is kept 35K above the cold-water temperature.

Dimensioning of through-flow water heaters without known performance indicator NL

For the dimensioning of through-flow water heaters, the 10-minute peak demand must be taken into account.

$$\Phi_{DHW} = \frac{6}{1h} \times Q_{10}$$

Dimensioning of through-flow water heaters with performance indicator NL

Analogue to „Dimensioning of storage water heaters according to the performance indicator N_L".

$$N_L \geq N$$

Design of non-domestic areas

For hotels with high peak loads, the hourly heating requirement $Q_{1,0}$ should be used as the assessment basis. For all other areas of application (e.g. industrial and commercial enterprises, gymnasiums, barracks, prisons), proceed according to the object-specific requirements. The basis for the dimensioning of the hot water heating system shall be agreed between the contracting parties.

Description and formulas for calculating the table 7 (Chapter 7.4)

$$N' = \frac{1+\sqrt{N}}{N\sqrt{N}}$$

Demand period 2T:

$$2T = 7.42 * \frac{\sqrt{N}}{1+\sqrt{N}} = \frac{7.42}{N'}$$

Frequency distribution of the heat demand Q_B and Q_Z:

$$Q_b = 5.82\ kWh$$

$$Q_z = Q_B * (N * K_{(u1)} + \sqrt{N} * K_{(u2)})$$

Peak distribution time 2t:

$$2\,t = \frac{0.5}{N'}$$

Period heat demand in the demand period 2T:

$$Q_P = Q_{2T} = Q_B * N * N'$$

Hourly heat requirement $Q_{1,0}$:

$$Q_{1,0} = Q_B * \left(N * K_{(u1)} + \sqrt{N}\right) = Q_B * \left(N * K * (0.244 * N') + \sqrt{N}\right)$$

Peak heat demand = 10 min. heat demand Q_{10}:

$$Q_{10} = Q_B * \left(N * K_{(u1)} + \sqrt{N} * K_{(u2)}\right)$$

for $u^1 = \frac{1}{6} * 0.244 * N'$ for

$u^2 = \frac{1}{6} * 3.599 * N'$

Limit value for the additional heat output:

$$\Phi_{DHW} = \frac{Q_{2T}}{2T}$$

7.2 Calculation according to the specific useful heat

Object type	Subdivision	Energy consumption for hot water
Hotel	Room with bath	5500 – 8000 Wh/Day
	Room with shower	3000 – 5000 Wh/Day

	retirement homes, pensions	1500 – 3000 Wh/Day
Indoor swimming		1480 – 2230 Wh/Guest
Sauna facilities		2500 – 5000 Wh/ Guest
Hospitals		1740 – 2330 Wh/Patient
Medical practices		2100 Wh/Doctor
Hairdressing		500 – 1000 Wh/Seat
Restaurant	Per menu	230 – 460 Wh/menu
	Per seat	460 – 1160 Wh/seat

Table 6: Heat requirement for hot water preparation according to type of property

As an approximation, the hourly peak can be assumed one third of the daily requirement.

Exercise (solved):
Motorway restaurant with 800 meals per day:

450 Wh/Menu x 800 = 360.000 Wh = 360 kWh

V = 360 x 3600 / (4.2 x (60-10)) = 6170 l/day

Hourly peak = 1/3 with 60°C = 2060 l/h

Example:
A hotel with 324 rooms (700 beds) with showers will be built (in addition to 31 staff showers). The capacity utilization is assumed to be 80%. The duration of use is calculated at 2h. The connected load of the heat exchanger is 400 kW. The tapping temperature is 45°C. Calculate the required storage size of the charging system. (Solution: V (Storage) = 5000 Liter)

7.3 Boiler Output Surcharge

The boiler output surcharge is a very complex issue, in the standard the heating output $\square_{HL}$ is multiplied by the design factor f_{HL}. This value f_{HL} is between 0.9 and 1.30 depending on the system (cf. ÖNORM H5151-1).

If the hot water is produced in a flow-through system and the type of use is residential or similar, f_{HL}= 0 can be set.

Otherwise, the $\square_{DHW}$ hot water output is added to the boiler output. In practice, however, it has been proven that an admission of approx. 50% of $\square_{DHW}$ is sufficient for charge storage systems.

With good measurement and control technology, some heating consumers can be reset if necessary - e.g. underfloor heating.

Approximate determination of the boiler surcharge according to Buderus

Note: The source for approximate determination is: „Handbuch für Heizungstechnik,34. Auflage 2002, Herausgeber: Buderus Heiztechnik GmbH, Verlag: Beuth GmbH, ISBN 978-3410-15283-5".

The decision on the amount of a boiler surcharge results from three requirements of DIN 47082 for the dimensioning of the drinking water heating system:

1. The determined performance indicator N_L of the selected storage shall be at least as high as the determined demand key figure N.
2. The boiler capacity Q_K must be at least as high as the continuous output Q_D required to achieve the performance indicator N_L.
3. The boiler capacity Q_K must be at least as large as the sum of the heat demand of the building $Q_{N, BIL}$ and a boiler surcharge Q_{WW} for the heating of drinking water. As an estimate, the size of the demand key figure N is assumed as boiler surcharge (in kW). A calculation value for the amount of the boiler surcharge Q_{WW} is shown in Figure 13.

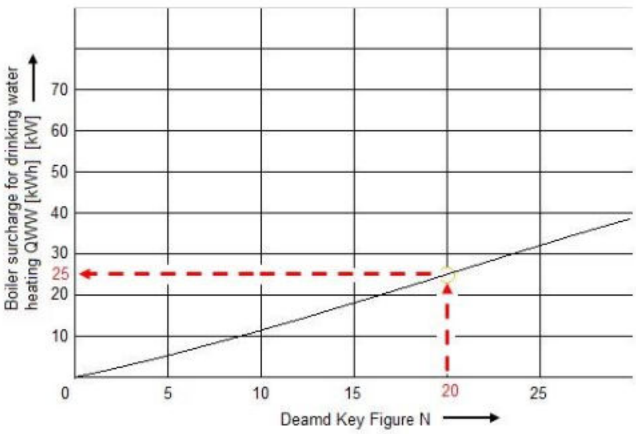


Figure 13: Boiler surcharge for domestic hot water according to the demand key figure N, (selfdrawn)

Boiler output for one and two-family houses

The smaller the buildings are, the greater the relative share of the heat demand for domestic hot water heating. The storage capacity of a 150-litre storage tank with ϑ_{Sp} = 60 °C is around 9 kWh. With a short heating time of ta = 40 min, the correction factor x = 0.85 increases the effective connected load to around 16 kW.

Since any kind of longer heating pause (e.g. night setback, storage tank heating) leads to a more or less noticeable reduction in room temperature, these losses can only be compensated by a larger boiler capacity.

In low-energy houses, the boiler output must be determined over the heating time (30 minutes to a maximum of 45 minutes) to ensure hot water comfort.

Example:
Determine tank size and capacity of the heat exchanger as well as a system with only throughflow hot water preparation for the following system:

The building heating load for the object is 95kW according to ÖNORM EN 12831, the object is operated with a wood chip boiler and the design factor is 0.90 according to the table for room heating.

The residential complex consists of 30 residential units with different sanitary facilities.10 apartments with shower bath, 10 apartments with one bath each, six apartments with shower bath and bathtub and four luxury apartments with large bathtubs and a shower bath in the guest room. Perform the calculations using the table and arithmetically.

As a special task, they dimension the system as a charge storage system with a preset hot water tank of 300 liters.

(Solution: Storage tank: 1000 liters; P (heat exchanger) = 42.2 kW; P (boiler) = 127.7kW - flow principle P = 209kW)

Example:

Sports hall with 35 showers with 8l/min and 15min usage time each, the connected load is 80kW. Compare a storage system with a load storage system. Storage temperature with 60°C. The tap temperature is 38°C. Assumption the storage tank has a heat exchanger surface of five m² and the k-value is 300W/m²K and tm = 27.5K. For the charge storage system: primary 60/25°C secondary 10/55°C.

(Solution: Charge storage system: V = 2000 liters; P = 80kW; Storage system: V = 2500 liters - but does not work because the heating time of 3.07h for a sports hall (possible change every 2 hours) is too long!)

7.4 Calculation values for the calculation of hot water preparation

N	Q_{2T}	$Q_{1,0}$	2 T	$\square_{DHW}$	Q_{10}	Storage volume V_{th}^{a} for $Q_{1,0}$ and $\square_{DHW}$			$Q_w = Q_{1,0} - \square_{DHW} * 1h$	2 t
						50 °C[c]	55 °C[c]	60 °C		
-	kWh	kWh	h	kW	kWh	I			kWh	h
1	11.6	8.8	3.71	3.1	5.8	150[b]	-	120[b]	5.7	0.25
2	19.9	13.4	4.35	4.6	7.9	200[b]	-	150[b]	8.8	0.29
3	27.5	17.3	4.70	5.9	9.5	250[b]	-	200[b]	11.4	0.32
4	34.9	20.8	4.95	7.1	10.9	300[b]	-	250[b]	13.7	0.33
5	42.1	24.1	5.13	8.2	12.1	350[b]	-	300[b]	15.9	0.35
6	49.2	27.3	5.27	9.3	13.2	400[b]	-	300[b]	18.0	0.36
7	56.1	30.3	5.38	10.4	14.2	450[b]	-	350[b]	19.9	0.36
8	63.0	33.2	5.48	11.5	15.2	500[b]	-	400[b]	21.7	0.37
9	69.8	36.0	5.57	12.5	16.2	500[b]	-	400[b]	23.5	0.38
10	76.6	38.8	5.64	13.6	17.0	542	482	433	25.2	0.38
11	83.3	41.5	5.70	14.6	17.9	578	514	462	26.9	0.38
12	90.0	44.1	5.76	15.6	18.8	613	545	490	28.5	0.39
13	96.6	46.8	5.81	16.6	19.6	647	575	518	30.2	0.39
14	103.3	49.3	5.86	17.6	20.4	681	606	545	31.7	0.39
15	109.8	51.9	5.90	18.6	21.1	714	635	572	33.3	0.40
16	116.4	54.4	5.94	19.6	21.9	747	664	598	34.8	0.40
17	122.9	56.8	5.97	20.6	22.6	779	693	623	36.2	0.40
18	129.5	59.3	6.00	21.6	23.3	811	721	649	37.7	0.40
19	135.9	61.7	6.04	22.5	24.1	842	749	674	39.2	0.41
20	142.4	64.1	6.06	23.5	24.8	973	776	699	40.6	0.41
21	148.9	66.5	6.09	24.4	25.5	904	803	723	42.1	0.41
22	155.3	68.8	6.12	25.4	26.1	934	830	747	43.4	0.41
23	161.8	71.2	6.14	26.3	26.8	964	857	771	44.9	0.41
24	168.2	73.5	6.16	27.3	27.5	994	883	795	46.2	0.42
25	174.6	75.8	6.18	28.2	28.1	1023	909	818	47.6	0.42
26	171.0	78.1	6.20	29.2	28.8	1052	935	842	48.9	0.42
27	187.4	80.4	6.22	30.1	29.4	1081	961	865	50.3	0.42

28	193.8	82.7	6.24	31.0	30.0	1110	987	888	51.7	0.42
29	200.1	84.9	6.26	32.0	30.7	1138	1012	911	52.9	0.42
30	206.5	87.2	6.27	32.9	31.3	1167	1037	933	54.3	0.42
31	212.8	89.4	6.29	33.8	31.9	1195	1062	956	55.6	0.42
32	219.2	91.6	6.31	34.8	32.5	1223	1087	978	56.8	0.42
33	225.5	93.9	6.32	35.7	33.1	1251	1112	1001	58.2	0.43
34	231.8	96.1	6.33	36.6	33.7	1278	1136	1023	59.5	0.43
35	238.1	98.3	6.35	37.5	34.3	1306	1161	1045	60.8	0.43
36	244.4	100.4	6.36	38.4	34.9	1333	1185	1066	62.0	0.43
37	250.7	102.6	6.37	39.3	35.4	1360	1209	1088	63.3	0.43
38	257.0	104.8	6.38	40.3	36.0	1387	1233	1110	64.5	0.43
39	263.3	107.0	6.40	41.2	36.6	1414	1257	1131	65.8	0.43
40	269.6	109.1	6.41	42.1	37.2	1441	1281	1153	67.0	0.43
41	275.9	111.3	6.42	43.0	37.7	1468	1304	1174	68.3	0.43
42	282.2	113.4	6.43	43.9	38.3	1494	1328	1195	69.15	0.43
43	288.4	115.5	6.44	44.8	38.8	1520	1352	1216	70.7	0.43
44	294.7	117.7	6.45	45.7	39.4	1547	1375	1237	72.0	0.43
45	300.9	119.8	6.46	46.6	40.0	1573	1398	1258	73.2	0.44
46	307.2	121.9	6.47	47.5	40.5	1599	1421	1279	74.4	0.44
47	313.4	124.0	6.48	48.4	41.1	1625	1444	1300	75.6	0.44
48	319.7	126.1	6.48	49.3	41.6	1651	1467	1321	76.8	0.44
49	325.9	128.2	6.49	50.2	42.1	1677	1490	1341	78.0	0.44
50	332.2	130.3	6.50	51.1	42.7	1702	1513	1362	79.2	0.44
52	344.6	134.5	6.52	52.9	43.7	1754	1559	1403	81.6	0.44
54	357.0	138.6	6.53	57.7	44.8	1804	1604	1444	83.9	0.44
56	369.5	142.7	6.55	56.4	45.8	1855	1649	1484	86.3	0.44
58	381.9	146.9	6.56	58.2	46.9	1905	1694	1524	88.7	0.44
60	394.1	151.0	6.57	60.0	47.9	1955	1738	1564	91.0	0.44
62	406.7	155.0	6.58	61.8	48.9	2005	1782	1604	93.2	0.44
64	419.0	159.1	6.60	63.5	49.9	2054	1826	1643	95.6	0.44
66	431.4	163.2	6.61	65.3	50.9	2103	1870	1683	97.9	0.45
68	443.8	167.2	6.62	67.1	51.9	2152	1913	1722	100.1	0.45
70	456.1	171.2	6.63	68.8	52.9	2201	1957	1761	102.4	0.45
72	468.4	175.2	6.64	70.6	53.9	2250	2000	1800	104.6	0.45
74	480.7	179.2	6.65	72.3	54.9	2298	2043	1838	106.9	0.45
76	493.1	183.2	6.66	74.1	55.9	2346	2085	1877	109.1	0.45
78	505.4	187.2	6.67	75.8	56.8	2394	2128	1915	111.4	0.45
80	517.7	191.2	6.67	77.6	57.8	2442	2171	1953	113.6	0.45
82	529.9	165.1	6.68	79.3	58.7	2489	2213	1992	115.8	0.45
84	542.2	199.1	6.69	81.0	59.7	2537	2255	2029	118.1	0.45
86	554.5	203.0	6.70	82.8	60.6	2584	2297	2067	120.2	0.45
88	566.8	206.9	6.71	84.5	61.6	2631	2339	2105	122.4	0.45
90	579.0	210.8	6.71	86.3	62.5	2678	2381	2143	124.6	0.45
92	591.3	214.8	6.72	88.0	63.4	2725	2422	2780	126.8	0.45
94	603.5	218.7	6.73	89.7	64.4	2772	2464	2217	129.0	0.45
96	615.7	222.6	6.73	91.5	65.3	2818	2505	2255	131.1	0.45
98	628.0	226.4	6.74	93.2	66.2	2865	2546	2292	133.2	0.45
100	640.2	230.3	6.75	94.9	67.1	2911	2587	2329	135.4	0.45
102	652.4	234.2	6.75	96.6	68.0	2957	2628	2366	137.6	0.45
104	664.6	238.1	6.76	98.4	68.9	3003	2669	2402	139.7	0.46
106	676.8	241.9	6.76	100.1	69.8	3049	2710	2439	141.8	0.46
108	689.0	245.8	6.77	101.8	70.7	3095	2751	2476	144.0	0.46
110	701.2	249.6	6.77	103.5	71.6	3140	2791	2512	146.1	0.46
112	713.4	253.4	6.78	105.2	72.5	3186	2832	2549	148.2	0.46
114	725.6	257.3	6.78	107.0	73.4	3231	2872	2585	150.3	0.46

116	737.8	261.1	6.79	108.7	74.3	3277	2913	2621	152.4	0.46
118	750.0	264.9	6.79	110.4	75.2	3322	2953	2658	154.5	0.46
120	762.2	268.7	6.80	112.1	76.1	3367	2993	2694	156.6	0.46
122	774.3	272.5	6.80	113.8	77.0	3412	3033	2370	158.7	0.46
124	786.5	276.5	6.81	115.5	77.8	3457	3073	2766	160.9	0.46
126	798.6	280.1	6.81	117.2	78.7	3502	3113	2802	162.9	0.46
128	810.8	283.9	6.82	118.9	79.6	3547	3151	2837	165.0	0.46
130	823.0	287.7	6.82	120.6	80.4	3592	3193	2873	167.1	0.46
132	835.1	291.5	6.83	122.3	81.3	3636	3232	2909	169.2	0.46
134	847.3	295.3	6.83	124.0	82.2	3681	3272	2945	171.3	0.46
136	859.4	299.1	6.83	125.8	83.0	3726	3312	2980	173.3	0.46
138	871.5	302.8	6.84	127.5	83.9	3770	3351	3016	175.3	0.46
140	883.2	306.6	6.84	129.2	84.7	3814	3390	3051	177.4	0.46
142	895.8	310.4	6.85	130.9	85.6	3859	3430	3087	179.5	0.46
144	907.9	314.1	6.85	132.6	86.4	3903	3469	3122	181.5	0.46
146	920.0	317.9	6.85	134.3	87.3	3947	3508	3157	183.6	0.46
148	932.2	321.6	6.86	136.0	88.1	3991	3547	3193	185.6	0.46
150	944.3	325.4	6.86	137.7	89.0	4035	3586	3228	187.7	0.46
155	974.6	334.7	6.87	141.9	91.1	4144	3684	3316	192.8	0.46
160	1004.8	344.0	6.88	146.1	93.2	4254	3781	3403	197.9	0.46
165	1035.1	353.3	6.88	150.4	95.2	43663	3878	3490	202.9	0.46
170	1065.3	362.6	6.89	154.6	97.3	4471	3974	3577	208.0	0.46
175	1095.5	371.8	6.90	158.8	99.4	4579	4070	3663	213.0	0.46
180	1125.7	381.1	6.91	163.0	101.4	4687	4166	3750	218.1	0.47
185	1155.9	390.3	6.91	167.2	103.4	4794	4262	3836	223.1	0.47
190	1186.0	399.5	6.92	171.4	105.5	4902	4357	3921	228.0	0.47
195	1216.2	408.6	6.92	175.7	107.5	5008	4452	4007	233.0	0.47
200	1246.3	417.8	6.93	179.8	109.5	5115	4547	4092	238.0	0.47
205	1276.4	426.9	6.94	184.0	111.5	5221	4641	4177	242.9	0.47
210	1306.5	436.1	6.94	188.2	113.5	5327	4736	4262	247.9	0.47
215	1336.6	445.2	6.95	192.4	115.5	5433	4830	4347	252.8	0.47
220	1366.7	454.3	6.95	196.6	117.4	5539	4923	4431	257.7	0.47
225	1396.8	463.4	6.96	200.8	119.4	5644	5017	4515	262.6	0.47
230	1426.9	472.4	6.96	205.0	121.4	5749	5110	4599	267.4	0.47
235	1456.9	481.5	6.97	209.2	123.3	5854	5204	5683	272.3	0.47
240	1487.0	490.5	6.97	213.3	125.3	5959	5297	4767	277.2	0.47
245	1517.0	499.6	6.97	217.5	127.2	6063	5390	4851	282.1	0.47
250	1547.0	508.6	6.98	221.7	129.1	6167	6482	4934	286.9	0.47
255	1577.0	517.6	6.98	225.8	131.1	6272	5575	5017	291.8	0.47
260	1607.0	526.6	6.99	230.0	133.0	6375	5667	5100	296.6	0.47
265	1637.0	535.6	6.99	234.2	134.9	6479	5759	5183	301.4	0.47
270	1667.0	544.6	6.99	238.3	136.8	6583	5851	5266	306.3	0.47
275	1697.0	553.5	7.00	242.5	138.7	6686	5943	5349	311.0	0.47
280	1727.0	562.5	7.00	246.7	140.6	6789	6035	5431	315.8	0.47
285	1757.0	571.4	7.01	250.8	142.5	6892	6126	5514	320.6	0.47
290	1786.9	580.4	7.01	255.0	144.4	6995	6218	5596	325.4	0.47
295	1816.9	589.3	7.01	259.1	146.3	7097	6309	5678	330.2	0.47
300	1846.8	598.2	7.01	263.3	148.2	7200	6400	5760	334.9	0.47

Table 7: Heat requirement for hot water preparation according to type of property

8 Pressure line dimensioning

This chapter provides an overview of the currently valid calculation methods for pressure line dimensioning of drinking water installations. In particular, dimensioning procedures for cold water and hot water pipes are given. In addition, methods for the dimensioning of circulation systems in central drinking water heating systems are also dealt with.

8.1 Procedure according to (ÖNORM) EN 806-3

The field of application of this standard covers standard installations of drinking water installations in buildings and properties, taking into account the type of installation, pressure conditions and flow velocities.

For the purposes of this standard, normal installations are defined as,

- whose taps do not have a greater tap flow rate than that shown in Table 8;
- whose type of use does not allow a higher peak flow rate to be expected than that shown in Figure 14;
- which do not supply permanent consumers with drinking water. Continuous consumption is defined as a withdrawal longer than 15 min.

Other installations are considered special installations.

„The installation for a residential building with up to 12 apartments is also regarded as a standard installation, provided that the supply pressure - taking into account the geodetic height of the consumption system and the built-in components (e.g. water meter, water treatment systems, hot water preparation) - is sufficient to ensure that the required minimum flow pressure at the hydraulically most unfavourable connection of a water tapping fitting is not undershot (ÖNORM EN 806-3, 2013)“.

Extraction point	Q_A l/s	Q_{min} l/s	Load values
washbasin, hand basin, bidet, cistern	0.1	0.1	1
household kitchen sink, washing machine[1], dishwasher, sink, shower head	0.2	0.15	2
Urinal flush valve	0.3	0.15	3
Bathtub spout	0.4	0.3	4
Extraction fitting for garden/garage	0.5	0.4	5
Commercial kitchen sink DN 20, bath tub outlet	0.8	0.8	8
Flush valve DN 20	1.5	1.0	15

[1] For commercial washing machines according to the manufacturer's specifications.

Table 8: Sampling valve flow rates Q_A, minimum valve flow rates Q_{min} and load values for tapping points (according to ÖNORM EN 806-3, 2013)

Table 8 shows the sampling valve flow rates (calculated flow rate) as well as the minimum flow rates (sampling flow rate that still guarantees the correct use of a valve) and the load values (LU) required for the calculation process for common sampling points in drinking water installations.

Figure 14 shows the relationship between the cumulative flow rate Q_T (in LU values) and the peak flow rate Q_D in l/s. This graph can be used to determine the peak flow rate from the buzzer of LU values. Furthermore, as described above, it serves as a definition criterion for a normal installation and thus also for the area of application of this calculation method.

Cumulative flow rate Q_T in [LU]

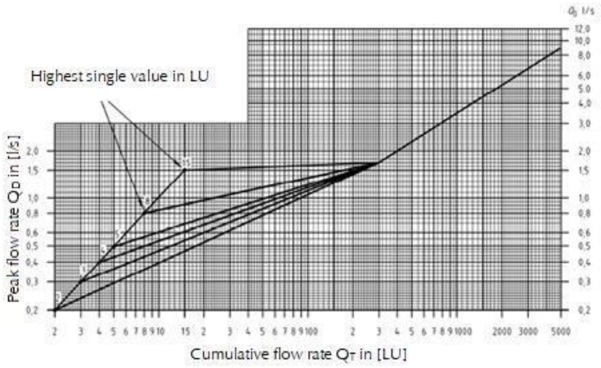


Figure 14: Ratio of peak flow rate to total flow rate. (Picture: ÖNORM EN 806-3, 2013)

Calculation bases

In addition to the criteria of a standard installation as required at the beginning, the calculation is based on fixed pressure conditions and flow velocities.

Pressure conditions

In drinking water installations, the resting pressure and the flow pressure at tapping points are of particular importance. The basis of this procedure is based on the principles set out in Table 9 for the pressure conditions.

Pressure condition	Pressure in [kPa]
Resting pressure at the tapping point[1]	max. 500
Flow pressure at the tapping point	min. 100
[1] *Tapping points for garden/garages*	max. 1000

Table 9: Pressure conditions in normal installations

"Some taps, such as thermally controlled mixers, may require a higher flow pressure. This must be taken into account in the calculations (ÖNORM EN 806-3, 2013)."

Flow velocities

The maximum permissible flow velocities, which are used to calculate the inside diameters are taken into account in this procedure according to Table 10.

Line type	**Velocity in [m/s]**
Collective supply lines, risers, floor lines	max. 2
Individual feed lines	max. 4

Table 10: Permissible flow velocities according to ÖNORM EN 806-3

Simultaneity

The simultaneous use of the tapping points is given in the calculation process by determining the peak flow rate.

Load Value LU

The load value LU (Loading Unit) is used to determine the calculation flow rate (in l/s) of each individual tapping point. The assignment of the load values to the tapping points is shown in Table 8. One LU corresponds to an extraction fitting flow rate Q_A of 0.1 l/s.

Application of the procedure

Starting from the most distant tapping point, the load values for the individual sections of the installation must be determined. The load values in the sections must be added together, whereby the respective pipe inside diameters of the sections can be determined from following tables (excerpts) - depending on the parameters: LU value, pipe length and pipe material. The probability of simultaneous use and peak flow are taken into account.

Hot dip galvanized steel pipes								
Max. exposure value	*LU*	**6**	**16**	**40**	**160**	**300**	**600**	**1600**
Largest single value	*LU*	4	15					
d_i	mm	16	21.6	27.2	35.9	41.8	53	68.8
Max. pipe length	m	10	6					

Stainless steel pipes											
Max. exposure value	*LU*	**3**	**4**	**6**	**10**	**20**	**50**	**165**	**430**	**1050**	**2100**
Largest single value	*LU*			4	5	8					
d_a x s	mm	**15** x 1.0			**18** x 1	**22** x 1.2	**28** x 1.2	**35** x 1.5	**42** x 1.5	**54** x 1.5	**76.1** x 2
d_i	mm	13.0			16.0	19.6	25.6	32	39	51	72.1

Max. pipe length	m	15	9	7								

Polyethylene (PE-X) pipes											
Max. exposure value *LU*	**1**	**2**	**3**	**4**	**5**	**8**	**16**	**35**	**100**	**350**	**700**
Largest single value *LU*					4	5	8				
d_a x s mm	**12** x 1.7		**16** x 2.2			**20** x 2.8	**25** x 3.5	**32** x 4.4	**40** x 5.5	**50** x 6.9	**63** x 8.6
d_i mm	8.4		11.6			14.4	18.0	23.2	29	36.2	45.6
Max. pipe length m	13	4	9	5	4						

Polypropylene (PP) pipes												
Max. exposure value *LU*	**1**	**2**	**3**	**3**	**4**	**6**	**13**	**30**	**70**	**200**	**540**	**970**
Largest single value *LU*			2			4						
d_a x s mm	**16** x 2.7			**20** x 3.4			**25** x 4.2	**32** x 5.4	**40** x 6.7	**50** x 8.4	**63** x 10.5	**75** x 12.5
d_i mm	10.6			13.2			16.6	21.2	26.6	33.2	42	50
Max. pipe length m	20	12	5	15	9	7						

Figure 15: Load values for the dimensioning of internal pipe diameters. (ÖNORM EN 806-3, 2013)

„For pipe systems which are not listed in the tables, the table with the most similar material and in this table the column with the same or most similar inner diameter must be selected (ÖNORM EN 806-3, 2013).“

Special Installations

“Special installations are those installations which do not meet the conditions for normal installations, or which belong to buildings with above average dimensions. It can happen that only individual parts of a project can be designated as special installations. In such cases, those parts that meet the conditions for normal installations can be dimensioned using the simplified method (ÖNORM EN 806-3, 2013).”

Hot water circulation lines

Hot water circulation pipes cannot be dimensioned using this method.

8.2 Circulation systems

Circulation lines can be dimensioned according to three different calculation methods. The starting point of each of these calculation methods is that for hygienic reasons the cooling of the medium must not exceed 5 Kelvin in all circulation circuits.

The following calculation methods can be distinguished:

- Short procedure
- Simplified procedure
- Differentiated procedure

The individual procedures are described in the Worksheet (Arbeitsblatt) W553 of the DVGW and can be found online. DVGW refers to the German Association of the Gas and Water Industry, which is a recognized rule-setter, technical and scientific know-how carrier and promoter of technical innovation and is the competence network for all questions concerning the supply of natural gas and drinking water.

9 Drainage systems for buildings and land

As in many other technical disciplines, the drainage of buildings and land has given rise to a large number of different sets of rules and regulations which, in compliance with these, ensure the flawless functioning and high operational safety of drainage systems.

For the planning, execution and inspection of drainage systems in buildings, following documents are particularly relevant:

- EN 12056 (here the Austrian Standard version of this European Norm is used): Gravity drainage systems inside buildings
  - Part 1: General and design requirements
  - Part 2: Wastewater systems, planning and calculation
  - Part 3: Roof drainage, planning and dimensioning
  - Part 4: Wastewater lifting plants - Planning and dimensioning
  - Part 5: Installation and testing, instructions for operation, maintenance and use
- ÖNORM B 2501, Drainage systems for buildings and land: Design, construction and testing - Supplementary guidelines to (ÖNORM) EN 12056 and (ÖNORM) EN 752

9.1 Normative references

The following cited documents are required as supplements to the above-mentioned documents. ÖNORM B refer to Austrian Standards, while all standards including “EN” are based on European standards.

- ÖNORM B 2503, Sewer systems - Design, construction, testing, operation - Supplementary provisions to ÖNORM EN 476, EN 752 and EN 1610
- ÖNORM B 2504, Shafts and shaft structures for gravity drainage systems.
- ÖNORM B 2506-1, Rainwater seepage systems for drains from roof surfaces and paved areas - Application, hydraulic design, construction and operation.

- ÖNORM B 2506-2, Rainwater seepage systems for drains from roof surfaces and paved areas - Part 2: Qualitative requirements for rainwater seepage and requirements for the design, construction and operation of cleaning systems
- ÖNORM B 2572, Principles of rainwater utilization.
- ÖNORM B 5101, Separator systems for light liquids (e.g. oil and petrol) - Supplementary requirements to ÖNORM EN 858-1 and -2
- ÖNORM B 8115-2, Noise insulation and room acoustics in buildings - Part 2: Requirements for noise insulation ÖNORM B 8115-4, Noise insulation and room acoustics in buildings - Part 4: Measures to comply with noise control requirements
- ÖNORM EN 752, Drainage systems outside buildings.
- ÖNORM EN 1253-5, Drains for buildings - Part 5: Drains with anti-liquid barriers.
- ÖNORM EN 1610, Installation and testing of sewerage pipes and sewers.
- ÖNORM EN 1825-2, Grease separator systems - Part 2: Selection of nominal size, installation, operation and maintenance
- ÖNORM EN 12050-1, Wastewater lifting plants for buildings and sites - Principles of construction and testing - Part 1: Lifting plants for faeces.
- ÖNORM EN 12050-2, Wastewater lifting plants for buildings and sites - Principles of construction and testing - Part 2: Lifting plants for wastewater containing faecal matter
- ÖNORM EN 12050-3, Wastewater lifting plants for buildings and sites - Principles of construction and testing - Part 3: Lifting plants for wastewater containing faecal matter for limited use
- ÖNORM EN 12050-4, Wastewater lifting plants for buildings and sites - Principles of construction and testing - Part 4: Non-return valves for wastewater containing or containing faecal matter
- ÖNORM EN 13564-1, Backwater valves for buildings - Part 1: Requirements.

9.2 Fields of application

The European series of standards EN 12056 Parts 1 to 5 applies to drainage systems operating under gravity. The series of standards applies to drainage systems within residential, commercial, institutional and industrial buildings.

The document ÖNORM B 2501 supplements ÖNORM EN 12056 (all parts) and EN 752 and contains provisions for the design, construction and testing of drainage systems inside buildings and on land up to the point where they join the road canal.

The application areas of the cited standards are as follows:

- ÖNORM B 2501 and ÖNORM EN 12056 (all parts) are applied inside of buildings.

- ÖNORM B 2503, ÖNORM EN 752 and ÖNORM EN 1610 are applied outside of buildings. Furthermore, ÖNORM B 2501 as well as ÖNORM B 2503, ÖNORM EN 752 and ÖNORM EN 1610 are also applied outside.

9.3 Definitions

The basic terms required for the application of the mentioned standards for drainage systems are quoted below from the documents ÖNORM EN 12056 Part 1 and ÖNORM B 2501.

Wastewater

Water modified by use and any water flowing into the drainage system, e.g. domestic sewage, industrial and commercial wastewater, condensates and rainwater when discharged into the drainage system.

Connection line
Drainage pipe that connects drainage objects to a downpipe or ground pipe.

Building trap
Intake from a wastewater or rainwater downpipe into a collection or ground pipe.

Ventilation valve

Valve that admits air into the drainage system but does not remove it to limit pressure fluctuations within the drainage system.

Single connection line for dirty water

Pipe from the drainage object to the point where it joins the continuing collective connection, wastewater downpipe, collection or ground pipe.

Drainage system

System, installed from drainage objects, pipelines and other components, which collects wastewater and drains it by means of gravity. A sewage-lifting unit can be part of a gravity drainage system.

Fall line delay

Non-vertical part of a wastewater downpipe with a constant cross-section as a connection of downpipe parts with an axial displacement of up to 10 m maximum length.

Drop distance (fall height)
Vertical section of a single connection line.

Greywater
Wastewater free of feces.

Main pipe

Sewerage pipes, which are laid in the ground under the foundations or in the floor, slab and to which wastewater downpipes, rainwater downpipes or drainage objects are directly connected.

Main ventilation

Extension of a vertical wastewater downpipe above the last connection to above the roof, the end of which is open to the atmosphere.

Domestic wastewater
Wastewater from kitchens, laundry rooms, bathrooms, toilets and similar rooms.

Industrial wastewater

Wastewater modified and contaminated after industrial or commercial use, including cooling water.

Line for direct auxiliary ventilation

In addition to the wastewater downpipe, there is an additional ventilation pipe, which is connected to the wastewater downpipe on each floor.

Line for indirect auxiliary ventilation

Additional ventilation pipe at the upper end of an individual or collective connection pipe, which either is routed above the roof or flows into the main ventilation.

Ventilation lines (L)

Piping system that compensates for pressure fluctuations within a drainage system, aerates, and de-aerates the drainage system.

Relevant backflow level

The highest level to which the water can rise due to a backwater in the development channel outside the property (usually a road channel).

Mixed system
Drainage system that drains rainwater and sewage in one pipe.

Rainwater
Water from natural precipitation that has not been contaminated by use.

Backwater valve

Device which is either installed directly in a pipe of a drainage system or integrated in a floor drain or drain fitting and which protects buildings, i.e. rooms located below the relevant backflow level, against backflow.

Backwater lifting system

System, consisting of a backwater valve with upstream overflow to the wastewater-lifting unit with collection chamber.

Collective connection line

Pipe for receiving the wastewater from several individual connection pipes from the first incoming individual connection pipe to the point where it joins a wastewater downpipe, rainwater downpipe or collection or ground pipe.

Collecting line

Horizontal pipe laid on the wall or ceiling, which drains wastewater from wastewater downpipes, rainwater downpipes or individual and/or collective connection pipes.

Wastewater (WW)
Collective term for grey water (feces-free) and black water (containing feces).

Wastewater down pipe
Downpipe (generally vertical), which drains dirty water from the sanitary drainage objects.

Black water
Wastewater containing feces.

Separation system
Drainage system that drains rainwater and wastewater in separate pipes.

Bypass line

Secondary line in the area of a downpipe distortion or in the area where a wastewater downpipe joins a collection or ground line.

Ventilation

Ventilation of individual or collective connection pipes that are connected to the dirty water down pipe, the main ventilation or the direct secondary ventilation on the same floor.

9.4 Execution requirements

Worldwide, and especially in Europe, many different drainage systems are used. These different systems, which are due to historical/technical backgrounds, could not be combined into a single drainage system at European level. For this reason, four system types were agreed upon throughout Europe.

System definition

Drainage systems can be divided into four systems. It is pointed out that in Austria, system I is to be used for wastewater.

System I

Single down pipe system with partially filled connection pipes.
The partially filled connection pipes are designed for a filling level of 0.5 (50%) and are connected to a single wastewater downpipe.

System II

Single down pipe system with connecting pipes of small dimensions.
The connecting pipes of small dimensions have a filling degree of up to 0.7 (70%) and are connected to a single wastewater downpipe.

System III

Single down pipe system with fully filled connection pipes.
The fully filled connection pipes have a filling level of 1.0 (100%) and each connection pipe is separately connected to a single wastewater downpipe.

System IV

System with separate wastewater down pipes.
The drainage system is divided into grey water and wastewater. One down pipe that drains wastewater from toilets and urinals and one down pipe that drains wastewater from all other drainage objects.

Mixed system, Separation system

Generally, wastewater and rainwater in buildings must be drained in separate pipes.

Mixed system

If wastewater in the street sewer is discharged according to the mixed system, wastewater and rainwater must be discharged in separate pipes. This separation is to be maintained - depending on the local conditions - as far as possible until it flows into the street canal. Exceptions may be made in this respect.

The filling degree of the wastewater pipe is to be dimensioned with max. 70%.

The filling degree of the rainwater pipe is to be dimensioned with a maximum of 80 %.

Separation system

If wastewater is discharged in the street sewer after the separation system, wastewater and rainwater must (without exception) be discharged in separate pipes.

Execution requirements

This section sets out some basic design requirements for drainage systems. Due to the large number of these, only an excerpt is given here. The listed requirements are quoted from the documents ÖNORM EN 12056-2 and ÖNORM B 2501.

General requirements

There must be a drain point under each tap in buildings.

Drainage objects connected to a drainage system must be connected with an odor trap to prevent sewage gases from escaping into the building. The odor trap height (H) must be at least 50 mm.

The nominal diameter of drainage pipes must not be reduced in the direction of flow.

Drainage pipes are often used to ventilate external ground/collection pipes or drainage systems. Care must be taken to ensure that ventilation lines open to the atmosphere are installed where necessary.

No wastewater pipes may be laid through rooms in which transformers for the conversion of high to low voltage are installed.

In rooms with systems for liquid fuels, only a floor drain in combination with a fuel oil barrier in accordance with ÖNORM EN 1253-5 may be installed. In rooms with installations for liquefied gases, in the vicinity of liquefied gas filling stations and in rooms in which work is carried out with hazardous substances heavier than air (e.g. chlorine gas) or such substances are stored, only a floor drain may be installed which permanently prevents the penetration of gases into the sewer system.

Main pipes in or under statically effective foundation plates must be arranged so that the pipes can be renovated or replaced at any time without endangering the statics of the component.

The noise behavior of a drainage system in connection with the building structure must be considered during planning and installation.

Inside buildings, the possibility of condensation forming on the pipe surface must be considered with rainwater pipes and this must be prevented by suitable measures.

Under no circumstances may room ventilation and WC pan extraction systems lead into drainage pipes and their ventilation ducts.

For semi-detached and terraced houses, separate downpipes, collecting and ground pipes must be arranged within the building for each object.

After emptying and cleaning, abandoned ground pipes, shafts, chambers, etc. must either be closed and filled in with hygienically safe, inert material or bricked in.

Hygiene

Drainage systems must be designed and installed in such a way that the health and safety of users and persons in the building is not affected by:

- Leak in the system,
- Backflow of wastewater into the building,
- Discharge of sewer gases into the building,
- Contamination of the drinking water system.

Cooling systems, fish crates and similar containers for foodstuffs as well as overflows and drains of containers and equipment directly supplied from a drinking water supply (e.g. safety valve of a hot water storage tank) must not be directly connected to the drainage pipe.

Water and gas density

Drainage systems must be sufficiently water- and gas-tight against the operating pressures that occur. No odors or sewer gases may escape into the building from pipe systems inside buildings.

Pipe connections must be able to withstand all expected stresses. They must allow slight movements without any risk of breakage or leakage and be root resistant.

Each drain must have a secured water inlet to supplement the seal water. If this water inlet cannot be ensured, the drain must have a mechanical gas-tight cover in addition to the odor trap.

Rainwater drains in the mixed system must be frost-protected in occupied areas, e.g. for roof terraces, pergolas, and must be provided with a drain trap.

Backwater protection

The relevant backwater level shall be set 15 cm above the level of the next sewer manhole with open channel or inlet grating seen against the direction of flow.

If the relevant backwater level is not obviously recognizable, it must be determined considering the local conditions, such as terrain elevations and crests on the one hand and road depressions, underpasses and flood plains on the other.

Wastewater generation below the relevant backwater level

In many cases, there are drainage objects in buildings that lie below the relevant backwater level. For example, this could be a toilet or a washbasin in the basement of a house.

Discharge with gradient to public sewer

If the disposal point is below the relevant backflow level, the wastewater shall be pumped into the sewer by means of a wastewater lifting system (with backflow loop) or a backflow lifting unit.
A wastewater lifting system or backwater lifting system can be omitted if the following requirements for the use of backwater valves are met:

- rooms are of subordinate use, i.e. that no essential material assets or the health of the occupants is impaired if the rooms are flooded,
- the circle of users is small and a WC above the backflow level is available to them,
- in case of backwater, the use of the drain point can be waived.

Discharge without enough gradient to the public sewer

If there is no sufficient gradient to the sewer or a disposal point is below the relevant backflow level, the wastewater must be pumped into the sewer using a wastewater-lifting unit with backflow loop. A wastewater lifting system for discharging rainwater into the public sewer must be installed outside the building. If a wastewater downpipe with a sufficiently dimensioned main ventilation above the roof is available, the pressure pipe of a wastewater lifting system may be connected to this wastewater downpipe.

<u>Backwater protection for grease separator systems</u>

Wastewater generation above the relevant backwater level

Backwater protection is not required if the installation location of the grease separator is selected in accordance with ÖNORM EN 1825-2 in such a way that the rest water level is above the relevant backwater level.

Wastewater generation below the relevant backwater level Discharge with gradient to public sewer

If the rest water level of the grease separator system is below the relevant backwater level, the grease separator system must be secured against backwater. As backwater protection, wastewater lifting systems with a subsequent backwater loop or backwater lifting systems, each with a mains-independent warning device, are to be provided. The grease separator system and the wastewater lifting system must be ventilated separately. A wastewater lifting system or backwater lifting system can be omitted if it is ensured that the use of the drainage point can be omitted in the event of backwater. In this case, only type 3 backwater valves in accordance with ÖNORM EN 13564-1 are permitted.

Discharge without enough gradient to the public sewer

If the grease separator system is below the relevant backflow level, the wastewater must be pumped into the sewer by means of a wastewater lifting system, with a backflow loop according to ÖNORM EN 12056-4. If the wastewater flow must not be interrupted, a double wastewater-lifting unit is required. The collecting or basic pipe between the inlet of the pressure pipe and the public wastewater channel must be designed according to the pressures that occur.

Wastewater quality

Suitable facilities, such as separators or neutralization plants, shall be provided for wastewater containing hazardous, toxic, nuisance or other substances, which attack the materials of the pipe system and have a detrimental effect on the operation of drainage systems or wastewater treatment. Domestic or animal waste (e.g. garbage, manure) and wastewater from agricultural operations (e.g. from cesspools) may not be fed into drainage systems (house canals, street canals). Waste shredders must not be installed in drainage systems.

10 Rainwater utilization

10.1 General information

The use of rainwater has recently been considered more and more often by the building owner. In the building permit of the individual municipalities this use is also already prescribed, often the accumulated rainwater has to seep away on the own property and therefore a use of this water is obvious.

The rainwater is collected and can be used for the following applications:

- Garden irrigation
- WC flushing
- Washing machine water

Up to 71 l/person and day can be saved by using rainwater.

10.2 Why use rainwater?

The following reasons should convince us to make the investment costs for rainwater utilization.

Rainwater for a future worth living: Environmental protection is necessary to keep the world worth living for our children. With a rainwater utilization system, you are actively committed to the environment and thus to the future of our children.

Environmental awareness in the zeitgeist: With a rainwater utilization system, you show that you can combine modern technology with ecological awareness. This is contemporary.

Rainwater utilization can do a lot: Thanks to modern technology, rainwater is used reliably and hygienically harmlessly for garden irrigation, but also for the operation of toilets, washing machines and many other areas where the use of valuable drinking water would be a waste.

Rainwater utilization is state-of-the-art environmental technology: The environmental technology of our specialist companies in the field of rainwater utilization enjoys the best reputation worldwide. Your plumbing and heating engineer has the knowledge to integrate this technology into your building services with professional competence.

Using rainwater saves money: Up to 60 % of drinking water can be saved by using rainwater - in many places there are also subsidies. Even more important, however, is the conservation of the vital resource water.

Rainwater utilization - as natural as waste separation: Rainwater utilization will soon be as common as waste separation. This is an important prerequisite for getting involved in rainwater utilization right now.

Rainwater utilization in the house is safe: Modern rainwater utilization systems meet the high requirements of German water regulations (which are among the strictest in the world) easily and safely.

With rainwater utilization, you are self-sufficient: New technologies give us back a bit of independence from the utilities.

Rainwater utilization - Technology with a future: In recent years, we have recorded a disproportionately high increase in the installation of rainwater harvesting systems - this too is proof that your investment is future-proof.

10.3 Basics of rainwater utilization

Determine yield

First, the catchment area must be determined. This includes the roofs of buildings including the roofs of outbuildings, e.g. garages or carports, if they are fed in for rainwater utilization. Only the projected area is ever used for the catchment area.

Annual precipitation of the place of residence, e.g. Austrian average value 1200 mm (corresponds to 1200 liters per m^2) multiplied by the roof area (length x width at the height of the eaves). The result is 75% of the available yield. The losses occur when the roof is wetted, and the storage tank overflows.

Local precipitation data can also be obtained from the responsible weather office.

Determine demand

The required water demand for rainwater must also be determined in order to select an optimal storage tank size.

Determine storage size

Experience has shown that an optimal storage size can hold approximately the supply for 3 weeks.

- The water quality in the storage tank decreases with larger storage volumes
- With smaller volumes the need for replenishment of drinking water is too high
- If rainwater is primarily used for garden irrigation, the range of the tank may also be extended
- Avoid oversizing a storage tank
- Periodic overflow of the storage tank is desired
- Overflow supports the self-cleaning of rainwater
- Surface contamination is rinsed out (skimmer effect)

Selection of the investment system

Generally, only high-quality products should be used for the core of a well-functioning rainwater utilization system. Inefficiency and low wear resistance with many cheap products are paid dearly during operation.

Requirements for a pump or a domestic waterworks:

- Demand-oriented design saves energy
- High efficiency, low electrical and hydraulic losses

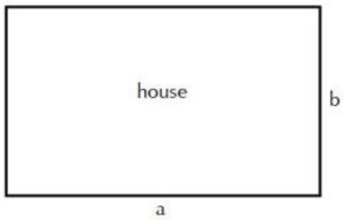
Use of non-corrosive materials

Operational safety due to high-quality mechanics

- Low noise emission
- Dry-running safety
- No stagnation areas for water inclusions

Calculation basis

Determination of the roof area:



Catchment area: A = a x b (m²) Discharge coefficients:

- Flat roof, planted = Discharge coefficient: 0.20
- Gabled roof, planted = Discharge coefficient: 0.25
- Flat roof, gravel) = Discharge coefficient: 0.60
- Flat roof, panels = Discharge coefficient: 0.70
- Saddle roof, tile = Discharge coefficient: 0.75
- Saddle roof, panels = Discharge coefficient: 0.80

The discharge coefficients are used to calculate the storage tank size. In the case of planted or bitumen-covered roofs, the use of rainwater systems should be checked in each individual case.

Filtering

The roof drainage water is to be passed through a filter before being stored; a mesh size of 0.3 to 1.8 mm has proven to be economical.

- It has been shown that a mesh size between 0.3 mm and 1.8 mm ensures both good filtering and a good service life of the filter (compliance with the criteria for building drainage according to DIN EN 12056)
- Max. of 300 l/(s x ha) must be able to pass the filter without backwater
- Passability even when the filter is clogged, or the tank inlet is shut off
- The cable cross section must be guaranteed throughout
- With free connection to the duct, the ball passage must be maintained throughout

Criteria for the selection of the filter:

- Good accessibility
- Simple cleaning without follow-up costs
- Maintenance must be quick and easy

- Low maintenance
- Frost resistance
- No clogging or clogging of the filter, no germs, no algae

  Reliable filtration of coarse and small particles from roof runoff water

  Long-term good filter effect with high efficiency
- High material resistance
- If possible, first discard (see Vortex Fine Filter (WISY))

Storage

Rainwater storage tanks are not only used for the pure storage of roof drainage water. A biological self-cleaning process also takes place. The cleaning performance depends on the water flow in the tank and the design of the inlet, overflow and suction. This applies to both outdoor and indoor storage tanks Storage requirements:

- Reservoirs are building products, therefore special attention must be paid to durability
- Dimensional stability
- Buoyancy safety
- Permanent water and light impermeability
- Frost resistance
- Calmed inflow of the precipitation water
- Safe overflow, avoidance of backwater, sewer gases and small animals
- Good accessibility
- Permanently sealed pipe inlets for inlet, outlet and technical empty pipe

A distinction is made between external and internal storage tanks. External storage tanks are manufactured much more often than the internal version.

Indoor storage tanks are suitable for retrofitting or renovation or in new buildings when earthworks are not required. The internal storage tanks are usually designed as battery tanks (see fuel oil storage tank) and are therefore flexible in terms of volume. Indoor storage tanks require an overflow above the backwater level. Otherwise an inlet barrier must be installed, since even a lifting unit does not provide 100% protection against flooding. Ground storage tanks are always preferable to internal storage tanks. There is no clear recommendation whether storage tanks should be made of concrete or PE.

Concrete storage tank:

- Suitable for installation in traffic and parking areas
- Are usually ready for connection with integrated filter, inlet and overflow
- High stability for outdoor use

- Flexible holes for inlet and overflow as well as variable installation depth
- With calculated buoyancy control insensitive to high groundwater levels
- Assembly effort is higher due to crane use
- Excavation pit must be easily accessible
- Load capacity class A-D

Polyethylene (PE) storage tank:

- Low weight enables convenient transport

  Easy settling into the excavation pit

  Well suited for difficult to access excavation pits

- Are usually ready for connection with integrated filter, inlet and overflow • Load capacity class A-D

Cover			Load
Class A:	Walkable	Pedestrian paths, cycle tracks	15 kN
Class B:	Conditionally passable	Pedestrian routes, pedestrian zones, car parking areas, parking decks	50 kN
Class C:	Restricted passable	kerb area (up to 0,5m under the road surface)	125 kN
Class D:	Passable	Roadways, hard shoulders, parking areas, suitable for trucks, logistics and industrial areas with forklift traffic	400 kN
Class E:	Passable	Dock facilities, airport taxiways	- kN
Class F:	Passable	Airport taxiways	- kN

Table 11: Load Capacity

It is also possible to convert former septic tanks or oil tanks for rainwater utilization, but this requires professional cleaning and lining.

Inlet, overflow and drain lines

The dimensioning, regular inspection and maintenance, as well as the selection of the pipe materials to be used must be in accordance with ÖNORM EN 12056 and the underground drainage pipes must comply with EN 476. Overflow pipes must be fitted with an odor trap and the penetration of small animals and sewer gases must be prevented. The installation parts must not reduce the cross-section. The floating layer in the storage tank must be drained through the overflow pipe. Ventilation pipes shall be arranged so that surface water, leaves and rubbish or small animals cannot enter the reservoir.

The rainwater is cleaned in 3 stages:

1. filtration e.g. vortex filter or downpipe filter
2. sedimentation in the reservoir (sedimentation)

3. overflow

After filtering, the precipitation water is stored in the tank. The storage tank also serves as a further purification stage. The oxygen-enriched rainwater is led downwards in the storage tank via a flow-calmed inlet without turbulence. Dirt particles, which are heavier than water, form a bottom sediment layer, which takes over a clarification function through constant oxygen input and microbiological processes.

With reliable filtering in front of the cistern, the sediment layer only grows by a few millimetres a year, so the cistern should only be cleaned at long intervals (5 - 10 years). Only with a calmed inflow, there is no constant turbulence of the sediment layer on the one hand, and on the other hand, oxygen is introduced into the sediment layer even with small amounts of rain.

The purpose of the overflow is to ensure that when the cistern is full, the water can be fed into the canal or an infiltration system. Through the overflow, a further cleaning stage of the reservoir is achieved by flushing off floating particles such as pollen, etc. A periodic overflow of the memory is definitely desired. The overflow of the tank supports the self-cleaning of the rainwater by flushing pollutants floating on the surface of the storage medium out of the tank. The diameter of the overflow must be dimensioned at least as large as the feed line and must be below the feed line.

Siphon and small animal barrier protect the reservoir from sewer gases and animals. The reservoir must be protected against backwater from the sewer or infiltration system. If the overflow is not backwater-proof connected to an infiltration system or a rainwater sewer, a backwater seal is sufficient. When connecting to a combined sewer, on the other hand, a lifting unit must be used if there is a risk of backwater. This lifting unit is designed according to DIN 1986-100 with $r_{5,100}$ (5 minutes for a 100-year rainfall event).

The water should be extracted by means of a floating suction pipe, because here the filter attached to a floating ball extracts the clean water below the water surface. If a foot valve is permanently installed, the rigid suction pipe must end high enough above the cistern floor that no suction is drawn from the sediment layer.

Calculation example:
Calculation of yield:

- Precipitation amount per year = 1000 l/m²
- Projected roof area = 100 m²
- discharge coefficient = 0.75

This results in a rainwater yield/year of 75,000 l/year. Divided by 365 it results in 205.5 liters per day.

Demand assessment

Toilet without economy button (per person) = 14 m³/year

Washing machine (per person) = 6 m³/year

Therefore, the demand per person is 20 m³/year. If there are four persons in a household, this results in a demand of 80 m³ per year.

If we include garden irrigation ($6m^3$/year per 100 m^2) and assume 200 m^2 of garden surface, an additional 2 * $6m^3$ = $12m^3$/year are added to the 80 m^3, resulting in 92 m^3/year of demand. Divided by 365 a daily demand of 0.252 m^3 /day = 25.2 liters per day.

Storage determination

A stock for 2 to 3 weeks is considered optimal.
Daily demand in m^3 multiplicated by 15 days equals the storage demand in m^3. Therefore, 0.252 m^3 * 15 = 3.78 m^3 storage demand.

The following documents were taken from a brochure by umweltberatung.at (utilize Rainwater):

Dimensioning of a rainwater utilization system

The correct size of the memory is of crucial importance. If the volume is too small, the efficiency of the system is reduced. If the system is too large, the long service life of the water can lead to hygienic problems and odor problems.

The size of the storage tank depends on the roof area, the amount of precipitation and the respective consumption data. As an empirical value for existing systems, an average storage tank size of 1 to 1.5 m^2 per person can be assumed. Before planning the system, it is essential to carry out an exact calculation of the storage size.

Calculation of the storage size

A simple formula can be used to calculate the rain yield, the rain requirement and the optimum storage size. The following information and calculations refer to a design period of one year.

Rain yield
This provides you with information about the amount of rainwater that is theoretically available to you throughout the year. Losses due to overflow are not considered here.

The projected roof area is the floor area of the house, regardless of the pitch or roof shape. The precipitation value indicates the local annual rainfall. It can be read from rainfall maps or obtained from the responsible municipal office or the Central Institute for Meteorology. The discharge coefficient is a measure of the rain retention capacity of the roofing material. The smaller the value, the more water is absorbed or evaporated by the roofing material.

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Discharge coefficients

- Glazed clay bricks – 0.9
- Clay bricks, slate, concrete blocks – 0.8
- Flat roof with gravel fill – 0.6
- Green flat roof – 0.4

Calculation of the rain yield

Multiply the projected roof catchment area (in m^2) by the annual precipitation (in l/m^2) and the discharge coefficient.

roof area (m^2) x precipitation (liter/m^2) x discharge coefficient = yield (liter)

10.4 Exercise example

Determine a rainwater harvesting system:

Basic roof area 13 x 11m (monopitch roof with 7° roof pitch and pure zinc covering) 4 person household with 1350m² ground (of which approx. 1000m² greened)

Location: Graz Umgebung (precipitation data) Calculate the memory size using both methods!

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(Solution: Storage size 5m³ or 7m³)

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Work Package 4: Second centre level "Continuing vocational training" (EQF Level 4-6)

Activity A6: Trainings in the Green Economy

Best Practice Curriculum

Training E – Cradle to Cradle in SMEs

Developed by:

Hungarian Association of Craftsmen Corporation (IPOSZ) in 2020 in the Project "Management and Technologies of Water, Waste Water, Waste and Circular Economy (WWW&CE)"

Prepared by:

Wirtschaftsförderungsinstitut (WIFI) Steiermark

August, 2021

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Chapter 1: Executive Summary

The course "Cradle to Cradle in SMEs" was developed in the project "Management and Technologies of Water, Waste Water, Waste and Circular Economy – WWW&CE", which was funded by the Erasmus+ Programme of the European Union. Eleven partners from seven EU Member States developed tools according to work-based learning principles that are piloted and evaluated. For more information: https://www.sa-ce.eu

The course is designed according to the qualifications on the European Framework Qualification Level 4 to 6. Furthermore, the six courses are primarily designed for young people with strong learning skills for vocational training. All courses of the WWW&CE project shall direct participants and in further sequence small and medium sized companies towards a more environmentally conscious approach to their personal and business objectives in order to generate a more sustainable world.

The main objective of the course "Cradle to Cradle in SMEs" is to equip the participants with valuable knowledge of the Cradle-to-Cradle concept, in order to be able to implement C2C strategies in their companies and thus promote the development of C2C-inspired designs. The participants will internalise the benefits of the C2C concept and contribute to the positive environmental development of the companies and their competitiveness within the market.

Chapter 1.1: Name of the Course

"Cradle to Cradle in SMEs"

Chapter 1.2: Contact Details

WIFI Steiermark

Körblergasse 111-113

A-8010 Graz

Tel.: +43 306 602 1234

Fax: +43 316 602 301

E-Mail: info@stmk.wifi.at

Web: https://www.stmk.wifi.at

To be adapted by each partner

Chapter 1.3: Need and Type of Course

Large enterprises are often already facing ecological production, circular economy and sustainability for a long time or are beginning to be aware of these topics. However, the engagement of SMEs with these issues often lacks due to insufficient knowledge about strategies and measures of implementation or simply financial resources. During special seminars for SMEs, this knowledge gap is to be closed by measures adjusted to the SMEs conditions and needs.

After the training, the participating SMEs should be aware of the huge amount of possibilities circular economy could offer them. Especially profound knowledge about the Cradle to Cradle (C2C) design and the feasibility of its implementation should be gained eventually.

Chapter 1.4: Target Group

The first priority belongs to owners, management personnel and employees of small and medium-sized enterprises – basically from all branches. Generally, Business founders and potential business founders from all branches. Scientists and consultants dealing with economic questions and furtherance of SMEs during research and consulting. In addition, Students who are interested in preparing seminar and bachelor works related to C2C in SMEs or would like to work in SMEs after completing their studies. People, who are temporarily unemployed and would like to improve their chance for employment through visiting the seminar.

Chapter 1.5: Course Duration

The course is divided into three parts:

- Part 1: First Workshop

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The first workshop should be held during two consecutive days; all weekdays are possible; with regard to the lack of time of SMEs Friday and Saturday, for example, are the best variant. The workshop should be approximately 12 – 15 clock hours (=16 – 20 class hours, 45 minutes each).

- Part 2: Self study and Project work

  The time frame for the second part should be approximately 12 weeks; at least 9 and maximum 15 weeks and consists of 150 -180 hours of work.

- Part 3: Final Workshop

  The final workshop should be held during two consecutive days; all weekdays are possible; with regard to the lack of time of SMEs Friday and Saturday, for example, are the best variant. The workshop should be approximately 12 – 15 clock hours (=16 – 20 class hours, 45 minutes each).

Overall, the course amounts to 174 to 210 hours.

Chapter 1.6: Teaching Units

Teaching Unit 1: Strengthening awareness

Small and medium-sized enterprises are often struggling with fulfilling the demands on the market in order to continue with their existence and work. Hence, there is seldom time and capacity for overthinking their strategies and ways of production.

C2C includes a circular economy with a 100% recycling rate of all produced goods. The participating SMEs should at the end of the seminar be aware of the innovative and important solutions of Cradle to Cradle. It is important that the training seminars are coordinated with the specific needs which are different for every SME. Enterprises are affected by C2C in various ways and thus, the possibilities for a successful implementation differ from SME to SME.

According to the C2C concept itself, an implementation of a comprehensive quality concept by knowing the exact composition of products/materials/ingredients and the subsequent input into (recycling) systems is fundamental.

In order to make a potential C2C implementation possible, SMEs in all branches have to be aware of the following tasks.

- Definition of the inputs (composition of the material flows, “know what it is”) with respect to high quality recycling
- Positive Definition (e.g. knowing the exact composition of)
- Collective understanding of recycling
- Set new standards of innovative product development for the industry by defining “positive”, beneficial and innovative products and developing an eco-effective business model for different branches.
- Creating products whose re-entrance into production is already taken into account at the product design stage.
- Improving lifecycle management into nutrient management to biological / technical metabolisms.

Teaching Unit 2: Developing potential qualification needs

Since every enterprise brings along different preconditions and capabilities, the C2C approach has to be adapted to the special needs of every single SME. A universal design or approach would only prevent the enterprises from reaching their full potential.

Special terms for enterprises in the building and construction sector for the C2C potential could be as follows:

- Change of thinking from C2C perspective: Regard of a building as a raw material base
- Deeper knowledge about properties and ingredients of construction products
- Define construction materials for biological or technical cycles
- Use of Cradle to Cradle Certified TM construction materials (LEED points possible under certain preconditions)
- Design of underground construction materials according to biological environment (e.g. no release of toxic metals)
- Roof greening for improved room climate and diversity
- Include defined C2C elements in new buildings
- Integrate renewable energy
- Water recycling measures
- Regard CO2 as a resource e.g. for vegetation instead of capturing and storing

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During the seminar, the SMEs need to receive deep knowledge about the possible chances and benefits they would face by using the C2C approach.It is important that the trainers examine the different qualification needs of the SMEs during the training in order to ensure a specific and detailed strategy of C2C.

Issues as

- financial resources
- capabilities in terms of skilled employees
- sales market conditions
- costumer services
- types of sales products

have to be considered while jointly developing a probable scenario. Especially essential is – next to the financial capabilities of the SME – how the goods produced by using the C2C design would perform on the sales market. It is possible that the market conditions in certain regions or the sales of certain companies would not respond positively to the C2C products.

In order to transform the gained awareness of circular economy, eco-efficiency and eco-efficacy into specific SME-adapted strategies, the initially stated circumstances have to be developed by the SMEs together with the consulting trainers during the seminar.

Teaching Unit 3: Developing certain strategies

Since the SMEs cannot develop strategies for implementing the C2C system by themselves, consultation is needed. C2C is an innovative, important but also demanding concept. In order to ensure that the SMEs make the most possible out of their will to work with C2C, strategies and measures have to be developed and implemented after considering their own demands and conditions. Together with the trainers who consult the SMEs in every step of the probable C2C implementation, these are created, transferred and evaluated. Thus, an application of C2C is feasible in the long term.

Chapter 2: Concept of the Training

Chapter 2.1: Objectives of the Participants

The objective of the participant is …

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a)….to receive a detailed understanding of the Cradle to Cradle® concept;

b) …to become interested in the practical implementation of C2C as well as initiating C2C inspired changes in own enterprise;

c) …to initiate first steps of implementation of a C2C project in their respective enterprise;

d) …to realise advantages through C2C for their own enterprise and be motivated to continue project work.

Chapter 2.2: Structure and Progress

Part I

One and a half days of training (knowledge transfer and best practice)

- 1st Day
  - 2pm - 7pm knowledge transfer + best practice
  - 7pm - 9pm exchange of experiences over dinner

- 2nd Day
  - 9am – 1pm knowledge transfer + best practice
  - 1pm – 2pm exchange of experiences over lunch
  - 2pm – 5pm knowledge transfer + best practice

C2C knowledge transfer and best practice	
Purpose	The first part serves the purpose of knowledge transfer, communicating best practices and the current state of C2C implementation, as well as the development a programme for independent exercise (Part II). The training in this first part should clarify and points and doubt about the application of C2C principles in the participants' area of expertise.
Day 1	
2pm – 2.45pm	**Module A: Introduction** • Introduction and expectations of participants • Thematic introduction into the topic

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	Break
3pm – 4.45pm	**Module B: C2C Design** • Three C2C principles • Biological and technical metabolism • Methadology: EPEA Assessment (methodology of ingredients) • C2C certified^{CM} programme as communication instrument (branding and marketing)
	Break
5 pm -7pm	**Module C: C2C Prototypes and Case Studies** • Presentation and discussion of C2C prototypes for SMEs and implementation modalities
Day 2	
9am – 1pm	**Module D: Innovation workshop (group work)** • Presentation of participants (products, processes, materials) • Brainstorming, discussion (potential C2C product innovation, preference list, know-how-trustee function of EPEA, roadmap, C2C instruments) • Advantage and opportunities for enterprises implementing C2C
	Lunch
2pm – 5.30 pm	**Module E: Roadmap** • Definition of project work of participants in own enterprises • Process/pipeline of project work and framework of contractual agreements
	Break
5.45pm – 7pm	**Roundup** • Organisational questions (which trainer will support which SME-project, when are meeting-times, how arranged, HandOuts, Guidance Sheets) • Concluding remarks
Training Methods	Lecture, visual material etc.
Training Materials	C2C Presentation (pdf/ppt), links to C2C videos etc.

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Part II

The second part encompasses 12 – 18 weeks of independent study and project work in respective own enterprises.

Participants receive coaching from their trainer (identified in 1st part). Coaching will take place 3 times and last 2 hours each. This includes:

I. One Meeting in the beginning to determine and agree on the topic of the written exercise; as a workshop or individual coaching?
II. One in the middle of the independent study period (discussion, draft and model); as a workshop or individual coaching?
III. One handing in the written exercise to evaluate the results of the independent study. as a workshop or individual coaching?

Furthermore, participants should receive the opportunity to meet with other participants for an exchange of their respective experiences, e.g. provision of materials, addresses, contacts, or electronic exchange.

Applying C2C methods – self study	
Purpose	This second part is for participants to apply C2C methods independently in their own respective enterprise, and to implement a concrete C2C project in their enterprise.
Week 6	**Module F: Workshop I** • After two weeks the participants are to hand in the theme and abstract of their first written work, which will be assessed by their teachers. • This written exercise should for instance comprise proposed changes in the enterprise (goals, action plans, milestones reached etc.) and should include a planning, what the process/roadmap of the enterprise should be after the third part.
Week 14	**Module G: Project workshop II** • A second written exercise will be completed and discussed in the company: developing a value-driven model for the company

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Training Methods	One-to-one mentoring, written work etc.
Training Materials	C2C handbook etc.

Part III

One and a half days of analysing project work, distillation of advantages and opportunities for enterprises, further knowledge sharing and proceedings.

- 1st Day
    - 2pm - 7pm knowledge transfer + best practice
    - 7pm - 9pm Exchange of experience with dinner
- 2nd Day
    - 9am – 1pm knowledge transfer + best practice
    - 1pm – 2pm Exchange of experience with lunch
    - 2pm – 5pm together with other representatives of the enterprises reflect and exchange experiences on the programme and potential continuation for enterprises

Exchange of experiences and next steps	
Purpose	The purpose of the third part is primarily to reflect and exchange experiences. In this context, the participants should have the opportunity to dive into greater depth should they desire. For this reason, there can only be limited prescription of content for the individual modules of this part of the programme. Potential modules and respective focus points are:
Day 1	
2pm – 3.45pm	**Module H: Exchange and reflections** • Reports/experiences by participants • Reflection of participants' project-workshops • Planning next steps
	Break
4pm – 4.45 pm	**Module I: Model and instruments** • Assessment and certification • Roadmap

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	• Communication and branding • SME Prototypes
	Break
5pm – 7pm	**Module J:** • Further in-depth study of individual modules depending on the needs of the participants
Day 2	
9am – 1pm	**Module K: Outlining the steps to implementation** • **Step 1 –** Have a look at the situation of your company • **Step 2 –** Find out what's already there to build upon • **Step 3 –** Identify what is needed to be even more helpful to employees and customers • **Step 4 –** Find indicators of achievement • **Step 5 –** Make a plan on how to implement activities • **Step 6 –** Check how the outcomes are and adapt activities accordingly
	Lunch
2pm – 5pm	**Module L: Steps ahead** • Roadmap after project • Long-term strategy, in terms of product/service development in C2C, network, etc. • Exchange experiences with others and potential continuation of project

Chapter 2.3: Teaching Material

Teaching Material:

C2C presentation, links to C2C videos, C2C handbook …

Chapter 2.4: Further recommendations

Learning methods: lecture, presentations, discussions, projects, one-to-one mentoring …

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Chapter 2.5: Requirements for the trainer's qualification:

The trainer must meet the requirements for a VET trainer by the procedure established by national legal acts.

Chapter 2.6: Testing of the Competence Level

- The whole training consist of three parts and comprises between 200 to 275 contact hours.
- In Germany, the training ends with an official examination with a recognised continuing education qualification.
- In the other countries, an internal examination is to take place, which can be carried out on the basis of the German examination regulations.
- Each participant should receive:
  - A certificate with the examination results
  - In any event, a qualified participant certificate in accordance with the model below. The training is concluded with an examination.

Logo Project Partner

Confirmation of attendance

Name of the participant

Name of the company

took part in the advanced training with the topic

Cradle to Cradle in SMEs

That was carried out within the EU co-financed project "Management and Technologies of Water, Wastewater, Waste and Circular Economy" (Project No. 600835-EPP-1-DE-EPPKA2-ssa).
The advanced training was carried out from *(date)* – *(date)* in *(city, country)*. It consisted of 3 training parts, in which the following contents were imparted, knowledge deepened and applied in practice:

Part I: 12 Hours

- Module A: Introduction of the SME-Training, curriculum and goals
- Module B: Cradle to Cradle® design concept
- Module C: Cradle to Cradle® prototypes, case studies and Cradle to Cradle® use in SMEs
- Module D: Cradle to Cradle® Toolbox and Roadmap
- Module E: Roadmap development
- Module F: Development of the outline of the own Cradle to Cradle® project

Part II: 150-180 Hours

- Practice: Processing an own Cradle to Cradle® project and implementation in the company, accompanied by individual coaching

Part III: 12 Hours

- Module G: Exchange of experiences and reflections
- Module H: Presentation and consultation of results of all individual projects
- Module I: Models and instruments
- Module J: Further in-depth study of individual modules
- Module K: Outlining the steps to implementation
- Module L: Cradle to Cradle® workshop with other persons of the company: practice meets science; new developments; planning in the company

…………Place, Date…………….

Signature
Name, Position
Implementing
Institution

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Chapter 3: Teaching Material

The teaching material can be found in the pdf file entitled "3LoE_WP4A61_E_TeachingMaterial".

Annexes

Content

Annex 1

Legislation for the further training examination for designers of sustainable products and services for small and medium enterprises (HWK) in accordance with § 42a HwO.

The Schwerin Chamber of Crafts will implement the following statutory provisions for further training examinations for the recognized degree of "Designer of sustainable products and services for small and medium enterprises (HWK)" in compliance with the ruling of the vocational training committee of 17th. March 2016 and the General Assembly on 10th. May 2016 in accordance with § 44 para. 4 and § 106 paragraph 1 No. 10 Handicrafts Regulation (HWO) in the version published on 24th. September 1998 (BGBl.I 3074;.. 2006, I S.2095), last amended by Article 283 of the Act of 31.08.2015 (Federal law Gazette I p 1474), as the competent authority in accordance with § 71 paragraph 1 of the vocational training Act of 23 March 2005, the last by Art. 436 of the Act of 08.31.2015 (I, p. 1474), in connection with § 42a and § 91 paragraph 1 No. 4a HWO

§ 1 Purpose of the examination and designation of the degree

1) The examination for designers of sustainable products and services for small and medium enterprises (HWK) is intended to determine whether the candidate possesses the necessary knowledge, skills and experience required for the development of Cradle to Cradle (C2C) design in small and medium-sized enterprises in craft-oriented functional areas.

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2) A successful pass in this examination leads to a recognized degree in design of sustainable products and services for small and medium enterprises (HWK).

§ 2 Requirements

The examination is to admit those who have:

1) successfully passed a Master Craftsman's examination in a skilled trade or have passed a commercial training test.

2) Further to Paragraph 1, admission to the examination may also be granted on presentation of certificates or otherwise, as proof that the requisite knowledge, skills and experience have been acquired in previous activities and can justify admission to the examination.

§ 3 Structure, content and duration of the test

1) Theoretical fundamentals

In the first part of the examination, basic knowledge will be tested in the following fields of activity:

a) analysis of operating conditions with respect to their current and future potential for the implementation of sustainable products and services

b) submission of economically viable proposals to support Cradle to Cradle measures

c) activities for the implementation of Cradle to Cradle measures in the operation

d) assessment of the operational suitability of Cradle to Cradle measures

e) development of optimization suggestions for improvement of Cradle to Cradle measures.

§ 4 Consideration of previous examinations

1) The examinee can apply for exemption from the Chamber examination in individual areas of action, if he/she has passed a previous examination before a competent authority, a public or state accredited educational institution or before a state examination board whose content requirements correspond to the respective fields of activity.

2) A complete exemption is not allowed.

§ 5 Passing the written and oral examinations

1) The examination results in the parts stipulated in § 3 must be assessed separately.

2) The number of points obtained in the three papers for the oral and written examinations should be summarized into a total score. The final grade is therefore:

15% from the first part of the examination,

25% from the written examination in the second part of the test,

40% of the project work in the third part of the test and

20% of the technical discussion in the third examination.

3) The written test in the second part of the examination is to be supplemented by an oral examination if this can tip the scales in passing the test. The oral examination should not last longer than 15 minutes per test.

4) The test is successfully passed if the performance achieved is at least adequate in each part of the examination.

5) A certificate is issued to confirm the passing of the test; this must show the final grade.

§ 6 Retests

(1) An examination which was not passed can be repeated twice.

(2) If the candidate has passed individual sections of the examination but has not performed at least adequately in sections in accordance with §3, the parts successfully passed must not be repeated on further application, provided that the candidate has filed for reassessment within two years from the date of the declared result of the failed examination. The assessment of the examination will be made with regard to this factor.

§ 7 Application of other provisions

Insofar as these provisions do not depart from the regulations, the training examination regulations of the Schwerin Chamber of Crafts are applied for non-craft occupations in the current version.

§ 8 Commencement of effect

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These regulations and their publication on the website www.hwk-schwerin.de under the heading "legal bases" take effect following their publication in the Official Gazette of the Schwerin Chamber of Crafts (Northern craft).

Annex II

Guidelines and check list for conducting of the C2C seminar for small and medium sized enterprises

Suggestions and recommendations	Check
A) Objectives of the seminar	
a) Communication of a substantiated overview and deep understanding for environmental protection, health and circular economy and meaning thereof for SMEs	
b) Learning about principles, biological and technical circulation and also Cradle to Cradle procedures	
c) Transfer of knowledge and skills for the evaluation of SMEs from the point of view of the Cradle to Cradle and identification of approaches for the implementation of C2C	
d) Start of Cradle to Cradle realization and implementation of C2C projects in SMEs	
B) Target groups of participants	
1. The first priority belongs to owners, management personnel and employees of small and medium-sized enterprises – basically from all branches	
2. Business founders and potential business founders – basically from all branches	
3. Scientists and consultants dealing with economic questions and furtherance of SMEs during research and consulting	
4. Students who are interested in preparing seminar and bachelor works related to C2C in SMEs or would like to work in SMEs after completing their studies	

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5. Persons who are temporarily unemployed and would like to improve their chance for employment through visiting the seminar	
C) Announcements and information for participants	
Avoid using the term "Cradle to Cradle" because it is hardly known. Instead of this circular economy, recycling and health should be mentioned.	
It should be emphasized that it's about environmental protection and about production and sale of **healthy** products.	
For the target groups specifically the importance and also advantages and benefits of participation should be emphasized, for example a) Health is a rapidly growing market: market success and intensive sales promotion through healthy production and healthy products b) Consumers and other customers are always more conscious in relation to the environment: stronger image building in environmental protection c) Raw materials are becoming scarcer and more expensive: saving energy and raw materials costs d) Public sector customers and major industrial enterprises will more often award contracts to those enterprises which implement circular economy; for example, already today in Holland e) Pioneer advantages are implemented through moving to the circular economy at an early stage f) To a large degree product innovation are achieved with the extension and improvement of existing products and services and also of new products and services; therefore, the future-oriented guarantee of sales and growth is obtained g) Strong increase of attractiveness and improved image for specialists and customers	....
Information should be distributed repeatedly in writing through various media and especially intensively personally, for example, during personal conversations, at meetings, during other further trainings, through consultants etc.	

Special emphasis that the participation and important qualification are **free of charge**. In case of future implementations participant fees are levied!	
D) Winning participants	
Preliminary and repeated announcement of the seminar in specialized magazines, at websites, in newsletters, circular letters etc.	
Production of posters or banners with invitations to the seminar and placement thereof in educational institutions, chambers, high schools etc.	
Sending personal letters of invitation with the indication of date and reply sheet through post and/or mail; at least 50 times more potential participants should be served than the desired number of participants	
Repeated telephone follow-up campaigns for registered potential participants	
Holding press meetings and sending press releases in order to achieve publications in the daily press with invitations to the seminar	
Engagement of disseminators (e.g. consultants, teaching staff etc.) who speak to potential participants personally and hand over letters of invitation	
At every opportunity personal contact, informing and consulting of potential participants	
Winning at least 15 (optimally 25) participants who will register obligatorily and participate in all 3 parts of the seminar	
As a basic principle persons from all branches and fields of activity participate in the seminar. If possible participants for chosen related branch groups should be addressed and obligatorily won over in order to facilitate the holding of the seminar. In case the number of applications is too low a variety of different branches can also be represented.	
E) Structuring of the seminar and employment of lecturers	
E 1) The first part: workshop	
The first workshop should be held during two consecutive days; all weekdays are possible; with regard to the lack of time of SMEs Friday and Saturday, for example, are the best variant. The workshop should be approximately 12 – 15 clock hours (=16 – 20 class hours, 45 minutes each).	

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The corresponding implementing partner is responsible for the whole preparation, implementation, moderation and support of participants of the seminar.	
Lecturers the teaching staff of the implementing partner and/or lecturers on a fee basis are employed – preferably persons who have participated in the Train the Trainer seminar. The employment of the teaching staff, range of tasks and division of responsibilities should be obligatorily agreed upon in a timely manner.	
E 2) The second part: self-study and project work	
The second part should be approximately 12 weeks; at least 9 and maximum 15 weeks.	
The corresponding implementing partner is responsible for the implementation of the second part. The employment and tasks of the teaching staff should be obligatory agreed upon in a timely manner. During the whole second part the support, the backing and the consulting of participants must be obligatorily provided by the own teaching staff and/or by lecturers on a fee basis.	
E 3) The third part: final workshop	
The final workshop should be held during two consecutive days; all weekdays are possible; with regard to the lack of time of SMEs Friday and Saturday, for example, are the best variant. The workshop should be approximately 12 – 15 clock hours (=16 – 20 class hours, 45 minutes each).	
The corresponding implementing partner is responsible for the whole preparation, implementation, moderation and support of participants of the workshop	
As lecturers the teaching staff of the implementing partner and/or lecturers on a fee basis are employed – preferably persons who have participated in the Train the Trainer seminar. The employment of the teaching staff, range of tasks and division of responsibilities should be obligatorily agreed upon in a timely manner.	
F) Conducting of the seminar	
F 1) Period for conducting	

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All 3 parts of the seminar must be conducted within the period from May 2020 till the end of April 2021 at the latest and must be completed in full.	
F 2) Materials for the conducting	
a) Curriculum b) Analyses of labour and education markets in Baltic Sea Region c) Qualification needs of the SMEs e) Power Point presentation g) Available check list h) Publications in the Internet under "Cradle to Cradle"	
Suitable seminar documentation should be prepared for the participants and distributed during the first workshop.	
F 3) Structuring of the first workshop	
a) Welcoming, introduction of participants and also goals and procedure of the whole seminar and of the first workshop The seminar must be consequently oriented at the needs of SMEs and their capabilities and also it must be based on the background experience of participants. b) Introduction and overview of the Cradle to Cradle, basic principles, biological and technical circuits, use of regenerative energies etc. c) More detailed studies of the Cradle to Cradle on the basis of SME prototypes and use thereof in SMEs d) Work in small groups (3 – 4 persons each) with reflection of the communicated material on the basis of the own enterprise and of the personal background experience e) Presentation of group results and discussion f) Examples for the first steps and for C2C use in SMEs with deeper studies of the C2C concept, for example: + A producer of conventional workwear in Hamburg expands the range of his products through the additional purchase of C2C workwear, he makes first	

experiences, wins over additional customers and creates the image. + A bakery does not use plastic bags any more, it sells C2C carrying bags to its customers much more and informs its customers about the ingredients of its products. + A retailer with a shop and internet sales uses social media and gets information from the customers which C2C products they have learnt and wish in the future which are then included in the range of products. + Beside traditional products a painting company offers to its customers the use of C2C products (e.g. paints) at additional costs, makes advertisement with arguments of environmental and health protection and begins using C2C in a processual manner. + A tailor makes advertisement that she produces clothes and suits which are so healthy that they can be eaten and implements this reliably with the use of C2C materials in case of corresponding wishes of the customers. + A bakery uses only raw materials and ingredients from the region and converts its production to healthy whole meal bakery. g) Work in small groups (3 – 4 persons in each) with identification of the first C2C applications at the own enterprise or in the own field of activity. h) Presentation and discussion of group results. i) Further communication related to C2C and more detailed information on the basis of results of working groups. j) During single work of each participant outline of the first C2C project which should be processed and implemented during the second part of the seminar. Subsequently presentation, consulting and assessment of the individual project in small groups (3 – 4 persons in each). k) In plenary presentation and discussion of each individual C2C project with the goal that for each participant a C2C project is agreed upon obligatorily for the processing and implementation during the second part of the seminar. l) Appointment of the further procedure, especially for the second part of the seminar and determination of the date for the final workshop.	

F 4) Indications related to the second part of the seminar	
For self-study, project work and exchange of experiences each participant receives a list with: a) All contact data of the teaching staff and lecturers of the corresponding implementing partner who can be addressed by the participant if necessary, any time with questions. b) All contact data of all the participants for the independent organization of exchange of experience. c) Literature references and web addresses for self-study	
After one to maximum three weeks the project work has to be finally agreed upon and discussed with each partner. It can be done at the site of the participant. Alternatively, for the reasons of simplification and time saving the implementing partner can offer and arrange for one-hour individual consultation appointments.	
Every participant must be contacted by the teaching staff and lecturers of the implementing partner at least every 2 – 3 weeks personally or per telephone. For this purpose, evening events with all participants can be held at regular intervals	
During contact with the participants teaching staff and lecturers of the implementing partners gather topics and questions of participants with the lack of knowledge and distinct need for improvement. For this purpose, a uniform survey form related to the written documentation is recommended.	
F 5) Structuring of the final workshop	
a) Transfer of knowledge and detailed information related to questions and topics which were collected by the teaching staff and lecturers during the second part of the seminar. b) Plenary discussion and clarification of further questions. c) Presentation, consultation and discussion of results of all individual project works.	

d) Following project works further studies and also further transfer of knowledge related to C2C. e) During independent work of each participant outline of his further plans and procedures for future further developments and implementations of C2C. After that presentation, consultation and assessment of individual plans in small groups (3 – 4 persons in each). f) In plenary presentation and consultation concerning each individual plan for future C2C works with the goal to make available a realistic plan for each participant. g) If necessary, transfer of deeper knowledge related to plans and final discussion of the contents. h) Scheduling further procedure	
F 6) Examination and certificate	
The C2C seminar for SMEs can be completed with an examination (assessment of the project work and oral examination). For this purpose, each implementing partner receives examination regulations timely as a basis and orientation.	
In case of examination each participant receives an examination certificate and also a separate document (participant certificate). For this purpose, each implementing partner receives timely a draft certificate.	
In case there is no examination each participant receives only one document (participant certificate). For this purpose, each implementing partner receives timely a draft certificate.	
G) Evaluations	
At the end of the first workshop each participant and each participating lecturer should evaluate the workshop in writing. For this purpose, each implementing partner receives timely a questionnaire for each participant and also for lecturers. The completed questionnaires are sent by the implementing partner within one week to the evaluating partner Satakunta University.	
During the second part of the project the teaching staff and the lecturers personally ask every participant. For this purpose, each implementing partner receives timely a	

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short-standardized form. The completed forms are sent by the implementing partner within one week after the end of the second part of the seminar to the evaluating partner Satakunta University.	
At the end of the final workshop each participant and every participating lecturer should evaluate the workshop and the whole seminar in writing. For this purpose, each implementing partner receives timely a questionnaire for each participant and also for lecturers. The completed questionnaires are sent by the implementing partner within one week to the evaluating partner Satakunta University.	
The evaluation of all questionnaires and surveys is performed by the partner Satakunta University which prepares an evaluation report till 31.05.2021.	
H) Implementation report	
Within 4 weeks after the end of the seminar each implementation partner prepares a clear implementation report till May 31, 2021 at the latest with a) number of participants in all 3 parts of the seminar b) represented branches and fields of activity d) possible drop out of participants and reasons for this e) possible new participants f) short outline of implemented projects g) possible results of examinations h) own experiences and evaluation of the procedure i) recommendations and instructions for future implementations of the C2C seminar for SMEs j) own plans for future implementation of the seminar by implementation partners after the end of the project	

Annex III

Qualification needs SMEs[1]

Cradle to Cradle (C2C) is a promising and innovative methodology of circular economy with 100% recycling rate, which corresponds to the objectives of policy and businesses particularly. C2C has been successfully used by individual major enterprises; more than 2.000 C2C products have already proven on the market. In SMEs, there does not currently exist knowledge of the C2C approach. The engagement of SMEs with these issues often lacks due to insufficient knowledge about strategies and measures of implementation or simply financial resources.

During this special further for SMEs, this knowledge gap is to be closed by measures adjusted to the SMEs conditions and needs. Various results resp. levels can be achieved by applying this very innovative approach, e.g. a Quality Statement, an Environmental Health Statement or "Inspired by C2C" or "Certified according to the Cradle to Cradle CertifiedTM product Standard".

- **Need for new effective solutions to maximum economic benefit**

Energy efficiency, climate and environmental protection belong to the EU top priorities and likewise of considerable and growing importance of the economy of the member states. With C2C approach SMEs can make crucial contributions to the achievement of objectives and at the same time strengthen their competitiveness, develop new market segments and create jobs on a large scale.

- **Training of SMEs and equipping with new knowledge, skills and experiences**

SMEs are often struggling with fulfilling the demands on the market in order to continue with their existence and work. Hence, there is seldom time and capacity for overthinking their strategies and economic management. According to the SME needs for effective innovative solutions with a maximum benefit (time is money!), the C2C training is time-saving with a maximum knowledge transfer and intense support by coaches.

- **"Time is money"**

[1] The needs analyses bases on experiences of project partners and analyses of different reliable sources.

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This aspect affects SMEs in particular due to the very limited time, financial and personnel capacities. Seminars/trainings taking several days are not appropriate for SMEs with less than 10 employees at all, which are the most SMEs in Baltic Sea Region. This is why the C2C training is planned with very short theoretical lessons at the beginning and end of the training. The main part makes a self-study phase in the own enterprise, when applying the theoretical knowledge in practice and developing very concrete individual solutions for own enterprise.

- **Need for imparting comprehensive information package on C2C**

In order to become, be and stay innovative and competitive SMEs need to look for new working, production and service opportunities continuously. The C2C design concept allows responding the environmental challenges and at the same time opens new economic opportunities. SMEs should be aware of the C2C design concept and numerous possibilities C2C offers. During the planned further training at least basic knowledge about the Cradle to Cradle (C2C) design and the feasibility of its implementation in individual/own enterprises are to be gained. So that, completing the training the participating SMEs should know the main aspects of the Cradle to Cradle approach and be able to find innovative solutions in their own enterprise by working closely along the C2C approach. For this an individual project work will be done with the support of coaches.

- **Consideration of individual needs by applying C2C**

Since every enterprise brings along different preconditions and capabilities, the C2C approach has to be adapted to the special needs of every single SME. A universal design or approach would only prevent the enterprises from reaching their full potential.

It is important that the trainers examine the different qualification needs of the SMEs during the training in order to ensure a specific and detailed strategy of C2C. Issues like

- financial resources
- capabilities in terms of skilled employees
- sales market conditions
- costumer services
- types of sales products

have to be considered while jointly developing a probable scenario.

In order to transform the gained awareness of circular economy, eco-efficiency and eco-efficacy into specific SME-adapted strategies, the initially stated circumstances have to be developed by the SMEs together with the consulting trainers during the seminar.

- **Need for high-quality services**

Given the limited time, personnel and financial resources in SMEs, there is a great need for high-quality services, which are tailored exactly to the needs for SMEs: duration of the training, date (in the week or rather at the weekend), relevance of the contents, structure, teaching methods, qualified trainers, etc. The C2C training contents are adapted to the needs of SMEs, the training will be organised concerning SME needs and training program for trainers developed and tested to ensure high-quality services for SMEs.

- **Intense support for SMEs**

C2C is an innovative, important but also demanding concept; a practical implementation accompanied by intensive coaching by trainers is needed. That ensures that the SMEs make the most possible out of their potential. Together with the trainers who consult and coach the SMEs in every step of the probable C2C implementation, favorable conditions for implementation are created. Thus, an application of C2C is feasible in the long term.

- **Practical implementation**

The experiences making and carrying out trainings for SMEs show that the step from theoretical knowledge gained in a seminar or training and its application in practice for the most of the SMEs is difficult. They fail often because of little things e.g. not knowing the proper way of implementation, methods or next steps for own enterprise. For this, the most optimum is if the training contains a practice part; support by coaches during such a practice part and even afterwards is required for successful implementation with sustainable effects. So that SMEs are able to find innovative solutions in their own enterprise.

- **Best practices**

Best practices serves best for SMEs to visualise difficult or even abstract contents in trainings. The experiences show that these also often ease the imagination how to use certain measures, approaches, methods in practice. In general, practical examples have proven as relevant and useful methods of teaching and better understanding of contents.

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Findings of further needs for SMEs

- Enterprises and their customers must be treated respectfully and regarded as esteemed partners.
- The information exchange can be performed in writing and electronically; however communication in person is especially important.
- The cooperation with SMEs must be arranged in a process-oriented and permanent manner and stand out due to its highest reliability. It is necessary to build and to earn trust.
- Lecturers, trainers and consultants must be familiar with the needs of SMEs. It is ideal to have a constant contact person for an enterprise who also possesses specific knowledge related to corresponding branches and if necessary involves further experts.
- In the most of the cases SMEs have small capacities for information processing and problem solution. It is difficult for SMEs to filter the relevant information from the constantly growing information flow, adjust it to the specific requirements of their enterprise and implement them.

Professional journals are appreciated; also open newsletters with very short articles and references where further information can be obtained if necessary. Especially intensively the information is taken from daily and district newspapers. A very short announcement in a daily newspaper brings more feedback than a long article in a professional journal or a letter.

Letters with long text passages are often not read. At the same time seminars must be announced through mailing actions which arouse interest when they are compiled in short form, communicate information specifically and possibly contain a flyer which makes clear what benefits the seminar brings for the enterprise.

- Follow-up by phone after the training is essential. What matters is the individual contact. It should take place at off-peak hours and all the possibilities must be used, for example, meetings, discussion evenings etc.
- The transfer of information, for example, an announcement of a seminar, is one of the important tasks of the organizer to be successful with the training.

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- Coaching of SMEs is the key to successful implementation of new economic practices, integration of new working structures, etc.
- All services and promotion for SMEs must be tailor-made for SMEs. A further training seminar must exactly correspond to the requirements and the problems of the participants to the maximum possible extent. A good preparation work to provide SMEs with specific knowledge or preliminary determination of demands of participants are decisive factors of success.
- Due to limited time SMEs further training and consultations must take place at a time which suits the enterprises best, for example, in the evening, on Friday afternoon and Saturday morning or during less intense working periods (e.g. in winter).
- SMEs require all the services and funding just in time. It is less important to get information or help at some point in time but the fact that they can directly obtain it when they have the need for it.
- For the most SMEs bureaucracy is annoying; they need all the services and funding from a single source. It is the task of the service and further training provider to guarantee it constantly. SMEs may not be loaded with coordination works among various institutions or persons.
  - In SMEs the enterprise management is constantly overcharged with plenty of management tasks which must be usually performed by one person. Unlike major enterprises SMEs cannot have internal staff departments. Promoters and further training providers must externally perform the required staff functions and thereby offer non-monetary advantages to SMEs.
  - The lecturers should be experts or possess profound knowledge in the certain field. They should also have good skills by the transfer of competences through the implementation of various didactic methods.
  - It is favorable to shape the training interactive and flexible. It is worthwhile to perceive the expertise of the participants and self-produced findings. These are more present than many other forms of communication. Work in small groups according

to the dynamics of the group requires for moderation, however, a high level of competence to use flexible methods.

Annex IV

Cradle to Cradle ® Prototypes

1. Rise to the formation of prototypes

Cradle to Cradle® (C2C) means a design concept related to circular economy, where all materials, equipment, tools, products, etc. are healthy as well as re-used to the maximum extent. The main focus lays not on the reduction of use of environmental goods but on the recycling and re-use of these goods. Here, Cradle to Cradle® approach pursues an optimization process with gradual solutions over time. Various results resp. levels can be achieved by applying this very innovative approach, e.g. a Quality Statement, an Environmental Health Statement or "Inspired by C2C" or "Certified according to the Cradle to Cradle Certified™ product Standard".

With C2C quality, health and safety of products are assured and at the same time the highest level of environmental and health protection.

The aim of identifying the prototypes of SMEs is the fact that depending on the nature of their business, SMEs can be affected by C2C to very different extent and also benefit from it differently (e.g. SME with main field of activity in an office work compared to a SME in production). Therefore, SMEs across all economic sectors are concerned in very different extent of C2C and accordingly have to apply C2C in various ways. The prototypes are prepared to classify SMEs with roughly comparable C2C application possibilities according to the potential of use and influence of C2C in a SME.

2. Intersectoral: All Branches

Possible Issues:

From a *Cradle to Cradle*® perspective, products are generally not well defined within the supply chain, which means the generic materials are mostly known but little or nothing about the minor ingredients. Furthermore, products enter the market, which are not designed for recycling. The main challenge lies in designing products, which are appropriate for continuous material flows,

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either making the materials suitable for returning safely and completely to the biosphere or being recovered at a consistently high quality. Therefore, the implementation of a comprehensive quality concept by positively defining products/materials/ingredients and the subsequent input into (recycling) systems is fundamental.

Remark: “Positive definition” of products means in the C2C sense knowing the exact composition of a product down to the level of chemical names described by the international CAS-numbers. C2C Potential and chances

The major tasks for all branches are as follows:

- Definition of the inputs (composition of the material flows, “know what it is”) with respect to high quality recycling
- Positive Definition of products/materials/ingredients
- Collective understanding of recycling
- Set new standards of innovative product development for the industry by defining “positive”, beneficial and innovative products and developing an eco-effective business model for different branches.
- Creating products whose re-entrance into production is already taken into account at the product design stage.
- Improving lifecycle management into nutrient management to biological / technical metabolisms.

EPEA invites companies to adopt Cradle to Cradle® Design as a tool to achieve Eco-effectiveness through the application of established EPEA methods. Opportunities of Cradle to Cradle® are shown in the following sections on a general basis as well as specified on particular branches.

Cradle to Cradle® is a registered trademark of McDonough Braungart Design Chemistry LLC (MBDC).

Cradle to Cradle Certified™ is a certification mark licensed exclusively for the Cradle to Cradle Products

Innovation Institute (C2CPII). For more information about the Cradle to Cradle Products Innovation Institute and a list of the full program criteria, visit www.C2Ccertified.org.

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3. Intersectoral: Office and Administration

Branches:

- All prototypes with offices Administration
- Ministries
- Consulting companies Government
- Chambers of commerce
- Administration
- Associations

Possible Issues

- Health effects on employees due to low indoor air quality (e.g. off-gassing of textiles or toner dust)
- Problematic waste management due to missing material flow management
- Take back systems to be established
- Electronics (see e.g. WEEE Guideline, RohS Guideline)
- Packaging
- Batteries
- Restriction of problematic and toxic substances (further than REACH)
- Development of Service Concepts for technical products
- Running out of materials will probably being earlier than running out of energy

C2C Potential

- Conducting office material (e.g. paper) in cycles
- Use of certified office equipment
- Introduce material flow management
- Use of healthy and cyclable office equipment
- Office buildings with C2C elements (see under "Building and Construction)
- Purchase renewable energy
- Water Management according to C2C
- Communication to customers about C2C achievements
- Improving social quality of the workplace

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C2C regions for implementation of the general idea of a comprehensive quality (including reutilization properties)

- Creating partnerships under the new C2C aspect
- Enhance use of renewable energy

Possible chances and benefits

- Creating positive agenda for office improvement
- Reduce waste management costs
- Getting money for sorted fractions like paper
- Improve health of employees
- Becoming more attractive for new employees
- Creating technical cycles
- Meeting EU requirements e.g. on recycling
- Less CO2 emissions due to recycling
- Development of new technology for recycling
- Import of technology from other countries with enhancement of technological level
- Organization as a catalyst in use of renewable energy

Added value

- Potential cost savings from a macroeconomic view due to material cycles, refer to "circular economy"
- Less dependent on import of raw materials like metals

Frame conditions to be taken into account

- C2C frameworks and partnerships not yet existing
- People and industry not yet familiar with C2C and possible effects
- Little consciousness in offices about C2C
- Possibly low standard of municipal-waste management

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- Possibly also low standard in separate collection of used products

4. Prototype: Building and Construction

- Concrete, cement
- Glass
- Wall covering (indoor and outdoor)
- Wood for construction purposes
- Flooring (plastics; textiles see under textiles)
- Indoor equipment (see there)
- Coatings, paints for construction materials
- Lighting

Possible Issues

- Construction materials not designed or selected in view of later de-construction
- Construction materials not safe from health standpoint for use in buildings
- Indoor air quality negatively affected by non-optimized materials
- Big amount of waste during demolition
- Value of materials and esp. metals which can be obtained during demolition not realized
- Dissipation of problematic materials and chemicals in the environment due to less effective waste management
- First step required: Sorting of non-optimized materials during demolition
- “Recycling” with undefined materials which are not designed for recycling

C2C Potential

- Change of thinking from C2C perspective: Regard of a building as a raw material base
- Deeper knowledge about properties and ingredients of construction products

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- Define construction materials for biological or technical cycles
- Use of Cradle to Cradle Certified™ construction materials (LEED points possible under certain preconditions)
- Design of underground construction materials according to biological environment (e.g. no release of toxic metals)
- Roof greening for improved room climate and diversity
- Include defined C2C elements in new buildings
- Integrate renewable energy
- Water recycling measures
- Regard CO2 as a resource e.g. for vegetation instead of capturing and storing

Possible chances and benefits

- Less contamination of the environment coming from potentially toxic ingredients of construction materials in combination with inappropriate waste management or recycling
- Valuable materials recovered
- Positive health effects for people in optimized buildings
- Positive environmental effects due to optimized construction products

Added value

- Optimization of recycling and reuse of materials may lead to positive cost effects
- Sorted metals can be sold
- Achievement of LEED points possible subsequent to certification
- Cost reduction by including renewable energy

Frame conditions to be taken into account

- Existing waste management and recycling structures in construction and demolition
- Motivation of construction companies not yet focused on C2C

5. Prototype: Production

C2C applicable for several branches

Biggest potential for C2C

Many examples of C2C projects and certifications

For all branches (points partly repeated in following production-prototypes):

Possible Issues

- No detailed knowledge about ingredients of their products
- Possibly unknown problematic ingredients
- Products entering the biosphere (e.g. waste water) not designed for this scenario,
- still e.g. aqua toxic or not biodegradable
- Product safety affected
- Not yet prepared on request of customers for "sustainable" or "healthy" products
- Conditions of production may become a public issue (like in Germany)

C2C Potential

- Deeper knowledge about their products
- Opportunity to achieve higher product quality
- Higher product safety
- Encouragement of supply chain for more transparency
- Opportunity for Certification C2C Certified™ and therefore market differentiation
- Awareness in company for possible simplification of recipes
- Products for Technical Cycle: Opportunity to get back materials "for free"
- More focus on renewable energy

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Possible chances and benefits

- Less vulnerable against attacks from test institutes or NGOs
- Higher sales due to higher product quality
- Differentiation in the market by better products
- Creation of communication measures within the supply chain and/or for the public

Added value

Specific for branches

Frame conditions to be taken into account

- Still little awareness in public about concept of comprehensive quality
- Supply chain not yet used to disclose confidential information to a know-how-trustee (EPEA)
- Chemical industry or importers focusing on requirements of European regulations of REACH and therefore not yet open to C2C
- Financial effects not predictable

a. Textiles and Shoes

- Fashion apparel
- Synthetic-, natural textiles (incl. leather products)
- Work wear
- Hospitals, construction sector, etc.
- Home textiles
- Upholstery, hangings, towels, etc. (incl. leather products)
- Accessories
- Buttons, Zippers, Labels, etc.
- Shoes
- Fashion and Casual
- Carpets and Flooring

Possible Issues

- Most of the chemicals are problematic with respect to specific scenarios (e.g. skin contact, inhalation, environmental fate, recycling and reuse, etc.)
- Sensitizing ingredients widely used in textile and shoe production are not designed for skin contact.
- Lots of problematic process chemicals are released uncontrolled into the waste water during production
- Most of the dyes and other textile additives used for production are not known by the textile producer
- Double standards: Textile production is in most of the cases abroad (e.g. Asia, South America, Africa) and mostly under very low social and environmental conditions.
- Standards of dye production in Asia
- Standards of leather production in Asia

<u>C2C Potential</u>

- Enhance product quality according to a comprehensive quality term
- Identifying and looking for C2C alternatives with respect to the sensitizing properties
- Basically design for biological and/or technical cycles possible
- For work wear:
- Existing renting system usable as logistics for take back
- Source for textile fibers to be used in other industries
- Creating transparency along with textile production, - processing, assembly, usage and after usage for new cycles of new quality products.

<u>Possible chances and benefits</u>

- Improved presence in the market due to introduction of new quality criteria
- Frontrunner because occupying the field of expected demand of customers who will ask for origin, usage and next cycle of clothing and shoes
- Frame conditions to be taken into account
- The new quality approach based on C2C to be explained, discussed, improved and published

- Textile production shall take place under comparable and safe environmental and socio-economic conditions worldwide.
- Advantage for the consumer: Textile and shoe production in consideration of joy, health and high quality

b. <u>Furniture</u>

- Office furniture
- Other furniture

Indoor:

- Wood
- Metals
- Plastics
- Multiple constituents, complex products

Outdoor

- Wood
- Metals
- Plastics
- Multiple constituents, complex products

<u>Possible Issues</u>

- No detailed knowledge about ingredients of their products
  - Coatings
  - Glues
- Wood origin and production
- Metal production conditions
- Metal alloys specification (toxic heavy metals?)
- Plastics additives esp. in indoor use (e.g. skin contact)
- Off gassing of volatile chemicals
  - from coatings
  - from additives
  - impurities from supply chain
- Indoor air quality affected
- Formaldehyde release
- Not designed for recycling
- Recycling system existing?

C2C Potential

- Knowledge about potential toxic ingredients of products
- Improving indoor air quality
- Encouragement of supply chain for more transparency

Possible chances and benefits, added value

- Positive health effects due to improved indoor air quality
- Enhancement of awareness of high-quality furniture in the public
- Marketing of better health quality potential for higher sales
- Supply chain not yet used to disclose confidential information to a know-how-trustee (EPEA)

Frame conditions to be taken into account

- Supply chain not yet used to disclose confidential information to a know-how-trustee (EPEA)
- Awareness of the C2C issues not yet developed in public

c. Health Care

- Cosmetics
- Baby care
- Possible Issues
- Generally, not made for entering the biosphere
- of problematic ingredients
- No detailed knowledge about ingredients of their products
- High exposure due to skin contact
- Possibly sensitization potential
- Health effects

C2C Potential

- Deeper knowledge about their products
- Higher product safety

Possible chances and benefits

- Less vulnerability against awakening public awareness for “healthy” products

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- Possible simplification of recipes

Added value

- Positive effects on production costs due to optimized and simplified recipes
- Advantage and market differentiation by offering optimized "healthy" products

Frame conditions to be taken into account

- Supply chain not yet used to disclose confidential information to a know-how-trustee (EPEA)
- Potential for higher awareness in the public regarding typical home products

d. Home Care

- Cleaning agents and detergents
- Laundry products
- Washroom supplies

Possible Issues

- Generally, not made for entering the biosphere
- No detailed knowledge about ingredients of their products
- Skin contact probable

C2C Potential

- Deeper knowledge about products
- Opportunity to achieve higher product quality

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- Encouragement of supply chain for more transparency

- Encouragement of supply chain for more transparency
- Improvement of wastewater

Possible chances and benefits

- Higher quality of a high-exposure-product used at home
- Less health effects on skin of users due to optimized, less problematic products
- Simplification of recipes

Added value

- Positive effects on production costs due to optimized and simplified recipes
- Higher sales due to less health effects of optimized, less problematic products

Frame conditions to be taken into account

- Supply chain not yet used to disclose confidential information to a know-how-trustee (EPEA)
- Potential higher awareness in the public regarding typical home products

e. Materials Basic for Designers

- Plastics
- Polymers
- Textiles (see there)
- Wood
- Paper
- Composite materials
- Packaging

Possible Issues

- Designers focusing more in the shape and design of products than in ingredients

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- Modification of thinking required regarding reutilization potential of designed products
- Composites included in design considerations, not designed for recycling

C2C Potential

- Creation of attractive products with C2C properties included
- Every day products connected to C2C principles
- Enhancement of awareness of designers regarding material properties (toxicological, reutilization)
- New way of thinking implemented also in producers of complex products like household appliances

Possible chances and benefits

- Higher sales due to higher product quality
- Chance for dissemination of C2C into the public

Added value

- New quality aspects included in products
- Support of cycles of valuable materials

Frame conditions to be taken into account

- In design field C2C not yet established

f. **Packaging**

- Packaging with metals (Steel cans, Aluminum cans) Metal (cans, bottles)
- Flexible paper packs, modules-pulp packs, Carton board packs, Corrugated fiberboard

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- Packaging with plastics
- Packaging with glass
- Printing, labeling
- Bioplastics

Possible Issues

- Migration of substances (e.g. of volatile substances, antimony, BPA, etc.)
- Migration takes place even from labels into the packed food
- Problematic substances in the packaging (e.g. PVC or problematic additives)
- Problematic substances arising from a recycling process (e.g. detection of residues of mineral oil in recycled paper)

C2C Potential

- Improvement of environmental, health and recycling aspects by applying C2C-principles
- Deeper knowledge about packaging
- Opportunity to achieve higher product quality
- Higher product safety
- Encouragement of supply chain for more transparency
- Development of strategic collaboration between packaging stakeholders for know-how exchange
- Defined input in recycling systems

Possible chances and benefits

- Less vulnerable against attacks from test institutes or NGOs
- Higher sales due to higher product quality
- Differentiation in the market by excluding problematic ingredients of packaging used in every household
- Energy savings and improvement of CO2 balance possible by implementation of a nationwide packaging recycling system

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Added value

- Reduction of waste management costs
- Higher value of sorted positively defined fractions of plastics and metals
- Enhanced branding and marketing value
- Avoidance of regulatory costs (water discharge, energy use etc.);

g. Paper

- Office paper
- Printed paper
- Tissue paper

Possible Issues

- Problematic substances arising from the recycling process
- (e.g. detection of residues of mineral oil in recycled paper)
- Paper sludge not made for returning back safely into biological systems (soil, air, water)
- Process chemicals in paper production not suitable for biological cycle
- Health protection in paper production, exposure of problematic chemicals
- High water use

C2C Potential

- Optimization of inks, coatings, glues, etc.
- Optimization of process chemicals in paper production
- Optimization of material flows in view of C2C (e.g. differentiation of input- and output streams)
- Long term goal: printing chemicals to be used I printing companies defined

- so that the recycling paper company receives a defined input

Possible chances and benefits

- Establish recycled paper as a suitable resource also for higher quality applications of paper
- No transfer of problematic substances from paper production or recycling into every day products

Added value

- Getting more money for sorted, positively defined, fractions
- Higher branding and marketing value
- Avoidance of regulatory costs (water discharge, energy use etc.);

h. Machine construction (complex products)

- Engines,
- Machines
- Appliances
- Gadgets

Possible Issues

- Valuable materials incl. electronics hidden in machines
- No take back system existing
- Machines become waste after use

C2C Potential

- Machines designed for disassembly in view of later take-back
- Introduce service concepts (machine leasing for defined use periods)

- Potential for complete definition limited due to high complexity, but implementation of C2C relevant elements possible in order to enhance quality
- Establish recycling potential also for rare high-value metals

Possible chances and benefits

- Getting defined, possibly high-quality materials back
- Use of higher quality materials for production because these are coming back after use
- In certain branches logistics is already existing (e.g. by active sales representatives)
- but products not yet designed for take back

Added value

- Better market position due to better service and take back of machines after use
- Getting defined materials back "for free"
- Reduction of waste management costs

Frame conditions to be taken into account

- Metal prices expected to increase in a long run
- Logistics to be developed
- Still little awareness in public about the concept of comprehensive quality
- Customers and suppliers not yet familiar with service concepts according to C2C

Metals

- Copper and copper products
- Zinc and zinc products
- Aluminum and Al products
- Steel and steel products

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Possible Issues

- Mining (environmental and social issues)
- Ore processing (emissions in air, water, soil; social issues)
- Contamination of metals during recycling by contaminated, undefined or little defined recycling input
- Toxic metals in alloys
- Toxic or rare metals in coatings

C2C Potential

- Introduce service concepts (for certain metals and defined use-scenarios)
- Better separation of metals during recycling of metal containing products
- If several metal qualities are used for the same purpose in one product:
- Review resp. redesign of products
- Creating new models of cooperation by service concepts according to C2C
- Development of pigments and dyes suitable for biological or technical cycles
- No dissipation of toxic and rare metals into the environment

Possible chances and benefits

- Improved material cycles of metals
- Maintain high quality of metals by definition of recycled input

Added value

- Maintain high value of metals if not contaminated

Frame conditions to be taken into account

- Metal industry highly optimized according to efficiency criteria

- Different environmental standards for metal producers in certain countries
- Chemical industry or importers focusing on requirements of European regulations of REACH and therefore not yet open to C2C

6. Prototype: Trading

Branches:

- Wholesale
- Retailer
- Online retailer
- Textiles
- Tools (metals, for handcraft and industry)

Possible Issues

- Quality of product ingredients not known due to lack of transparency in the supply chain

C2C Potential

- Opportunity for influence by trading and retailing companies on their supply chain
- Preference Lists as guideline for suppliers
- Documenting high product quality and pathway of improvement
- Improvement packaging
- Influencing the supply chain esp. by bigger customers to deliver C2C quality
- Encourage qualified and regulated packaging recycling

Possible chances and benefits

- Integration supply chain in product optimization
- Cost savings by improved packaging
- Less vulnerable against attacks from test institutes or NGOs
- Higher sales due to higher product quality

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- Differentiation in the market

Added value

- Reduction of waste management costs
- Image of a frontrunner in quality may result in higher sales

Frame conditions to be taken into account

Possibly new approach, potential partners not yet acquainted with

7. Organizations

- Government
- Chambers of commerce
- Administration
- Ministries
- Associations

Possible Issues

- Take back systems to be established
  - Electronics (see e.g. WEEE Guideline, RohS Guideline)
  - Packaging
  - Batteries
- Restriction of problematic and toxic substances (further than REACH)
- Development of Service Concepts for technical products
- Running out of materials will probably being earlier than running out of energy

C2C Potential

- C2C regions for implementation of the general idea of a comprehensive quality
- (Including reutilization properties)
- Creating partnerships under the new C2C aspect

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- Enhance use of renewable energy

Possible chances and benefits

- Creating technical cycles
- Meeting EU requirements e.g. on recycling
- Less CO2 emissions due to recycling
- Development of new technology for recycling
- Import of technology from other countries with enhancement of technological level
- Organisation as a catalyst in use of renewable energy

Added value

- Potential cost savings from a macroeconomic view due to material cycles, refer to "circular economy"
- Less dependent on import of raw materials like metals

Frame conditions to be taken into account

- C2C frameworks and partnerships not yet existing
- People and industry not yet familiar with C2C and possible effects

Cradle to Cradle for Small and Medium-sized enterprises

Jenny Pfau & Robert Meyer
EPEA GmbH / Hamburg, Germany

Introduction: EPEA

EPEA Internationale Umweltforschung GmbH

- Headquarters in Hamburg, Germany
- In the Building of the Patriotic Society
- founded in 1987
- by Prof. Dr. Michael Braungart

EPEA The Cradle of Cradle to Cradle

cradletocradle

EPEA

Cradle to Cradle

• Developed btw. 1987-1992 as "Intelligent Product System" (IPS)

• In 1995, establishment of McDonough Braungart Design Chemistry (MBDC) in Charlottesville, Virginia (USA), together with architect William McDonough

• In 2002, publication of the book "Cradle to Cradle – Remaking the Way We make Things" by Michael Braungart und William McDonough

Round of introductions

1. Who am I?

2. Where do I come from? (Background, job)

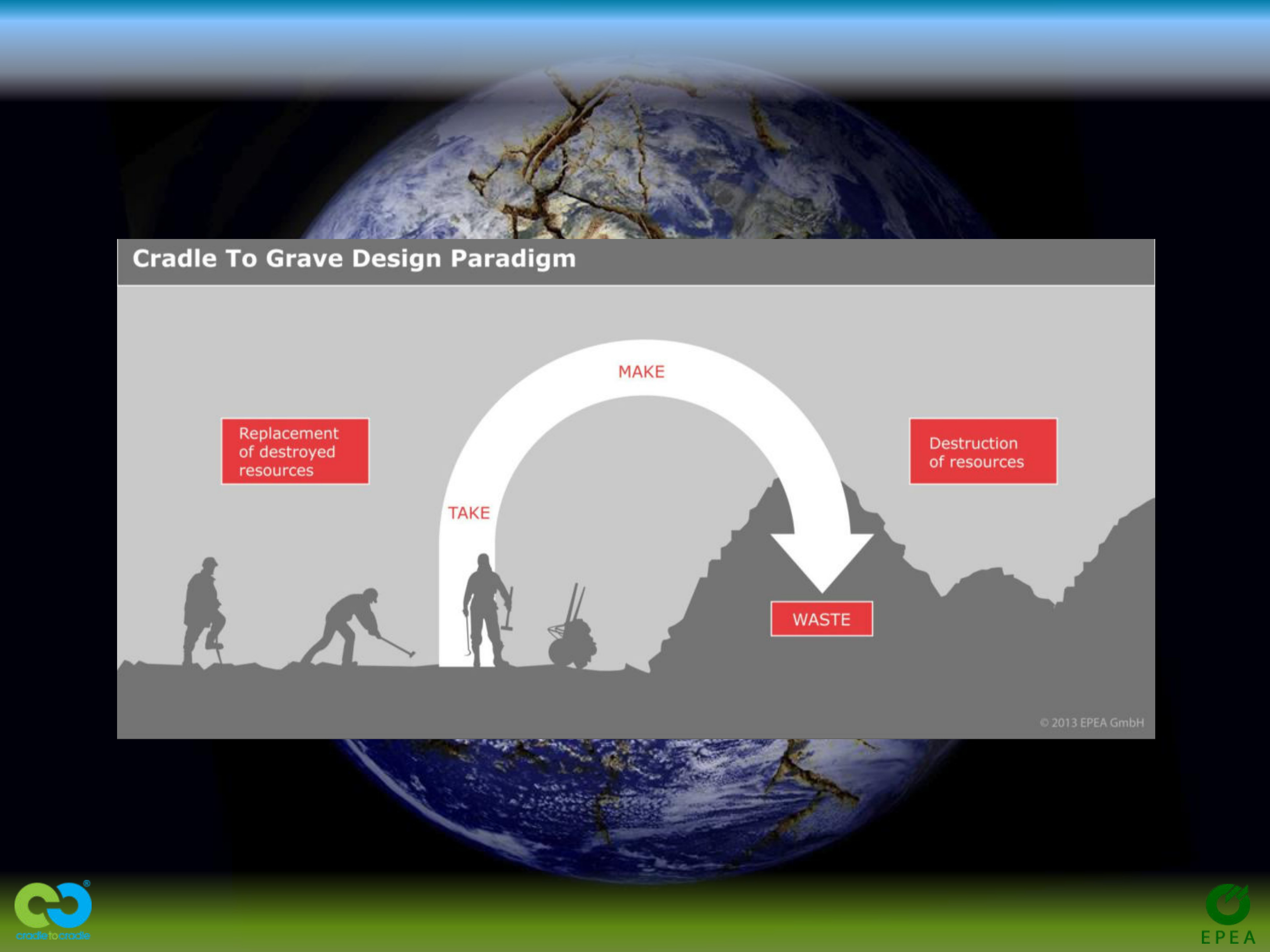
3. Experience with and knowledge about Cradle to Cradle

4. Expectations regarding this workshop

Cradle to Cradle Philosophy & Principles

EPEA Internationale
Umweltforschung GmbH

Robert Meyer



Cradle To Grave Design Paradigm
MAKE
Replacement of destroyed resources
Destruction of resources
TAKE
WASTE
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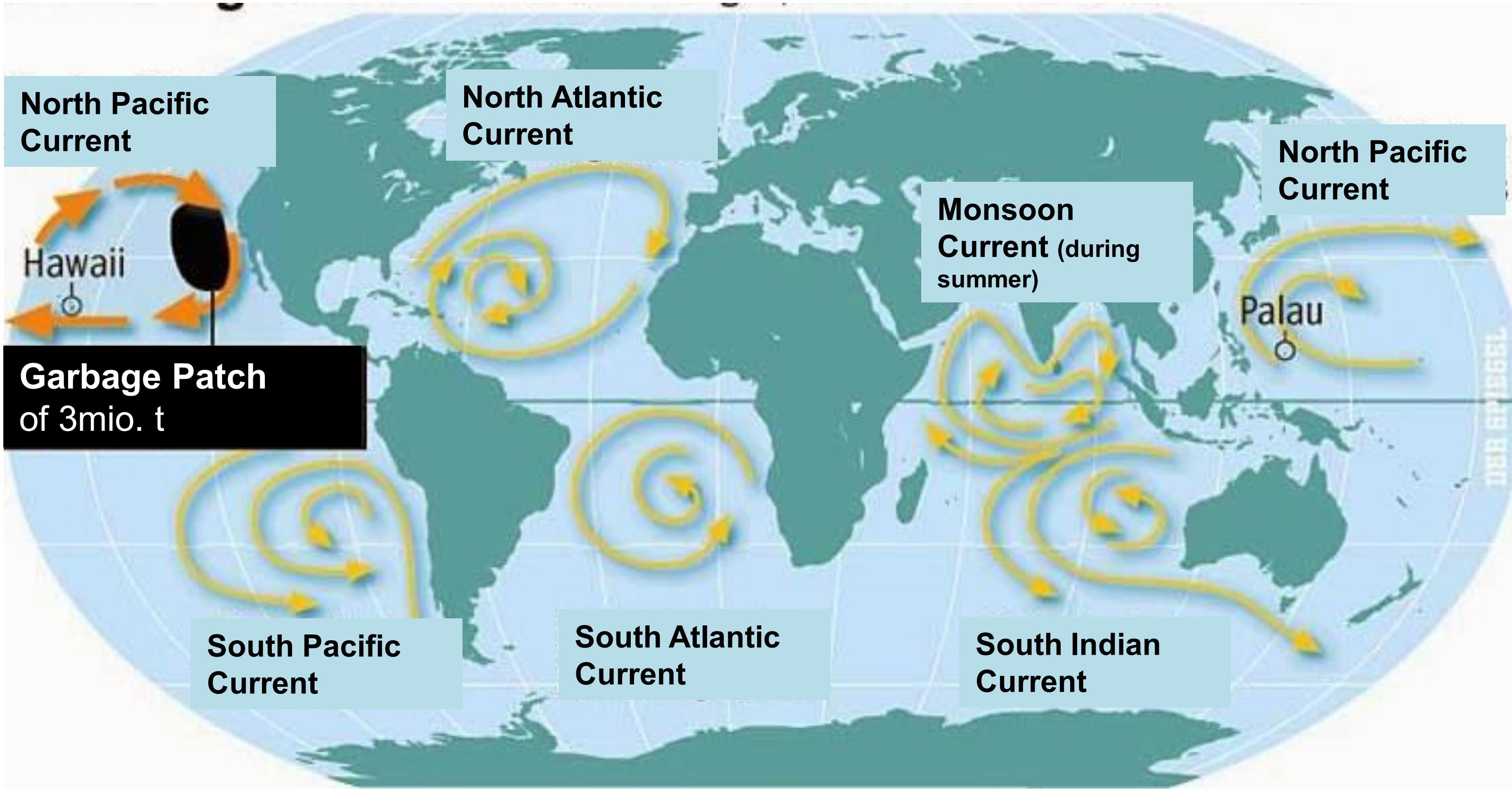
CRADLE TO GRAVE DESIGN PARADIGM

Great Pacific Garbage Patch covers an area as big as Central Europe



http://stefanseite.blogspot.de/2013/12/sechs-mal-mehr-plastik-als-plankton-im.html

Death in Plastic Soup

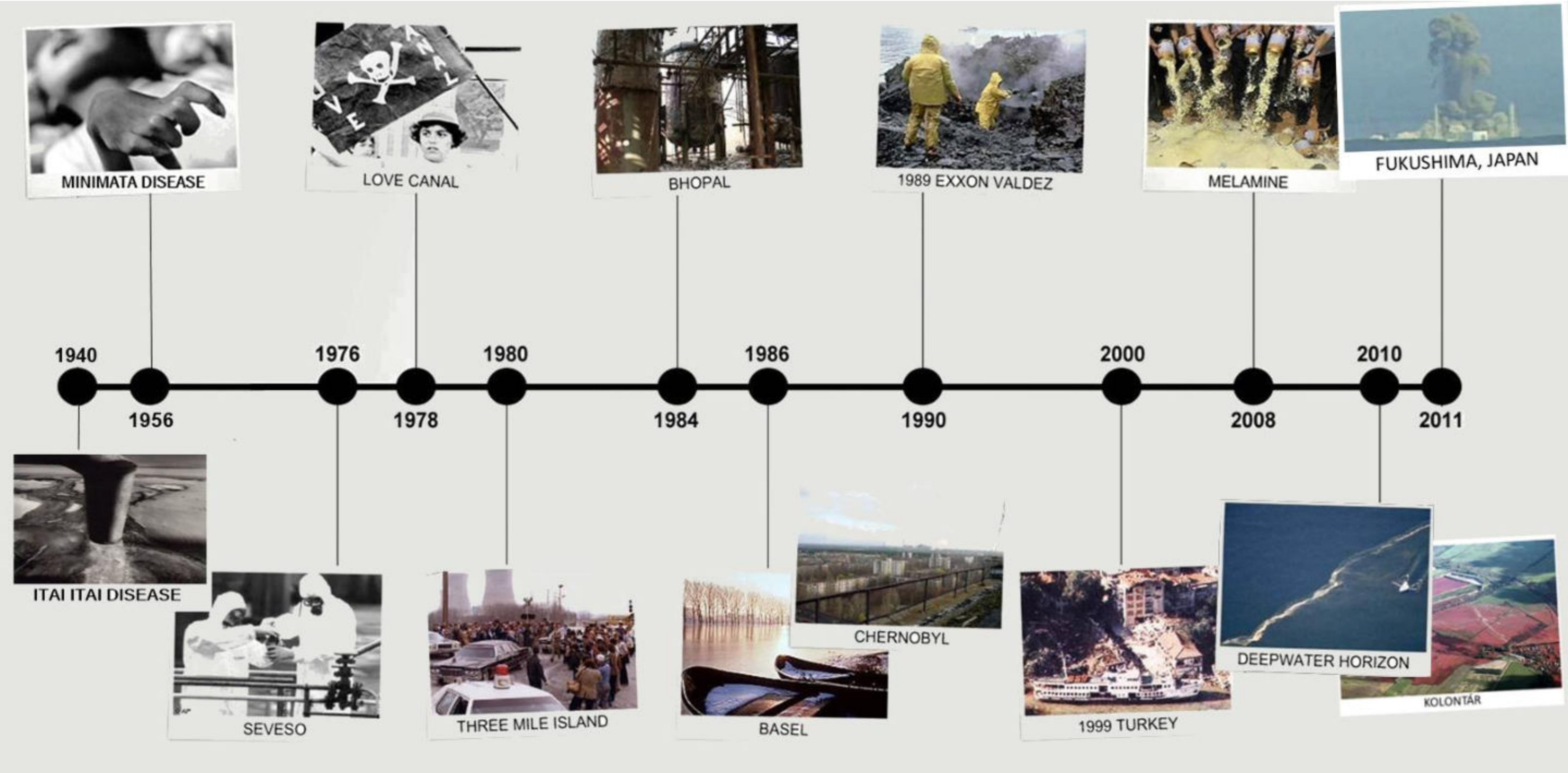
The proof is found in the stomach of seabirds: plastic pollution of the oceans has now reached the Northwest coast of Canada, which until just recently was considered one of the last unpolluted coasts. A Team of scientists "[…]" discovered plastic laces, Styrofoam, or plastic wrap in **92.5%** of the 67 fulmars found dead on the beach.

On average, 36.8 pieces of plastic were found per bird, and one even had 454 pieces in its stomach.

Source: Süddeutsche Zeitung No. 153 from Thursday, July 5th 2012, page 18

http://katha-kocht.de/austern-ganz-klassisch/

Environmental Disasters

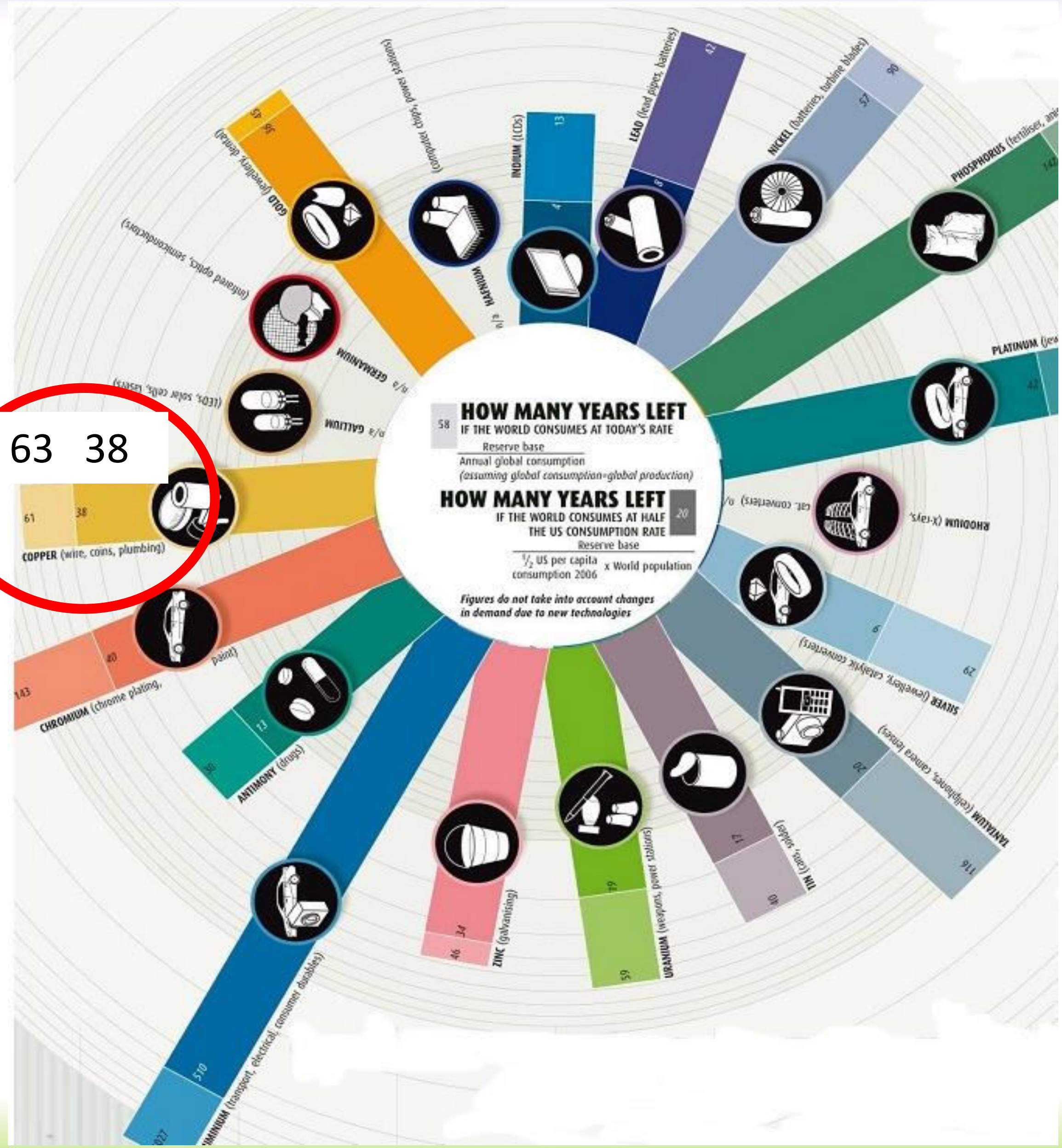


zero emissions
reduce, reuse, recycle
minimize your ecological footprint
zero emissions
reduce consumption
sustainable
green
carbon - neutral
energy - efficient
simply useless
reduce consumption
zero emissions
energy - efficient

We do not have an energy-problem.

But limited natural resources!

Scarcity of Resources



cradletocradle

EPEA

http://www.welovead.com/en/works/details/e65xkloB

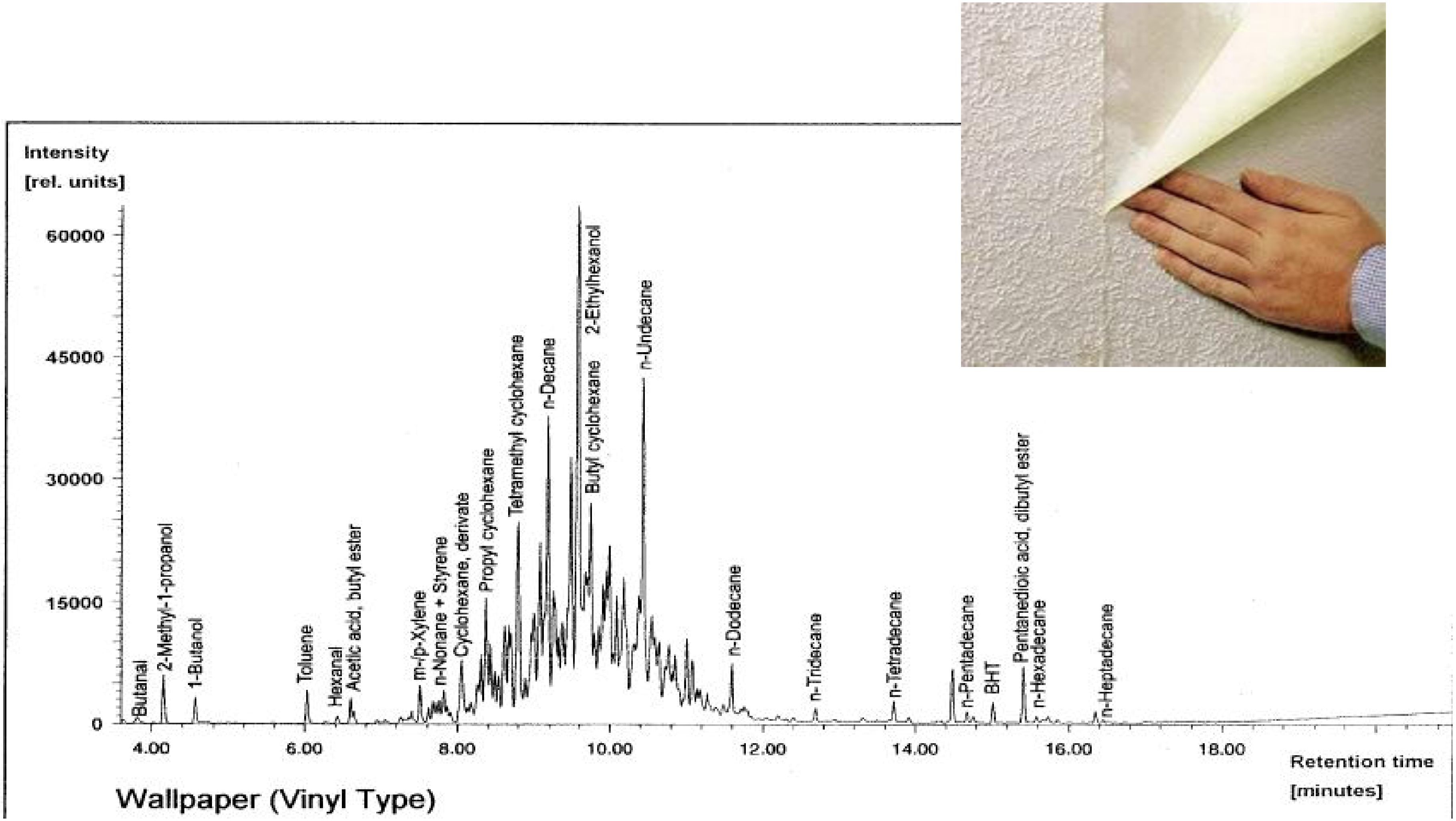
aim: zero emissions

Ecoefficiency Has Limits

You Want Your Customers As Friends Not Enemies


www.businessweek.com
BusinessWeek
JUNE 5, 2000
A PUBLICATION OF THE McGRAW-HILL COMPANIES
IS YOUR OFFICE KILLING YOU?
The dangers of sick buildings
By Michelle Conlin
PAGE 114

Off-Gassing Cromatogram: Wallpaper



Off-Gassing: Toy, Batman

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Operator   : Ostrop
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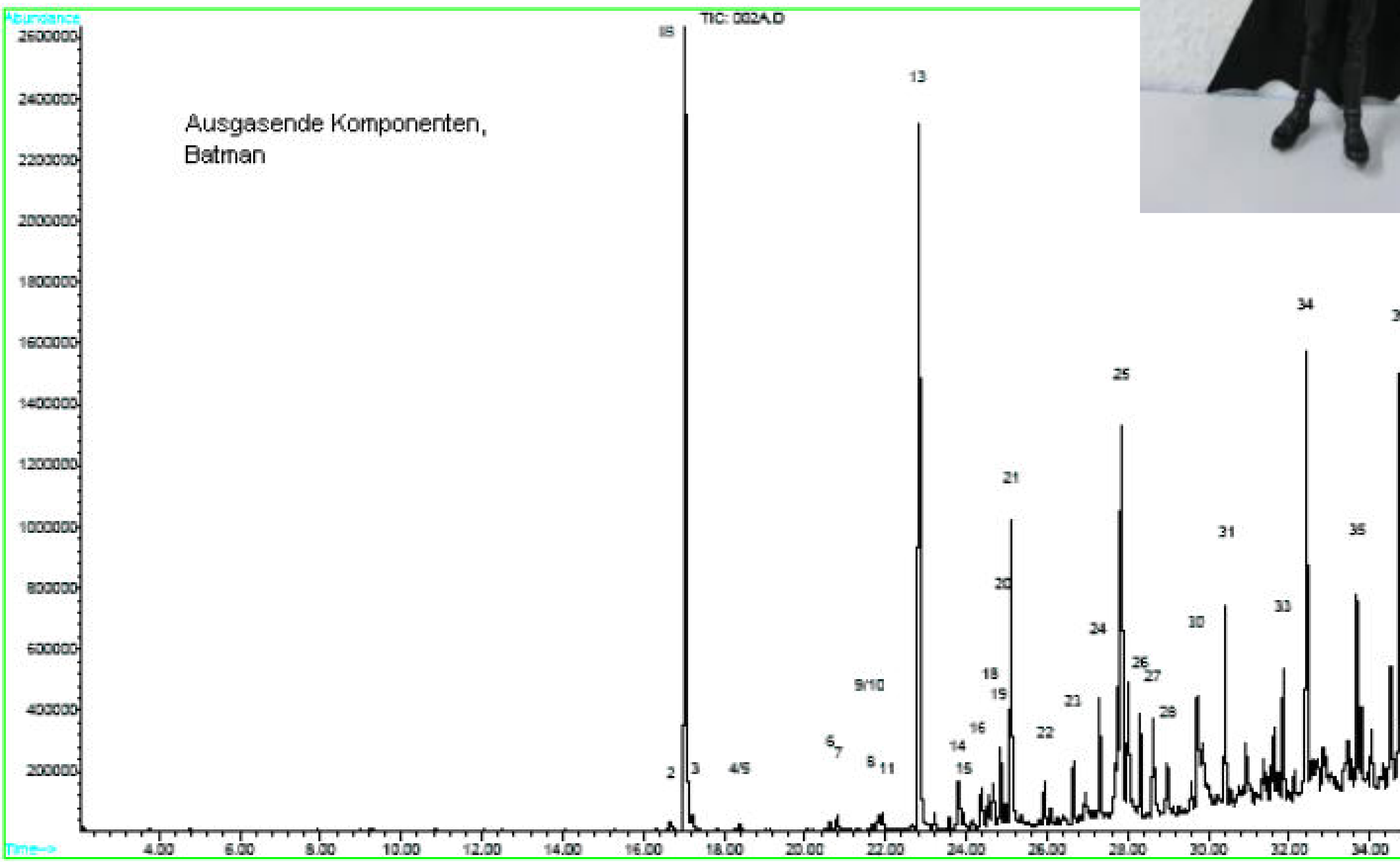
Instrument :   ALGE GCD
Sample Name: 12204057-002
Misc Info  : 34 L, 30 min, 60 Grd.
Vial Number: 6
```



DETOX: IS IT A SOLUTION?

„Free of …“ leads to

Revision of recipes for getting rid of first excluded chemicals today

Repeating the operation one year later for 20 additional chemicals ?

Again and again ?

What is the quality at the end?

cradletocradle

EPEA

Example: yoghurt pots

How many different ingredients?

Coatings, Pigments and PVC

Lid:

Aluminum
Printing inks
Top Coat
Primar
Sealing wax
Binder
Pigments
Photoinitiators
Additives

http://www.bild.de/ratgeber/verbrauchertipps/recycling/fg-35094438.bild.html, picture alliance

Cup:

Plastics
Additives
Pigments
Filler
Label
Printing inks

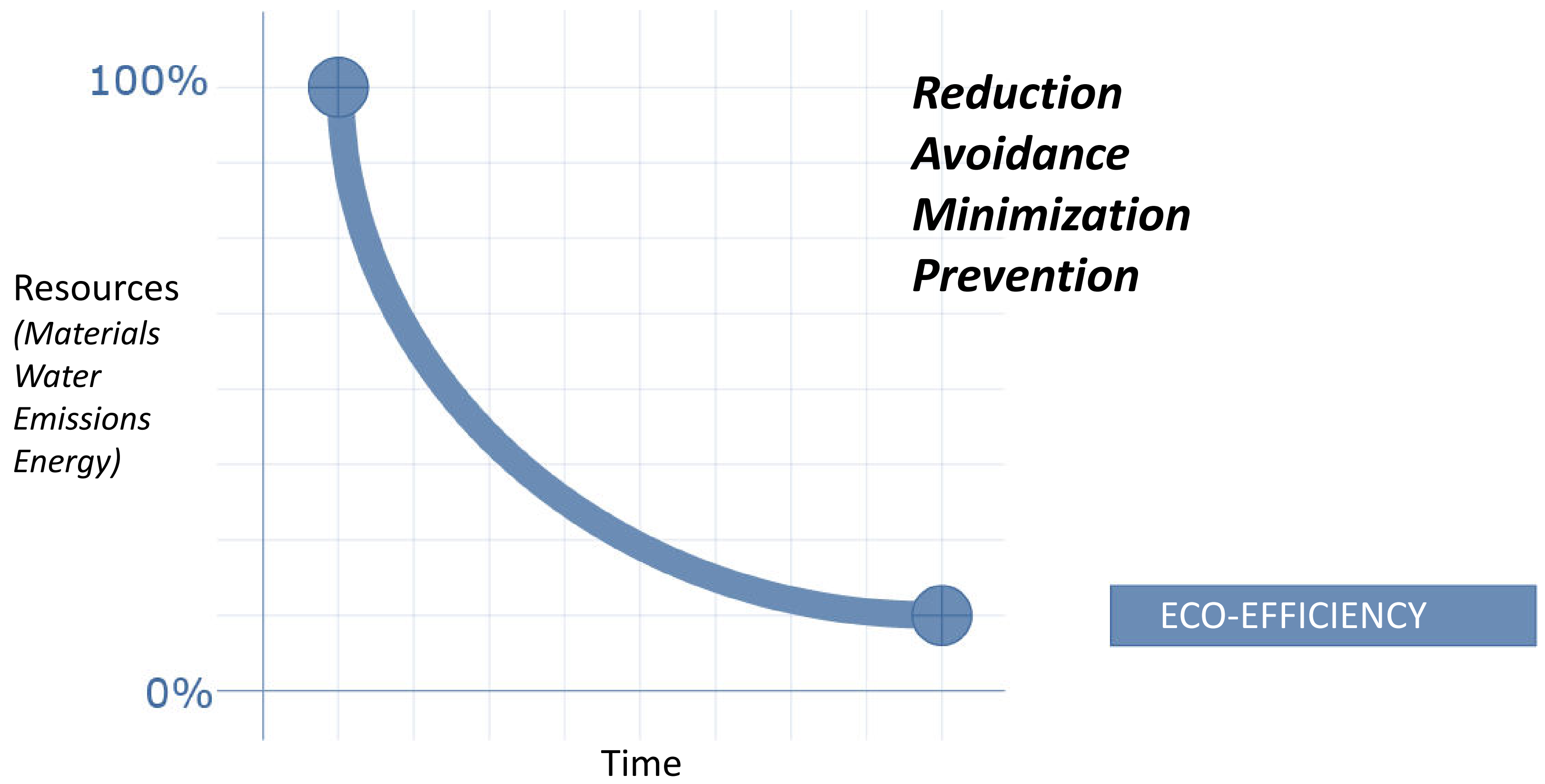
More than 600 different chemicals used for one yoghurt pot!

Not welcome on the planet?

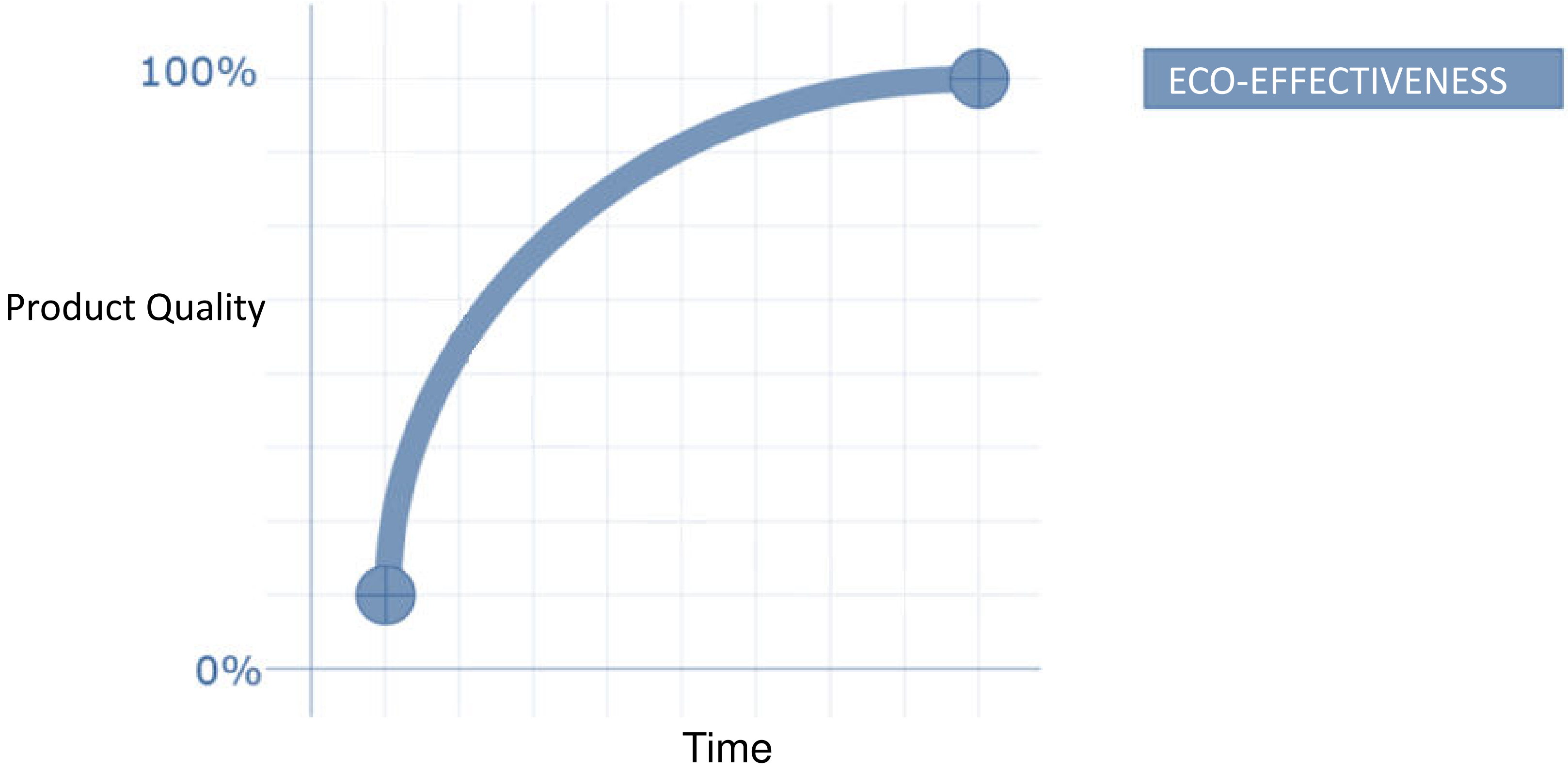
Are we too many?

…are <u>they</u> too many?

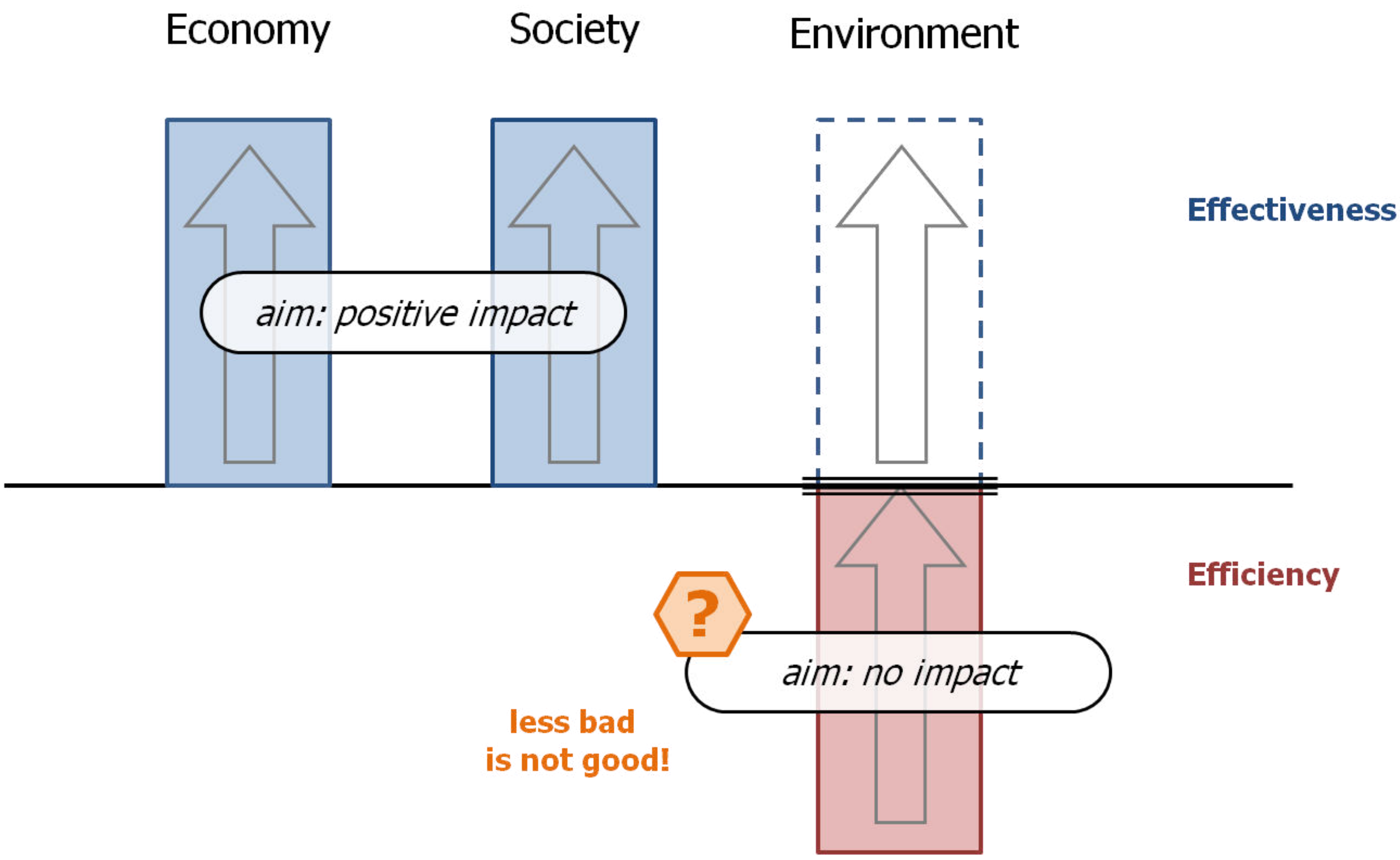
Cradle to Grave: target is zero harmfulness



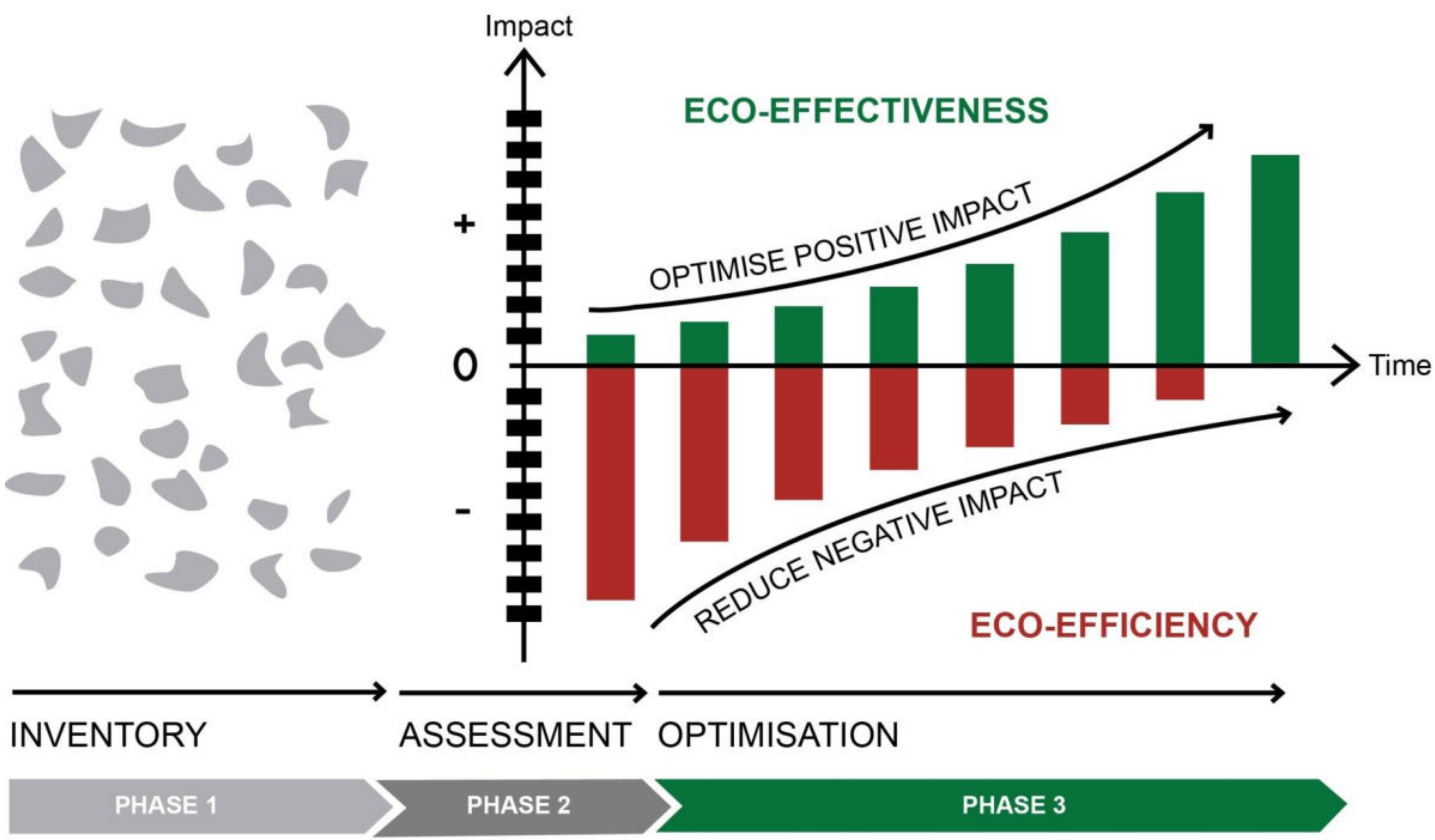
Cradle to Cradle®: target is all-encompassing quality and usefulness



Why Aim For Zero?



Cradle to Cradle® DESIGN PROCESS



The Journey To Positive Impacts

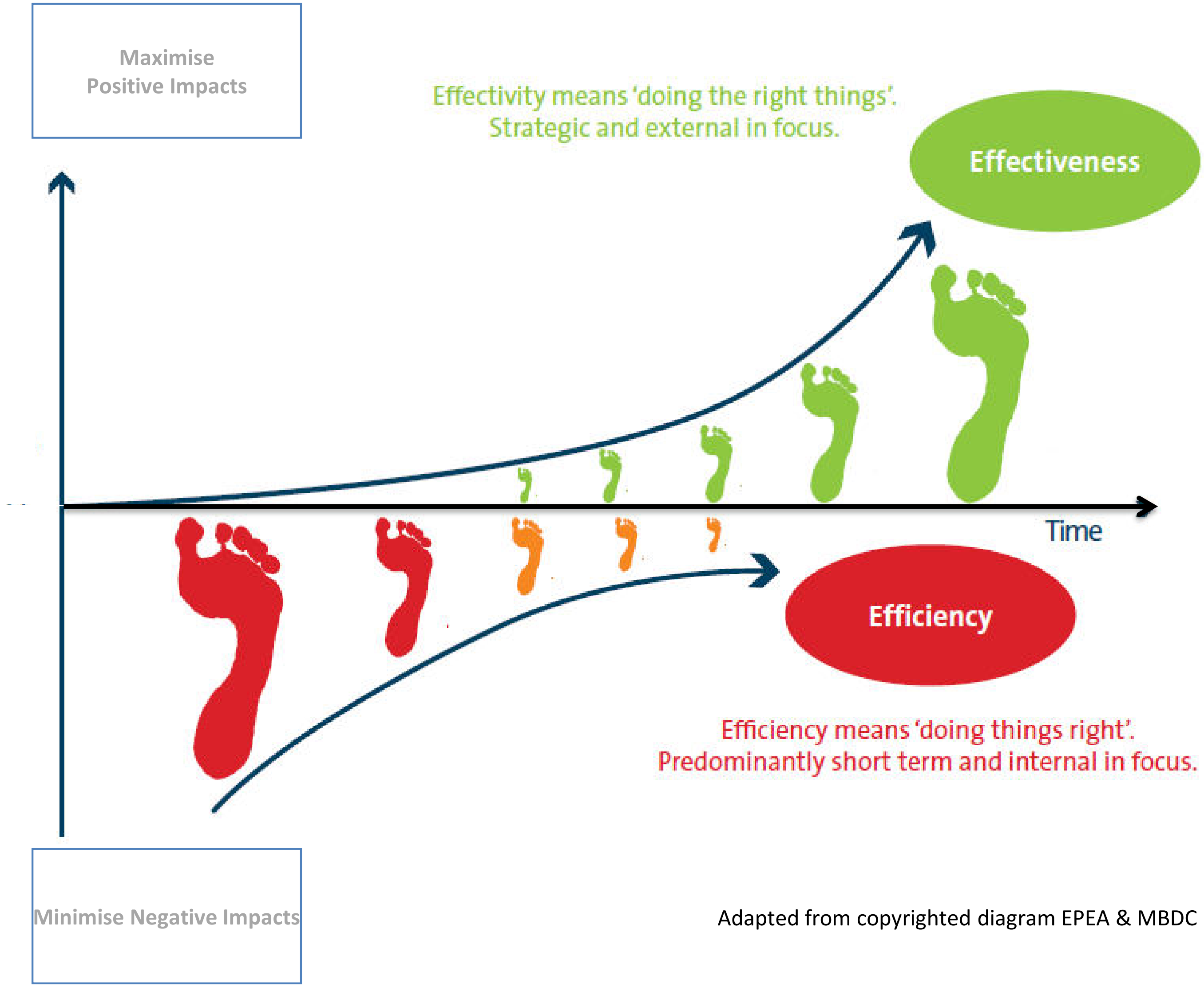
RETHINK
Innovation New Uses

REUSE
with high quality

UPCYCLE
Quality Improvement

RECYCLE
Downcycling

REDUCE
Incremental Reduction

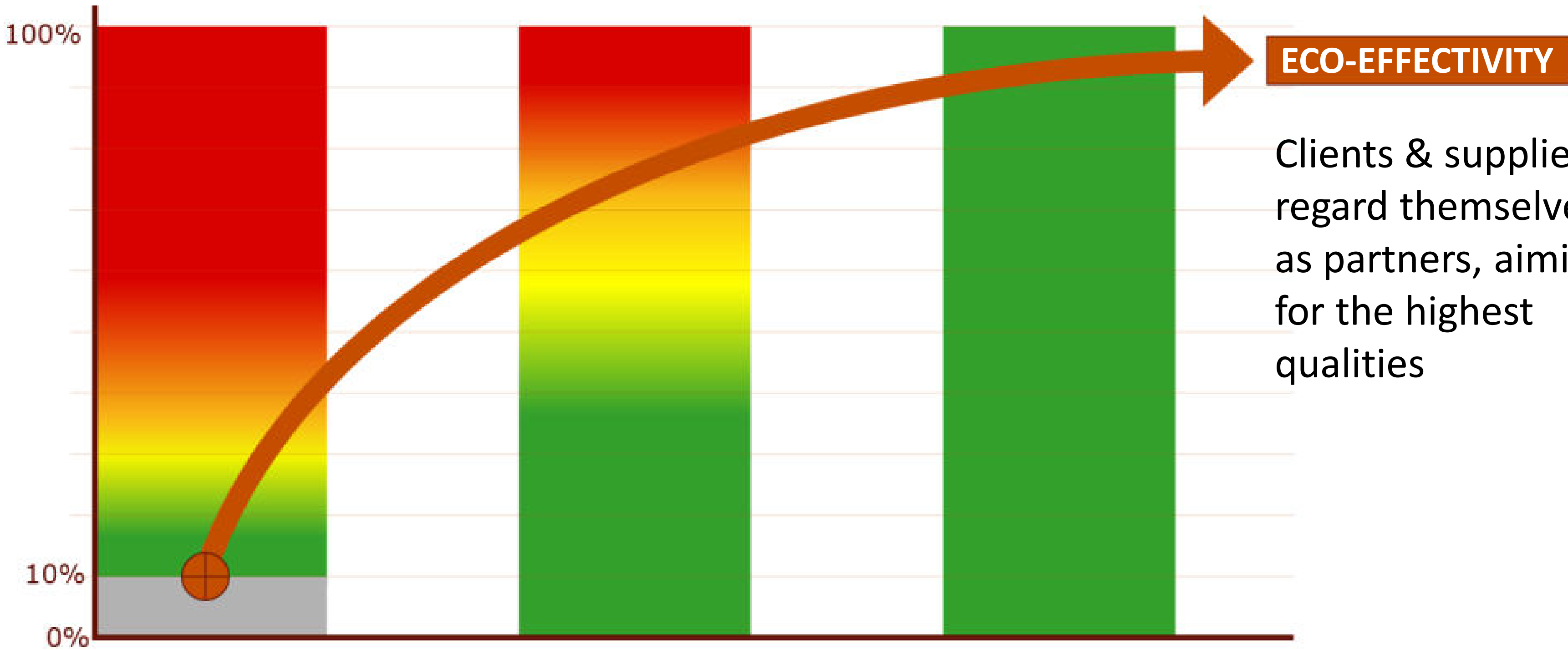


Adapted from copyrighted diagram EPEA & MBDC

cradletocradle

EPEA

Progress of quality from Cradle to Cradle® with time



Clients & suppliers regard themselves as partners, aiming for the highest qualities

Cradle to Cradle®: doing the right things!

Doing things right

Doing the right things!

Eco-Efficiency

Rearranging the deck chairs on the Titanic

POSITIVE IMPACTS!

- ✓ Absorbs CO_2
- ✓ Produces Oxygen
- ✓ Produces biomass
- ✓ Supports biodiversity
- ✓ Provides habitat
- ✓ Filters the air
- ✓ Makes soil

Cradle to Cradle Principles



Nutrients = Nutrients

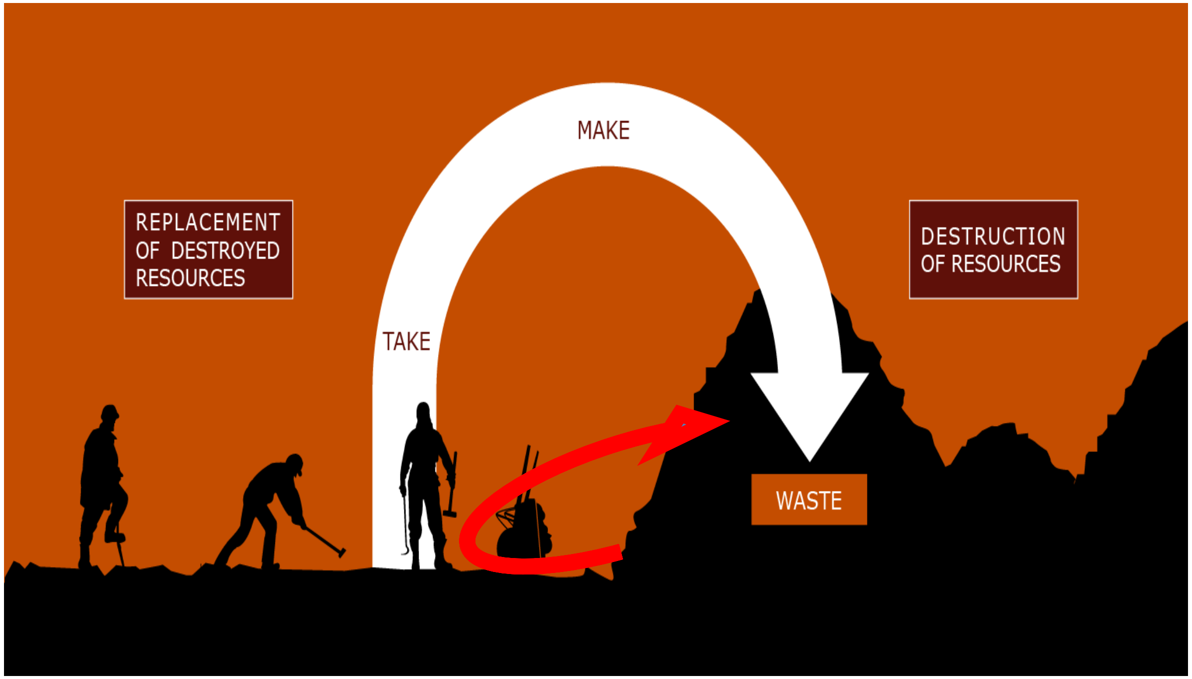


Use Current Solar Income



Celebrate Diversity

Most Recycling Is Still Cradle To Grave



Recycling = Downcycling

Downcycling = Poor quality

Poor Quality = Poor products

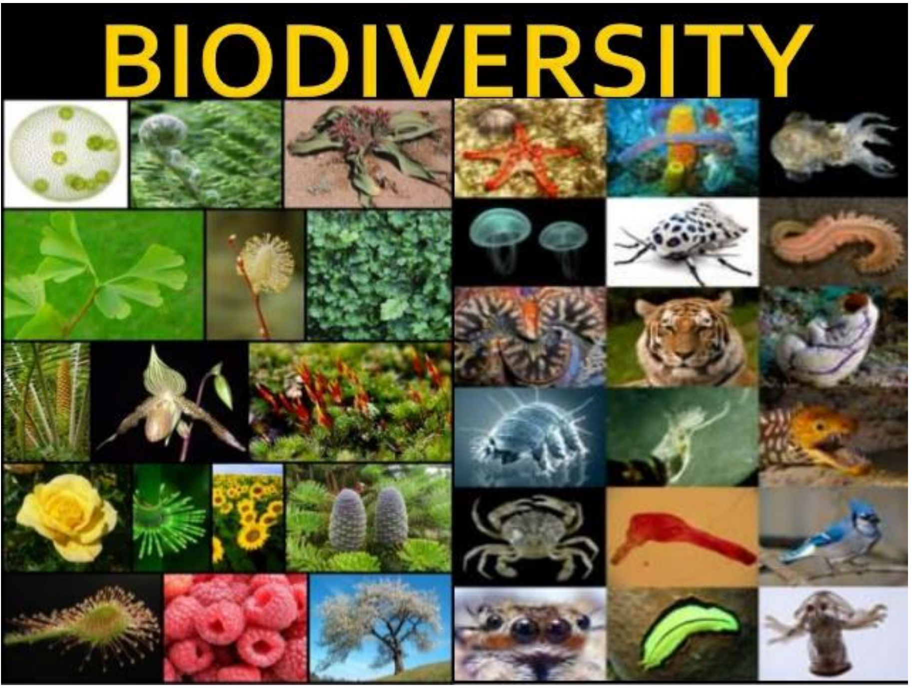
Renewable Energy vs. C2C Energy

More than just wind power - what materials are used and can they be a resource for something else? Is energy storage combined with generation?

More than just solar power - SunPower solar panels.

C2C certified for resource re-use;
potential for multiple land-use, potential for energy storage

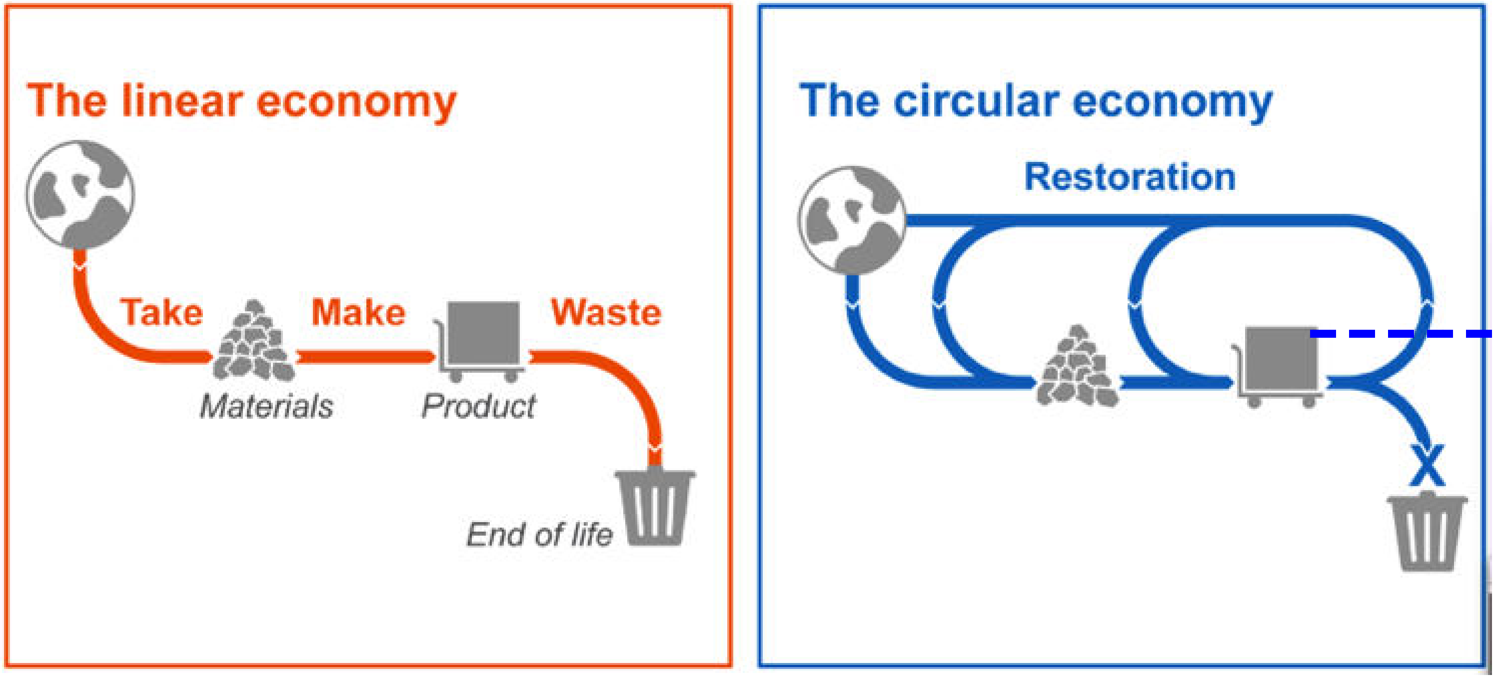
Diversity



Cultural Diversity

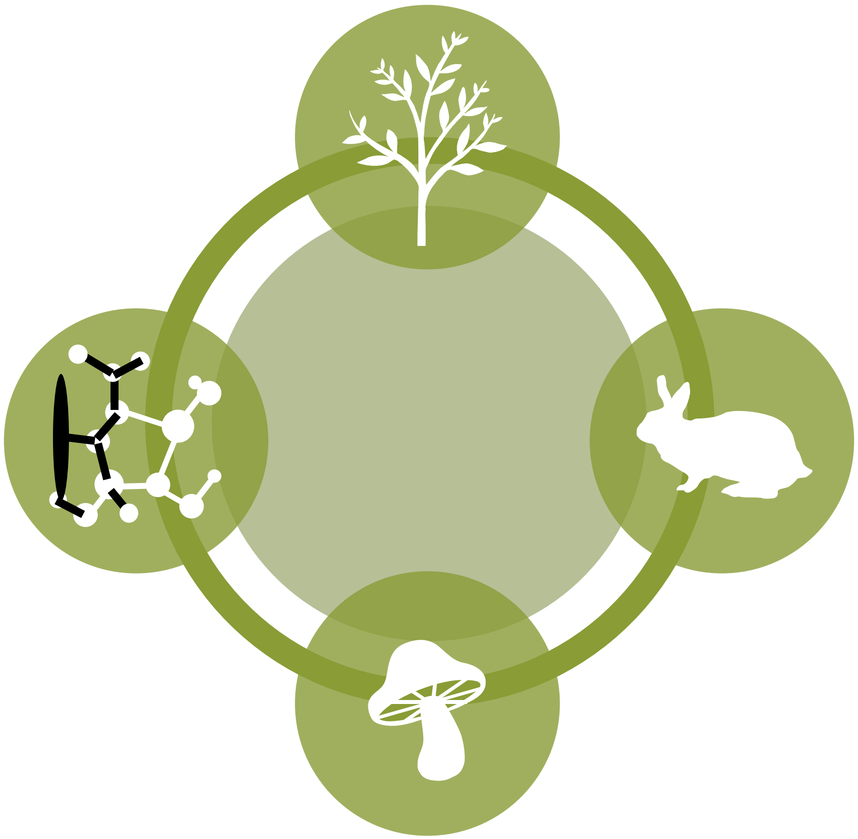
Conceptual Diversity

C2C Is The Most Effective Way To Get From Here To There

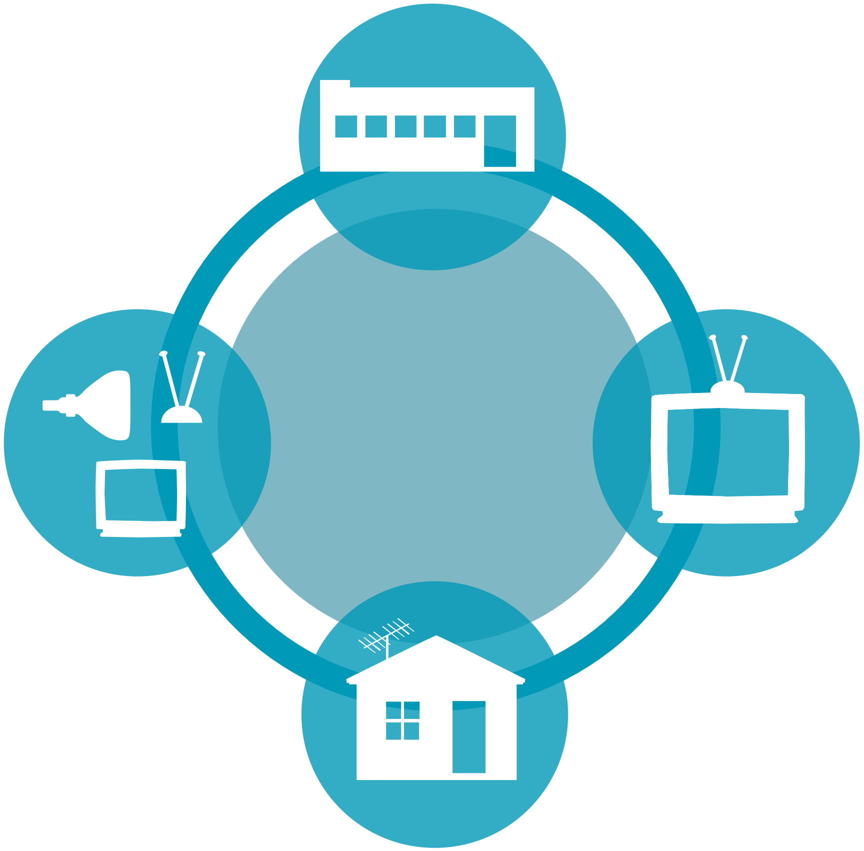


Source: Desso

KH



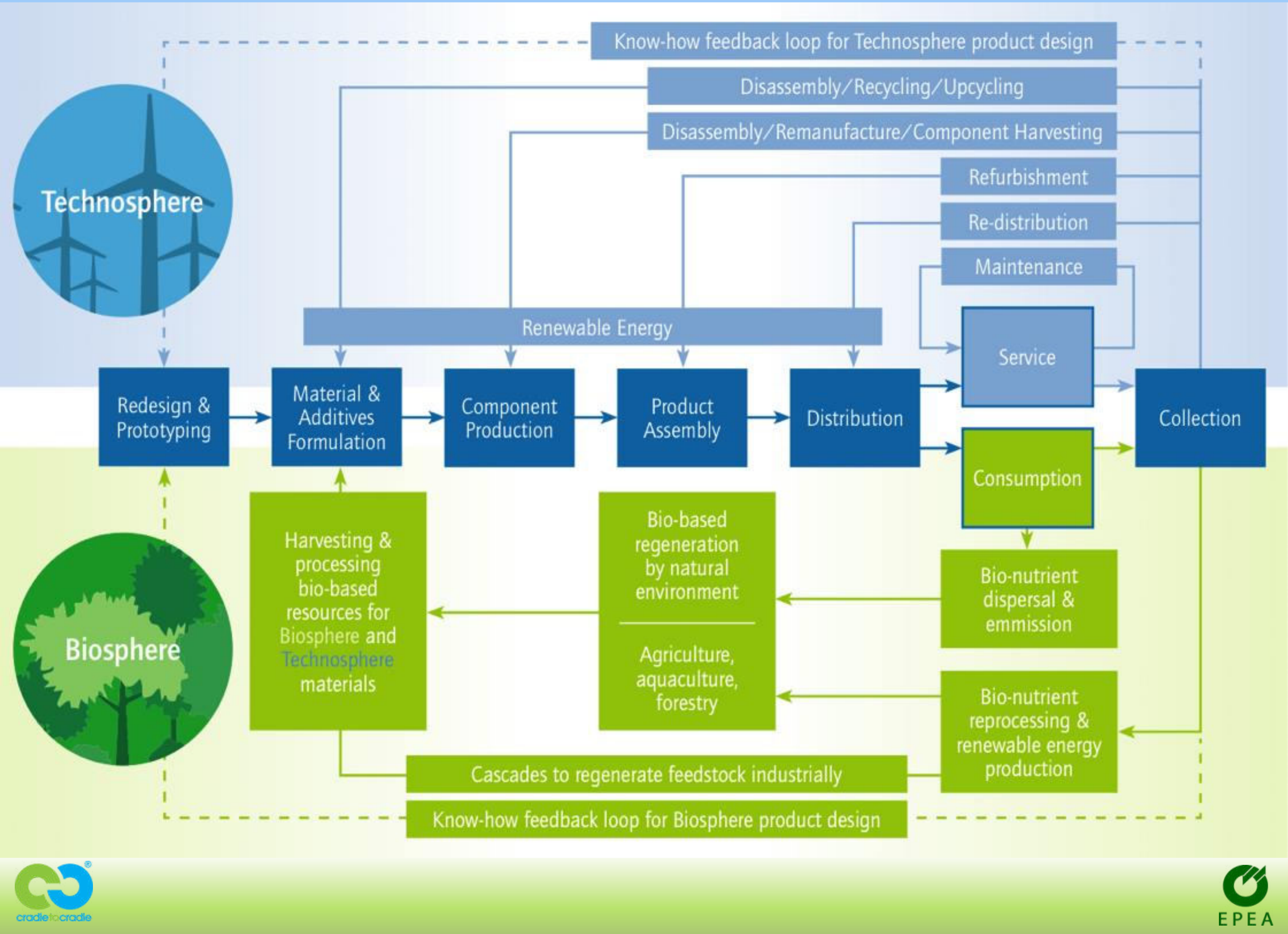
Biological Metabolism



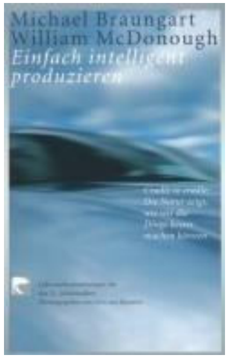
Technical Metabolism

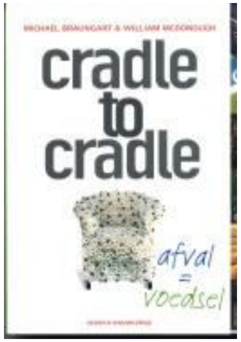
cradle to cradle

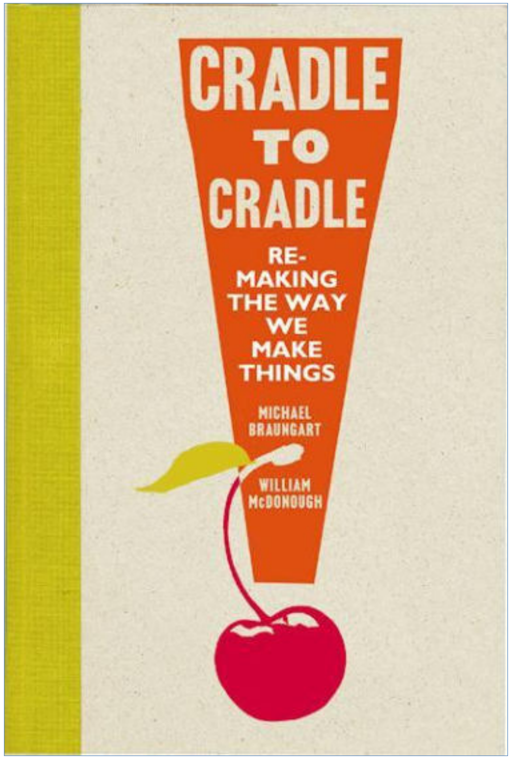
EPEA

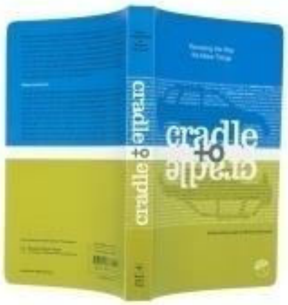

Know-how feedback loop for Technosphere product design
Disassembly/Recycling/Upcycling
Disassembly/Remanufacture/Component Harvesting
Refurbishment
Re-distribution
Maintenance
Technosphere
Renewable Energy
Service
Redesign & Prototyping
Material & Additives Formulation
Component Production
Product Assembly
Distribution
Collection
Consumption
Biosphere
Harvesting & processing bio-based resources for Biosphere and Technosphere materials
Bio-based regeneration by natural environment
Agriculture, aquaculture, forestry
Bio-nutrient dispersal & emmission
Bio-nutrient reprocessing & renewable energy production
Cascades to regenerate feedstock industrially
Know-how feedback loop for Biosphere product design
cradle to cradle
EPEA

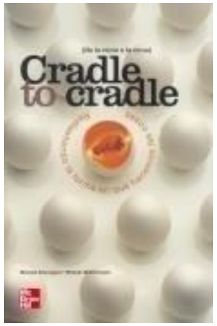
Cradle to Cradle®: Remaking the way we make things

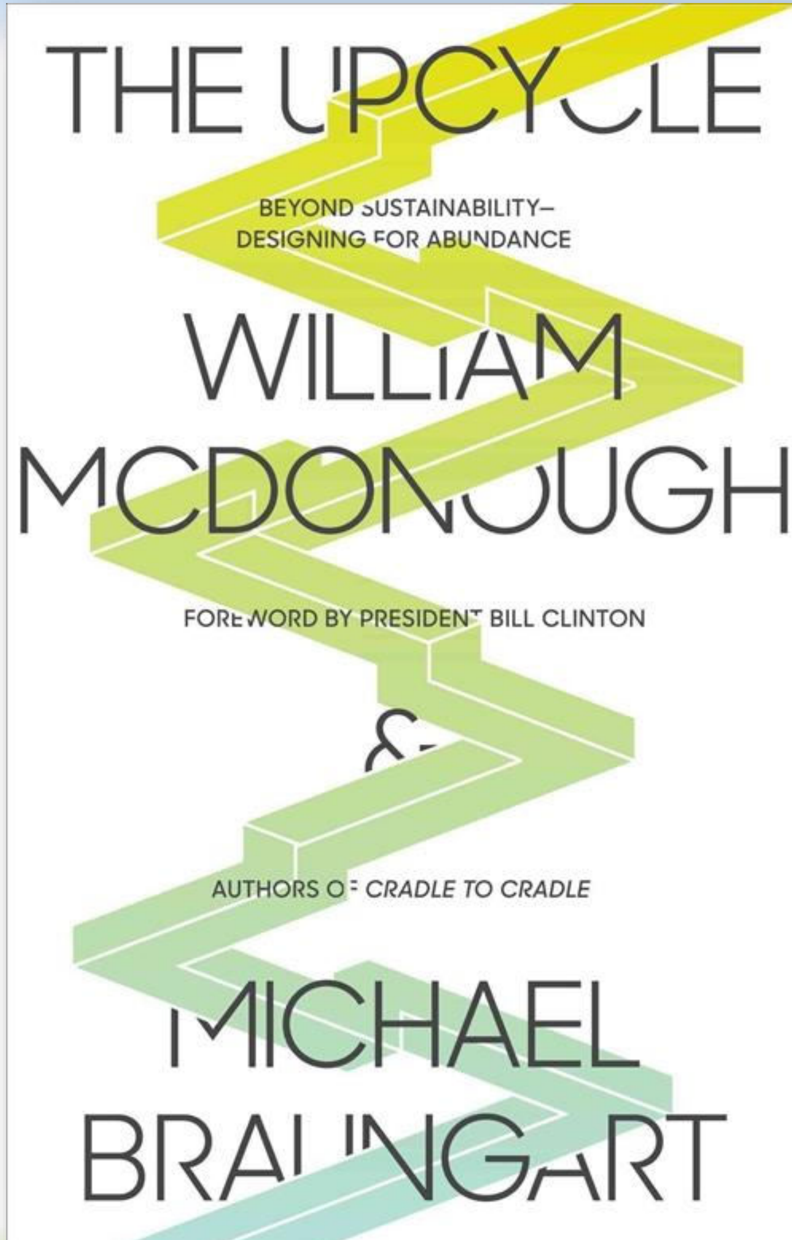











THE UPCYCLE
BEYOND SUSTAINABILITY—
DESIGNING FOR ABUNDANCE
WILLIAM
MCDONOUGH
FOREWORD BY PRESIDENT BILL CLINTON
&
AUTHORS OF CRADLE TO CRADLE
MICHAEL
BRAUNGART

Brainstorming:

How could C2C work in SMEs?

(in 2 groups)

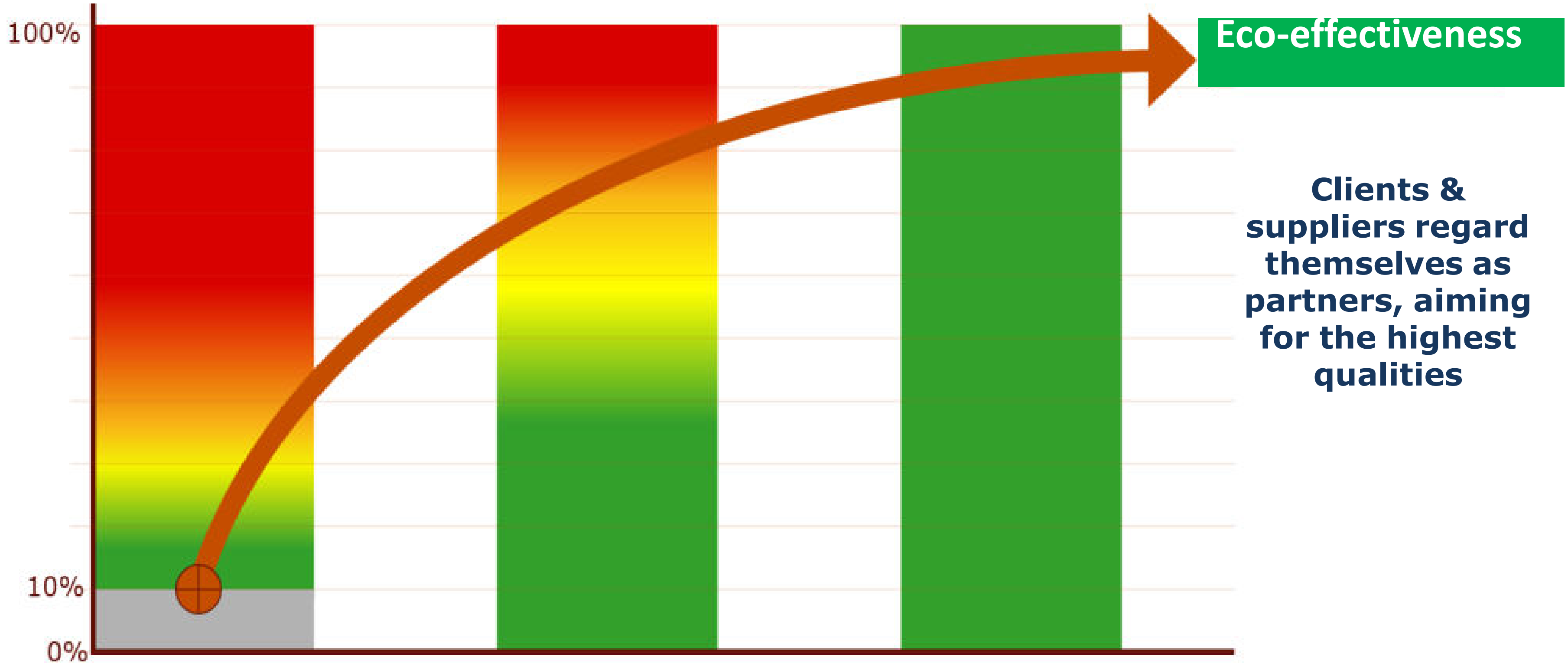
Cradle to Cradle
Methodology & Criteria

EPEA Internationale
Umweltforschung GmbH

Jenny Pfau
Geoecologist & Building Biologist IBN
& PermacultureDesigner

Cradle to Cradle ® - Inspired by Nature

Progress of Quality



Clients & suppliers regard themselves as partners, aiming for the highest qualities

Which criteria should be fulfilled?

Is it safe for Use?

- Safe for Skin Contact?
- Chewing?
- Inhaling?

Colored synthetic fibres

The new cupboard is smelling like glue and colorants?

Is it safe for Use?

- Safe to keep Foodstuff?
- Beverages?
- Toxic Materials: endocrine disruptors, cancerogenic, mutagenic, teratogenic…

Antimon?

BisPhenol A?

Is it safe for our Environment?

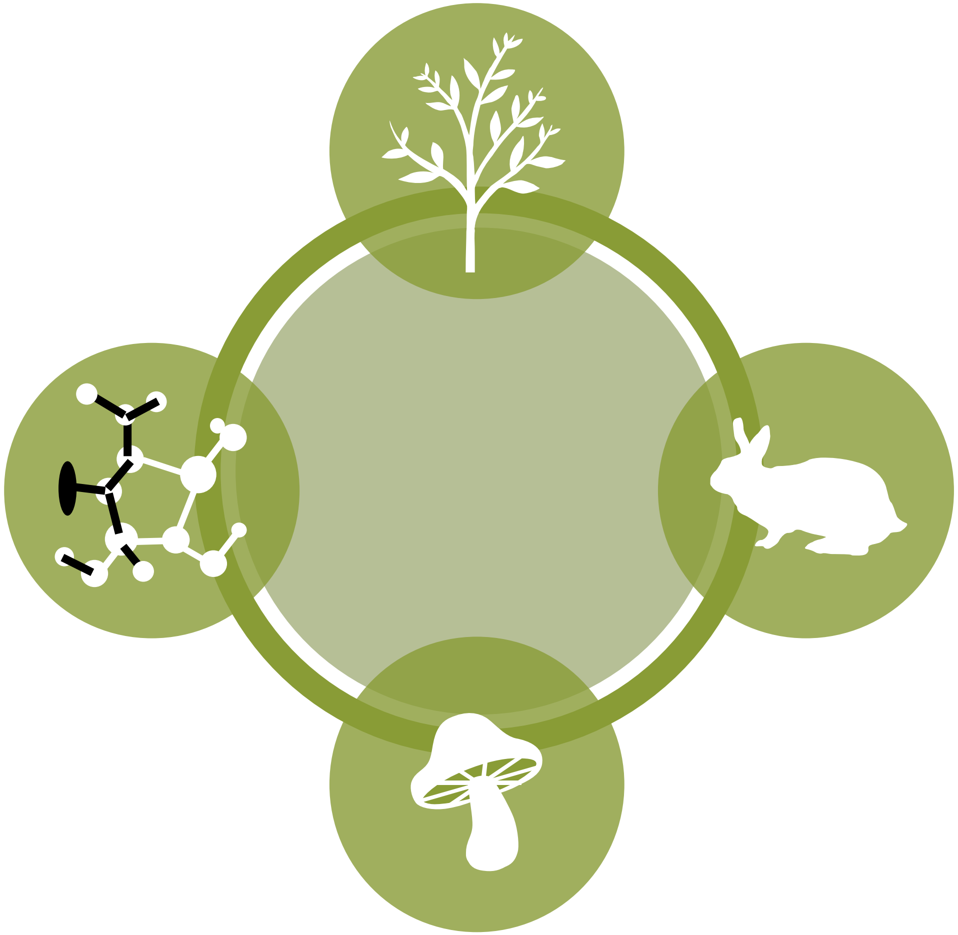
Chemicals are directly released into our environment


Consumption Products
Biological Nutrients
Service Products
Technical Nutrients

Definition of a CRADLE TO CRADLE® Metabolism Scenario

Consumption Product (Materials enter the environment through diffuse processes during use)	**Service Product** (No relevant material flows during use of the product)
Biological Cycle	**Technical Cycle**
Is made from renewable resources	**Necessary for non-renewable resources**
Materials are nutrients in the environment enabling production of new resources	**Materials flow in industrial systems and are nutrients for the production of new products of same or higher quality**
Is non-toxic or beneficial to humans or ecosystems along the biological cycle	**Is non-toxic or beneficial to humans or ecosystems along the technical cycle (e.g. due to deficits)**

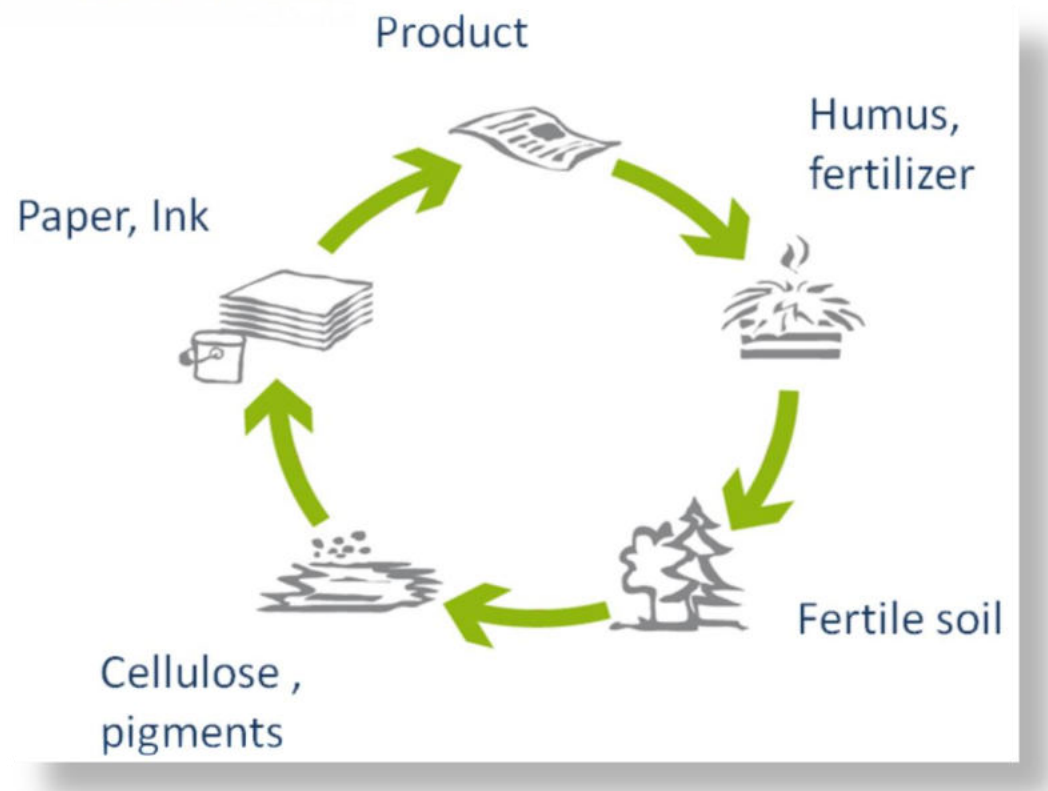
Product examples



Biosphere

Paper

gugler* cross media



van Gansewinkel

océ

STEINBEIS
Papier mit besten Werten

Printing inks: Marabu

In Kooperation mit:
Marabu GmbH & Co. KG
71730 Tamm

Compostable or combustible printing inks

Paper

VanHoutum

CERTIFIED
cradletocradle
SILVER

Satino
BLACK
IT'S SO EASY TO GO GREEN

Textile

Trigema
SILVER

Textile

CERTIFIED
cradletocradle CM
SILVER

Quelle: http://c2ccertified.org/index.php/products/scorecard/climatex_lifeguard
Quelle: http://c2ccertified.org/images/made/images/product_images/lifecycle_270_180_c1_0_0.jpg

Health & Beauty

Home & Office Supply

method

Cradle to Cradle Certified GOLD

GREEN CARE PROFESSIONAL CLEANING & CARE RANGE

tana-Chemie GmbH and Werner & Mertz Group

Certification Standard Version 3.0

tana PROFESSIONAL schafft den Unterschied

ECOVER

MARKE Frosch®

Cradle to Cradle Certified SILVER

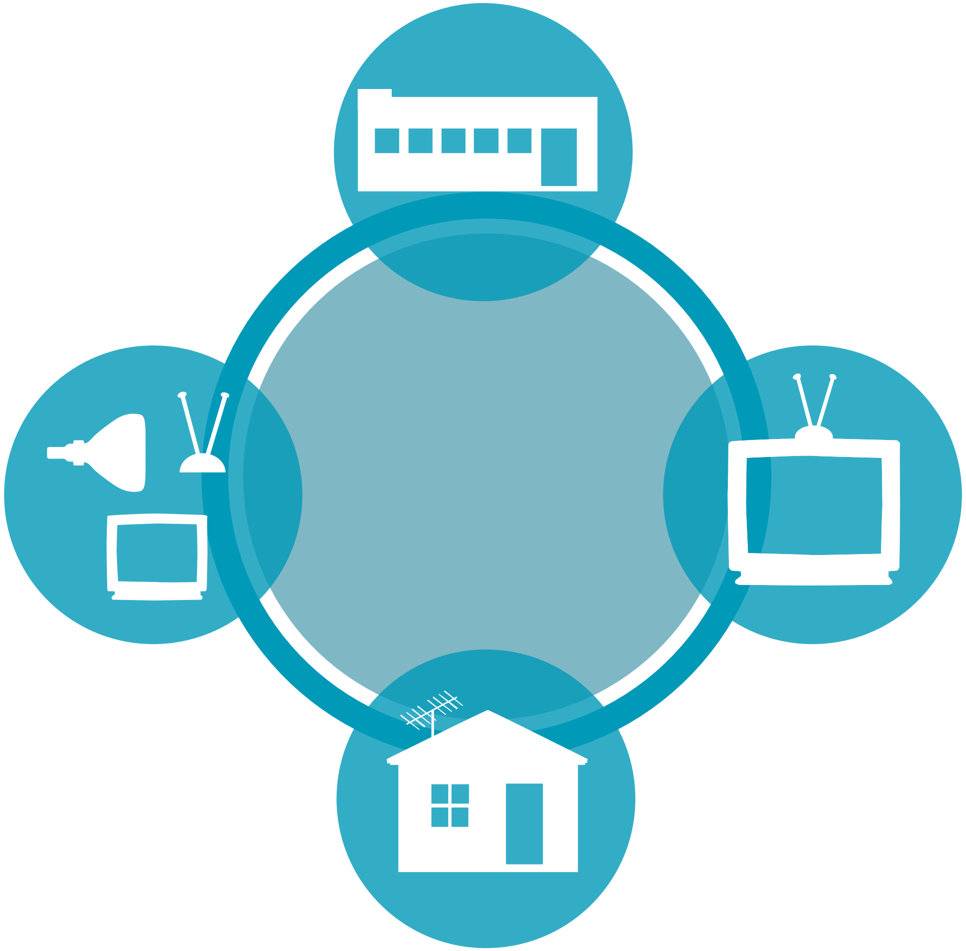
ADD CIP 15 - ECO-POINT INTERNATIONAL B.V.

Eco-Point International B.V.

Certification Standard Version 2.1.1

replenish

Product examples



Technosphere

Toys

Gustav the first Cradle to Cradle® Cuddly toy

- ✓Material optimisation
- ✓Cradle to Cradle certified (Basic level)

Floors

Tarkett

cradletocradle

EPEA

Furniture

ahrend

giroflex
designed to work

Herman Miller, Inc.

Packaging

Packaging

Cradle to Cradle Certified SILVER

INCA PRESSWOOD PALLETS - LITCO INTERNATIONAL, INC.
Litco International, Inc.

Certification Standard Version 2.1.1

FOODSERVICE PACKAGING
Be Green Packaging, LLC

Certification Standard Version 2.1.1

PRODUCT WEBSITE

Cradle to Cradle Certified SILVER

MICRO-PAK® PE SHEET
Micro-Pak Ltd.

Certification Standard Version 2.1.1

PRODUCT WEBSITE

Cradle to Cradle Certified SILVER

220 L / 55 US GAL. PLASTIC TIGHT HEAD DRUM - MAUSER WERKE GMBH
Mauser Werke GmbH

Building Materials

STRUCTURAL BUILDING MATERIALS — Gold V2.1.1

ACCSYS TECHNOLOGIES PLC

Accoya® Wood (Radiata Pine & Alder)

Accoya® is a world leading high technology wood with properties that surpass the best tropical...

MORE INFO »

BUILDING EXTERIORS — Gold V2.1.1

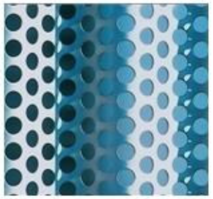
HIGHLAND CRAFTSMEN

Bark House® Poplar Bark Shingle Siding and Wall...

Bark House® shingle siding was the first product HC® developed in 1990. We are the original...

MORE INFO »

BUILDING EXTERIORS — Gold V2.1.1



CENTRIA

EcoScreen

CENTRIA offers exterior perforated screenwall panels using Econolap 3/4", Style-Rib, and BR5-36 in 20...

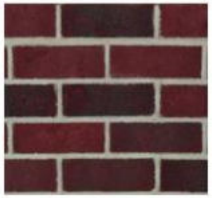
MORE INFO »

GARDEN & LANDSCAPE — Silver V2.1.1

VAN HELVOIRT GROENPROJECTEN BV

Bomenzand+ (Tree-Terra)

CONCRETE, CEMENT, AND MASONRY — Silver



BORAL BRICKS, INC.

Boral Bricks

Boral® manufacturing plants are located across the southeast and southwest, and this geographic...

MORE INFO »

BUILDING EXTERIORS — Silver V2.1.1

BORAL COMPOSITES

Boral TruExterior® Trim - Boral Composites

Boral TruExterior® Trim is a revolutionary new exterior trim product that combines superior...

MORE INFO »

SPECIALTIES AND MISCELLANEOUS APPLICATIONS — Gold V2.1.1

CONSTRUCTION SPECIALTIES, INC.

Expansion Joint Covers (Selected Models)

C/S offers a wide variety of expansion joint covers for seismic, thermal and wind sway applications...

MORE INFO »

INSULATION — Gold V2.1.1

BAUFRITZ-GMBH & CO. KG

HOIZ Insulation

The first sustainable natural insulation in the world, made from wood chips "HOIZ" by Baufritz,...

MORE INFO »

CONCRETE, CEMENT, AND MASONRY — Gold V2.1.1

HYCRETE TECHNOLOGIES

Hycrete Admixtures - Hycrete Technologies

Hycrete admixtures for concrete shut down capillary transport of water and chlorides through concrete...

MORE INFO »

ELECTRICAL — Silver V2.1.1

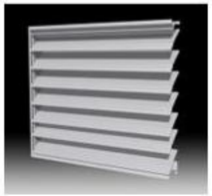
BYRNE ELECTRICAL SPECIALISTS

Byrne Power/Data Centers

Introducing an edgy solution to solve desktop power and data demands that takes your business where...

MORE INFO »

HEATING, COOLING, & VENTILATION — Silver V2.1.1



CONSTRUCTION SPECIALTIES, INC.

C/S Louvers

Conventional, Storm Resistant and Hurricane (Anodized finish only)

DAYLIGHTING & SHADES — Silver V2.1.1

CONSTRUCTION SPECIALTIES, INC.

C/S Sunshades

Our Cradle to Cradle Silver certified C/S Cantilevered Sunshades not only look great on buildings,...

MORE INFO »

Architecture

Daas Baksteen: ClickBrick®

Cradle to Cradle Certified™ Silver

Wood Cube – Wilhelmsburg

Thoma
IMMER SCHON GEBORGENHEIT

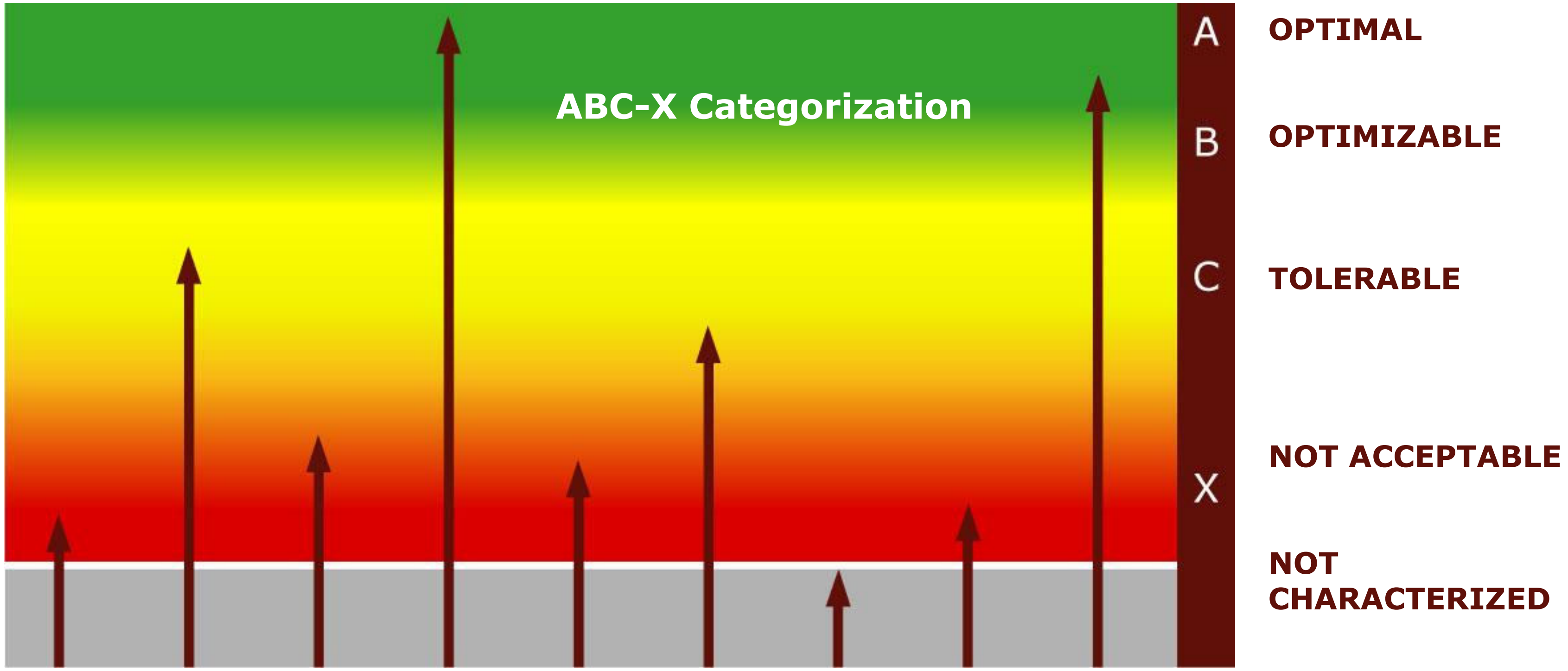
Cradle to Cradle Certified™ Gold

cradle to cradle

EPEA

CRADLE TO CRADLE DESIGN

Material Assessment Methodology


ABC-X Categorization
A
B
C
X
OPTIMAL
OPTIMIZABLE
TOLERABLE
NOT ACCEPTABLE
NOT CHARACTERIZED

NEEDED DATA FOR AN ASSESSMENT

- Composition of a product (BoM)
- Data/ Information of the Ingredients:

  Chemical Name

  CAS-Number

  Pigments: Color Index Number

→ **High Requirements!**

Definition of a CRADLE TO CRADLE® Metabolism Scenario

Consumption Product (Materials enter the environment through diffuse processes during use)	Service Product (No relevant material flows during use of the product)
↓	↓
Biological Cycle	**Technical Cycle**
Is made from renewable resources	Necessary for non-renewable resources
Materials are nutrients in the environment enabling production of new resources	Materials flow in industrial systems and are nutrients for the production of new products of same or higher quality
Is non-toxic or beneficial to humans or ecosystems along the biological cycle	Is non-toxic or beneficial to humans or ecosystems along the technical cycle (e.g. due to deficits)

ABC-X Assessment Methodology (SIMPLIFIED)

Definition of a *Cradle to Cradle*® Scenario

Hazard Criteria

Szenario Context

Risk Assessment:
Risk = Hazard* Exposition

Cyclability

Categorisation:
ABC-X

ABC-X Assessment Methodology (SIMPLIFIED)

- **Material**
  Component
  Polymer + Additives
  Masterbatch
- **„Ingredient“**
  Monome
  Chemicals
- **„Component“**
  Polymer
  Chemicals
  - Colorant
  - Pigment

„Human Health“ Criteria

- Acute Toxicity (oral, dermal, inhalativ)
- Chronic Toxicity
- Skin Irritation
- Sensitation Potential
- Mutagenicity
- Cancerogenicity
- Reprotoxicity
- Endocrine Disrupter

„CMR“

ABC-X Assessment Methodology (SIMPLIFIED)

- Material
- „Ingredient“
- „Component“

Environmental Toxicity - Criteria

- Toxicity against Fish
Daphnia
Bacteria
Algae
- Bioaccumulation/Persistence
- Biodegradation
- Potential of Ozone Layer Depletion

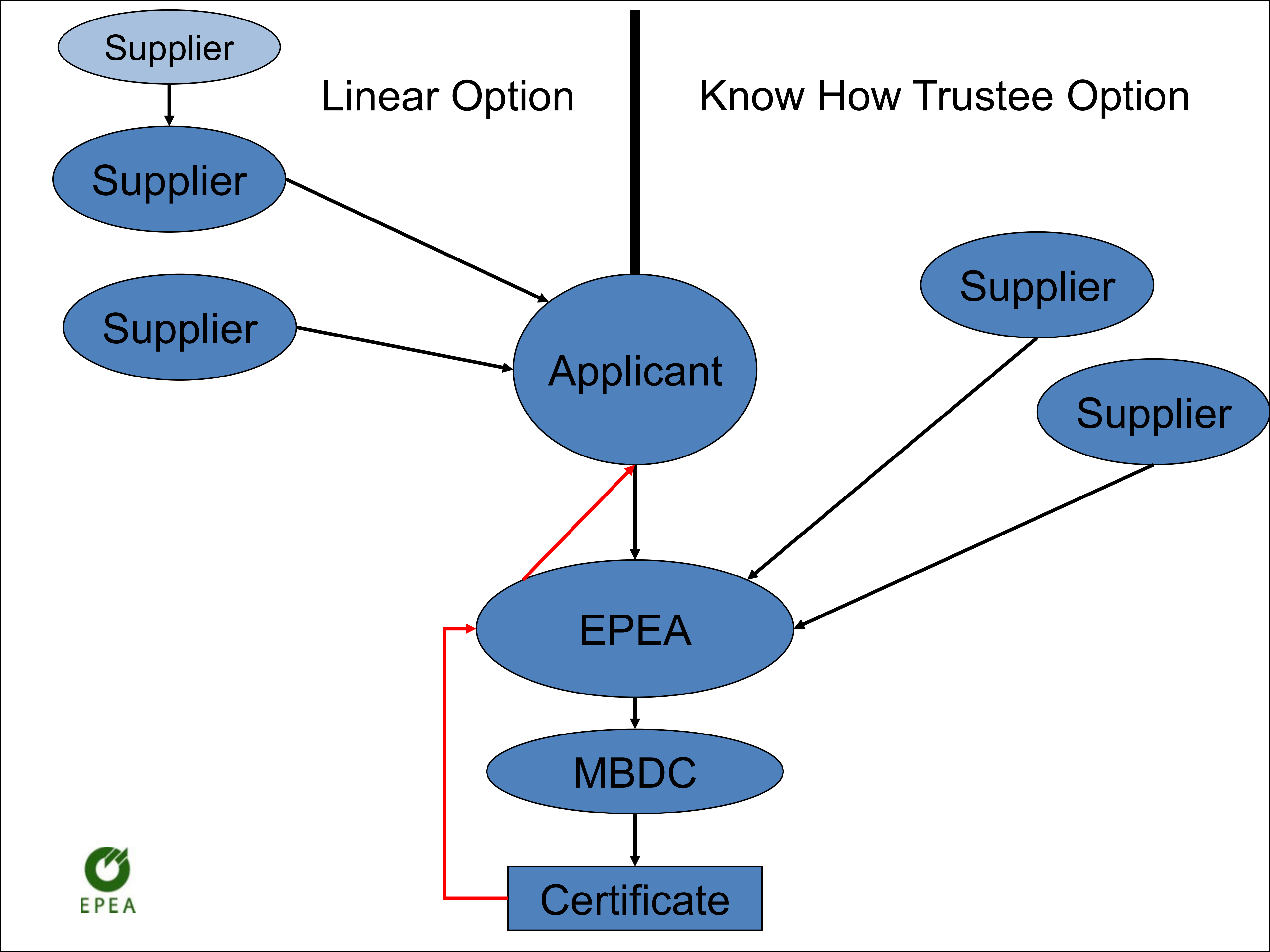
RESEARCH SOURCES

Basis of Data

- Evaluation of Supplier-Data and –information (like MSDS, SDS)
- Databases referring toxicological Information
- Chemical Analysis (like ICP-AES, GC-MS)

Examples of Hazard Rating Criteria

Criterion	Green	Yellow	Red
Carcinogenicity	Not known or suspected of being carcinogenic or TLV A5, IARC 4	Not classifiable as a human carcinogen or MAK III 3A, 4, 5	Known or suspected carcinogen or MAK III 1, 2, 3B; IARC Group 1, 2A, 2B; TLV A1, A2, A3; GHS Category 1A, 1B, 2; H350, H351
Mutagenicity/ Genotoxicity	Substance induces neither punctual mutations nor aberrations of chromosomes/ chromosome segregation at concentrations up to 100 mg/l in in vitro systems	Substance doesn't induce punctual mutations at concentrations up to 100 mg/l	Substance has been tested and induces either punctual mutations or aberrations of chromosomes or of their segregation at concentrations lower than to 100 mg/l in in vitro systems or classified as GHS 1A, 1B, 2; listed MAK 1, 2, 3A, 3B; H340, H341
Reproductive Toxicity	Exhibits no adverse effects to sexual function or to the development of an embryo or fetus and based on human or animal studies	Equivocal evidence of toxic effects to sexual function, fertility, or to the development of an embryo or fetus	Known or suspected of causing adverse effects to sexual function, fertility, or to the development of an embryo or fetus based on human or animal studies or listed as MAK Group A or B, classified as GHS 1, 1A, 1B, or 2; H360, H361, H362
Oral Toxicity	**Acute:** Oral LD50 > 2000 mg/kg BW **Single exposure organ:** LOAEL > 2000 mg/kg BW **Chronic/Sub-chronic:** LOAEL > 100 mg/kg BW/day	**Acute:** 2000 ≥ Oral LD50 > 300 mg/kg BW **Single exposure organ:** 2000 ≥ LOAEL > 300 mg/kg BW **Chronic/Sub-chronic:** 100 ≥ LOAEL > 10 mg/kg BW or listed H373	**Acute:** Oral LD50 ≤ 300 mg/kg BW **Single exposure organ:** LOAEL ≤ 300 mg/kg BW **Chronic/Sub-chronic:** LOAEL ≤ 10 mg/kg BW or listed H372


Supplier
Linear Option
Know How Trustee Option
Supplier
Supplier
Applicant
Supplier
Supplier
EPEA
MBDC
Certificate
EPEA

C2C BANNED LIST

- What is it?

  - List of highly toxic and or problematic chemicals in terms of products and how they are used and/or recycled.

- What is its Purpose?

  - Provide a very basic exclusion criteria for C2C Certification.

- Can it be compared to the REACH SVHC list?

  - No, but with X-substances

- How does EPEA assess chemicals?

  - EPEA's seeks to identify chemicals that best fit into a biological or technical system

The C2C Certification Criteria

The C2C Certification Criteria

Step by Step

CRADLE TO CRADLE CERTIFIED PRODUCT SCORECARD

QUALITY CATEGORY	BASIC	BRONZE	SILVER	GOLD	PLATINUM
MATERIAL HEALTH			✔		
MATERIAL REUTILIZATION			✔		
RENEWABLE ENERGY & CARBON MANAGEMENT				✔	
WATER STEWARDSHIP			✔		
SOCIAL FAIRNESS					✔
OVERALL CERTIFICATION LEVEL			✔		

EPEA INTERNATIONALE UMWELTFORSCHUNG GMBH
Head Office
Trostbrücke 4
20457 Hamburg, Germany
T. +49 40 43 13 49 0
F. +49 40 43 13 49 49
Email: epea@epea.com
www.epea.com

Follow us with c2cworld at

Three-level Centers of Professional Excellence: Qualification, Entrepreneurship and Innovation in the Green Economy (3LoE)

Work Package 4: Second centre level "Continuing vocational training" (EQF Level 4-6)

Activity A6: Trainings in the Green Economy

Best Practice Curriculum

Training F – Energy generation from Wastewater and Waste

Developed by:

WIFI WKO in 2020 in the Project "Management and Technologies of Water, Waste Water, Waste and Circular Economy (WWW&CE)"

Prepared by:

Wirtschaftsförderungsinstitut (WIFI) Steiermark

August, 2021

Co-funded by the Erasmus+ Programme of the European Union

TABLE OF CONTENTS

Co-funded by the Erasmus+ Programme of the European Union

Chapter 1: Executive Summary

The course "Energy Generation from Wastewater and Waste" was developed in the project "Management and Technologies of Water, Waste Water, Waste and Circular Economy – WWW&CE", which was funded by the Erasmus+ Programme of the European Union. Eleven partners from seven EU Member States developed tools according to work-based learning principles that are piloted and evaluated. For more information: https://www.sa-ce.eu

Co-funded by the
Erasmus+ Programme
of the European Union

The course is designed according to the qualifications on the European Framework Qualification Level 4 to 6. Furthermore, the six courses are primarily designed for young people with strong learning skills for vocational training. All courses of the WWW&CE project shall direct participants and in further sequence small and medium sized companies towards a more environmentally conscious approach to their personal and business objectives in order to generate a more sustainable world.

The main objective of the course "Energy generation from Wastewater and Waste" is to equip the participants with valuable knowledge about energy generation of wastewater and waste, energy management as well as standards and regulations on the national and international level. The participants are studying different types of wastewater and waste treatment procedures and their potential for energy generation. Additionally, the students build knowledge around various forms of energy production and their environmental impact. After successful completion, they are able to analyse waste, wastewater and energy management of a company and are able to propose improvement measures. The knowledge acquired by the participants promotes careful use of energy in the company and raises awareness of the importance of sustainable energy generation and thus contributes towards a positive environmental development of enterprises.

The course “Energy generation from Wastewater and Waste” (4 ECTS) is divided into the following modules:

- Module I – "Introduction to the topic of Energy Generation" (0.5 ECTS)
- Module II – "Basics about Wastewater and Waste" (0.5 ECTS)
- Module III – "Energy Generation from Wastewater and Waste" (1 ECTS)
- Module IV – "Practical Application and Utilization" (2 ECTS)

The modules are offered in the form of classroom training with integrated home-based learning. The course is concluded with a seminar paper based on use cases and an analysis of the respective company of the course participant. The modules are described in the following.

Chapter 1.1: Name of the Course

“Energy Generation of Wastewater and Waste”

Chapter 1.2: Contact Details

WIFI Steiermark

Körblergasse 111-113

A-8010 Graz

Tel.: +43 306 602 1234

Fax: +43 316 602 301

E-Mail: info@stmk.wifi.at

Web: https://www.stmk.wifi.at

To be adapted by each partner

Chapter 1.3: Type of Course

Training course for further education.

Chapter 1.4: Demand and Acceptance

Due to the anthropogenic climate change, certain sectors will need more and more qualifications in the future and will have to cope with increasingly complex tasks in order to meet the demands of

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the times. Energy generation plays a major role here. While energy production from fossil fuels is expected to decrease globally, alternatives from regenerative energy production must prevail. For small and medium-sized enterprises (SMEs), it may be relevant to decentrally generate their own energy requirements by generating energy from wastewater or waste.

Due to legal requirements, every company in Austria with more than 20 employees must establish and train employees in the field of waste management, so that these employees can take over the environmentally relevant work and activities in the company. For companies with fewer employees, however, such a training can also offer a great deal of benefits.

Especially companies in the areas of water, wastewater, waste management, recycling, circular economy, etc. will not only be affected by this change, but will also be able to benefit from it. In order to meet the requirements, it is essential that small and medium-sized enterprises (SMEs) adapt their business models and conduct further training in the relevant areas at all levels of the enterprise. Since especially SMEs suffer from strong competition and therefore, available time is a scarce commodity, further training courses are developed in this project in order to be able to meet future requirements on the one hand and to take into account the lack of time of decision makers, managers, owners, experts and other employees of SMEs on the other hand.

The WIFI Steiermark aims to initiate an innovative course of further education "Energy generation from Wastewater and Waste", which will provide further education on the European Qualification Framework (EQF) level 5 (in Austria this corresponds with a finished “Meisterabschluss”) for the following target groups:

- The first target group are decision makers (i.e. owners, managers and experts) in the field of “installation and building technology”, which would like to follow-up with a further education in this relevant field.
- The second target group comprises people in the environmentally related occupations, who want to broaden their knowledge. This includes people working in the field of quality and environmental management.
- The third group comprises of industry employees, who want to further educate themselves, in order to gain applicable knowledge in their field of work. This group is not limited by any factor, as environmentally related educations will gain in importance in many, if not all

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sectors. Thus, spreading information and applying future trends can benefit all types of companies.

The main aim of this curriculum is to provide further training for specialists, managers and entrepreneurs in the professions and sectors of energy generation from wastewater and waste, e.g. installation and building technicians.

The objective is to impart knowledge in the field of energy generation, with a focus on energy generation from wastewater and waste as well as to learn, test and discuss future challenges and sustainable solutions. This curriculum is part of a training programme for decision makers (owners, managers), quality and environmental managers and professionals of SMEs.

Six different training courses in Green technologies are included in the whole programme and are offered to trainees with vocational training and several years of professional experience to acquire skills in water, wastewater, waste and circular economy. The learning content thought are cross professional and are addressed at experts and interested companies from all sectors. The training of the individual courses is specially tailored to the needs of SMEs and different qualification levels. Furthermore, it combines the transfer of technical and professional expertise.

Decision makers (owners and managers) of SMEs are struggling with the task of combining training and work under great lack of time. Employees as well are exposed to the same situation, which prevents them from leaving their work for a longer period of time to attend trainings or further educations measures. Thus, this course is designed in a way so that employers and employees of SMEs have the opportunity to participate in this course without great loss of time or resources, but with a maximum in learning success. Furthermore, an additional benefit for SMEs is created by the fact that the teaching contents and qualifications offered, meet the qualification needs of the employees of SMEs and simultaneously take into account the specific requirements of the SMEs.

To better represent the potential of the target groups, current figures from the Austrian Federal Economic Chamber, the Austrian Federal Waste Management Plan (2017) as well as data from the Federal Institute Statistics Austria were used as sources.

In the year 2017, approximately 39,800 employees were engaged in the waste management sector. It had an annual turnover of approximately 5,200 million Euros. The area of public administration (associations, municipalities, etc.) with almost 14800 employees and a turnover of 1.2 billion euros is particularly noteworthy. Turnover and number of employees in this industry are constantly increasing and the demands on the employees are also increasing enormously.[1]

In 2017, 1,674,234 people aged between 25 to 64 in Austria out of 4,903,139 people in total, completed an apprentice training (this corresponds to EQF Level 4).[2] In 2018, 14,272 people completed a master craftsman training in Austria.[3]

A statistic showing how many people out of a thousand take part in further educational programs in an annual average.[4] 330 out of 1000 wage earners and 288.8 out of 1000 employed persons, took part in further educations. Between the ages of 24 and 64, 15,1 % of the population took part in further education programmes in 2018.

These numbers further underline how of people in Austria who are technically available and willing to take part in courses such as the one described in this curriculum.

There are currently several University courses offered in Austria and many more on a European level that offer similar theoretical contents as this course. However, as the whole study programme is a combination of theoretical and practical experience, within Austria, only the training course for waste management officer and courses related to energy (energy manager, etc.) can be considered as similar, yet they are differentiated as these studies usually involve entire study programmes and not individual qualifications. These courses are very general and either technical or commercial in nature. In addition, the above-mentioned training options lack the application part which for participants is directly integrated into this course.

Chapter 1.5: Target Group

The first priority belongs to owners, management personnel and employees of small and medium-sized enterprises – basically from all branches. Generally, Business founders and potential business founders from all branches. Scientists and consultants dealing with economic questions and furtherance of SMEs during research and consulting. In addition, Students who are interested in preparing seminar and bachelor works related to C2C in SMEs or would like to work in SMEs after completing their studies. People, who are temporarily unemployed and would like to improve their chance for employment through visiting the seminar.

[1] https://www.bmlrt.gv.at/umwelt/abfall-ressourcen/bundes-abfallwirtschaftsplan/BAWP2017-Final.html
[2] http://statistik.at/web_de/statistiken/menschen_und_gesellschaft/bildung/schulen/reife-_und_diplompruefungen/index.html
[3] http://wko.at/statistik/Meisterpruefung/Meisterpruefung2018.pdf
[4] http://statistik.at/web_de/statistiken/menschen_und_gesellschaft/bildung/index.html

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Chapter 1.6: Competences Obtained

CONSULTING AND CALCULATION COMPETENCES	The participants acquire the ability to work in companies in the fields of consulting and calculations concerning energy production from wastewater and waste as well as energy use.
KNOWLEDGE OF ENVIRONMENTAL OBLIGATIONS	The candidate is aware of environmental requirements on the international and national level.
ABILITY TO ANALYSE ENERGY POTENTIALS	Through the preparation of the seminar paper, which is a use-case of their company, the participants have the knowledge of the preparation of energy potential analyses.
ENVIRONMENTAL COMMUNICATION SKILLS	The participants are able to take over parts of the internal and external environmental communication for their company and create communication concepts for various environmentally relevant areas (energy, wastewater, waste)..
AWARENESS OF THE IMPORTANCE OF SUSTAINABLE ENERGY GENERATION	The participant has an insight into the importance of energy generation in the national and international context as well as its relevance to anthropogenic climate change
KNOWLEDGE OF TECHNOLOGIES AND PROCESSES FOR SUSTAINABLE ENERGY GENERATION	The participant has knowledge of measures and technologies for generating energy from wastewater and wastewater.
RECOGNITION OF ENERGY GENERATION POSSIBILITIES	The participant has an insight into energy generation opportunities for SMEs.
INDUSTRY KNOWLEDGE	The participant has industry knowledge and knows which technologies represent a sensible alternative in his company.

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CONSCIOUSNESS OF THE RELEVANCE OF SUSTAINABLE ENERGY GENERATION	The participant understands the role of his own industry and the importance of working towards a sustainable economy through measures in energy generation and wastewater and waste management.
ABILITY TO DO RESEARCH WITHIN THIS FIELD	The participant can update his or her knowledge through literature, websites, courses, seminars and technical literature as reports and mentors from organisations and agencies and through interaction with industry
KNOWLEDGE OF PROFESSIONAL TOOLS WITHIN THIS FIELD	Using appropriate professional tools, the participant will be able to design and describe sustainable wastewater heat utilisation with a heat pump, as well as supervise technical solutions and methods for work related to energy generation.
ABILITY TO INTERPRET ENERGY MANAGEMENT MEASURES	The participant can interpret energy management measures and related environmental documents and create them for practical use.
AWARENESS OF THE PRINCIPLES OF ENERGY PRODUCTION	The participant has an understanding of the principles of energy production to reduce greenhouse gases and the context of anthropogenic climate change.
UNDERSTANDING OF THE BASIC CONCEPTS OF NATIONAL AND EUROPEAN ENERGY MANAGEMENT	The participant has insights into the basic concepts of national and European wastewater and waste management, as well as measures for energy management in SMEs

The graduates can carry out assessments and potentials of the company with regard to energy generation from wastewater and waste. The course also serves as an introduction to other courses

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in the field of environmental management. Through other courses, graduates can acquire the qualification of waste management officer, environmental officer, internal and external auditors ISO 14001 / EMAS III, internal environmental management, quality management, environmental consulting and become active in these areas.

Chapter 1.7: Field of application

Typical Organization

Every company in the fields of energy generation, wastewater and waste, as well as every company in building and installation technology.

Austria: Every company with more than 20 employees or if a new company is set up in Austria is required by law to develop and train employees in this area so that these employees can take over the environmentally relevant work and activities in the company.

Typical Industries

On a global or European level: in addition to public institutions, typical industries that deal with waste and environmental management or energy generation and wastewater management are present in all industrial sectors, such as the automotive industry, electrical industry, wood and pulp industry, chemical and petrochemical companies. Moreover, the entire private and public waste management and wastewater management are to be considered as target groups. Furthermore, a considerable amount of small and medium sized enterprises in all types and forms of sectors and industries is in some way related to energy generation, wastewater management or waste.

Austria: The area of public administration (associations, municipalities, etc.) with almost 14800 employees and a turnover of 1.2 billion euros is particularly noteworthy. However, all industry sectors and all sizes of enterprises within Austria that utilize energy or generate waste and/or wastewater are considered as typical industries.

Chapter 1.8: Course Duration

The duration of this course is measured in ECTS. One ECTS corresponds to 25 hours of work. In this course, the amount of work required is measured in lessons - one lesson corresponds to 50 minutes.

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The entire course comprises 4 ECTS, which corresponds to a total of 100 hours or 120 lessons of workload. These 4 ECTS (or 100 hours) include every activity that needs to be undergone to finish the course, i.e. classroom-setting lessons, studying the content at home (self-study), preparing a seminar paper and presenting this paper to fellow peers.

In the case of an extra-occupational course of study, an annual load of 45 ECTS is assumed as the minimum duration of the study. This results in approximately 3.75 ECTS per month. As this course includes a case study in the form of a seminar paper, which is based on real-life working experience, the total duration of this course was set at three months.

The course is divided into three phases:

- The first phase will comprise of frontal teaching in a classroom setting, which takes place at the course venue and includes home-based e-learning of the presented content by the participants. The total amount for this phase is 60 lessons (i.e. 50 hours or 2 ECTS).
- The second phase comprises of executing a case study and writing a seminar paper about the company of the participant. This work or phase is supported by a trainer. This task will account for approximately 51 lessons (i.e. 42.5 hours or 1.7 ECTS).
- The third phase is again at the course venue, where the participants present their projects and exchange experiences and learned lessons. This will take 9 lessons (i.e. 7.5 hours or 0.3 ETC).

Summarized, the total workload for this curriculum including classroom participation, self-study and the preparation and presentation of a seminar paper is 120 lessons, each corresponding to 50 minutes, which equals 100 hours (per 60 Minutes) or 4 ECTS.

Chapter 1.9: Required Prerequisites

The access and admission requirements for this course are not as stringent as for other courses in the sector of further education. This is due to the fact that this course addresses a large target group and the imparted knowledge is very fundamentally oriented.

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For this course "Energy generation from Wastewater and Waste" advised prior knowledge, when available, include knowledge in the energy and environmental area. This also includes occupational related experience or education related experience in these fields.

After completion of this course and the completion of related courses, the participants will be able to apply the knowledge gained in their companies. The skills will include the creation of a company waste management concept according to national and international regulations. The knowledge and duties of a Waste Management Officer will be known as well as the fundamentals of energy management.

Chapter 2: Curriculum

The four modules of the course …

- Module I – "Introduction to the topic of Energy Generation"
- Module II – "Basics about Wastewater and Waste"
- Module III – "Energy Generation from Wastewater and Waste"
- Module IV – "Practical Application and Utilization"

…are taught in the form of classroom teaching and self-study. In the theoretical modules, consisting of the thirst three modules, the knowledge foundation for the seminar work to be written by the participants is established. All modules are characterized by theoretical lecture contents and tasks for independent self-study work. In this way, the practical relevance is placed in the foreground and an immanent examination of the teaching content can be guaranteed. Students acquire the 0.5 ECTS for the first two modules and 1 ECTS for the third module by attending the lectures and active participation, as well as by independently preparing and subsequently presenting the seminar, i.e. the project work.

Basic knowledge of the natural sciences and energy, waste and wastewater as well as related issues, such as anthropogenic climate change, are integrated in modules I to III.

Module IV consists on preparing and executing a case study in the company of the participant itself. It will be written in independent work by the participants and supported by the trainer via online tools. This module requires the most amount of work and is therefore worth 2 ECTS.

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Module Number & Name	Content of the Curriculum		
I Introduction to the topic of Energy Generation	In this module the basics of energy production are taught. The different types, the potentials of different types of generation, energy in the context of climate change, etc. are to be addressed in this module in addition to the operational effects of energy management. This module gives the participants a general overview of the topic regarding energy and energy generation, including the national, European and global challenges. Furthermore, the topic of which types of energy and energy generation exist will be addressed as well as the relationship to the environment (fossil vs renewable). Another addressed subject is the relevance for SMEs and in a larger context the problem of energy generation using fossil energy sources. The contents will be integrated by the participants in their seminar paper.		
	ECTS: 0.5 Hours: 12.5 Lessons: 15	<u>Type of the course:</u> Integrated course consisting of lecture and self-study parts	<u>Type of Examination:</u> Seminar Paper (about the overall course and the contents of all modules)
Course targets	The participants know the fundamental concepts of energy and energy generation on a national and international as well as on the European level. Furthermore, the students know measures towards energy management within companies and especially small and medium sized enterprises.		
Recommended literature	European Commission on Energy: https://ec.europa.eu/energy/home_en European Commission Long Term Strategy 2050: https://ec.europa.eu/clima/sites/lts/lts_at_de.pdf Bank, Matthias: Basiswissen Umwelttechnik: Wasser, Luft, Abfall, Lärm, Umweltrecht/ Matthias Bank. – 4., Würzburg: Vogel, 2000; ISBN 3-8023-1797-1 Förstner, Ulrich; Köster, Stephan: Umweltschutztechnik / Ulrich Förstner, Stephan Köster. – 9. Berlin: Springer, 2018; eBook ISBN 978-3-662-55163-9; DOI: 10.1007/978-3-662-55163-9 Tomašić, Vesna; Zelić, Bruno: Environmental Engineering: Basic Principles / Vesna Tomašić; Bruno Zelić. – 1., De Gruyter, 2018; ISBN-13: 978-3110468014 Nathanson, Jerry A.: Basic Environmental Technology: Water Supply, Waste Management and Pollution Control / Jerry A. Nathanson. – 6. USA: Pearson Education; ISBN-13: 978-0132840149		

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<table>
<tr><td></td><td colspan="3">Kunz, Peter: Behandlung flüssiger Abfälle: flüssige Rückstände, Abfälle und Konzentrate / Peter M. Kunz. – 1. Aufl. – Würzburg: Vogel, 1995 ISBN 3-8023-1443-3
Sattler, Klaus: Behandlung fester Abfälle: Vermeiden, Verwerten, Beseitigen, Sanieren; Verfahrensweise – Technische Realisierung – rechtliche Grundlagen / Klaus Sattler; Jürgen Emberger. – 4. Würzburg: Vogel, 1995 ISBN 3-8023-1511-1
Water Environment Federation: Wastewater Treatment Fundamentals I: Liquid Treatment / Water Environment Federation – 1. 2018, - WATER ENVIRONMENT FEDERATION; ISBN-13: 978-1572783508
Nzihou, Ange: Re-Use and Recycling of Materials: Solid Waste Management and Water Treatment / Ange Nzihou. 2019, River Publishers. ISBN-13: 978-8770220583</td></tr>
<tr><td>II
Basics about Wastewater and Waste</td><td colspan="3">In this module the basics of national and European waste management and wastewater management are taught. The different types of waste and wastewater as well as their heat energy potentials are addressed in addition to the operational effects of waste and wastewater management. The potentials of waste and wastewater in an SME setting are explored and the opportunities of what can be used in the energy technology sector are conveyed. This module gives the participants a general overview of the topic regarding waste and wastewater, including the national, European and global challenges and regulations. Furthermore, the topic of which types of waste and wastewater exist will be addressed as well as the relationship to the environment (hazardous vs non-hazardous). Another addressed subject is the relevance and positions for SMEs and in a larger context the problem of waste generation for the environment. The contents will be integrated by the participants in their seminar paper</td></tr>
<tr><td></td><td>ECTS: 0.5
Hours: 12.5
Lessons: 15</td><td><u>Type of the course:</u>
Integrated course consisting of lecture and self-study parts</td><td><u>Type of Examination:</u>
Seminar paper (about the overall course and the contents of all modules)</td></tr>
<tr><td>Course targets</td><td colspan="3">The participants know the fundamental concepts of waste and wastewater on a national and international as well as on the European level. Included are the different kinds and types of waste and wastewater as well as their potentials for heat energy. Furthermore, the participants know measures towards waste and wastewater management within companies and especially small and medium sized enterprises with an applicable approach.</td></tr>
</table>

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Recommended Literature	European Commission Hazardous Waste: https://ec.europa.eu/environment/waste/hazardous_index.htm European Commission. Waste Framework Directive: https://ec.europa.eu/environment/waste/framework/ Austria Federal Environmental Agency Waste: https://www.umweltbundesamt.at/umweltsituation/abfall/ Handbook of Solid Waste Management and Waste Minimization Technologies. Butterworth-Heinemann. 2003. ISBN 9780750675079. Bank, Matthias: Basiswissen Umwelttechnik: Wasser, Luft, Abfall, Lärm, Umweltrecht/ Matthias Bank. – 4., Würzburg: Vogel, 2000; ISBN 3-8023-1797-1 Förstner, Ulrich; Köster, Stephan: Umweltschutztechnik / Ulrich Förstner, Stephan Köster. – 9. Berlin: Springer, 2018; eBook ISBN 978-3-662-55163-9; DOI: 10.1007/978-3-662-55163-9 Tomašić, Vesna; Zelić, Bruno: Environmental Engineering: Basic Principles / Vesna Tomašić; Bruno Zelić. – 1., De Gruyter, 2018; ISBN-13: 978-3110468014 Nathanson, Jerry A.: Basic Environmental Technology: Water Supply, Waste Management and Pollution Control / Jerry A. Nathanson. – 6. USA: Pearson Education; ISBN-13: 978-0132840149 Kunz, Peter: Behandlung flüssiger Abfälle: flüssige Rückstände, Abfälle und Konzentrate / Peter M. Kunz. – 1. Aufl. – Würzburg: Vogel, 1995 ISBN 3-8023-1443-3 Sattler, Klaus: Behandlung fester Abfälle: Vermeiden, Verwerten, Beseitigen, Sanieren ; Verfahrensweise – Technische Realisierung – rechtliche Grundlagen / Klaus Sattler; Jürgen Emberger. – 4. Würzburg : Vogel, 1995 ISBN 3-8023-1511-1 Water Environment Federation: Wastewater Treatment Fundamentals I: Liquid Treatment / Water Environment Federation – 1. 2018, - WATER ENVIRONMENT FEDERATION; ISBN-13: 978-1572783508 Nzihou, Ange: Re-Use and Recycling of Materials: Solid Waste Management and Water Treatment / Ange Nzihou. 2019, River Publishers. ISBN-13: 978-8770220583
III Energy generation from Wastewater and Waste	In this module the contents of the first two modules are enhanced and used to address the combination of energy generation from wastewater and waste. This includes theoretical as well as operational waste and wastewater management as well as energy management on a national and European level. Various technologies and their potentials with a focus on wastewater utilization by heat pump technology are addressed. The contents are oriented on applicable utilization in a company and SME setting and the opportunities of which technologies and potentials can be used are taught. This module gives the participants an overview of the topic energy generation from the sources waste and wastewater and includes national, European and global challenges and regulations. Furthermore, actual use cases are demonstrated to prepare the

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	participants with hand on examples for their own seminar paper. Another addressed subject is the relevance, opportunities and positions for SMEs and in a larger context the challenges and opportunities of energy generation for the environment and the economy. The contents will be integrated by the participants in their seminar paper.		
	ECTS: 1 Hours: 25 Lessons: 30	<u>Type of the course:</u> Integrated course consisting of lecture and self-study parts	<u>Type of Examination:</u> Seminar paper (about the overall course and the contents of all modules)
Course targets	The participants know various technologies and concepts of energy generation from waste and wastewater on a national and international as well as on the European level. A special focus is laid on the heat pump technology. Included are the different kinds and types of energy generation as well as their potentials for SMEs and companies. Furthermore, the participants are able to create concepts for their own companies (by exploring use cases) and can evaluate their own waste, wastewater and energy management within their company.		
Recommended Literature	European Commission Long Term Strategy 2050: https://ec.europa.eu/clima/sites/lts/lts_at_de.pdf Bank, Matthias: Basiswissen Umwelttechnik: Wasser, Luft, Abfall, Lärm, Umweltrecht/ Matthias Bank. – 4., Würzburg: Vogel, 2000; ISBN 3-8023-1797-1 Förstner, Ulrich; Köster, Stephan: Umweltschutztechnik / Ulrich Förstner, Stephan Köster. – 9. Berlin: Springer, 2018; eBook ISBN 978-3-662-55163-9; DOI: 10.1007/978-3-662-55163-9 Tomašić, Vesna; Zelić, Bruno: Environmental Engineering: Basic Principles / Vesna Tomašić; Bruno Zelić. – 1., De Gruyter, 2018; ISBN-13: 978-3110468014 Nathanson, Jerry A.: Basic Environmental Technology: Water Supply, Waste Management and Pollution Control / Jerry A. Nathanson. – 6. USA : Pearson Education; ISBN-13: 978-0132840149 Water Environment Federation: Wastewater Treatment Fundamentals I: Liquid Treatment / Water Environment Federation – 1. 2018, - WATER ENVIRONMENT FEDERATION; ISBN-13: 978-1572783508		

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	Nzihou, Ange: Re-Use and Recycling of Materials: Solid Waste Management and Water Treatment / Ange Nzihou. 2019, River Publishers. ISBN-13: 978-8770220583 Water Environment Federation: The Energy Roadmap: A Water and Wastewater Utility Guide to More Sustainable Energy Management / Water Environment Federation – 1. 2013, - WATER ENVIRONMENT FEDERATION; ISBN-13: 978-1572782730		
IV Practical Application and Utilization	This module gives the participant the final instruction for their own seminar paper. The contents of the first three modules are revised and enhanced by using specific use cases. The contents are oriented on applicable utilization in a company and SME setting and the opportunities of which technologies and potentials can be used in the companies of the participants. This module gives the participants all required information for the preparation of their seminar paper.		
	ECTS: 2 Hours: 50 Lessons: 60	Type of the course: Integrated course consisting of lecture and self-study parts	Type of Examination: Seminar paper (about the overall course and the contents of all modules)
Course targets	The participants have the required knowledge and skills to write a seminar paper about the potentials of waste, wastewater and energy generation in their own company or in an illustrative example. This seminar paper is at the same time the final paper of the course and is presented by the participant to the other participants in a classroom session.		
Recommended Literature	See "Recommended Literature" of Module I, Module II and Module III		

Chapter 2.1 Speakers & Trainers

This part is filled out by the performing institute.

Name:	

Title:	
E-Mail Address:	
Telephone:	

Training and additional qualifications:

Current professional activity:

Previous teaching activities:

Publications (if applicable):

Chapter 2.2.: Requirements for the trainer's qualification:

The trainers' competences are wide-ranging and include the energy, environmental and waste management sectors, legal areas such as environmental law, plant and trade law, chemical and toxicological areas, employee protection as well as quality and environmental management and communication.

As the further education course "Energy generation from wastewater and waste" is to be designed very company-related and implementation-oriented, lecturers with a high practical relevance and lecturers with high scientific expertise are used.

Areas such as legal compliance, environmental costs, energy, environmental indicators, handling of solid and liquid waste, wastewater use, internal environmental communication, etc. convey the basic

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scientific knowledge and are presented by qualified persons from the further education and training sector.

Chapter 2.3: Testing of the competence Level

The course and examination regulations of the applicable institution apply.

The performance assessment in the classroom courses is based on the attendance of modules I, II and III, while module IV concludes with a project work (seminar paper) of the students. In this project work (seminar paper), the application of the learned concepts and methods to cases from the professional practice of the students is in the foreground.

The composition of examination commissions as well as repetition possibilities are regulated in the course and examination regulations of the applicable institution.

Chapter 2.4: Access Requirements and Admission

The access and admission requirements for this course are not as stringent as for other courses in the sector of further education. This is due to the fact that this course addresses a large target group and the imparted knowledge is very fundamentally oriented.

For this course "Water Supply and Water Saving" recommended previous knowledge, if available, includes knowledge of water management and wastewater. This also includes jobrelated experience or training-related experience in these areas.

After completing this course and completing other related courses, participants will be able to apply the acquired knowledge in their companies. Skills include the creation of an operational water concept according to national and international regulations. Knowledge and tasks in the water sector will be just as familiar as the basics of wastewater management.

Chapter 2.5 Quality assurance

The quality assurance of the course "Energy generation from wastewater and waste" will be integrated into the existing quality assurance system of WIFI Styria. In addition, extensive testing and evaluation by third parties will take place before the official start of the course. Furthermore, the leadership will visit the classroom courses at random.

Finally, each classroom course is evaluated by the course participants with the help of anonymous evaluation sheets with regard to content and communication of the course contents. These evaluations are continuously incorporated into the improvement of the course.

Chapter 3: Teaching Material

The teaching material can be found in the pdf file entitled "3LoE_WP4A61_F_TeachingMaterial".

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3LoE – WP4 A6.1 – Curriculum F

Energy generated from Wastewater & Waste

Content

Module I - Introduction to the Topic of Energy Generation

Content

- What is Energy?
- Types of Energy
- Energy Generation
- Potentials
- Energy in the EU
- Energy scenarios
- Energy in the context of climate change
- Excursion: Introduction to the environment and systems
- Summary

What is Energy?

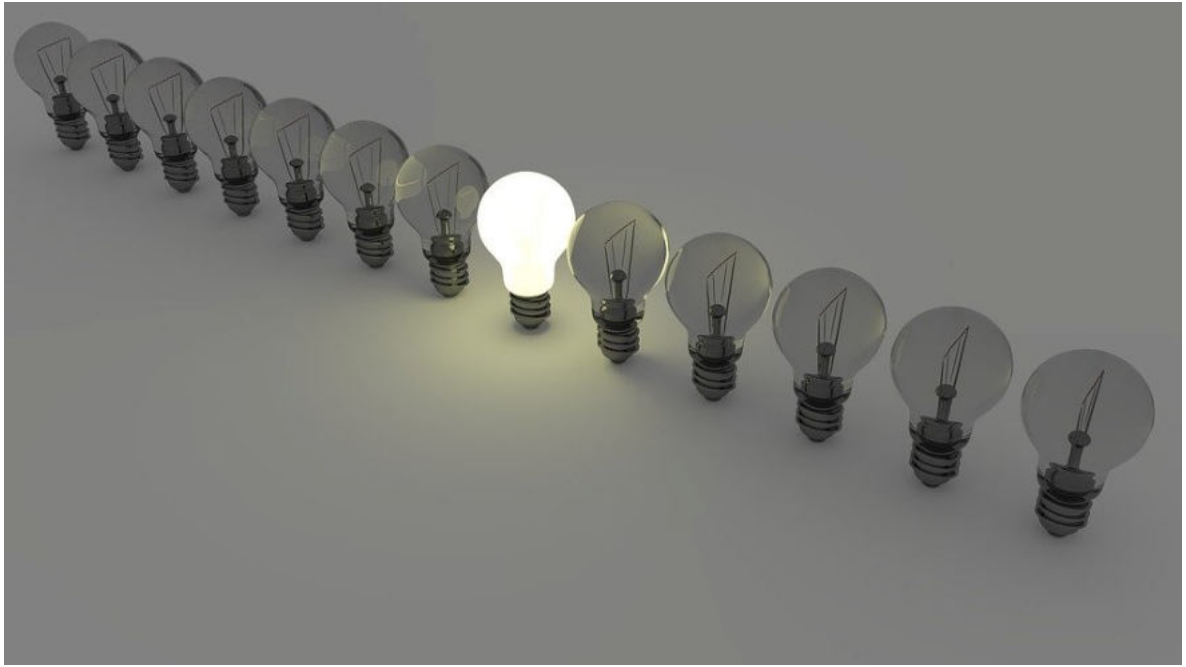

Photo by ColN00B on Pixabay

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What is Energy?

- **Energy is the quantitative property that must be transferred to an object in order to perform work on, or to heat the object.**

- Energy exists in different forms of energy that can be converted into each other.

- **Examples of forms of energy:**
  - Potential
  - Kinetic
  - Electrical
  - Chemical
  - Thermal

- **Examples of conversions of energy:**
  - A person lifting a box
  - A person accelerating a bicycle
  - Charging a battery
  - The metabolism
  - A heater giving off heat
  - etc.

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Potential Energy

- **The potential energy (also called positional energy) describes the energy of a physical system, which is determined by its position in a force field or by its current system configuration.**

- Example:

In a gravitational field the "potential energy" is the energy that a body has due to its altitude: If an object falls from a height of 100 meters, it has ten times more working capacity as at a height of 10 meters.

During the fall, the potential energy is converted into kinetic energy or other forms of energy and decreases.

In hydroelectric power plants, potential energy from the water of a reservoir can be converted into electrical energy.

Kinetic Energy

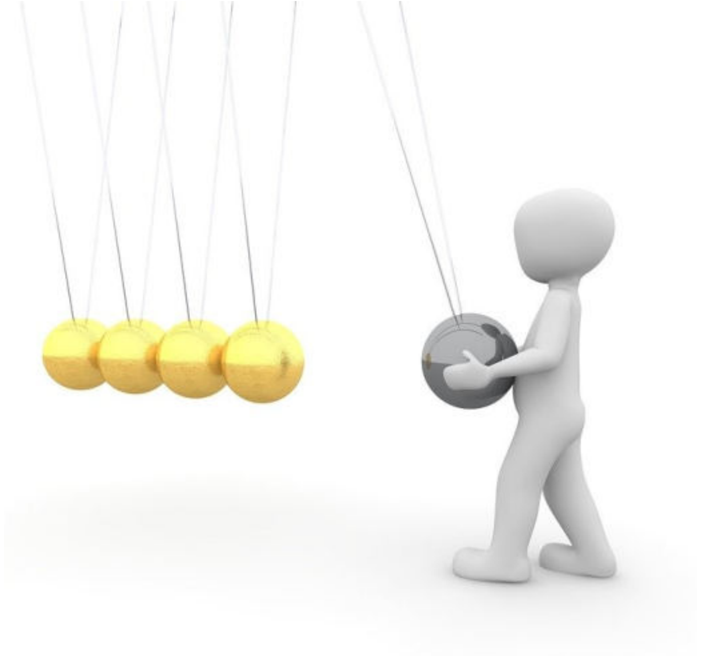

Photo by Peggy_Marco on Pixabay

Kinetic Energy

- **The kinetic energy (Greek: “kinesis” = “movement”) or rarely velocity energy is the energy that an object contains due to its movement.**

It corresponds to the work that must be done to move the object from rest to its current movement. It depends on the mass and speed of the moving body.

Moving bodies such as a cyclist, a moving car, a falling stone or a rotating flywheel have kinetic energy.

Instead of kinetic energy, one also speaks of energy of movement. With rotating bodies, kinetic energy is also called rotational energy.

Electrical Energy

- **Electrical energy is energy that is transmitted by means of electricity or stored in electrical fields.**

Electrical energy can be used in many ways, as it can be converted into other forms of energy with **low losses and can be easily transported**. Its generation and supply to the economy and consumers is of great importance in modern societies.

Photo by Free-Photos on Pixabay

Electrical Energy

- **Electrical energy is energy that is transmitted by means of electricity or stored in electrical fields.**

In power plants, batteries and accumulators, **electrical energy is generated by converting other forms of energy**, e.g. thermal energy or chemical energy.

This is transported to the consumers via power lines, where it is converted back into other forms of energy (kinetic, potential, light or heat energy). The electrical energy is localized in the electromagnetic field, which manifests itself macroscopically in current and voltage.

Chemical Energy

- **Chemical energy is the form of energy that is stored in an energy carrier in the form of a chemical compound and can be released during chemical reactions.**

The term chemical energy describes macroscopically the energy associated with electrical forces in atoms and molecules that are involved in chemical reactions.

The term "chemical energy" is not used in the field of chemistry. It is only clearly defined when the environmental conditions are specified - there is then a different established term for each scenario.

Thermal Energy

- **Thermal energy (not to be confused with heat) is a collective name for macroscopic and microscopic forms of energy, which refer to the disordered motion of particles (including photons) in macroscopic matter or in other many-particle systems. Macroscopic forms of energy include internal energy, heat, enthalpy.**

Thermal energy refers to several distinct thermodynamic quantities, such as the internal energy of a system; heat or sensible heat, which are defined as types of energy transfer.

Energy Generation

- **Energy generation is the main end use of such emulsions, though burners and boilers have to be modified and environmentally adapted.**

There are **many different forms** of energy generation. Often energy generation is equated with electricity generation.

There are 10 main sources of energy. These different sources of energy are used primarily to produce electricity.

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Sources of Energy

- **Solar Energy:**

Solar power **harvests the energy of the sun** through collector panels.

It can be used as **small or large applications**.

While large solar panel fields are often used in deserts or big and flat areas to gather power to charge small sub-stations, small applications refer to homes or communities that use solar energy.

Photo by PublicDomainPictures at Pixabay

Sources of Energy

- **Solar Energy:**

Many homes use solar systems to **provide for hot water, cooling and supplement their electricity**.

The issue with solar energy is that while there is **basically unlimited amounts** of sun and therefore energy available, **only certain geographical ranges get enough** of the **direct power** for long enough to generate usable power from this source.

This is also related to the angle in which areas or homes are compared to the sun.

Sources of Energy

- **Wind Energy:**

Wind energy or power is **becoming a common to create energy**.

By using large turbines to utilize available wind as the power to turn, the turbine can then turn a generator to produce electricity.

Photo by Phillip Katzenberger at Unsplash

Challenge with wind power generation: wind farms have unforeseen ecological impacts.

Sources of Energy

- **Wind Energy:**

Furthermore, the **not in my backyard (NIMBY) effect** plays a role with wind energy.

The NIMBY effect relates to communities that are in favor of e.g. renewable energy but don’t want it directly in their own community.

There are several examples for this effect. It also applies e.g. for the construction of hydro plant, prisons, coal mines etc.

Sources of Energy

- **Hydrogen Energy:**

Hydrogen is available in water (H_2O). It is the most **common element available on earth**.

Water contains two-thirds of hydrogen and can be found in combination with other elements.

Once it is separated, it can be used as a fuel for generating electricity.

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Sources of Energy

- **Hydrogen Energy:**

Hydrogen is a **large source of energy** and can be used as a source of fuel to power ships, vehicles, homes, industries and rockets.

Within the EU **several countries** (e.g. Austria) have **included hydrogen** and the research and development of it **in their sustainability measures** to reach set climate targets.

Sources of Energy

- **Geothermal Energy:**

Geothermal energy is the energy that is available and can be harvested from beneath the earth(crust).

It is clean, sustainable and environmentally friendly.

High temperatures are produced continuously inside the earth’s crust by the slow delay of radioactive particles. Basically, hot rocks heat up the water that produces steam. The steam is then captured and helps to move turbines. The rotating turbines then power generators.

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Sources of Energy

- **Geothermal Energy:**

It can be used as a residential unit or as an industrial application.

The biggest disadvantage with geothermal energy is that it **can only be utilized at selected sites**.

Photo by Hans Braxmeier at Pixabay

The largest group of geothermal power plants in the world is located at "The Geysers" - a geothermal field in California.

Sources of Energy

- **Tidal Energy:**

Tidal energy uses the **rise and fall of tides to convert** kinetic **energy** of incoming and outgoing tides into electrical energy through fixed generators in the ocean.

Obviously, the generation of energy through tidal power is mostly prevalent in coastal areas.

Large investment and limited availability of sites are drawbacks of tidal energy.

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Sources of Energy

- **Tidal Energy:**

When there is increased height of water levels in the ocean, tides are produced which rush back and forth in the ocean.

Tidal energy is a **renewable source of energy** and produces a lot of energy even when the tides are at low speed.

A major player in utilization of tidal energy in Europe is Scotland.

Sources of Energy

- **Wave Energy:**

Similar to tidal energy in terms of the technology and generation is wave energy, which **is produced from the waves in the ocean**.

Wave energy is **renewable, environmentally friendly and causes no harm** to atmosphere **in terms of pollution**.

It can be harnessed along coastal regions of many countries and **can help** a country **to reduce** its **dependence on foreign countries** for fuel as well as **decrease their own carbon footprint**.

Sources of Energy

- **Wave Energy:**

However, producing wave energy **can damage marine ecosystem** and can also be a **source of disturbance to private and commercial vessels**.

It is highly dependent on wavelength and can also be a source of visual and noise pollution but is still regarded as a viable option compared to fossil fuels where applicable.

Sources of Energy

- **Hydroelectric Energy:**

Many **urban regions** in the world **rely on hydropower**.

The history of hydro power technically goes back for several centuries (e.g. mills).

Nearly every major dam, it is providing hydropower to an electrical station.

The power of the **water is used to turn generators to produce electricity**, which is then used for other applications.

Sources of Energy

- **Hydroelectric Energy:**

Challenges with hydropower are the **aging of dams** and **availability** of new cost and energy **effective sites**.

Many dams require major restoration work to remain functional and safe, which is very costly.

The drain on the world's drinkable water supply is also causing issues as townships may wind up needing to consume the water that provides them power too.

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Sources of Energy

- **Biomass Energy:**

Biomass energy is **produced from organic materials** and is utilized globally.

Chlorophyll present in plants captures the sun's energy by converting carbon dioxide from the air and water from the ground into carbohydrates through the process of photosynthesis.

When the plants or **organic matter is burned**, the water and carbon dioxide is released back into the atmosphere. By utilizing this energy **it can be directly used** (stove) or **generated into other forms of energy** (power plants).

Sources of Energy

- **Biomass Energy:**

Biomass generally include crops, plants, trees, yard clippings, wood chips and animal wastes.

Biomass energy is used for heating and cooking in homes and as a fuel in industrial production.


Photo by roberto_bellasio at Pixabay

This type of energy **produces large amount of carbon dioxide into the atmosphere**. However, there are ways to be kind of carbon neutral.

Sources of Energy

- **Nuclear Energy:**

While nuclear power remains **a great subject of debate** as to how safe it is to use, and whether or not it is really energy efficient and sustainable when taken into account the waste it produces as well as the supply chain of uranium – fact is that it remains **one of the major sources of energy available**.

Photo by distelAPPArath at Pixabay

Sources of Energy

- **Nuclear Energy:**

The energy is created through a specific nuclear reaction, which is then collected and used to power generators.

While almost every country has nuclear generators, there are moratoriums on their use or construction as scientists try to resolve safety and disposal issues for waste.

Germany is currently phasing out their nuclear power plants.

Sources of Energy

- **Fossil Fuels (Coal, Oil and Natural Gas)**

When most people talk about the different sources of energy, they often list natural **gas, coal and oil** as options.

However, all of these are considered to be just one source of energy - fossil fuels.

Photo by ARMBRUSTERBIZ at Pixabay

Fossil fuels provide the power for most of the world (primarily coal and oil).

Sources of Energy

- **Fossil Fuels (Coal, Oil and Natural Gas)**

Oil is converted into many products, e.g. plastic or gasoline.

Natural gas is starting to become more common but is used mostly for heating applications, although there are more and more natural gas-powered vehicles appearing on the streets.

Global primary energy sources consisted of petroleum (34%), coal (27%), natural gas (24%), amounting to an **85% share for fossil fuels in primary energy-consumption in the world in 2018.**

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Sources of Energy

- **Fossil Fuels (Coal, Oil and Natural Gas)**

The issue with fossil fuels is twofold. To get to the fossil fuel and convert it to use there has to be a **heavy destruction and pollution of the environment**. The fossil fuel **reserves are also limited**.

Most energy plans in Europe are **trying to phase out fossil fuels** and the dependence on them.

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Energy Management

- Energy management is about **planning and operation of energy-related generation and consumption** units.

- Energy management can (and should) **be applied on many different levels** from state level to regional level as well as in individual companies

Energy Management

- The main objectives are the **conservation of resources, climate protection and cost reductions**, while ensuring that the energy needs of the users are met.

- Within energy management there are **various sub disciplines** such as e.g. energy controlling, which supports cost-effective and material-efficient energy and material flow management.

Energy Management

- Fundamental considerations for energy management:
  - To ensure the security of energy supply (e.g. uninterrupted energy supply)
  - To ensure economic electricity and heat prices (e.g. avoiding to high fluctuations)

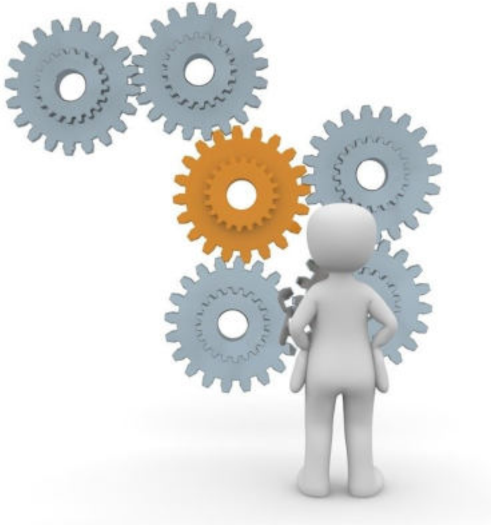

Photo by Peggy_Marco at Pixabay

Energy Management

- Fundamental considerations for energy management:
  - The consideration of environmental aspects (e.g. through independence from fossil primary energy sources or emission rights trading as well as the consideration of what energy sources to use and the composition of the energy mix)
  - The assurance of voltage and current quality in the area of power supply

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Energy Management

- Application areas of Energy Management are:
  - Commercial and industrial energy management in production and logistics (small, medium and large sized)
  - Energy management for residential construction and of residential buildings

Photo by geralt at Pixabay

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Energy Management

- Application areas of Energy Management are:
  - The municipal energy management (national, regional and local)
  - Building energy management, especially for complex functional buildings and buildings necessary for the infrastructure.
    - e.g hospitals, fire and police stations, stores, etc.

Energy Management

- Application areas of Energy Management in cooperate functions are:
  - Facility Management
  - Energy Procurement
  - Production
  - Maintenance
  - Information Technology
  - Logistics
  - Production planning and control

Photo by Metthew Henry at Unsplash

Energy Management

- To ensure security of supply and to be able to react flexibly to fluctuations in energy consumption and energy production, **access to stored energy is required.**
- Energy storage hereby refers to the means of and **capturing of produced energy** in order to **utilize the energy at a later time**.

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Energy Management

- Chemical energy is usually stored temporarily in "**energy carrier containers**" (e.g. fuel tank) and kept in stock.
- Thermal energy can be temporarily stored in **technical energy storage systems** (e.g. district heating storage).
- Electrical energy is either **stored directly** (capacitor) **or indirectly** (e.g. battery) also in technical energy storage systems.

Energy Management

- With most forms of secondary energy it is an advantage to **have more in stock than can be consumed at the current moment**. Options include gas tanks, coal heap, boilers, oil tanker, dams, etc.

- A very important **exception to this is electrical energy**. With electricity it is very important that supply and demand are always in balance, otherwise electrical appliances and power grids can be damaged!

Energy Management

Electricity consumption and electricity generation:

As power plants that "generate" electricity from renewable primary energy sources obtain their energy from natural sources (e.g. wind), **the output of many plants is subject to irregular fluctuations**.

Photo by ybernardi at Pixabay

Energy Management

Electricity consumption and electricity generation:

- For wind turbines the **weather**, for photovoltaic systems the difference between the position of the sun (**day and night**) and the weather (**clouds**), for run-of-river power plants the water (**flow rate**), etc. are all **fluctuating factors** that can only be limitedly calculated.

- While the **demand** for energy **can be calculated** with very little fluctuations, the **supply** of electricity however **changes all the time**!

Energy Management

Electricity consumption and electricity generation:

- Energy consumption and thus the demand for electricity also changes, however in a more predictable manner compared to the supply.
- Energy demand mostly changes according to the time of year and the time of day.

Photo by Coleur at Pixabay

Photo by Peggychoucair at Pixabay

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Energy Management

Electricity consumption and electricity generation:

- Examples for changes:
  - In the evening, after work, energy demand goes up.
  - At night, when everyone is asleep, not as much energy is consumed.
  - At lunchtime, when many people are cooking energy is consumed.
  - In winter more people heat their homes than in summer. Thus a seasonal consumption change occurs.
  - Etc.

Energy Management

Electricity consumption and electricity generation:

- For the operation of the power grid, however, it is important that the supply of the power plants and the demand of the consumers are in balance at all times so that the frequency of the alternating current remains constant.
- If the deviation from the ideal is too great, electrical equipment and transformers can be damaged!
- This can result in a grid failure.

Energy Management

Electricity consumption and electricity generation:

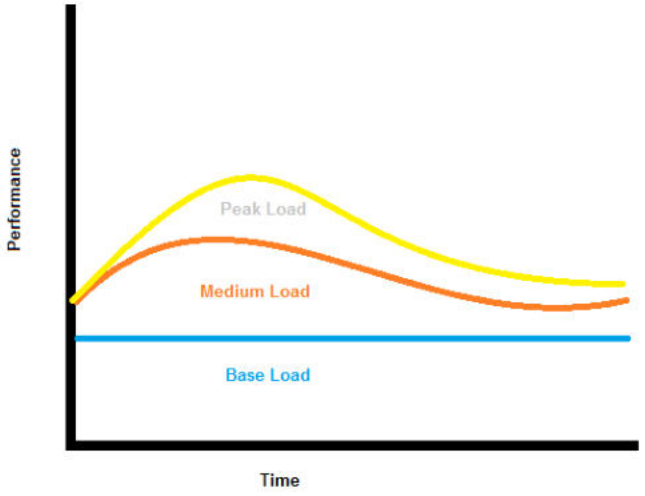
- To address this problem of balance, there are possible approaches and several possible combinations of these approaches:
  1. The electricity supply is being adjusted to the demand (i.e. the hydroelectric power plants produce less or more electricity depending on demand).
  2. Actively adjusting the consumption and production of small power plants (smart grid, "intelligent network") in real time.
  3. Temporarily store the electricity through energy storage options.

Energy Management

Base, medium and peak load:

Base Load:

- Is **always the same.**
- Is globally mainly covered by nuclear power plants and run-of-river power plants.
- In the future, this may also be performed by geothermal power plants in addition to run-of-river power plants.



Energy Management

Base, medium and peak load:

Base Load:

- The base load is **below the minimum energy requirement**, which is always necessary.
- Nuclear and run-of-river power plants are very difficult to regulate ☾ they always produce their rated output (this is the maximum power that can be produced during longer operation).

Energy Management

Base, medium and peak load:

Medium Load:

- Medium load power plants **adapt their output to the requirements of the electricity market** as far as possible.
- They produce more/less energy depending on the energy requirements.
- Medium load power plants are **designed to satisfy regular**, "normal" periodic **fluctuations in supply demand** (e.g. day/night fluctuations).

Energy Management

Base, medium and peak load:

Medium Load:

- Medium load power plants are thermal power plants, i.e. plants that burn any kind of fuel (coal, oil, gas, to a certain extend biomass).
- This area **can be taken over by wind, solar, hydroelectric power plants, etc.** in combination with appropriate storage technologies.

Energy Management

Base, medium and peak load:

Peak Load:

- Peak-load power plants are **brought in when the output increases very strongly**, when consumption peaks occur or when unforeseeable incidents occur (e.g. if another power plant fails).

- Peak-load power plants **react very quickly** and are typically hydroelectric power plants.

Energy Management

Base, medium and peak load:

Peak Load:

- In the future, this area can be supplemented with other fast-reacting energy storage systems (e.g. large accumulators). Biomass power plants, can be controlled very flexibly and are therefore also important.

Energy Management

Base, medium and peak load:

- Peak-load energy is of the **highest quality**, and therefore the **most expensive**, as it can be called up very flexibly and can be regulated quickly.

- Thus it is **used for fast increases** in demand or energy output fluctuations.

- It is important to keep interrelations of the different plants in mind.

Energy Management

Base, medium and peak load:

- For example, wind power plants **produce electricity at lower cost** than biomass power plants.

- Biomass power plants, in turn, can be **controlled very flexibly** and are therefore also important.

- A good **Energy-Mix** to combine advantages and disadvantages of renewable energies is currently the desired solution for the future. Keep in mind that there will not be the "ultimate renewable energy“.

European Union (EU)

- **EU law:**

The EU is legally above the nation states. They are above regional legislation, which is above local legislation.

EU

National

Regional

Local

Photo by Capri23auto at Pixabay

European Union (EU) - Energy

- **Directorate-General ENER**

This Commission department is **responsible for the EU's energy policy**: **secure, sustainable, and competitively priced energy** for Europe.

- **Policy**

To **ensure a reliable supply of energy** and to **keep prices affordable**, the European Union aims to build a more integrated, competitive European energy market (energy union).

The EU also **supports energy from renewable sources** and the efficient use of energy, both of which help to cut greenhouse emissions.

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EU - Energy

- There are many **policies** and topics handled by the EU:

  ➢ **Secure Energy Supplies**

  The EU has to become **less dependent on imported energy** - by making more efficient use of our domestic energy while diversifying sources and supplies.

  ➢ **Energy Efficiency**

  EU rules on buildings, industry, consumer products and transport are helping the EU to **meet its energy-efficiency targets** and **move to a low-carbon society**.

Photo by succo at Pixabay

EU - Energy

- There are many **policies** and topics handled by the EU:

  - **Nuclear Energy**

    EU action helps ensure nuclear **reactors are safe and secure**, radioactive waste is well managed and nuclear materials are used only for legitimate purposes.

  - **Energy Technology and Innovation**

    The EU supports **deployment of low-carbon technologies** such as photovoltaic, wind power, carbon capture and storage (CCS), and energy storage technologies.

EU - Energy

- There are many **policies** and topics handled by the EU (2):

  - **Single Energy Market**

    The EU wants **fewer technical and regulatory barriers** so that energy can flow across national borders and energy providers can compete throughout the EU.

  - **Renewable Energy**

    The EU coordinates work to **reach national targets** in line **with the renewable energy directive**. It also promotes alternative energy use in transport.

EU - Energy

- There are many **policies** and topics handled by the EU (3):

  - **Oil, Gas and Coal**

    EU rules aim to **keep fossil fuel markets fair and to protect the environment**, including when new technologies such as shale gas extraction are being used.

  - **Energy Infrastructure**

    The Trans-European Networks (TEN-E) strategy focuses on **extending and upgrading Europe's infrastructure** and creating networks that cross-national borders.

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EU – Energy Strategy

The European climate and energy framework for 2030 and the legislative packages of the European Union for an energy union are of **key strategic significance for the future direction of European and national climate and energy policies**, and thus for the successful implementation of the energy reforms.

Link: 2030 Climate & Energy Framework

EU – Energy Strategy

The Energy Union Strategy is a project of the European Commission to **coordinate the transformation of European energy supply**.

It was launched in February 2015, with the **aim of providing secure, sustainable, competitive, affordable energy**.

EU – Energy Strategy

The European Council concluded on 19 March 2015 that the EU is committed to building an Energy Union with a **forward-looking climate policy** on the basis of the Commission's framework strategy, with five priority dimensions:

1. Energy security, solidarity and trust.
2. A fully integrated European energy market.
3. Energy efficiency contributing to moderation of demand.
4. Decarbonising the economy.
5. Research, innovation and competitiveness.

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EU – Energy: 2050 Long Term Strategy

The EU aims to be **climate-neutral by 2050** – an economy with **net-zero greenhouse gas emissions**. This objective is at the heart of the European Green Deal and in line with the EU's commitment to global climate action under the Paris Agreement.

The transition to a climate-neutral society **is both** an **urgent challenge** and an **opportunity** to build a better future for all.

LINK: https://ec.europa.eu/clima/policies/strategies/2050

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EU – Energy: 2050 Long Term Strategy

All parts of society and economic sectors will play a role – from the power sector to industry, mobility, buildings, agriculture and forestry.

The EU can lead the way by **investing** into realistic technological solutions, **empowering** citizens and **aligning** action in key areas such as industrial policy, finance and research, while ensuring social fairness for a just transition.

LINK: https://ec.europa.eu/clima/policies/strategies/2050

EU – Energy: 2050 Long Term Strategy

Commissions View:

The Commission set out its vision for a climate-neutral EU in November 2018, looking at all the key sectors and exploring pathways for the transition.

The Commission's **vision covers nearly all EU policies** and is in line with the **Paris Agreement objective** to keep the **global temperature increase** to well **below 2°C** and pursue efforts to keep it to 1.5°C.

Paris Agreement: https://unfccc.int/sites/default/files/english_paris_agreement.pdf

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EU – Energy: 2050 Long Term Strategy

Commissions View:

As part of the European Green Deal, the Commission proposed on 4th of March 2020 the **first European Climate Law** to enshrine the **2050 climate-neutrality target into law**.

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EU – Energy: 2050 Long Term Strategy

EU Strategy

All Parties to the Paris Agreement are invited to communicate, by 2020, their mid-century, long-term low greenhouse gas emission development strategies.

The European Parliament **endorsed the net-zero greenhouse gas emissions objective** in its resolution on climate change in March 2019 and resolution on the European Green Deal in January 2020.

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EU – Energy: 2050 Long Term Strategy

EU Strategy

The European Council endorsed in December 2019 the **objective of making the EU climate-neutral by 2050**, in line with the Paris Agreement.

The EU submitted its **long-term strategy** to the United Nations Framework Convention on Climate Change (UNFCCC) in March 2020.

Long term strategy: https://unfccc.int/documents/210328

EU – Energy: 2050 Long Term Strategy

Stakeholder Input

- A stakeholder event on the 10th and 11th July 2018 brought together **stakeholders from business, research and civil society** for a discussion on the forthcoming EU strategy.
- The public consultation from 17 July to 9 October 2018 received **more than 2800 replies**.
- The Commission’s vision launched an EU-wide reflection on the EU strategy, involving EU institutions, national parliaments, business sector, non-governmental organisations, cities, communities and citizens across Europe.

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EU – Energy: 2050 Long Term Strategy

National Strategies

EU Member States are required to develop national long-term strategies on how they plan to achieve the greenhouse gas emissions reductions needed to meet their commitments under the Paris Agreement and EU objectives.

- Link: https://ec.europa.eu/info/energy-climate-change-environment/overall-targets/long-term-strategies_en

EU – Energy: 2050 Long Term Strategy

National Strategies: Long Term Strategy Austria

Link: https://ec.europa.eu/clima/sites/lts/lts_at_de.pdf

- Austria has the goal of becoming **climate neutral at the latest by 2050**.
- A strategy that implies a **comprehensive change** in **energy supply** and **consumer behavior** and an **adapted competitive economic system** also goes beyond the aspect of greenhouse gas reduction.

EU – Energy: 2050 Long Term Strategy

National Strategies: Long Term Strategy Austria

- It takes into account all **three pillars** of sustainability, namely **economy, social issues and ecology**.
- Only in this way is it possible to gain the approval of the population for the far-reaching change.
- **Resource-saving, sustainable and innovative technologies and the circular economy play a central role**.

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EU – Energy: 2050 Long Term Strategy

National Strategies: Long Term Strategy Austria

- **The Paris Convention**, which was adopted in December 2015 and entered into force on 4 November 2016, **is the first ambitious and legally binding global agreement on climate protection** with obligations for all states.

- Based on the Paris convention, Austria defined goals in its strategy.

EU – Energy: 2050 Long Term Strategy

National Strategies: Long Term Strategy Austria

Included are (among others):

- Temperature target
- Adaptation target
- Financial target
- Long-term objective
- Climate protection measures
- Etc.

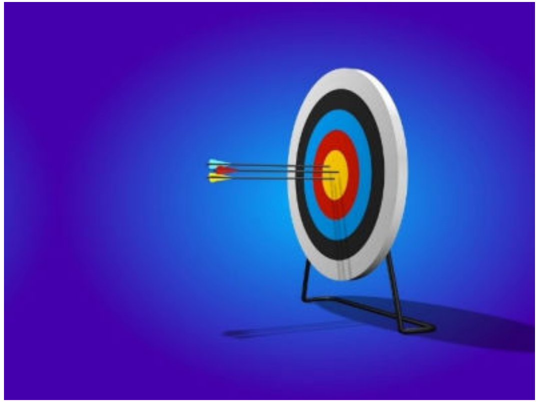


Photo by QuinceCreative at Pixabay

EU – Energy: 2050 Long Term Strategy

National Strategies: Long Term Strategy Austria

- Furthermore the **Paris Convention should be strengthened** to ensure a global shift towards sustainable energy technologies.

- The agreement not only marked the beginning of the **phase-out of fossil fuels**, but also a **global transformation** of **energy systems**, the **economy** and **society**.

EU – Energy: 2050 Long Term Strategy

National Strategies: Long Term Strategy Austria

- While the market and competition have already been successfully driven forward in the past, we still **face complex challenges** in **achieving our goal** of making the energy sector significantly more climate-friendly in the medium term and **decarbonising it by 2050**.

Photo by EliasSch at Pixabay

EU – Energy: 2050 Long Term Strategy

National Strategies: Long Term Strategy Austria:

- The decarbonisation of the Austrian energy system requires a large number of **coordinated measures and activities**. What is needed is a **balanced, sustainable energy mix** that consistently promotes the expansion of domestic renewable resources along the decarbonisation path and makes targeted use of bridging technologies in the interests of supply security.
- This implies a **rapid phase-out of coal**, an **"end" to fossil oil heating systems** and the **switch to zero and ultra-low emission vehicles**.

Energy Scenarios - Austria

Federal Environment Agency Austria (Umweltbundesamt Österreich)

Various scenarios (studies) available at their website*.

- Scenarios with existing measures (WEM) and Transition
- Renewable energy scenario for climate targets 2030 and 2050
- Energy economic scenario with regard to the climate targets 2030 and 2050 – with additional measure (WAM) plus
- Energy economic scenarios with regard to the climate targets 2030 and 2050 – WEM and WAM
- Industry scenarios 2030 and 2050

*Link: https://www.umweltbundesamt.at/umweltsituation/energie/energieszenarien/

Energy Scenarios - Austria

Energy economic scenarios regarding the climate targets 2030 and 2050 - WEM and WAM

- **Scenario with existing measures (WEM)**:

In the WEM scenario, the **goal of the Energy Efficiency Act** (EEffG) of limiting final energy consumption to a maximum of 1,050 PJ in 2020 **is clearly missed**.

Energy Scenarios - Austria

Energy economic scenarios regarding the climate targets 2030 and 2050 - WEM and WAM

- **Scenario with existing measures (WEM)**:

Significant existing measures:

- → Mobility management and awareness raising (transport sector)
- → Economic incentives (e.g. increase in mineral oil tax in 2011)
- → Implementation of the Green Electricity Act in 2012 (energy sector)
- → Changes in EU emissions trading (industry sector)
- → Thermal refurbishment of buildings & renewal of heating systems (buildings - households and services sector).

Energy Scenarios - Austria

Energy economic scenarios regarding the climate targets 2030 and 2050 - WEM and WAM

- **Scenario with additional measures (WAM)**:

In the WAM scenario, the value of 1,050 PJ for 2020 **is maintained by adopting** additional measures.

Energy Scenarios - Austria

Energy economic scenarios regarding the climate targets 2030 and 2050 - WEM and WAM

- **Scenario with additional measures (WAM)**:

Prerequisites for the modelled achievement of the target:

→ the implementation of extensive energy efficiency measures

→ the reduction of fuel exports in the tank by bringing fuel prices closer to the foreign level (transport sector)

→ an improvement in the quality of refurbishment and a shift in the focus of funding from new construction to thermal refurbishment (buildings sector).

Austria Energy Scenarios

Energy economic scenarios regarding the climate targets 2030 and 2050 - WEM and WAM – Results:

- **WEM Scenario:**

Final energy consumption increases from 1,138 PJ (2010) in the to 1,149 PJ (2020) and to 1,213 PJ (2030).

Gross inland consumption was 1,467 PJ (2010) and rises to 1,481 PJ (2020) and 1,554 PJ (2030).

Austria Energy Scenarios

Energy economic scenarios regarding the climate targets 2030 and 2050 - WEM and WAM – Results:

- **WAM Scenario:**

Final energy consumption decreases to 1,050 PJ by 2020 and to 1,043 PJ by 2030.

Gross inland consumption was 1,467 PJ (2010) and rises to 1,379 PJ (2020) and 1,381 PJ (2030).

Austria Energy Scenarios

Energy economic scenarios regarding the climate targets 2030 and 2050 - WEM and WAM – Results:

The share of renewable energy in gross final energy consumption **increases continuously** from 32.2% in 2010 **in both scenarios.**

- In WEM to 36.0% (2020) and to 37.7% (2030).
- In WAM to 38.5% (2020) and to 42.6% (2030).

Austria Energy Scenarios

Energy economic scenarios regarding the climate targets 2030 and 2050 - WEM and WAM – Results:

- With current legally binding measures (scenario WEM) the target of 34% share of renewable energy sources in 2020 will be achieved.
- In contrast, the target of reducing final energy consumption to 1,050 PJ by 2020 will not be achieved.
- With additional measures (WAM scenario), however, this target could be met.

Energy in the context of Climate Change

In order to put energy generation and consumption as well as supply and demand into any relation, one has to **understand basics about the environment and system sciences**.

Photo by WikiImages at Pixabay

The next couple of slides give you an introduction to these topics.

Environment

Photo by John O'Nolan at Unsplash

- **What is the environment?**
- **What is a system?**
- **What are the links between humans and the environment and what are environmental burdens and pollution?**

Environment

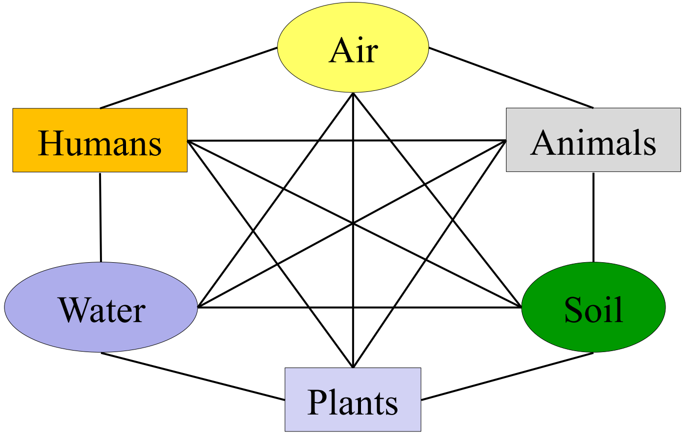
The environment is the **totality of all direct and indirect effects on a living being** and **its relationship** to the rest of the world.

Environmental influences on living organisms:

- The influence of abiotic, inanimate, and biotic, animate factors.
- Climatic, chemical or mechanical influences.
- Natural and anthropogenic, man-made, impacts and others more

Environment

Often one speaks of **the biosphere** instead of the environment and refers to the entirety of the layers of the earth populated by living organisms - humans, animals, plants, microorganisms - i.e. the atmosphere up to a height of about 25 km, the oceans down to a depth of about 10 km and the earth's crust down to a depth of about 3 km.



Note: in the biosphere everything is connected

Environment

No matter where you set the limit: the environment is **always a complex system**, in which the soil, water and air as well as the flora and fauna and the climate are main components.

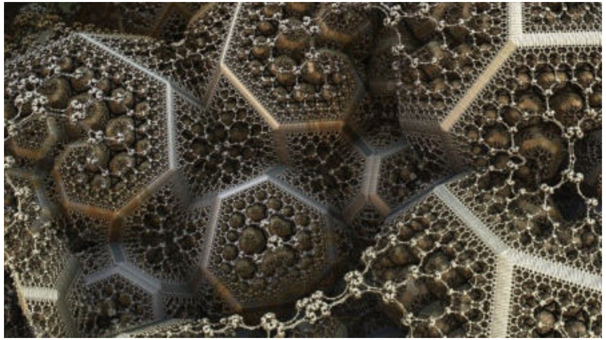
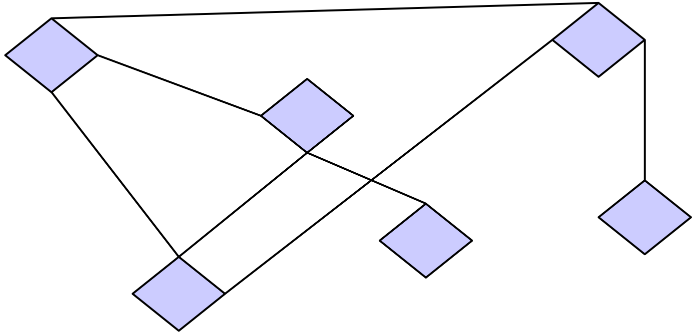


Photo by TheDigitalArtist at Pixabay

Environment

- **What is a System?**

A system is a delimited arrangement of parts (components) that interact with each other.



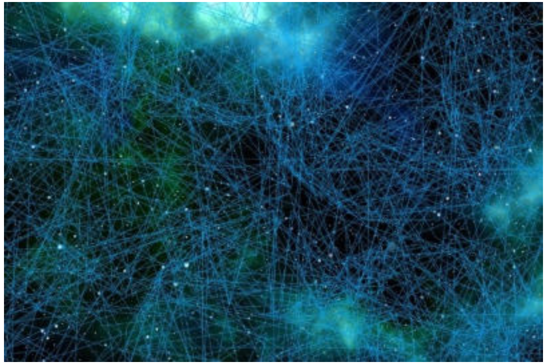
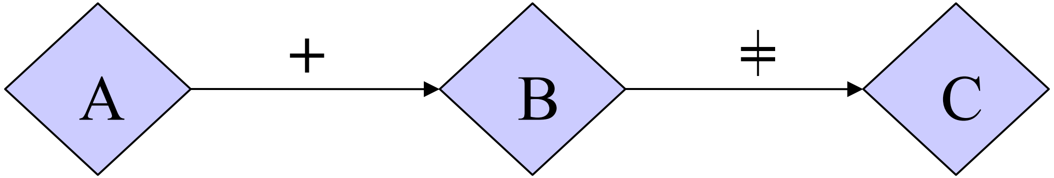


Photo by geralt at Pixabay

Environment

Important Note:

- Linear thinking - every effect is attributed to only one clear cause - usually does not lead to the goal in environmental problems.



Environment

- In complex ecosystem environments, "**networked thinking**" is much more important!

- Due to **strong interconnections and far-reaching feedback** in the environment, it is often **impossible to give a simple answer** to an ecological or environmentally relevant (environmentally significant) question.

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Environment

- Nevertheless, **certain areas** of the highly networked environment **are viewed separately** because the overall system is too complicated and too complex.

- Such delimitable sections, which are interrelated as functional units, are also called compartments.

Environment

Anyone who does not want to **run behind technical developments** and legal requirements in industrial production in the future **must integrate environmental protection goals into the overriding corporate objectives** in a binding manner and implement them in all areas of the company!

Summary

- Energy
- Energy Types/ Source
- Energy Management
- European and national energy plans
- Environment and Systems

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Module II - Basics about Wastewater and Waste

Content:

- Basics in the Environmental Area
- What is Waste
- Types of Waste
- Wastewater
- Waste management
- Waste in the European Union
- Waste in Austria
- Summary

Environmental Area Basics

Environment

The environment is the totality of all direct and indirect effects on a living being and its relationship to the rest of the world.

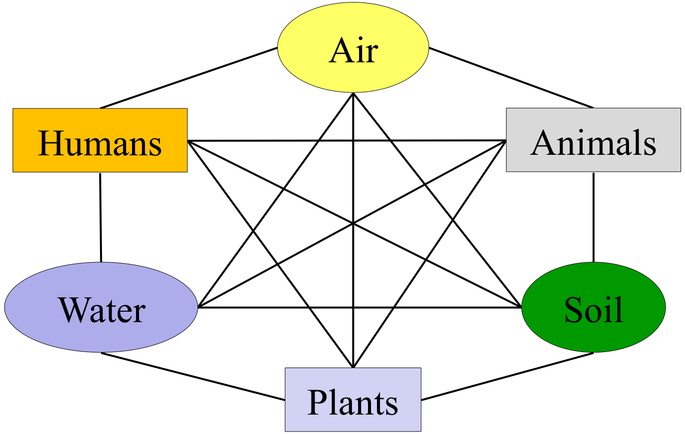
Environmental influences on living organisms are:

- The influence of abiotic, inanimate, and biotic, animate factors.
- Climatic, chemical or mechanical influences.
- Natural and anthropogenic, man-made influences and others.

Environmental Area Basics

Environment

Interactions between humans and the environment:



Environmental Area Basics

Environmental Pollution

- Environmental pollution is defined as the totality of all disturbing environmental factors.
- Terms such as **environmental stress** or **environmental impact** are used when **no clear negative effect** on the environment is expected from a pollution.
- If it is a pollution of nature by intrusion of substances, one often speaks (in the narrower sense) of **environmental pollution**.

Environmental Area Basics

Environmental Pollution

Air Pollution

- In the past, air pollution problems were usually "smoke problems“ ☾ mainly related to sulphur dioxide dust.
- Today, the innumerable combustion engines in road and air traffic cause new pollution and dangers.

Photo by Marcin Jozwiak at Unsplash

Environmental Area Basics

Environmental Pollution

Water pollution

- **Direct or indirect disposal** of waste into rivers and lakes.
- Industrial wastewater and domestic wastewater **discharged directly** into rivers or lakes.

Photo by yogendras31 at Pixabay

Environmental Area Basics

Environmental Pollution

Causes of environmental pollution:

- Pollution from industry:
  - Chemical industry
  - Paper Industry
  - Steelworks

Photo by JuergenPM at Pixabay

- Environmental impacts of agricultural use:
  - Fertilizers
  - Insect repellents
  - ...

Environmental Area Basics

Environment

Occupational health and safety is an area of environmental protection which should not be neglected and which plays a considerable role mainly in industrial environmental protection.

Environmental Area Basics
Environment awareness

The following environmental topics play **an important role** (among others):

- Dying forests and Desertification
- Ozone hole
- Acid rain
- Greenhouse effect
- Toxins in food

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Environmental Area Basics

Environment awareness

So-called “**time bombs of humanity**”:

- Short-sighted, wasteful use of natural resources
- Air, water and soil pollution
- Deforestation
- Climate time bomb
- Population time bomb

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Environmental Area Basics

!! Important !!

→Environmental protection is protection of posterity

- In addition to the number of people living on earth, another important problem is the **waste-intensive lifestyle**.
- It must be changed to help reduce the amount of waste and the associated environmental pollution.
- **But what is waste?**

What is Waste?

“Waste occurs when **any organism returns substances** to the environment.”[1]

“Waste are **items we** (individuals, offices, etc.) **don’t need and discard.**”[2]

“Waste is a **substance or** an **object** that the person who has produced it, wants to get rid of.”[3]

Photo by Pexels at Pixabay

1: https://enviroliteracy.org/environment-society/waste-management/what-is-waste/
2: https://www.eschooltoday.com/waste-recycling/waste-management-tips-for-kids.html
3: http://www.eniscuola.net/en/argomento/waste/what-is-waste/what-is-waste-and-how-is-it-created/

What is Waste?

“**Unwanted matter or material of any type**, especially what is left after useful substances or parts have been removed.”[4]

“Article 3(1) of the new EU Waste Framework Directive defines waste as ‘**any substance or object which the holder discards or intends or is required to discard**’.”[5]

4: https://dictionary.cambridge.org/de/worterbuch/englisch/waste
5: https://ec.europa.eu/environment/waste/framework/pdf/guidance_doc.pdf

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What is Waste?

Looking at the definitions, it can be said that **waste** from a human perspective:

- **is every object or substance that is regarded as not useful for an individual entity** (i.e. person, industry, office, etc.).

From a **legal perspective**:

- A substance becomes waste if there is either the intention to dispose of it or the public interest in its collection and treatment as waste.

What is considered **waste** for one person **can be of benefit** for another person.

It is therefore important to know and understand the **different types of waste**.

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Types of Waste

Waste types can be divided into e.g.:

- Waste from households
- Waste that cannot be disposed of with waste from households in terms of type and quantity (hazardous waste)
- Waste from commercial or other enterprises that requires monitoring.

In addition, waste can be classified according to its origin, nature, composition and state.

Types of Waste

Household wastes in tones (hazardous and non-hazardous):

- European Union (27 countries)
  - 2014: 180.780.000 tones
  - 2016: 187.400.000 tones (increase of 3.7%)

- Austria:
  - 2014: 4.170.023 tones
  - 2016: 4.268.278 tones (increase of 2.3%)

Source: https://ec.europa.eu/eurostat/databrowser/view/ten00110/default/table?lang=de

Types of Waste

Waste can be classified according to many different criteria. An overarching classification, especially regarding waste management, is usually done in following manner:

- **Solid Waste**
- **Liquid Waste**
- **Hazardous Waste**
- **Non-Hazardous Waste**
- **(e-waste)**

Photo by Thoxuan99 at Pixabay

Types of Waste

Solid waste

Waste collected from residences, commercial buildings, hospitals, schools, universities, offices, light industrial operations etc. is usually considered as **municipal solid waste**.

Municipal Solid Waste **mainly consists of**:

- Paper, Containers and packaging (plastic, glass and metal), Food/Bio waste, Yard trimmings, Textiles, Other Inorganic Waste

Types of Waste

Solid waste

Depending on the country municipal solid waste can also include industrial sludge, classified as hazardous or non-hazardous, resulting from a wide array of mining, construction, and manufacturing processes.

Moreover, **substantial amounts** of household waste is **classified as hazardous**.

Photo by meineresterampe at Pixabay

Types of Waste

Solid waste

Everyday, one kilogram of municipal solid waste is generated per person in Europe.

→This does not sound like a lot, but across the whole of Europe this accumulates to a total of around 200 million tonnes of municipal waste per year (1999).

In Europe, we currently use **16 tones of material per person per year**, of which 6 tones become waste (2019).

Types of Waste

Liquid Waste

Fluid wastes, consisting of sewage and domestic wastewater, or processed water, or other liquids, produced by industrial activity, particularly by such industries as pulp and paper production, food processing, and the manufacture of chemicals.

Liquid waste can also be defined as such liquids:

- Wastewater
- Fats, oils, grease
- Used oil
- Liquids, solids, gases, or sludges and hazardous household liquids

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Types of Waste

Liquid Waste

Liquids that are hazardous or potentially harmful to human health or the environment. They can also be discarded commercial products classified as “Liquid Industrial Waste” such as cleaning fluids or pesticides, or the by-products of manufacturing processes.

Liquid waste can therefore be classified as **wastewater**!

Types of Waste

Wastewater

Wastewater is a **generic term for water from various sources**, which is discharged via building structures.

- **Rainwater** - rainwater running off paved surfaces (in some contexts rainwater is not counted as wastewater)
- **Extraneous water** - entering the sewerage system due to structural damage

Types of Waste

Wastewater

Wastewater is a **generic term for water from various sources**, which is discharged via building structures.

- **Wastewater** - water contaminated by use or changed in its properties or composition. It is further differentiated:
  - **Greywater** - according to EN 12056-1: faecal-free, slightly contaminated wastewater (e.g. water originating from showering, bathing or washing hands, from the washing machine) which can be treated to produce **process water.** Rainwater **running off the roof or balcony** is also included.

Types of Waste

Wastewater

Wastewater is a **generic term for water from various sources**, which is discharged via building structures.

- **Wastewater** - water contaminated by use or changed in its properties or composition. It is further differentiated:
  - **Blackwater** - according to **ISO 6107-7:1997**: Domestic wastewater containing urine and/or faecal matter. Blackwater can be further subdivided into:
    - Yellowwater – water containing urine (flushing water)
    - Brownwater – water containing faeces and/or toilet paper (without urine)

Types of Waste

Wastewater

Wastewater is a **generic term.** Depending on the country the definition of wastewater varies. The EU defines wastewater as:

- **Domestic wastewater:** Wastewater from residential settlements and services which originates predominantly from the human metabolism and from household activities
- **Industrial wastewater:** Any wastewater which is discharged from premises used for carrying on any trade or industry, other than domestic wastewater and run-off rain water

Link: https://ec.europa.eu/environment/water/water-urbanwaste/info/glossary_en.htm

Types of Waste

Hazardous Waste

Environmental contamination that can be caused by hazardous wastes has **aspects and elements**.

One of them, which is also crucial, is when old hazardous waste dumps are discovered. They might be a couple of decades old. The clean-up of these dumps and the contamination caused can be severe.

Another aspect that has to be mentioned, is the changing behavior and state of the various contaminants that occur. New advancements in the chemical industry also causes new sources of various wastes and problems.

Types of Waste

Hazardous Waste

- Every year new chemicals and chemical mixtures are introduced to the environment. They are added to the many thousand which are already in use.

- Most natural resources and habitats (including the air, surface and ground water, the soil, woods, bio habitats, etc.) have already **become contaminated** with these hazardous chemicals.

Types of Waste

Hazardous Waste

… mainly refers to industrial, chemical, bio-chemical and other wastes which can cause significant hazards to human health or the environment.

According to the US Environmental Protection Agency the four **major characteristics of hazardous wastes** are:

- **ignitability**, or something flammable
- **corrosivity**, or something that can rust or decompose
- **reactivity**, or something explosive
- **toxicity**, or something poisonous

Types of Waste

Hazardous Waste

According to the US Environmental Protection Agency the four **major characteristics of hazardous wastes** are:

Ignitability:

There are 3 types of ignitable forms:

- Liquids with a flash point –lowest temperature at which fumes above waste ignite –of 60 °C or 140 °F. E.g. alcohol, gasoline, and acetone
- Solids that spontaneously combust.
- Oxidizers and compressed gasses.

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Types of Waste

Hazardous Waste

According to the US Environmental Protection Agency the four **major characteristics of hazardous wastes** are:

Corrosivity:

Corrosive substances (e.g. hydrochloric acid, nitric acid, and sulfuric acid) have the ability “eat” through containers - causing the leakage of harmful materials.

A corrosive is anything liquid with a pH of less than or equal to “2” or greater than or equal to “12.5” or has the ability to corrode steel. E.g. battery acid and rust removers.

Types of Waste

Hazardous Waste

According to the US Environmental Protection Agency the four **major characteristics of hazardous wastes** are:

Reactivity:

Given their instability, reactive wastes can be very dangerous. There are too many conditions and situations to identify all types of reactive materials. However, the following serves as guideline:

- unstable and routinely experiences violent change without detonating
- potential for explosive mixture or violent reaction when combined with water
- toxic gasses are released when mixed with water

Types of Waste

Hazardous Waste

According to the US Environmental Protection Agency the four **major characteristics of hazardous wastes** are:

Toxicity:
Poisonous materials pose a threat and can have long term effects to human health and the environment.

Types of Waste

Hazardous Waste

Waste material that is flammable, corrosive, reactive, or toxic - which can be in the form of a solid, liquid, or gas - is defined as hazardous waste.

Although the term often evokes an image of items marked with skull and crossbones, many hazardous wastes include **products used every day**, e.g.:

- Paint
- Used oil
- Batteries
- Shoe polish
- Laundry detergent
- Etc.

Many items that we generally rely upon **generate hazardous waste** during the process of their production.

Types of Waste

Hazardous Waste

- Some hazardous materials can be **recycled** if it is environmentally safe to do so, although it can be expensive.
- Many industries are attempting to **reduce** their **generation of hazardous waste** by **modifying** their **manufacturing processes** or by **replacing hazardous materials** with less hazardous or non-hazardous substitutes.[1]
- **Hazardous wastes pose a greater risk to the environment and human health than non-hazardous waste and thus require a stricter control regime.**[2]

Types of Waste

Non-Hazardous Waste

- **All types of waste which are not considered as hazardous waste.**

Photo by Bru-nO at Pixabay

Types of Waste

Waste is raw material in the wrong place!

Types of Waste

Waste versus raw materials

Raw materials are:

- natural resources that have not been processed except for the solution from their natural source.
- either consumed directly or used as raw materials for further processing stages in production.

Waste:

- is understood to be remnants from private and industrial consumption or from production that are no longer needed.

Environmental aspects and waste

To improve the waste and environmental situation, **four points need to be considered**:

- **Minimization** of the use of operating resources, e.g. through improvements in equipment
- **Recycling** of operating materials, e.g. by circulation
- **Process-integrated disposal** of operating resources through process conversions that minimize the amount of old operating resources
- Production of **environmentally friendly products**

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Operational environmental protection

Environmental protection is the **totality of all measures** that are necessary,

- in order to **secure** for mankind an environment that he needs for his **health** and for a **dignified existence**,
- to **protect** soil, air and water, flora and fauna from the lasting effects of human intervention,
- in order to **eliminate damage or disadvantages** from human influences.

A big part of (operational) environmental protection is **Waste Management!**

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Waste Management

- Waste management (or waste disposal) include the **activities and actions required to manage waste** from its inception to its final disposal.

- Waste management includes **collection, transport, treatment and disposal** of waste and waste products (garbage, sewage, etc.), as well as monitoring and regulation of the waste management process.

Waste Management

- Waste management is **intended to reduce adverse effects of waste** on human health, the environment or aesthetics.
- Waste management practices **are not uniform** among countries, regions, residential and industrial sectors.
- A large portion of waste management practices deal with municipal solid waste which is the bulk of the **waste** that is **created by household, industrial, and commercial activity**.

Waste Management

- Waste management is the process of treating solid wastes and offers a **variety of solutions** for recycling items that don’t belong to trash.
- It is about **how garbage can be used** as a valuable resource.
- Waste management is something that every household and business needs and should utilize for their own advantage.
- Waste management disposes of the products and substances in a safe and efficient manner.
- There are **various methods** of waste management. The following slides provide an overview of the most common ones.

Waste Management

Landfills

- Landfills are the **most popular used method** of waste disposal used today.
- This process of waste disposal focuses attention on **burying the waste** in the land.
- Landfills are commonly found in developing countries.
- There is a process used that eliminates the odors and dangers of waste before it is placed into the ground.

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Waste Management

Landfills

- This method is **becoming less popular** nowadays, due to a lack of available space and the strong presence of methane and other landfill gases, both of which can cause numerous contamination problems.

- Landfills **give rise to air and water pollution**.

Waste Management

Incineration/Combustion

- Incineration or combustion is a disposal method in which municipal solid wastes are **burned at high temperatures to convert them** into residue and gaseous products.
- The biggest advantage of this type is that it can **reduce the volume** of solid waste to 20% to 30% of the original volume, decreases the required space and reduce stress on landfills.
- This process is also known as **thermal treatment** where solid waste materials are converted by incinerators into heat, gas, steam and ash.

Waste Management

Recovery and Recycling

- Resource recovery is the process of **taking useful discarded items for a specific next use**.
- These discarded items are **processed to extract or recover materials** and resources or convert them to energy in the form of useable heat, electricity or fuel.

Waste Management

Recovery and Recycling

- Recycling is the process of **converting waste products into new products** to prevent energy usage and consumption of fresh raw materials.
- Recycling is the third component of **Reduce, Reuse and Recycle waste hierarchy**.
- The idea behind recycling is to **reduce** energy usage, volume of landfills, air and water pollution, greenhouse gas emissions and **preserve** natural resources for future use.

Waste Management

Composting

- Composting is an **easy and natural bio-degradation process** that takes organic wastes (i.e. remains of plants, garden, kitchen waste, etc.) and turns into nutrient rich soil for plants.
- Composting, normally used for organic farming, occurs by allowing organic materials to sit in one place for months until microbes decompose it.
- Composting is one of the best method of waste disposal as it can turn unsafe organic products into safe compost. However, **it is slow process and takes lot of space**.

Waste Management

Waste to Energy (Recover Energy)

- Waste to energy process involves **converting of non-recyclable waste items** into useable heat, electricity, or fuel through a variety of processes.
- This type of source of energy is **a renewable energy source** as non-recyclable waste can be used over and over again to create energy.

Waste Management

Waste to Energy (Recover Energy)

- It can help to **reduce carbon emissions** by offsetting the need for energy from fossil sources.
- **Waste-to-Energy is the generation of energy in the form of heat or electricity from waste.**

Waste Management

Avoidance/Waste Minimization

- The **easiest method** of waste management is to **reduce creation of waste materials** and thereby reducing the amount of waste.

Waste reduction can be done through:

- recycling old materials (e.g. jars, bags),
- repairing broken items,
- avoiding use of disposable products (e.g. plastic bags),
- reusing secondhand items.

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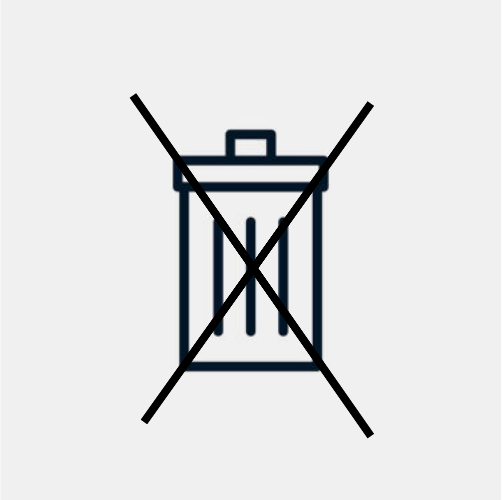
Waste Management

Avoidance/Waste Minimization

- Recycling and composting are a couple of the best methods of waste management regarding the environment.

There are **many different ways to treat and manage waste**!

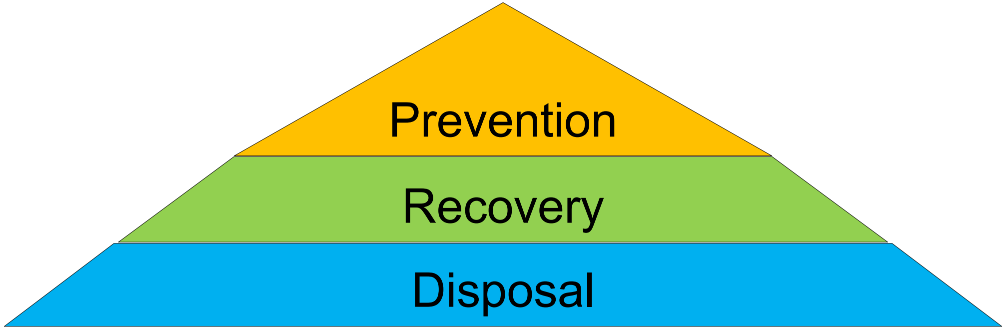
They all depend on the **situation, location and type of waste**.



Waste Management

The **previous general principle** in waste management was:

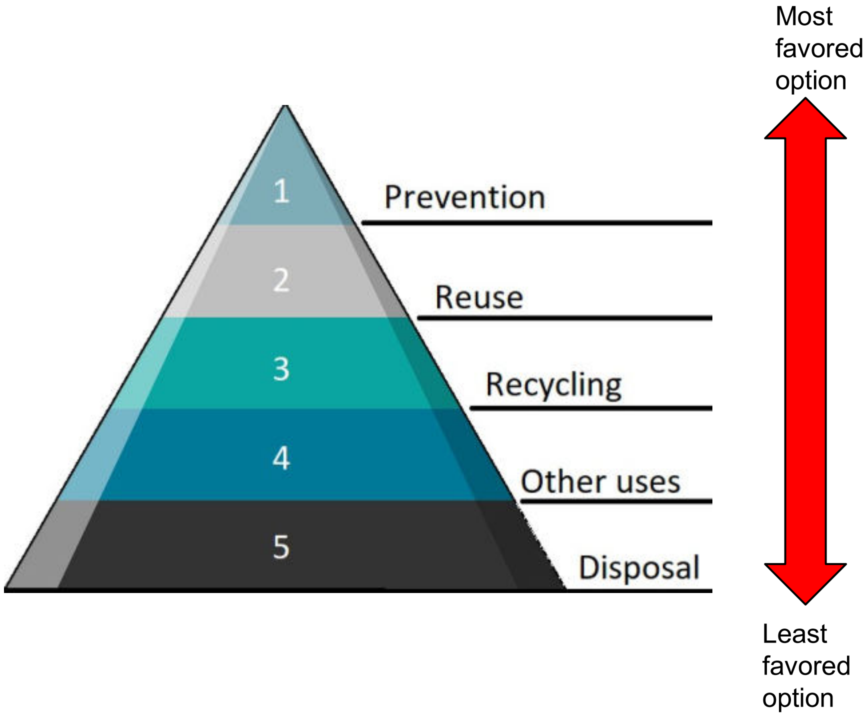
- **Prevention,**
- **prior to recovery,**
- **prior to disposal.**



Waste Management

The new waste hierarchy should now look as follows :

- Prevention,
- Preparation for reuse,
- Recycling,
- Other recovery (e.g. energy recovery)
- Disposal



Note: In some waste hierarchies the step "minimization" is included between "Prevention" and "reuse".

Waste Management

Liquid waste

- **Liquid waste is wastewater** with a chemical oxidizability using **potassium dichromate** (COD) of 10 g O_2/l.

Potassium dichromate is:

- a strong oxidizing agent
- highly soluble in water

In the laboratory, potassium dichromate is used as a common oxidizing agent because of its good storage capability and weighing capacity.

Waste Management

Liquid waste - Types:

Liquid wastes are:

- **Wastewater**
- **Waste oil**
- **Liquid manure** or **slurry**
- **Solvent wastes**
- **Seepage water**

Special cases of liquid wastes are:

- **Concentrate**
- **Mud**
- **Raw sludge**
- **Sewage sludge**

Partially liquid waste:

- **Compost**

Waste Management

Liquid waste – Definitions:

- **Wastewater** is water contaminated by domestic, commercial and industrial use, as well as rainwater and groundwater, which is transported in pipes.
- **Waste oil** is a used lubricant based on mineral oil, such as motor oil, gear oil with contamination by heavy metals or a water content of up to 5%.
- **Liquid manure** or **slurry** is a more or less diluted mixture of faeces and urine, mixed with leftover feed.

Waste Management

Liquid waste – Definitions:

- **Solvent wastes** are used liquids that have dissolved other substances without reacting with them.

- **Seepage water** is the water from precipitation which escapes from a landfill body and is enriched with elutable substances.

Waste Management

Liquid waste – Definitions special cases:

- **Concentrate** is a liquid-solid mixture from which solvent has been removed.
- **Mud** is a mixture of liquid and solids, which is either a result of the separation and concentration of solids from liquids and/or the phase transformation from dissolved to undissolved.
- **Raw sludge** refers to an untreated sludge from a wastewater treatment plant.
- **Sewage sludge** is the sludge produced during the treatment of wastewater in municipal or industrial wastewater treatment plants.

Waste Management

Liquid waste – Definition partially liquid waste:

- **Compost** is a mixture of mainly vegetable, organic and mineral raw materials, more or less strongly modified by microbial activity.

Waste Management

Liquid waste

- **Wastewater** is both water contaminated by use (or changed in its properties or composition) and precipitation water running off paved surfaces as well as extraneous water entering the sewerage system due to structural damage.

- **Wastewater** is collected via the sewerage system, treated in sewage treatment plants and then discharged into a body of water.

Waste Management

Liquid waste

A distinction is made between the **substances contained** in the wastewater:

- **Organic compounds** (fats, proteins, carbohydrates)
- **Oxygen consuming compounds** (uric acid, glucose)
- **Nutrients** (nitrogen and phosphorus compounds): increased algae growth
- **Pollutants** (poisons, heavy metals, synthetic organic substances, bacteria, fungi or viruses)
- **Impurities** (salts, fats, oils, clays, sand)

Waste Management

Liquid waste

Criteria for waste properties are:

- **Water and solids content**
- **Calorific value in kJ/kg (heating value)**
- **Landfillability**
- **Substance parameters**

Waste Management

Liquid waste

Water and solids content:

- The **solids content** indicates the weight percentage after a defined drying time of 24 hours at 105 °C.

- The solids content is an **important parameter** for determining the degree of dewatering of sewage sludge and should be at least 30 to 35% for sludge suitable for landfill

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Waste Management

Liquid waste

Water and solids content:

- The **water content** is the gravimetric percentage of water in a mixture of substances

Waste Management

Liquid waste

Heating value:

- **Calorific value** is the maximum amount of heat that can be used during combustion without condensation of the water vapour contained in the exhaust gas.

- **Condensing value** is the maximum amount of heat that can be utilised during combustion with condensation of the water vapour contained in the exhaust gas (cf. "condensing boiler") in relation to the amount of fuel used Colloquially "energy content

Waste Management

Liquid waste

Heating value examples:

- Fresh wood: approx. 7 MJ/kg
- Domestic waste: approx. 10 MJ/kg
- Dry wood: approx. 15 MJ/kg
- Paper: approx. 15 MJ/kg
- Wood pellets: approx. 18 MJ/kg
- Hard coal: approx. 30 MJ/kg
- Diesel/heating oil: approx. 42 MJ/kg

Waste Management

Liquid waste

Landfillability:

- Consistency of the waste
- Elution of substance components

In Austria a distinction is made between:

- Excavated soil landfill
- Landfill of inert waste
- Landfills for non-hazardous waste: (construction waste landfill, residual waste landfill, bulk waste landfill)
- Landfills for hazardous waste

Waste Management

Liquid waste

Origin and prevention:

- The basic principle is that **without production no waste is produced.**

Waste Management

Liquid waste

Prevention/avoidance and reduction:

Prevention/avoidance of a specific waste may mean that production is changed so that

- this specific waste is no longer produced or
- recycled internally or externally

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Waste Management

Liquid waste

Waste prevention/avoidance:

Waste prevention means all measures taken before a product has become waste and which reduce

- the amount of waste, including by reusing products or extending their life cycle;
- the adverse effects on the environment and human health of the waste subsequently generated; or
- the pollutant content in products

Waste Management

Liquid waste

Waste prevention/avoidance:

Waste avoidance **occurs as early as the conception and design of products and production processes**, in particular through the selection and use of raw materials and consumables according to criteria of freedom from pollutants, length of service life and recyclability

Waste Management

Liquid waste

Waste prevention includes:

- avoiding the use of toxic or otherwise problematic substances
- the avoidance of substance composites
- the minimization of the number of substances used to a maximum of one substance (for simple products)
- the design of products for multiple use in product-service systems (e.g. eco-leasing).

Waste Management

Liquid waste

Waste prevention through internal or external recycling:

- **Internal**: resources that would otherwise be considered waste can be recycled or reused within the company
- **External**: Resource that would otherwise be considered waste can be recycled by external parties (customers or other companies) or reused in a sensible way

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Waste Management

Liquid waste

Waste reduction:

Reduction of a special waste can mean:

- that production is reorganised so that fewer production resources are lost, or
- that the treatment of this particular waste has been changed and less auxiliary materials are required, so that the waste mixture is smaller, or
- that a part of it is also used internally or externally.

Waste Management

Liquid waste

Measures for waste reduction include for example:

- all measures aimed at reducing the amount of waste produced later (e.g. thinner-walled packaging films)
- the conception of products with a long service life for reuse, further use with the characteristics of reparability, cleanability, washability, refillability etc.

Waste Management

Liquid waste

Avoidance/prevention and reduction strategies are:

- Clarification of product properties
- Avoidance through substitution
- Enabling internal recycling
- Increase of the efficiency
- Production of high quality residues

Why is the obvious, i.e. avoidance, usually neglected by process-integrated measures?
☾ **Barriers**

Waste Management

Liquid waste

Barriers to make changes in production are:

- Lack of information about prevention technologies
- Need for adaptation to special production systems
- Economic and personnel situation
- Lack of transparency of process flows
- Missing requirement profiles
- Daily business and high flexibility requirements

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Waste Management

Treatment of liquid waste

Treatment of **liquid residues:**

- has the objective of **recovery** or **preparation** for disposal.

It is in the **interest of every entrepreneur** to treat liquid waste according to **quantity** and **substance**.

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Waste Management

Treatment of liquid waste

Why quantity and substance related?**:**

- **Quantity based**: Quantity multiplied by the specific costs gives total costs.
- **Substance-related**: substance defines specific costs; quantity defines total costs)
- **Safety, reliability** (defined by substance)

Waste Management

Treatment of liquid waste

Detoxification/inactivation/reduction of the toxic effect by**:**

- **qualitative destruction of the relevant compounds** (toxic components are then no longer contained in the wastewater) or
- **masking of toxic effects** (the prevention of certain reaction sequences)

Waste Management

Treatment of liquid waste

Wastewater detoxification:

- The aim of wastewater detoxification is to free wastewater from chemical waste and foreign substances.
- It is an essential component of wastewater purification and treatment in industry.
- The aim is to **eliminate, inactivate/cancellate or at least reduce** the existing toxic potential to a certain level.
- There are various chemical-physical processes that make this possible.

Waste Management

Treatment of liquid waste

Possibilities of **detoxification, depletion, enrichment and inactivation:**

- Oxidative and reductive destruction
- Masking of toxic waste components
- Catalytic or photochemical attack of toxic waste components
- Extraction and electrolysis of heavy metals

Waste Management

Treatment of liquid waste

Besides the removal of pollutants from residues and waste, the **mineralisation of organic compounds** is an important prerequisite for further disposal.

Mineralization is the **release of organically bound chemical elements** and their conversion into inorganic compounds.

This means the conversion of organic compounds into a carbon atom, water and minerals, whereby the emission of CO_2 from the mixture of substances is considered a desirable product.

Waste Management

Treatment of liquid waste

The **decomposition of organic material** takes place in two steps:

- Step 1: into a coarse decomposition (humification)

- Step 2: into a subsequent complete splitting of the carbon, oxygen and hydrogen containing substances by microorganisms (biological oxidation)

Waste Management

Treatment of liquid waste

Microorganisms decompose the higher molecular organic compounds as part of their energy metabolism and, as part of their building material metabolism, also rebuild them into new organic compounds.

The presence of bacteria capable of mineralization is also of **great importance for the self-purification of waters**.

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Waste Management

Treatment of liquid waste

There are **2 basic types of biological treatment:**

- **Aerobic treatment (with oxygen)**
- **Anaerobic treatment (without oxygen)**

Waste Management

Treatment of liquid waste

Aerobic treatment (composting) refers to the supply of dissolved oxygen to the decomposing microorganisms. The oxygen can be supplied in the form of compressed air, pure oxygen, hydrogen peroxide or ozone.

Example of an activated sludge tank in a sewage treatment plant: In this area, microorganisms break down the organic substances in the wastewater and inorganic substances are partially oxidized. For this purpose, air (oxygen) is pumped in, i.e. aerobic treatment

Waste Management

Treatment of liquid waste

Anaerobic treatment (digestion/fermentation): Systems with fixed beds are particularly interesting for the treatment of liquid waste in the absence of oxygen, because immobilised microorganisms are easier to handle when problems occur.

Example digestion tower of a sewage treatment plant: sewage sludge can be decomposed in digesters under anaerobic conditions by anaerobic bacterial strains to digested sludge and combustible digester gas (essentially a mixture of methane and carbon dioxide)

Waste Management

Treatment of liquid waste

Other biological treatment methods are:

- **Wet oxidation**
- **Pyrolysis (decomposition)**
- **Thermal oxidation**

Waste Management

Treatment of liquid waste

Wet Oxidation:

- Chemical oxidation of organic compounds in a liquid phase by supplying oxygen under high pressure and temperature
- In wastewater treatment, wastewater constituents can be oxidized by wet oxidation with the help of atmospheric oxygen at 240-290°C and approx. 120 bar

Basically nothing else than mineralization of organic compounds in aqueous phases

Waste Management

Treatment of liquid waste

Pyrolysis:

- Pyrolysis is the decomposition (degassing) of carbonaceous mixtures of substances by the action of heat, but excluding oxygen.

- A thermo-chemical cleavage of organic compounds, whereby high temperatures (approx. 500 - 900°C) force a bond to break within large molecules, resulting in smaller molecules.

For example, pyrolysis of higher quality KWe in methane.

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Waste Management

Treatment of liquid waste

Thermal oxidation:

- the combustion - or oxidation, in terms of process engineering, of the organic components of a mixture of substances with atmospheric oxygen at high temperatures.

Waste Management

Treatment of liquid waste

Incineration:

Prerequisites are:

- Sufficient oxygen supply
- Sufficient ignition temperature
- Sufficient contact of fuel and oxygen
- Continuous removal of the products (flue gas and slag)

Waste Management

Solid waste

Properties of solid waste:

- Waste quantities
- Waste volume
- Calorific value

Waste Management

Solid waste

Properties of solid waste:

- The waste quantity is recorded gravimetrically via the waste weight over a certain collection range.

Waste Management

Solid waste

Properties of solid waste:

- The waste volume can be determined from the number of weekly emptied collection containers and their individual volumes.

Waste Management

Solid waste

Properties of solid waste:

Waste quantities and waste volume: In practice, **conversion factors** are applied on the basis of experience.

e.g.:

Waste identification	Masses in tons	Conversion into kg/m³	Volume in m³
Residual waste	1,402,100	130	10,785,000
Glass (packaging)	211,600	280	756,000
Metals (packaging)	30,600	50	612,000

Waste Management

Solid waste

Properties of solid waste:

- The calorific value is used to assess the combustibility of waste.
- Calorific value of **business waste greater than that of household waste** (more paper, cardboard, plastics).

Calorific value of analytical waste in kJ/kg:

- Household waste: Winter – 6661 to 7821 kJ/kg; Summer – 7093 to 8235 kJ/kg
- Business waste: Winter – 10400 kJ/kg; Summer – 13989 kJ/KG

Waste Management

Solid waste

Analysis of waste samples:

Average raw waste sample (1000 – 2000kg)

↓

Sieve analyses

↓

Separate weighing of the individual fractions and determination of their mass fractions.

↓

Sorting analysis with subsequent weighing → Substances that can be incinerated and composted. Substances that can only be incinerated. Substances that can neither be incinerated nor composted.

↓

Crushing to 8 mm and mixing of the crushed fraction

↓

Pre-sampling → Residual sample

↓

Collection of laboratory samples → Residual sample

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Waste Management

Solid waste

Analysis of residual samples:

Taking of laboratory samples of certain mass for the determination of:

water gelate and hygroscopic residual moisture, ignition residue and ignition loss, calorific value, self-heating behaviour, organic substance content, C/N ratio, cellulose content, pH value, conductivity, content of toxic substances after prior special preparation of the respective sample

Waste Management

Solid waste

Analysis of residual samples:

- **Hygroscopic residual moisture**: after drying, the sample absorbs moisture from the ambient air; this moisture absorption serves to characterize the waste sample
- **Residue on ignition**: determine the mass of the residue after annealing (2 hours at 775°C); organic ingredients are oxidised, mineral residue remains
- **Loss on ignition**: initial mass minus the ignition residue corresponds to the loss on ignition

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Waste Management

Solid waste

Analysis of residual samples:

- **Content of organic substances:** Determined by TOC value (total organic carbon = total amount of CO_2 after a thermal reaction)
- **pH value:** pH < 7: acidic, pH = 7: pure water or neutral, pH > 7 basic
- **Conductivity:** physical quantity specifying the ability of the waste sample to conduct electric current; high conductivity = high salinity

Waste Management

Solid waste

Analysis of residual samples:

- **Self-heating behaviour:** biodegradation of organic substances is exothermic; the degree of self-heating is used to characterise the waste sample
- **C/N ratio:** indicates the ratio of carbon (C) to nitrogen (N) in the waste sample and is an indicator of its fertility. The smaller the number, the better the availability of nitrogen. Domestic sewage sludge has a C/N ratio in the range 5-20

Waste Management

Solid waste

Analysis of residual samples:

- **Cellulose content:** Cellulose is the main component of plant cell walls and thus the most common organic compound; the cellulose content thus serves to characterise the waste sample and is an indication of the expected amount of compost
- **Content of toxic substances:** Analysis is usually very complex and must be carried out substance-specific!

Waste Management

Solid waste

Facts about solid waste:

Composition of waste

Waste type	Total mass percentage (%)	Mass percentage in household waste (%)
Household waste	70 – 80	
Substance group 1: Materials that can be incinerated (in the grain size range 8 - 40mm, organic kitchen waste, paper, straw, textiles, etc.)		30 – 60
Substance group 2: substances that can only be burnt (wood, leather, plastics, etc.)		4 – 7
Substance group 3: Substances which can neither be incinerated nor composted (= inert materials) (iron, glass, porcelain, etc.)		14 – 25
Substance group 4: fine waste with grain size below 8mm, partly compostable and combustible (ash, sand, organic matter)		20 – 35
Bulky, flammable and non-flammable goods from trade and small industry	1 – 14	
Combustible and non-combustible industrial waste	10 – 20	
Street sweepings, garden waste	10 – 20	

Waste Management

Solid waste

Facts about solid waste:

Mixed municipal waste from households and similar establishments: Composition (1)

- Biogenic waste – 20.5%
- Paper, cardboard and cartons – 5.3%
- Toiletries and diapers – 20.4%
- Plastics and composites – 10.1%
- Textiles and shoes – 4.8%
- Glass – 3.0%
- Inert materials – 2.0%

Source: mixed municipal waste from Upper Austria from 2013

Waste Management

Solid waste

Facts about solid waste:

Mixed municipal waste from households and similar establishments: Composition (2)

- Metals – 2.3%
- Problem substances – 0.3%
- waste electrical and electronic equipment – 0.4%
- Other waste (flat glass, wood, wood composites) – 10.4%
- Fine Fraction – 20.7%
- Total – 100.00%

Source: mixed municipal waste from Upper Austria from 2013

Waste Management

Solid waste

Avoidance/reduction:

Formation of products and residues in industrial production processes

Raw material 1 ⇄ Raw product → Pure product

- Reaction medium
- Catalyst
- Auxiliary material

- Processing medium

+

Raw material 2
Secondary component

Residual Material

Crosspoint	Converted minor constituent
By-products/following products	Contaminated reaction/processing medium

Waste Management

Solid waste

Measures to avoidance/reduction of solid waste:

- Use of pre-cleaned raw materials
- Improvement of the production process through new synthesis routes
- Use of catalysts with higher selectivity
- Plant and control engineering optimizations

Waste Management

Solid waste

Measures to avoidance/reduction of solid waste:

- Recycling of auxiliary materials
- Reduction of the pollutant load of the residues
- Separation for volume reduction

Waste Management

Solid waste

Avoidance/reduction of solid waste:

Process for the recovery of the material and energy content of the waste

- Separate collection of waste materials from the waste
- Mechanical waste sorting and separation processes
- Composting
- Pyrolysis with recycling of the pyrolysis products
- Waste incineration with heat recovery
- Pyrolysis with use of the pyrolysis products as energy source

Waste Management

Solid waste

Solid waste collection:

Waste collection includes the following systems:

- Conventional collection systems
  - Transfer vessels;
  - Vessel Exchange Systems;
  - Disposable packs
- Waste suction systems
- Separate collection systems

Waste Management

Solid waste collection

Waste suction systems:

In a waste suction system, the **waste in multi-family houses** is **thrown into deposit shafts** and in **the areas of individual houses** into **outdoor entry points** and pneumatically transported via a public pipeline system with negative pressure to a collection point, from where it is transported by vehicles to the landfill.

Waste Management

Solid separate waste collection systems overview

Systems involved in the collection of household waste:

- Simultaneous collection of waste and materials
    - Individual waste bags
    - Multi-chamber waste systems
    - Waste bag in the container
- Separate collection of waste and materials
    - Green ton
    - Compost bin
    - Garbage bag plus container

Waste Management

Solid separate waste collection systems overview

System independent from household waste collection:

- House collection
  - Wastepaper, Waste clothes
- Collection at central locations
  - Collection container
    - Glass
    - Paper
    - Batteries
    - Combi-Container

Waste Management

Technical facilities

Requirements for technical facilities for waste treatment are:

- Simple and robust design
- As few moving parts as possible with good maintenance and cleaning possibilities
- Cover of all drive devices
- Large passage cross sections
- Little deflection of the material flows
- Resistance to mechanical abrasion and corrosion

Waste Management

Technical facilities

Bunker systems should have three functions:

- Recording the amount of waste delivered and unloaded
- Temporary storage of waste to decouple the processes of delivery and abandonment
- Dosing of the waste quantity for feeding to the following processing equipment

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Waste Management

Technical facilities

Bunker and dosing equipment include:

- Apron feeder hoppers and depth hoppers
- Crane systems
- Flat bunker

Waste Management

Technical facilities

Shredding aggregates for waste are:

- Hammer mills
- Impact mills
- Impact tearer
- Knife mills
- Ball mills (cascade mills)

Waste Management

Technical facilities

Hammer Mill:

- Principle: One or more rotors rotate in a housing and hammers are attached to their circumference. The material to be ground hits the rotating hammers, thus achieving the primary crushing effect.
- The hammers also hurl the pieces onto the housing wall, where they are further broken up by the impact.
- The ground material remains in the grinding chamber until it is small enough to fit through a grate on the outer circumference of the machine.

Waste Management

Technical facilities

Impact Mill:

- Principle: One or more rotors rotate in a housing, on the circumference of which beater bars are attached. Static baffle plates are additionally attached to the housing.

- The material to be ground is thrown by the rotating beater bars against the static baffle plates until the desired degree of size reduction is achieved.

Waste Management

Technical facilities

- **Ball mill**: It consists of a rotating grinding chamber in which ground material is crushed by grinding media.
- **Knife mill**: Knives at high speeds crush the material to be ground.

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Waste Management

Technical facilities

Sieves are used in waste treatment plants for:

- pre-sieving the fine waste or the coarse waste
- Post-sieving of the shredded waste for the separation of non-shreddable waste
- Post-sieving of the waste rotting in the reactor for the separation of difficult or non-rotting waste materials
- Sieving of the finished compost to achieve higher compost qualities

Waste Management

Technical facilities

sieving machines for waste:

- Vibrating sieves
- Clamping shaft sieves
- Drum sieves
- Tension shaft drum sieves

Waste Management

Solid waste

Recycling

Recycling means **the reintroduction of waste materials into the production process** as a substitute for primary raw materials.

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Waste Management

Solid waste

Recycling

- The use of old materials not only **conserves raw material reserves**.
- At the same time, **considerable amounts of energy are saved**.
- The reuse of production waste in the manufacture of new goods **has always been common practice** in the **paper** and **glass industries**.
- However, there are still many untapped, or at present uneconomical recycling possibilities for a wide range of materials.

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Waste Management

Solid waste

Recycling

In Europe, mainly recycled materials are:

- Paper and cardboard
- Plastic foils
- Scrap iron
- Glass
- Non-ferrous metal (all metals except ferrous alloys in which the proportion of pure iron exceeds 50%; examples: copper, aluminium, zinc, bronze, brass)

Waste Management

Solid waste

Recycling

Glass recycling:

Colour separation is important for the recycling process, because a single green champagne bottle tints 500 kg of colourless glass greenish. Conversely, white glass discolours stained glass.

In Austria, more than 200,000 tons of used glass packaging are collected annually.

Before being melted down, the waste glass is cleaned manually and mechanically from the wrong types of glass, pieces of glass of the wrong colour and foreign matter.

Waste Management

Solid waste

Landfills

- From the recent past, the small community owned or wild dumps in quarries, sand or gravel pits without landfill regulations are still known.

- These landfills were constructed according to the principle of pre-head dumping, in which waste from greater dumping heights rolls off over inclined dumps in a highly loosened up state and forms a hollow deposit mass with low bulk density and a large surface area for leaching by precipitation water

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Waste Management

Solid waste

Landfills

Apart from disfiguring the landscape and reducing the utility value of the area surrounding the dump, this disposal of waste has led to:

- ... a high pollution of ground and surface water due to pollutant extraction by trickling rainwater,
- ... pest breeding and the associated danger of epidemics,
- ... and extensive air pollution from uncontrolled fires.

Waste Management

Solid waste

Landfills

Defined landfill options are:

- Controlled landfill
- Rott landfill (preliminary stage of composting)
- Landfill of hazardous waste (commercial or industrial waste not similar to household waste)
- Special landfill (e.g. radioactive material)

Waste Management

Solid waste

Landfills

Requirements for the construction and operation of a landfill in Austria:

- Legal basis, site selection, planning approval
- Explanatory report on the assessment of the project
- Plan documents
- Expert opinion
- Documents on construction and operation
- Leachate disposal, degassing
- …

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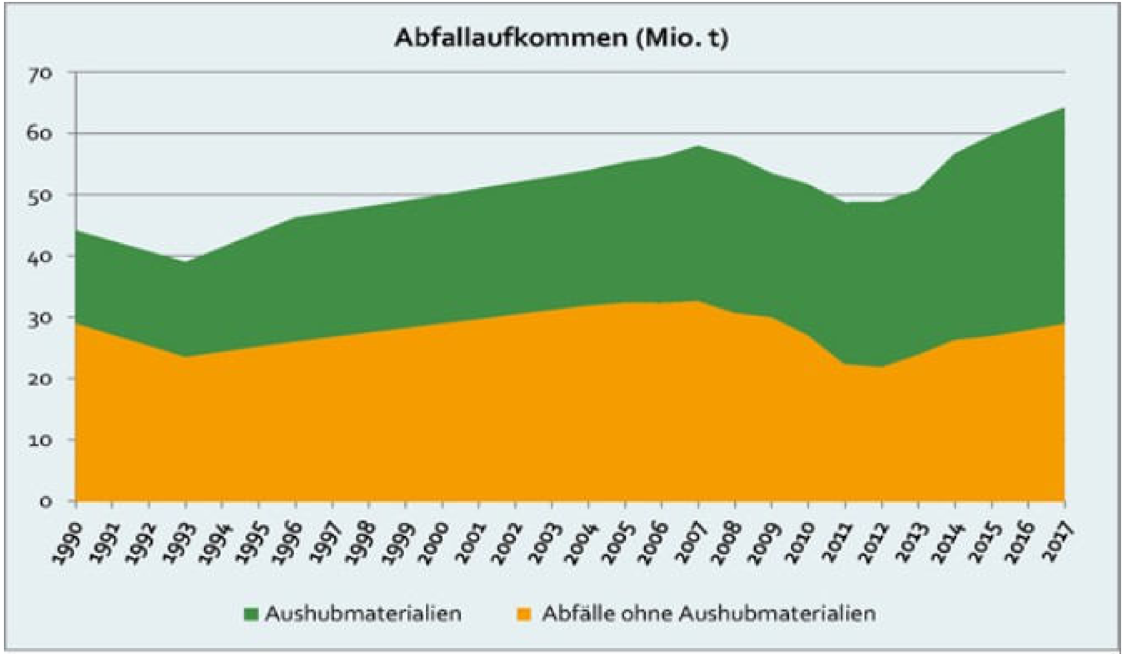
Waste Management

Waste Data: Austria

The waste volume in 2017 was around 64.19 million tonnes.



Quelle: BMNT

Source:
https://www.umweltbundesamt.at/umweltsituation/abfall/abfall_datenbanken/jahresdaten_abfall/

Waste Management

The EU's approach to waste management:

The European Union's approach to waste management is based on the "waste hierarchy" which sets the following priority order when shaping waste policy and managing waste at the operational level: prevention, (preparing for) reuse, recycling, recovery and, as the least preferred option, disposal (which includes landfilling and incineration without energy recovery).

Source: https://ec.europa.eu/environment/waste/index.htm

Waste Management

The EU’s approach to waste management:

Directive 2008/98/EC on waste (Waste Framework Directive)

- Directive 2008/98/EC sets the basic concepts and definitions related to waste managament, such as definitions of waste, recycling, recovery.
- It explains when waste ceases to be waste and becomes a secondary raw material (so called end-of-waste criteria), and how to distinguish between waste and by-products.

Source: https://ec.europa.eu/environment/waste/framework/

Waste Management

The EU’s approach to waste management:

Directive 2008/98/EC on waste (Waste Framework Directive)

- The Directive lays down some basic waste management principles: it requires that waste be managed without endangering human health and harming the environment, and in particular without risk to water, air, soil, plants or animals, without causing a nuisance through noise or odours, and without adversely affecting the countryside or places of special interest.
- Waste legislation and policy of the EU Member States shall apply as a priority order the following waste management hierarchy.

Source: https://ec.europa.eu/environment/waste/framework/

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Waste Management

The EU's approach to waste management:

Directive 2008/98/EC on waste (Waste Framework Directive)

Source: https://ec.europa.eu/environment/waste/framework/

Waste Management

The EU's approach to waste management:

Directive 2008/98/EC on waste (Waste Framework Directive)

The Directive introduces the "polluter pays principle" and the "extended producer responsibility". It incorporates provisions on hazardous waste and waste oils (old Directives on hazaroud waste and waste oils being repealed with the effect from 12 December 2010), and includes two new recycling and recovery targets to be achieved by 2020.

Source: https://ec.europa.eu/environment/waste/framework/

Waste Management

The EU's approach to waste management:

Directive 2008/98/EC on waste (Waste Framework Directive)

Two new recycling and recovery targets to be achieved by 2020:

- 50% preparing for re-use and recycling of certain waste materials from households and other origins similar to households, and
- 70% preparing for re-use, recycling and other recovery of construction and demolition waste.

The Directive requires that Member States adopt waste management plans and waste prevention programmes.

Source: https://ec.europa.eu/environment/waste/framework/

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Waste Management

The EU's approach to waste management:

The 7th Environment Action Programme sets the following priority objectives for waste policy in the EU:

- To reduce the amount of waste generated;
- To maximise recycling and re-use;
- To limit incineration to non-recyclable materials;
- To phase out landfilling to non-recyclable and non-recoverable waste;
- To ensure full implementation of the waste policy targets in all Member States.

Source: https://ec.europa.eu/environment/waste/index.htm

Waste Management

The EU's approach to waste management:

More information on the main elements of EU waste legislation can be found in more detail (see source):

- Waste framework legislation
- Waste stream legislation
- Landfilling and incineration
- Shipment of waste
- Implementation and reporting
- Review of EU waste policy
- Studies/publications/links

Source: https://ec.europa.eu/environment/waste/index.htm

Waste Management

The EU's approach to waste management:

Furthermore, the EU has a brochure about the "EU's approach to waste management":

Link: https://ec.europa.eu/environment/waste/pdf/WASTE%20BROCHURE.pdf

Waste Management

Waste management in Austria :

A lot of information can be found at:

Umweltbundesamt (Environment Agency) Austria – Environmental Situation - Waste

- https://www.umweltbundesamt.at/umweltsituation/abfall/

Summary

- Environment (Pollution, Awareness)
- Solid Waste
- Liquid Waste
- Wastewater
- Waste Management

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Module III - Energy generation from wastewater and waste

Content

- Waste
- Waste Management
- Energy Management
- Waste Utilization
- Wastewater Utilization (Technologies etc.)
- Heat Pump Technology
- Use Cases
- Summary

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Waste

Waste can be classified according to many different criteria. An overarching classification, especially regarding waste management, is usually done in following manner:

- **Solid Waste**
- **Liquid Waste**
- **Hazardous Waste**
- **Non-Hazardous Waste**
- **(e-waste)**

Waste

Solid waste

Waste collected from residences, commercial buildings, hospitals, schools, universities, offices, light industrial operations etc. is usually considered as **municipal solid waste**.

Municipal Solid Waste **mainly consists of**:

- Paper, Containers and packaging (plastic, glass and metal), Food/Bio waste, Yard trimmings, Textiles, Other inorganic waste

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Waste

Liquid Waste

Fluid wastes, consisting of sewage and domestic wastewater, or processed water, or other liquids, produced by industrial activity, particularly by such industries as pulp and paper production, food processing, and the manufacture of chemicals.[1]

Liquid waste can also be defined as such liquids:[2]

- Wastewater
- Fats, oils, grease
- Used oil
- Liquids, solids, gases, or sludges and hazardous household liquids

Waste

Liquid Waste

Liquids that are hazardous or potentially harmful to human health or the environment. They can also be discarded commercial products classified as “Liquid Industrial Waste” such as cleaning fluids or pesticides, or the by-products of manufacturing processes.

Liquid waste can therefore be also classified as **wastewater**!

Types of Waste

Wastewater

Wastewater is a **generic term for water from various sources**, which is discharged via building structures.

- **Rainwater** - rainwater running off paved surfaces (in some contexts rainwater is not counted as wastewater)
- **Extraneous water** - entering the sewerage system due to structural damage

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Types of Waste

Wastewater

Wastewater is a **generic term for water from various sources**, which is discharged via building structures.

- **Wastewater** - water contaminated by use or changed in its properties or composition. It is further differentiated:
    - **Greywater** - according to EN 12056-1: faecal-free, slightly contaminated wastewater (e.g. water originating from showering, bathing or washing hands, from the washing machine) which can be treated to produce **process water.** Rainwater **running off the roof or balcony** is also included.

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Types of Waste

Wastewater

Wastewater is a **generic term for water from various sources**, which is discharged via building structures.

- **Wastewater** - water contaminated by use or changed in its properties or composition. It is further differentiated:
  - **Blackwater** - according to **ISO 6107-7:1997**: Domestic wastewater containing urine and/or faecal matter. Blackwater can be further subdivided into:
    - Yellowwater – water containing urine (flushing water)
    - Brownwater – water containing faeces and/or toilet paper (without urine)

Types of Waste

Wastewater

Wastewater is a **generic term.** Depending on the country the definition of wastewater varies. The EU defines wastewater as:

- **Domestic wastewater:** Wastewater from residential settlements and services which originates predominantly from the human metabolism and from household activities
- **Industrial wastewater:** Any wastewater which is discharged from premises used for carrying on any trade or industry, other than domestic wastewater and run-off rainwater

Link: https://ec.europa.eu/environment/water/water-urbanwaste/info/glossary_en.htm

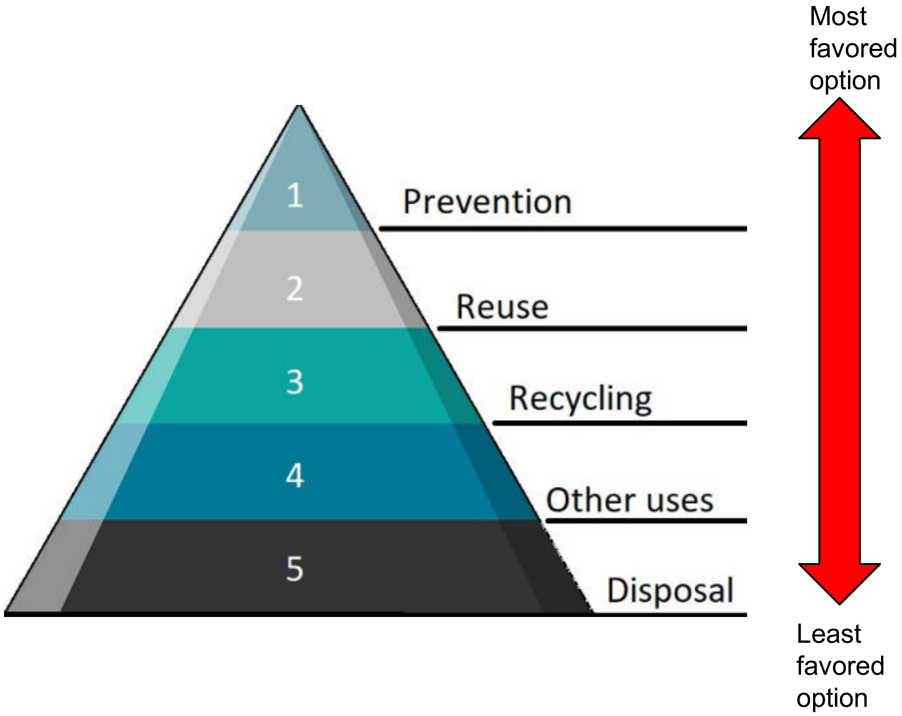
Waste Management

- Waste management is the **sum of all activities and actions** required to manage waste from its inception to its final disposal.
- Waste management includes **all waste types**:
  - Industrial
  - Biological
  - Household
- Waste is produced by human activity (production, extraction, processing of materials)
- Waste poses a **threat to environmental and human health**.
- Waste management is intended to reduce adverse effects of waste on human health, the environment.

Waste Management

The waste hierarchy:

- Prevention,
- Preparation for reuse,
- Recycling,
- Other recovery (e.g. energy recovery)
- Disposal



Note: In some waste hierarchies the step “minimization” is included between “Prevention” and “Reuse”.

Energy Management

- Energy management is about **planning and operation of energy-related generation and consumption** units.
- Energy management can (and should) **be applied on many different levels** from state level to regional level as well as in individual companies
- The main objectives are the **conservation of resources, climate protection and cost reductions**, while ensuring that the energy needs of the users are met.

Energy Management

- Fundamental considerations for energy management:
  - ➢ To ensure the security of energy supply (e.g. uninterrupted energy supply)
  - ➢ To ensure economic electricity and heat prices (e.g. avoiding to high fluctuations)

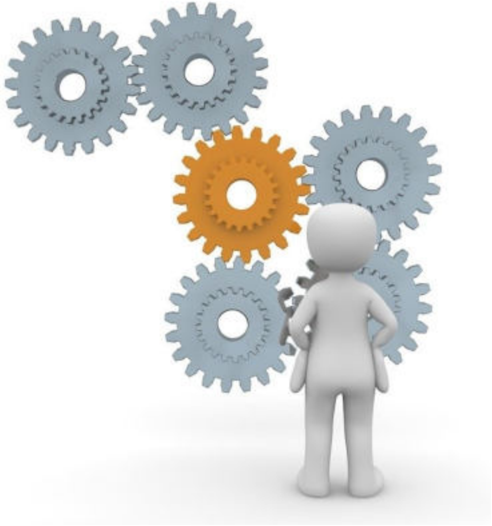


Photo by Peggy_Marco at Pixabay

Energy Management

- Application areas of Energy Management are:
  - Commercial and industrial energy management in production and logistics (small, medium and large sized)
  - Energy management for residential construction and of residential buildings

Photo by geralt at Pixabay

Energy Management

- Application areas of Energy Management are:
  - The municipal energy management (national, regional and local)
  - Building energy management, especially for complex functional buildings and buildings necessary for the infrastructure.
    - e.g hospitals, fire and police stations, stores, etc.

Energy Management

- Application areas of Energy Management in cooperate functions are:
  - Facility Management
  - Energy Procurement
  - Production
  - Maintenance
  - Information Technology
  - Logistics
  - Production planning and control

Waste utilization as energy supply

- Utilizing waste as “energy supply” is usually referred to as:
  - **Waste-to-energy** (WtE), or
  - **Energy-from-waste** (EfW)
- WtE is the process of generating energy in the form of electricity and/or heat from the **primary treatment** or the **processing of waste** into a fuel source.
- As products and materials already had an energy input in some form to become waste, waste-to-energy is considered as a **form of energy recovery**.

Waste utilization as energy supply

The majority of waste-to-energy processes have one of the following two effects.

- Either they **generate electricity and/or heat** directly through combustion, or
- the WtE processes **produce a combustible fuel commodity**, like:
  - Methane,
  - Methanol,
  - Ethanol, or
  - Synthetic fuels

Waste to Energy

There are **several methods** used globally to turn waste into energy:

- The most common one is **incineration** (or **combustion**) of waste.
- Other methods include:
  - **Thermal technologies**
    - Gasification
    - Pyrolysis
    - etc.
  - **Non-thermal technologies**
    - Anaerobic digestion
    - Fermentation
    - etc.

Waste to Energy

Incineration/Combustion

- Waste incineration refers to the **combustion of organic (waste) material** with energy recovery, is the most common method of Waste-to-Energy.
- Not only **is energy recovered**, but simultaneously it has the advantage of **getting rid of waste**, which would otherwise have to be processed or dumped into a landfill.
- All new WtE plants in the EU must meet severe emission standards laid down in the Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste.

Directive 2000/76/EC: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:332:0091:0111:EN:PDF

Waste to Energy

Incineration/Combustion

- The Directive 2000/76/EC includes emission standards on:
  - Nitrogen oxides (NOx)
  - Sulphur dioxide (SO_2)
  - Heavy metals
  - Dioxins
- Therefore, WtE incineration plants built after 2000 are very different to older plants.
- New incinerators can **reduce the volume** of the input waste by approximately **95%**.
  - ➢ Hereby, the composition and degree of recovery of the materials plays a role.

Waste to Energy

Incineration/Combustion

Getting rid of waste, while simultaneously generating, or rather recovering, energy sounds great. However, there are several downsides to the WtE incineration process:

- WtE plants need a continuous, uninterrupted, **high volume waste stream** for about **25 years** to be economically viable.
  - ➢ This leads to waste imports (e.g. Sweden imports waste form the UK).
- Waste materials that are easiest to gather and are recyclable (e.g. paper and plastic) produce most energy when burned.

Waste to Energy

Incineration/Combustion

- Getting rid of waste in such an easy way, reduces innovation in the waste sector
- Furthermore, WtE does not comply with a circular economy (trying to keep goods in circulation). Instead, it strengthens the “make-use-dispose” mentality.
- Burning waste contaminates and impacts the environment, even when restrictions and standards are applied and adhered.
  - Incinerators may emit fine particulate, heavy metals, trace dioxin and acid gas, albeit these emissions are relatively low.

Waste to Energy

Incineration/Combustion

- Incinerators may destroy valuable resources that could be used in another way.
- They also may reduce incentives for recycling.
- It is however certainly a viable and useful option for waste management as some Member States of the EU which recycle the most (up to 70%) also utilize the incineration process to avoid landfilling.
- Incinerators have electric efficiencies between 14% and 28%.
- In Euope there were 431 WtE plants in 2005 and 89 in the US in 2004.

Waste to Energy

Incineration/Combustion

- To avoid losing rest energy, it can be used for e.g. district heating (cogeneration).
- Cogeneration incinerators have total efficiencies of more than 80% (based on the lower heating value of the waste).
- For incineration usually waste is burned (residual municipal solid waste, commercial and industrial).
- This boils water which powers steam generators that generate electric energy and heat to be used in homes, businesses, institutions and industries.

Waste to Energy

Incineration/Combustion

- Modern incinerators encompass primary and secondary burn chambers, and controlled burners designed to burn completely with the lowest possible emissions.
- Thereby, eliminating/reducing the need for lime scrubbers and electro-static precipitators on smokestacks.
- By passing the smoke through basic lime scrubbers, acids in the smoke are neutralized. This prevents the acid from reaching the atmosphere and hurting the environment.
- Other devices (fabric filters, reactors, and catalysts) destroy or capture other pollutants.

Waste to Energy

Incineration/Combustion

While there are downsides to incineration plants there are also arguments for incineration:

- Incineration plants can generate electricity and heat that can substitute power plants powered by other fuels.
- Reduces waste that would end up in landfills.
- Finding space for landfills is becoming increasingly difficult.
- New plants adhere to strict emission standards.
- Incineration of municipal solid waste reduces methane.
- The volume of combusted waste is reduced by approximately 90% to 95%.

Waste to Energy

Incineration/Combustion

Different furnaces for combustion are:

- **Rotary kiln** - pyroprocessing device used to raise materials to a high temperature (calcination) in a continuous process.
- **Fluidized bed combustion chambers** - fuel particles are suspended in a hot fluidity bed of ash and other particulate materials, such as sand, limestone etc., through which jets of air are blown to provide the oxygen required for combustion or gasification.
- **Special combustion chambers** – special combustion chambers that are part of e.g. an internal combustion engine in which fuel/air mix is burned.

Waste to Energy

Thermal Technologies

- **Gasification**: produces combustible gas, synthetic fuels or hydrogen
- **Plasma arc gasification:** produces syngas (incl. hydrogen and carbon monoxide). Can be utilized for generating electricity or fuel cells.
- **Thermal depolymerization**: produces synthetic crude oil (can be further refined)
- **Pyrolysis**: produces combustible tar/bio-oil and chars.

Energy from Wastewater

- The energy content in wastewater from households, trade and industry is considerable.
- However, in Member States of the EU including Austria, wastewater is hardly used and not really seen as a viable energy source.
- An example for this is with wastewater treatment plants (WWTP). Their main function is to remove contamination from wastewater. However, research suggests that it can serve as a source of energy internally in the WWTP and also externally in infrastructure.
- Results show that the amount of thermal energy available in WWTP exceeds the internal demands of the WWTP.

Energy from Wastewater

- A general approach that does not require a WWTP but might also be utilized in small or private facilities would be to use heat exchangers in order to extract thermal energy contained in wastewater.
- Subsequently, heat pumps can be used to bring it to the required temperature level, e.g. for heating or cooling purposes.
- All year wastewater temperatures are around or above 10°C.
- Therefore, it is optimally suited for the use of heat pumps as this corresponds roughly to the annual average heat of groundwater (12 °C) which is also utilized with heat pump technology.

Energy from Wastewater

How can heat be utilized/ extracted/ transferred from wastewater?

It can be recovered …

- in buildings from, e.g. raw wastewater
- from sewers, e.g. from raw wastewater
- Or in a sewage treatment plant, e.g. from the treated wastewater

This wastewater heat utilization can have effects on sewer systems and the sewage treatment plants.

Energy from Wastewater

Wastewater heat utilisation

There are several requirements that must be met for installations:

- A corresponding heat potential in the sewer - wastewater temperature
- Relevant customers must be within a reasonable distance (heat transfer loss)
- A minimum flow rate of 15 l/s in dry weather, i.e. no rain
- Negative effects on the sewerage system and sewage treatment plants must be avoided
- Sufficient hydraulic reserves in the sewer itself

Energy from Wastewater

Wastewater heat utilisation

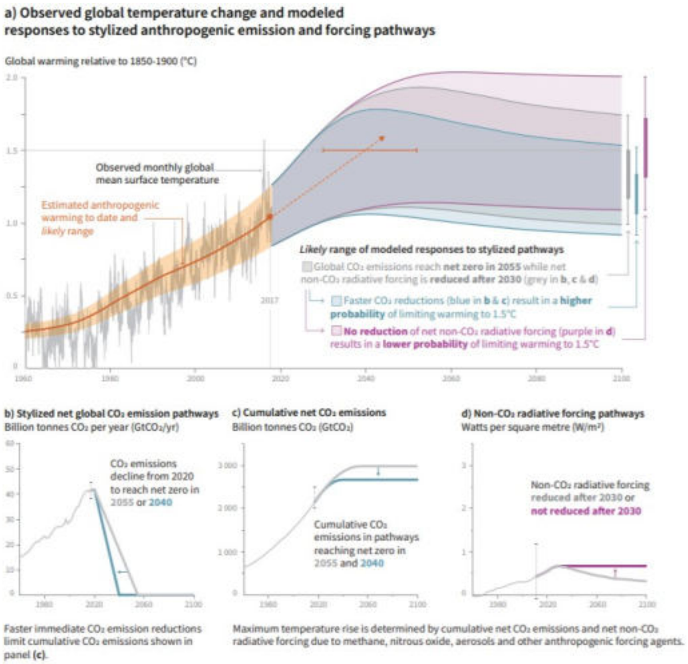
Additionally to requirements, some aspects also must be considered:

- Wastewater temperatures are fluctuating
- Biological processes depend on temperature, therefore change with the temperature.
- In the case of longer-term cooling (i.e. caused by long periods of precipitation, use of wastewater heat, etc.), an overall lower temperature level is achieved.
- It must by energy-economical (close to end customer)
- Urban water management must be involved
- Wastewater heat utilization can lead to an temperature drop. This affects water protection issues.

Energy from Wastewater

- Ecological: wastewater heat utilization seems reasonable.
- Economic: in each case it must be examined if it makes economic sense and is efficient.
- It must be observed that the sewer systems and the sewage treatment plant don't get damaged or loose their functionality if wastewater heat is utilized.
- Like with most other things (especially related to the environment) all important stakeholders and actors need to be involved and need to cooperate and interact in order for wastewater heta utilization to be successfully implemented.

Paris Climate Treaty and global CO_2-Budget



Source: IPCC https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Summary_Volume_Low_Res.pdf

Importance of the heating market

- The heating market accounted in 2017 for approximately 35% of the primary energy market.
- The total market in 2017 was about 3800 TWh/a.
- In households about 65% are used for space heating. A small percentage went to process heat, while about 20 % were used for hot water.
- In the industry also the mayor percentage went to space heating.
- Throughout the European Union, it is planed to decarbonize the heating market by 2050.

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Heat Pump

- Is a device that transfers heat energy from a heat source to a thermal reservoir.
- Heat pumps move thermal energy in the opposite direction of spontaneous heat transfer by absorbing heat from a cold space and releasing it to a warmer one.
- A heat pump uses external power to transfer energy from the heat source to the heat sink.

Heat Pump

- Heat pumps are not a new invention.
- In 1857 the prototype of the new "steam pump" goes into operation in the Ebensee (Upper Austria) salt works. This is the world's first application of the "heat pump" principle.
- Therefore, heat pumps have been around for more than 150 years.
- Because heat pump manufacturers have been able to continuously develop the technology, highly efficient and technically mature heat pump systems are now available which require little electricity to drive and work reliably for decades.

Heat Pump

- Heat pump technology is one of the most environmentally friendly methods of heating and hot water preparation.
- It reduces climate-damaging CO_2 emissions and energy consumption.
- It requires hardly any maintenance and, with correct planning and optimum operation, provides many times the electrical drive power used in terms of thermal energy.

Heat Pump

Heat pumps work like refrigerators, but the principle is used in exactly the opposite way:

- While the refrigerator's refrigerant circuit extracts heat from its interior and releases it to the environment, the refrigerant circuit of a heat pump extracts heat from its surroundings.
- This heat is brought to a higher temperature level inside the appliance and can then be used for heating or for warming domestic water.
- An efficient heat pump can thus generate 100% heat output with 75% free environmental energy.

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Heat Pump

- The heat pump's main energy source is ambient heat, i.e. solar energy stored in the air, in the ground or in groundwater.
- To bring this ambient heat from a relatively low temperature level to the temperature level required for heating and hot water, the heat pump uses a **refrigerant**.
- Due to its low boiling point, this already evaporates at relatively cold temperatures of the heat source.

Heat Pump

- Drive energy in the form of electricity or gas compresses the vaporous refrigerant, thereby raising the temperature to the required level.
- The refrigerant is then liquefied again in a condenser, whereby it releases both the drive energy supplied and the absorbed environmental heat to the heating medium at a higher temperature level.
- How efficiently a heat pump works as a heat source is shown by the ratio of the energy used to the energy generated.

Heat Pump

- In order to be able to compare different designs and models, the so-called COP value (coefficient of performance) is determined under standard laboratory conditions.
- This value indicates how high the energy gain is compared to the energy input.
- Modern heat pumps achieve COP values of 4 to 5 under the standardized test conditions.
- Simplified: 4 to 5 times the energy used is recovered as heat.

Heat Pump

- Heat pumps can also be used for cooling.
- As the temperature in the ground in summer is lower than the room temperature, ground or groundwater heat pumps can make direct use of the coolness of the ground.
- This requires only a very small amount of energy, which makes this type of cooling very energy-efficient.
- If the cooling requirement is higher, the heat pump circuit can also be reversed and used for active cooling

Heat Pump

- The most common design of a heat pump involves four main components:
    - a condenser
    - an expansion valve
    - an evaporator
    - a compressor

- The heat transfer medium circulated through these components is called refrigerant.

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Heat Pump

Heat pumps have different operating modes:

- Monovalent
- Bivalent
- Monoenergetic

Heat Pump

Monovalent

- The monovalent heat pump covers the heat requirement throughout the year without additional heating.
- Even at low outside temperatures, the heat pump provides sufficient heat at all times.

Heat Pump

Bivalent (1)

- In bivalent operation there are two different heat generators. If the heat pump cannot cover the heat demand at low outside temperatures on its own, it is supported by an additional heat generator.
- In bivalent-parallel operation, the heat pump and the second heat generator operate together from a certain outside temperature (e.g. +3 °C).
- This operating mode is selected if the required flow temperature or the required heating energy is too high. This occurs, for example, in old buildings in conjunction with an air-to-water heat pump, whereby the old heat generator, which is usually available, can still be used.

Heat Pump

Bivalent (2)

- Since the annual coverage is relatively low compared to the other modes of operation, this mode of operation is rarely chosen today.
- In addition to the heat pump, there is a second heat generator which supports the heating of the building when outside temperatures are lower.
- The dimensioning point (bivalence point) depends on the heating system and/or the heat source. The degree of coverage is, for example, 60%.
- The bivalent-alternative operating mode is selected if high flow and return temperatures are required or the heat flow from the heat source is only sufficient to a certain extent.

Heat Pump

Bivalent (3)

- Only one heat generator heats at a time, i.e. either the heat pump or the second heat generator.

- Since the annual coverage is relatively low compared to the other modes of operation, this mode of operation is rarely chosen today.

Heat Pump

Monoenergetic

- The monoenergetic mode of operation corresponds to the bivalent mode of operation in terms of behaviour.
- If necessary - i.e. on very cold days - an electric heating element supplements the heat pump.
- Since the heat pump and the heating rod use the same form of energy (electric current), this is referred to as monoenergetic.
- An electrical control system prevents the auxiliary heating from operating for longer than necessary. It can be assumed that no more than 5% of the annual heating energy required is generated by the heating rod.

Heat Pump

- Heat pumps can be classified according to the used heat source.
- The heat pump uses stored solar energy, which is available on site at any time - day or night, summer or winter.
- This solar energy can be drawn from three different sources: from the ground (geothermal energy), the groundwater or the air.
- Analogous to the three heat sources, a distinction is therefore made between brine/water, water/water and air/water heat pumps.

Heat Pump

Geothermal energy (1)

- Geothermal energy can be used either with vertical geothermal probes or horizontal geothermal collectors for a heat pump and thus for heating and hot water purposes.
- Both techniques make use of near-surface geothermal energy.
- A frost-proof working medium (brine, or in the case of the so-called "direct evaporators" the refrigerant of the heat pump directly), extracts energy from the ground, which is then brought to a higher temperature level by the heat pump.

Heat Pump

Geothermal energy (2)

- Geothermal probes are U-shaped plastic pipes that are vertically embedded in the ground via a bore hole.
- The advantages of this system are the small area required and their high efficiency, as from a depth of about 10 metres the temperature is almost constant throughout the year.
- The depth of the probe depends on the heat requirement and the thermal conductivity of the soil.
- For a new single-family home, it averages around 140 meters.

Heat Pump

Geothermal energy (3)

- Geothermal heat collectors work with a horizontal (or inclined/vertical) surface collector, a pipe system laid below the frost line (in practice this means at a depth of approximately 1 to 1.5 meters).
- The surface required for this must not be sealed or built over, as the ground must absorb the heat from rainwater and solar radiation.
- Nor should there be any deep-rooted plants.
- Because of the lower effort required, heat source development saves about half the cost compared to a geothermal probe.

Heat Pump

Geothermal energy (4)

- Regardless of with which system uses geothermal energy, in summer such a system is also very well suited for effective passive cooling, which additionally leads to a "regeneration" of the probe and in winter results in an even more efficient system due to the increased source temperature.

Heat Pump

Ground water (1)

- Groundwater is an optimal heat supplier and is often used as a heat source for heat pumps, provided that the conditions for using the water are met.
- Water is pumped up via a well, from which heat is extracted by the heat pump.
- The water is fed back into the groundwater via an absorption well.
- In summer, this technology can also be used for passive cooling in a very energy-saving way.

Heat Pump

Ground water (2)

- Heat pumps that extract heat from the groundwater achieve the best performance and performance figures, but are usually subject to approval.
- The contact points for water legislation and the licensing procedures under water law are usually the respective provincial governments.
- The water law itself is usually a federal matter.

Heat Pump

Outside air and exhaust air (1)

- Air exists in unlimited quantities and everywhere.
- Air as a heat source is very popular in new buildings as well as in renovation projects because the installation and investment costs of air heat pumps are low.
- Outside air as a heat source can be tapped extremely easily and almost anywhere - no drilling or permits are required.
- The air-to-water heat pump is particularly effective at high outside temperatures.

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Heat Pump

Outside air and exhaust air (2)

- This is ideal for domestic hot water preparation in summer or for the heat source exhaust air, which provides constantly high temperatures.
- Since the temperatures of the outside air are relatively low in winter - i.e. at times of greatest heating demand - an air source heat pump works slightly less efficiently than ground coupled systems and requires a little more drive energy.
- However, the lower construction costs save investment costs. Exhaust air is often used in pure domestic hot water heat pumps or for ventilation of living spaces. These variants are ideal additions to existing heating systems.

Heat Pump

Annual performance factor of a heat pump (1)

- The efficiency of a heat pump is expressed by the so-called "performance factor".
- This is the ratio between the heat output generated and the electrical drive energy.
- If this figure refers to a whole year, it is referred to as an “annual performance factor”.

Heat Pump

Annual performance factor of a heat pump (2)

- Depending on the heat source used and the application in new buildings or renovation, annual performance factors (APF) are between 3 and 4 or higher.
- An APF of 4 means that with 1 kWh of electrical energy to drive the heat pump, 4 kWh of usable heat is available.
- The environment thus provides 3 kWh of free heat.
- The higher the performance factor, the more efficient the system!

Heat Pump

Annual performance factor of a heat pump (3)

- There are various factors influencing the APF.
- The most important one is the temperature difference between the source (soil/ground water/air) and the heating system.
- The smaller the temperature difference, which the heat pump has to "compensate" for, the higher the annual performance factor.

Heat Pump

Annual performance factor of a heat pump (4)

- On the one hand, this can be achieved by keeping the source temperature as high as possible, for example by deeper drilling, less cooling of the ground or use of the groundwater.
- On the other hand, in heating systems, the temperature should be as low as possible - temperatures of up to 35 °C are typical for surface heating systems (floor or wall heating).
- Flow temperatures of 55 - 65 °C are also no problem, but at the expense of efficiency.

Heat Pump

Annual performance factor of a heat pump (5)

- Important for the efficiency of the overall system is the interaction of all components (development of the subsoil, optimal building services, low temperature difference).
- High efficiency can therefore only be achieved through careful planning and installation, as well as through heat pump-compatible operation without lowering.

Heat Pump

Coefficient of performance (COP) (1)

- In contrast to the annual performance factor, the coefficient of performance (COP) indicates how well the heat pump works at the optimum operating point, i.e. it is not measured over the whole year.
- The COP can only be measured under constant operating conditions - in the so-called "steady-state" - which is only possible in the laboratory.
- The COP is therefore a quality feature for a heat pump make or type, but has only limited information about the expected energy demand.

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Heat Pump

Coefficient of performance (COP) (2)

- A coefficient of performance of 5, for example, does not mean that you only have to supply one-fifth of the heating requirement in the form of electrical energy.
- The achievable annual performance factor will therefore always be lower than the coefficient of performance.
- There is also the so-called SCOP (Seasonal Coefficient of Performance) for heat pumps.

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Heat Pump

Coefficient of performance (COP) (2)

- The SCOP value can be seen as the Seasonal Coefficient of Performance (SCOP) in heating operation, but it represents the performance of a heat pump much more realistically and strikingly, since the performance measurement takes place at 4 different temperatures, weighted differently depending on the climate.
- This enables devices with modulating (adapting to demand) output to show their strength. Furthermore, standby losses and other energy, e.g. for a possibly existing heating element, are also taken into account.

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Heat Pump

Advantages of a heat pump:

- Low operating costs and future-proof supply security.
- Environmental friendliness, especially in comparison to conventional heat generators such as oil and gas.
- A high level of comfort, as they not only provide heating, but can also be used for cooling, domestic hot water preparation and in conjunction with controlled domestic ventilation.
- They are extremely low-maintenance.

Heat Pump

Advantages of a heat pump:

- Heat pumps are already prepared today for the legal and technical requirements of tomorrow and no longer need to worry about finite energy sources.
- Because the heat pump works independently of oil and gas, the question of the availability of these fuels no longer arises for heat pumps.
- Heat pumps therefore offer long-term security of supply.

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Heat Pump

Advantages of a heat pump:

- Heat pumps are usually used for heating and hot water preparation.
- It is also possible to use a heat pump exclusively for domestic hot water preparation, with a positive side effect:
  - a domestic hot water heat pump cools and dehumidifies the room in which it is installed.
- This is particularly beneficial in pantries, wine cellars or laundry rooms.

Heat Pump

Advantages of a heat pump:

- Hot water heat pumps are particularly suitable for combination with fossil heating systems.
- Heat pumps can be used for both active and passive cooling, although energy-saving passive cooling (also known as "silent" or "green" cooling) is only possible with ground-coupled systems.

Heat Pump

Advantages of a heat pump:

- To cool a building using the heat pump, no additional equipment is necessary.
- But the system must have a cooling function - so this should be taken into account at the planning stage.
- The extremely energy-saving passive cooling is a recommended option.
- As a rule, a room can be cooled down by around 5 °C.

Heat Pump

Advantages of a heat pump:

- A higher cooling capacity can only be achieved by active cooling.
- The heat pump principle is reversed, whereby the drive energy is used for cooling.
- A combination of active and passive cooling is also possible (e.g.):
  - if there is a lower cooling requirement, "silent energy-optimised" cooling can be used first and then, if the heat is very hot, there is the option of switching to active cooling.
  - Even with active cooling, no additional devices are required.
- If cooling is planned from the start, the additional costs are comparatively low.

Heat Pump

Advantages of a heat pump:

- In well-insulated houses, heat pumps can also be combined with controlled ventilation.

- Heat pumps use the waste heat from the exhaust air to generate heating and hot water with the help of additional drive energy.

Heat Pump

Advantages of a heat pump:

- The heat pump is also very well suited for combination with solar thermal or photovoltaic systems.
- Solar thermal energy can be used to support the heat pump in heating and hot water preparation.
- If the homeowner uses the electricity generated by a photovoltaic system himself, he receives an additional financial benefit - this is particularly interesting for heat pump owners.
- If the house owner generates the same amount of electricity via his photovoltaic system as he needs to drive his heat pump system, he heats practically CO_2-free.

Heat Pump

Advantages of a heat pump (summarized):

- Low operating costs
- Environmental friendliness
- High level of comfort
- No space required for boiler room or fuel storage
- Versatile: can heat, cool and prepare hot water
- Extremely low maintenance
- Flexible field of application (new construction / renovation)
- Long-term security of supply
- Domestic energy source
- No additional costs for fireplace
- Valuable contribution to the achievement of climate protection goals
- No fuel storage costs

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Energy from Wastewater

- Wastewater is usually produced in large quantities close to where energy is also required, i.e. where there are sufficient heat and cold consumers, such as in
  - Small and medium houses/flats
  - Small and medium sized enterprises
  - Public and governmental buildings
- In several research projects the technical and economic prerequisites for the use of wastewater energy and the possibilities for its integration into municipal energy systems were investigated.
- Some Use Cases and Examples are given in the following slides.

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Application Example/ Use Case (1)

Thermal use of wastewater energy:

- The objective of the project “Energy from Wastewater” was to analyze technical possibilities of energy recovery from wastewater by the means of heat pumps as well as potentials and legal framework conditions and thus to create the basis for a dissemination of this form of energy recovery in Austria.
- The investigations showed that the thermal utilization possibilities of WWTP effluent are significant for e.g.
  - Sludge drying
  - Heating of wastewater treatment plant operation buildings
  - Other buildings around the WWTP and in the vicinity of collection sewers
- Link: https://www.energy-innovation-austria.at/article/energie-aus-abwasser/

Application Example/ Use Case (1)

Thermal use of wastewater energy:

- Examples from around the globe demonstrated that when wastewater heat is used after the treatment plant, buildings located several kilometers away can be supplied with heat in an economic fashion.
- Thus, the utilization of thermal energy of wastewater may theoretically be used as a local heat supplier.
- However, whether or not thermal wastewater utilisation at a particular site is technically and economically feasible must be investigated in detail in each case.

Application Example/ Use Case (1)

Thermal use of wastewater energy:

- Within the scope of the research work, concepts and planning tools for municipal energy space planning were developed, e.g.
  - to determine whether surrounding buildings can be accessed by pipelines, or
  - to estimate how the heating and cooling demand of new development areas will develop.
- It was also analysed whether and how the heating & cooling demand around sewage treatment plants with new settlements that have a constant low temperature demand all year round (e.g. greenhouses, sports halls or indoor swimming pools) can be increased.

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Application Example/ Use Case (1)

Technology for wastewater utilization:

- The heating and cooling of wastewater can take place before or after the treatment plant or even in the building itself.
- The energy is extracted either from the sewer (untreated wastewater) or in the effluent of the treatment plant (treated wastewater).
- For large objects there is the possibility of direct use of the own wastewater via a collection shaft.
- The most important components of a wastewater energy system are the heat pump and the wastewater heat exchanger.

Application Example/ Use Case (1)

Technology for wastewater utilization:

- Energy and economy efficiency depend on the optimal coordination of these elements.
- A suitable wastewater heat exchanger, a heat pump with an optimized cooling circuit for the highest possible coefficients of performance and a heating and cooling system optimized for heat pump operation must be selected for the respective application.
- It is also important to optimize the temperature level already at the plant planning stage, as this also has a great influence on the efficiency of the entire plant.

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Application Example/ Use Case (1)

Technology for wastewater utilization:

"Sewage systems represent an ideal heat source for use with heat pumps. Energy from municipal wastewater could provide a total of 5% of the total heat demand of cities. The technology is proven and should be given a corresponding status in holistic energy planning." - Dipl.-Ing. ETH Karl Ochsner, CEO Ochsner Energie Technik GmbH

More information on the project can be found at:

- https://www.energy-innovation-austria.at/article/energie-aus-abwasser/
- http://www.abwasserenergie.at/

Application Example/ Use Case (2)

Energy from wastewater:

- Most of the thermal energy from hot water production in households and businesses currently goes unused into the sewer.
- The aim of this project is to investigate the possibility of heat recovery from wastewater using heat pumps in more detail and to establish it in Austria.
- In Switzerland and in Germany there are already many realized projects.
- According to studies, about 5% of buildings could be supplied with heat coming from wastewater utilization.
- Link: https://www.energyagency.at/projekte-forschung/energiewirtschaft-infrastruktur/detail/artikel/energie-aus-abwasser.html

Application Example/ Use Case (2)

Energy from wastewater:

- The heat pump itself is already widely used in Austria.
- A common problem with the heat sources used so far (especially air) is the low temperature during the main heating period.
- Wastewater has a temperature between 10 and 15°C all year round. This means that wastewater is an optimal heat source for a heat pump:
  - higher annual performance factors can be achieved, or higher flow temperatures can be realized with the same efficiency.
- The use of wastewater heat closes the only heat leakage that is normally ignored even in low-energy and passive house construction.

Application Example/ Use Case (2)

Prerequisites for wastewater heat utilization:

- In order for wastewater heat utilization to be applicable, the channels and the consumers must fulfil certain conditions.
- This type of heating is particularly suitable for areas with a high population density because the transport distances are shorter to achieve a certain reduction in output (lower investment costs, less heat loss).
- Further conditions for the realization of a waste water heat recovery plant are the proximity to a sufficiently large sewer pipe (800 mm diameter), a dry weather flow of at least 15 l/s (the more, the more continuous the waste water flow) and the use of low-temperature heating systems in the objects to be heated.

Application Example/ Use Case (2)

Prerequisites for wastewater heat utilization:

- This type of heating is economically sensible, especially for larger objects, or a block heating for several individual objects is also conceivable.
- Particularly favourable economic conditions always arise where investments in sewerage systems, building heating, etc. are necessary anyway or in new buildings.
- As is very often the case when using renewable energy sources, one has to deal with comparatively high initial costs and low operating costs.
- The heat pump output should not fall below 100 kW, as high investment costs are incurred, some of which do not depend on the size of the system, or hardly at all.

Application Example/ Use Case (2)

Further possibilities of wastewater energy utilization:

- Cooling by means of wastewater is also a possibility that is being investigated in the project. A particularly energy-saving variant of cooling is so-called free cooling:
  - If the wastewater temperature is sufficiently below the desired cooling temperature, it is sufficient to let the heat medium circulate without a heat pump and heat energy is transported out of the building due to the natural heat gradient.
- For some purposes feeding into a district heating network is also possible.

Application Example/ Use Case (3)

Heating Technology - This company generates energy from wastewater:

- The Baden-Württemberg company “Uhrig” has dedicated itself entirely to sewerage systems.
- With a new technology, Uhrig now generates energy from wastewater.
- To be precise: thermal energy.
- Link: https://hlk.co.at/a/dieses-unternehmen-gewinnt-energie-aus-abwasser

Application Example/ Use Case (3)

Thermal energy from wastewater:

- At Uhrig wastewater is used as a thermal energy source for heat pumps.
- *"We look at properties to see if there is a sewer nearby that is suitable for heat recovery from wastewater. The crucial question is whether the canal is large enough and flows through the required minimum volume of wastewater."* – Stephan von Bothmer
- The wastewater has a temperature of seven to twelve degrees. Uhrig has developed a wastewater heat exchanger that can be individually adapted to the size of the sewer.

Application Example/ Use Case (3)

Thermal energy from wastewater:

- *"Roughly speaking, the Therm-Liner consists of two stainless steel elements that are fixed to the bottom of the channel. The heat energy from the wastewater is then transferred via the heat exchanger to a transport medium, in our case water. This heated water is then directed to the heat pump in the house,"* says von Bothmer.
- Due to the preheated water, the heat pump requires considerably less energy for heat generation. Thus, not only is an otherwise wasted thermal source used, but the customer also saves electricity and energy costs.

Application Example/ Use Case (3)

Thermal energy from wastewater:

- *With air heat pumps, considerably more energy is required to bring the cold outside air up to temperature. In principle, geothermal energy provides good heat energy, but the associated drilling is very complex and also expensive,"* explains the expert.

- Moreover, the wastewater potential is large, as a study by enervis energy advisors shows. Around 14 percent of the heating requirements of German buildings could be covered by energy from wastewater. This corresponds to about 100 terawatt hours per year.

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Application Example/ Use Case (3)

Bureaucracy stands in the way:

- However, the installation of the Uhrig heat exchanger is not entirely uncomplicated - at least not when it comes to permits.
- *"Much will depend on the willingness of the sewer system operators We try to make it clear to them that they should make the heat available and thus generate added value from it. But ultimately the decision is up to them,"* says Stephan von Bothmer.
- However, Uhrig has already received the necessary permits in most major German cities and some smaller towns.

Application Example/ Use Case (3)

Bureaucracy stands in the way:

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- However, Uhrig has already received the necessary permits in most major German cities and some smaller towns.

Application Example/ Use Case (3)

Bureaucracy stands in the way:

- The company was also already active in Austria.
- *"We have installed a heat exchanger near the administrative buildings of the sewer network operators in Innsbruck and Vienna. This allows the companies to see the system for themselves,"* says von Bothmer.
- For the sewer network operators, heat recovery brings a decisive advantage: money
- Since the network operators must disclose in advance which sewers are suitable for heat recovery, they receive a small fee for each heat exchanger installed in return.

Application Example/ Use Case (3)

Bureaucracy stands in the way:

- *"With one or two devices, it doesn't make much difference yet, but with more than 100 devices, the cooperation will pay off very quickly for the network operators,"* says Stephan von Bothmer. The Therm-Liner does not impair the flow of water.
- There is no reduction in cross-section and the stainless steel can remain in the sewer for around 50 years without hesitation. Even cleaning work is not disturbed by the stainless-steel elements.
- Since the heat exchanger is a physical and not an electronic principle, the heat exchanger requires very little effort.

Application Example/ Use Case (3)

For public and private buildings:

- The Therm-Liner can not only be used for administrative buildings or other public real estate, but is also applied in the private sector.
- *"If, for example, several single-family homes are grouped together in a neighbourhood, they too can use the heat from the wastewater. From 20 kilowatts upwards, there are no limits,"* explains von Bothmer.
- It is important to note that the system does not use the wastewater from a single house, but is installed in the next larger sewer.

Application Example/ Use Case (3)

For public and private buildings:

- This is where dirty water and rainwater from several sources converge, making it worthwhile to operate the heat exchanger even if individual households are empty for some time.

- *"If a suitable sewer is no more than 900 meters away, the Therm-Liner can be installed without any problems,"* adds Stephan von Bothmer.

Application Example/ Use Case (4)

Powerstep: Full-scale demonstration of energy positive sewage treatment plant concepts towards market penetration:

- POWERSTEP aims for a full-scale demonstration of energy positive sewage treatment plant concepts towards market penetration.
- We look at converting sewage treatment plants (STEPs) into power production facilities (POWER).
- **Link:** http://www.powerstep.eu/at-a-glance-0

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Application Example/ Use Case (4)

Powerstep:

- Municipal wastewater in Europe contains a potential chemical energy of 87,500 GWh per year in its organic fraction, which is equivalent to 12 large power stations!
- Due to the currently applied technologies and related energy loss at each process step, wastewater treatment in Europe consumes instead the equivalent of more than 2 power stations.
- While many operators are targeting incremental energy efficiency towards energy neutrality, recent studies have shown that with novel process schemes sewage treatment plants could actually become a new source of renewable energy, this without compromising the treatment performance.

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Application Example/ Use Case (4)

Powerstep:

- Shifting wastewater treatment plants (WWTPs) technology means increasing regions' and cities' energy production capacity.
- Today, about 1% of the EU electricity demand is consumed by WWTPs.
- This accounts typically for the largest part of the municipality energy bill while municipal wastewater contains a potential chemical energy of 87,500 GWh/year in its organic fraction (equivalent to the output of 12 large power stations).

Application Example/ Use Case (4)

Powerstep:

- In the European context of Energy efficiency for better competitiveness and enviromental protection, **POWERSTEP aims for a real paradigm shift in the wastewater treatment industry**.

- Thanks to 6 full-scale case studies located in 4 European countries our consortium will merge treatment scheme modelling and design, global energy and heat management, carbon foot-printing, integrated design options, POWERSTEP aims to demonstrate through a first full scale reference each essential process step to design an energy positive wastewater treatment plan - with the currently available technologies
- Case studies: http://www.powerstep.eu/

Application Example/ Use Case

Further Information to the application examples can be found at:

- https://www.klimaundenergiemodellregionen.at/service/newsletter/newsletter-032015/energie-aus-abwasser/
- http://www.abwasserenergie.at/fileadmin/energie_aus_abwasser/downloads/Broschuere-Energie-aus-Abwasser.pdf
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Application Example/ Use Case

Further papers, brochures and information on this topic:

Sustainable biogas production in municipal wastewater treatment plants:

- https://nachhaltigwirtschaften.at/resources/iea_pdf/reports/iea_bioenergy_task37_wastewater_biogas_grey.pdf

Renewable energy from wastewater - Practical aspects of integrating a wastewater treatment plant into local energy supply concepts:

- https://www.researchgate.net/publication/307939326_Renewable_energy_from_wastewater_-_Practical_aspects_of_integrating_a_wastewater_treatment_plant_into_local_energy_supply_concepts

Reclaiming green energy from wastewater treatment plants

- https://www.globalwaterintel.com/sponsored-content/reclaiming-green-energy-from-wastewater-treatment-plants-evoqua

Stanford researchers develop technology to harness energy from mixing of freshwater and seawater

- https://news.stanford.edu/2019/07/29/generating-energy-wastewater/

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Summary Application Example/ Use Cases

Looking at the use cases, several factors can be observed:

- Utilizing heat/energy from wastewater is already applied.
- It can be applied to various areas.
- It has economic and environmental advantages.
- It has potential that can and should be utilized in various scales.

Summary

- Energy Management
- Waste Utilization
- Wastewater Utilization
- Heat Pumps
- Application Examples/ Use Cases

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Module IV - Practical Application and Utilization

Content

- Recap
  - Module I - Introduction to the Topic of Energy Generation
  - Module II - Basics about Wastewater and Waste
  - Module III - Energy Generation from Wastewater and Waste
- Instruction for the Seminar Paper

Module IV - Practical Application and Utilization

Recap: Modul I - Introduction to the Topic of Energy Generation

- Energy
- Energy Types/ Sources
- Energy Management
- European and national energy plans
- Environment and Systems

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Recap – Module I

- **Energy is the quantitative property that must be transferred to an object in order to perform work on, or to heat the object.**

- Energy exists in different forms of energy that can be converted into each other.

- **Examples of forms of energy:**
  - Potential
  - Kinetic
  - Electrical
  - Chemical
  - Thermal

- **Examples of conversions of energy:**
  - A person lifting a box
  - A person accelerating a bicycle
  - Charging a battery
  - The metabolism
  - A heater giving off heat
  - etc.

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Recap – Module I

- **Energy Types**:
  - **Potential**
  - **Kinetic**
  - **Electrical**
  - **Chemical**
  - **Thermal**

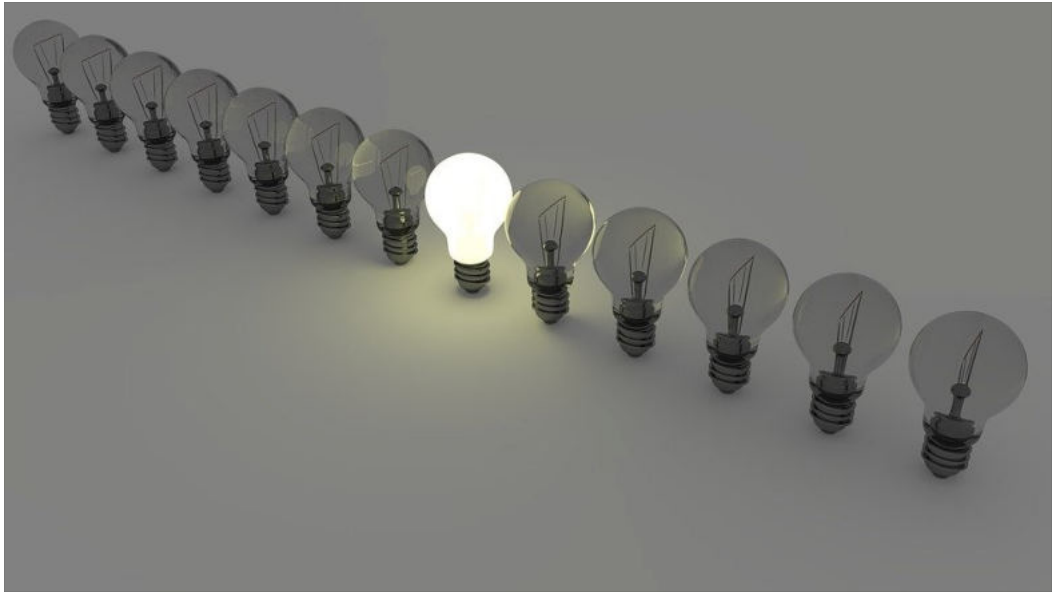

Photo by ColN00B on Pixabay

Recap – Module I

- Energy sources:
  - Solar
  - Wind
  - Hydrogen
  - Geothermal
  - Tidal
  - Wave
  - Hydroelectric
  - Biomass
  - Nuclear
  - Fossil

Photo by ybernardi at Pixabay

Recap – Module I

- Energy management is about **planning and operation of energy-related generation and consumption** units.

- Energy management can (and should) **be applied on many different levels** from state level to regional level as well as in individual companies

Recap – Module I

- Application areas of Energy Management in cooperate functions are:
  - Facility Management
  - Energy Procurement
  - Production
  - Maintenance
  - Information Technology
  - Logistics
  - Production planning and control

Photo by Metthew Henry at Unsplash

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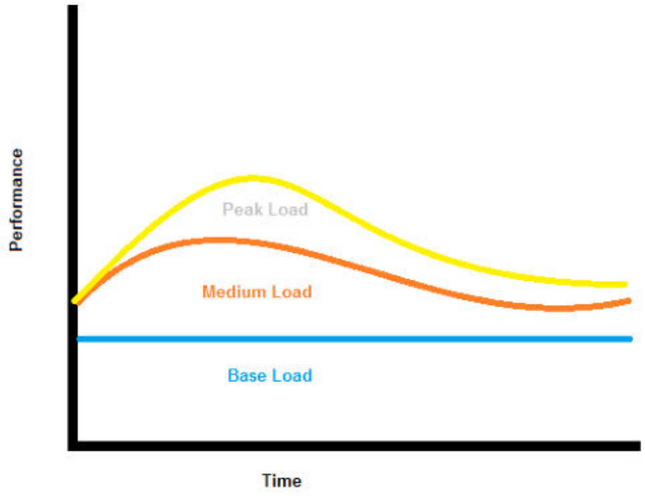
Recap – Module I

Base, medium and peak load:



Recap – Module I

- **EU law:**

The EU is legally above the nation states. They are above regional legislation, which is above local legislation.

EU
↓
National
↓
Regional
↓
Local

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Recap – Module I

- **Directorate-General ENER**

This Commission department is **responsible for the EU's energy policy**: **secure, sustainable, and competitively priced energy** for Europe.

- **Policy**

To **ensure a reliable supply of energy** and to **keep prices affordable**, the European Union aims to build a more integrated, competitive European energy market (energy union).

The EU also **supports energy from renewable sources** and the efficient use of energy, both of which help to cut greenhouse emissions.

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Recap – Module I

The European climate and energy framework for 2030 and the legislative packages of the European Union for an energy union are of **key strategic significance for the future direction of European and national climate and energy policies**, and thus for the successful implementation of the energy reforms.

Link: 2030 Climate & Energy Framework

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Recap – Module I

The European Council concluded on 19 March 2015 that the EU is committed to building an Energy Union with a **forward-looking climate policy** on the basis of the Commission's framework strategy, with five priority dimensions:

1. Energy security, solidarity and trust.
2. A fully integrated European energy market.
3. Energy efficiency contributing to moderation of demand.
4. Decarbonising the economy.
5. Research, innovation and competitiveness.

Recap – Module I

The EU aims to be **climate-neutral by 2050** – an economy with **net-zero greenhouse gas emissions**. This objective is at the heart of the European Green Deal and in line with the EU's commitment to global climate action under the Paris Agreement.

The transition to a climate-neutral society **is both** an **urgent challenge** and an **opportunity** to build a better future for all.

LINK: https://ec.europa.eu/clima/policies/strategies/2050

Recap – Module I

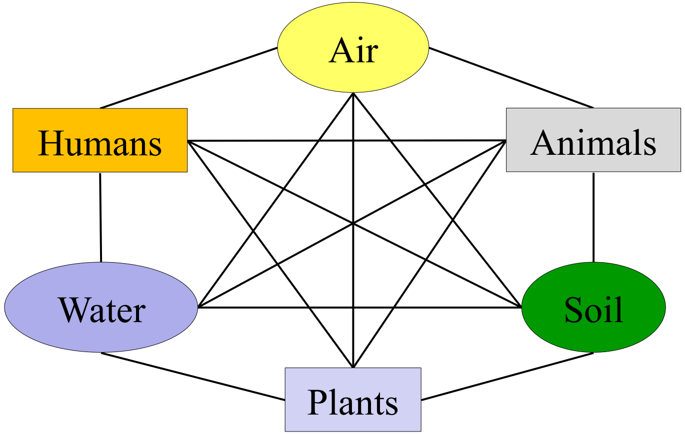
National Strategies

EU Member States are required to develop national long-term strategies on how they plan to achieve the greenhouse gas emissions reductions needed to meet their commitments under the Paris Agreement and EU objectives.

- Link: https://ec.europa.eu/info/energy-climate-change-environment/overall-targets/long-term-strategies_en

Recap – Module I

Environment

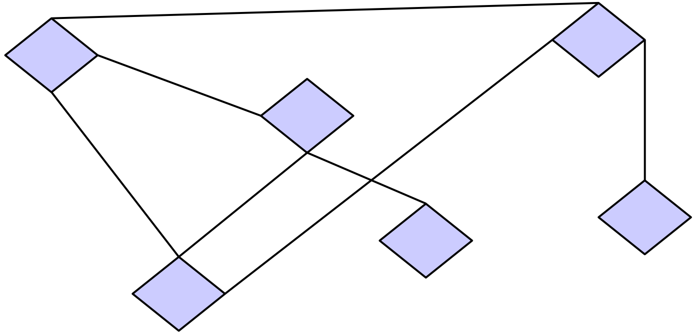


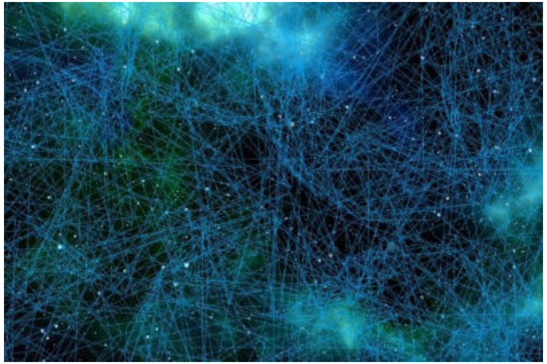
Note: in the biosphere everything is connected

Recap – Module I

- **What is a System?**

A system is a delimited arrangement of parts (components) that interact with each other.





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Module IV - Practical Application and Utilization

Recap: Module II - Basics about Wastewater and Waste

- Environment (Pollution, Awareness)
- Solid Waste
- Liquid Waste
- Wastewater
- Waste Management

Recap: Module II

Environmental Pollution

- Environmental pollution is defined as the totality of all disturbing environmental factors.

- Terms such as **environmental stress** or **environmental impact** are used when **no clear negative effect** on the environment is expected from a pollution.

- If it is a pollution of nature by intrusion of substances, one often speaks (in the narrower sense) of **environmental pollution**.

Recap: Module II

Environmental Pollution

Causes of environmental pollution:

- Pollution from industry:
  - Chemical industry
  - Paper Industry
  - Steelworks

Photo by JuergenPM at Pixabay

- Environmental impacts of agricultural use:
  - Fertilizers
  - Insect repellents
  - ...

Recap: Module II

Occupational health and safety is an area of environmental protection which should not be neglected and which plays a considerable role mainly in industrial environmental protection.

Recap: Module II

Solid waste

Waste collected from residences, commercial buildings, hospitals, schools, universities, offices, light industrial operations etc. is usually considered as **municipal solid waste**.

Municipal Solid Waste **mainly consists of**:

- Paper, Containers and packaging (plastic, glass and metal), Food/Bio waste, Yard trimmings, Textiles, Other Inorganic Waste

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Recap: Module II

Solid waste

Depending on the country municipal solid waste can also include industrial sludge, classified as hazardous or non-hazardous, resulting from a wide array of mining, construction, and manufacturing processes.

Moreover, **substantial amounts** of household waste is **classified as hazardous**.

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Recap: Module II

Liquid Waste

Fluid wastes, consisting of sewage and domestic wastewater, or processed water, or other liquids, produced by industrial activity, particularly by such industries as pulp and paper production, food processing, and the manufacture of chemicals.[1]

Liquid waste can also be defined as such liquids:[2]

- Wastewater
- Fats, oils, grease
- Used oil
- Liquids, solids, gases, or sludges and hazardous household liquids

Recap: Module II

Liquid Waste

Liquids that are hazardous or potentially harmful to human health or the environment. They can also be discarded commercial products classified as “Liquid Industrial Waste” such as cleaning fluids or pesticides, or the by-products of manufacturing processes.

Liquid waste can therefore be classified as **wastewater**!

Recap: Module II

Wastewater

Wastewater is a **generic term.** Depending on the country the definition of wastewater varies. The EU defines wastewater as:

- **Domestic wastewater:** Wastewater from residential settlements and services which originates predominantly from the human metabolism and from household activities
- **Industrial wastewater:** Any wastewater which is discharged from premises used for carrying on any trade or industry, other than domestic wastewater and run-off rain water

Link: https://ec.europa.eu/environment/water/water-urbanwaste/info/glossary_en.htm

Recap: Module II

Waste is raw material in the wrong place!

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Recap: Module II

- Waste management (or waste disposal) include the **activities and actions required to manage waste** from its inception to its final disposal.

- Waste management includes **collection, transport, treatment and disposal** of waste and waste products (garbage, sewage, etc.), as well as monitoring and regulation of the waste management process.

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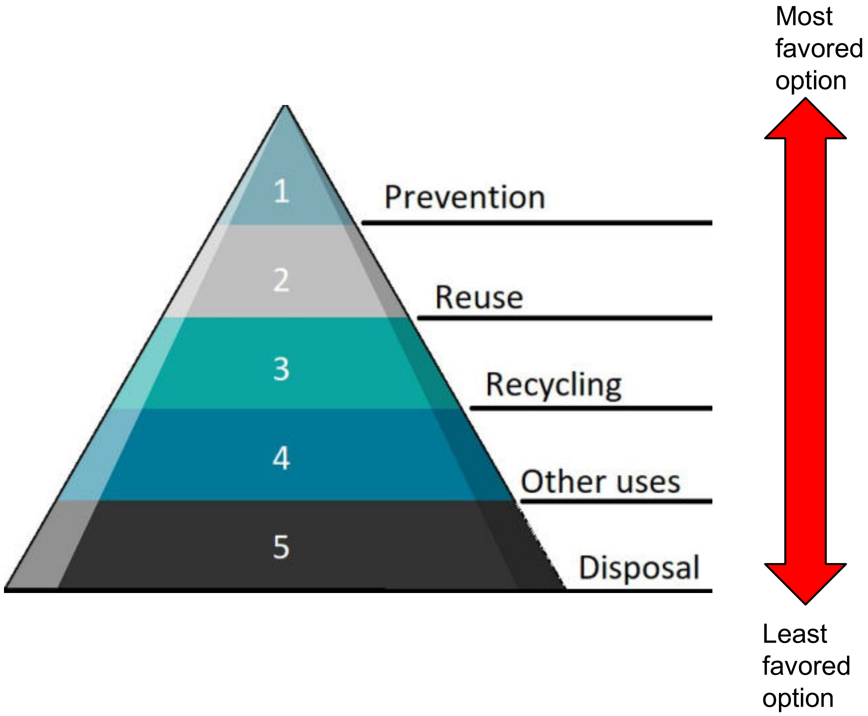
Recap: Module II

- Waste management is **intended to reduce adverse effects of waste** on human health, the environment or aesthetics.
- Waste management practices **are not uniform** among countries, regions, residential and industrial sectors.
- A large portion of waste management practices deal with municipal solid waste which is the bulk of the **waste** that is **created by household, industrial, and commercial activity**.

Recap: Module II

The new waste hierarchy should now look as follows :

- Prevention,
- Preparation for reuse,
- Recycling,
- Other recovery (e.g. energy recovery)
- Disposal



Note: In some waste hierarchies the step “minimization” is included between “Prevention” and “reuse”.

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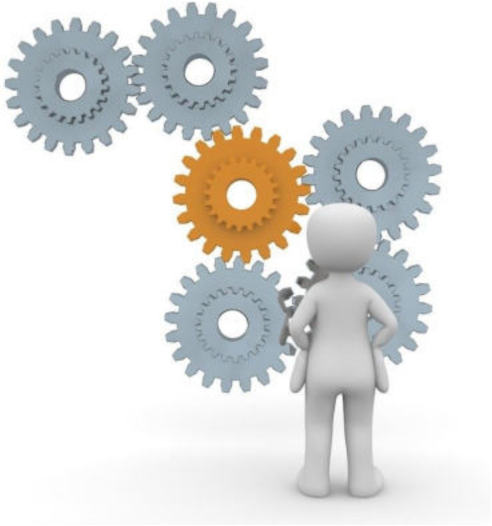
Module IV - Practical Application and Utilization

Recap: Modul III - Energy Generation from Wastewater and Waste

- Energy Management
- Waste Utilization
- Wastewater Utilization
- Heat Pumps
- Application Examples/ Use Cases

Energy Management

- Fundamental considerations for energy management:
  - To ensure the security of energy supply (e.g. uninterrupted energy supply)
  - To ensure economic electricity and heat prices (e.g. avoiding to high fluctuations)



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Energy Management

- Application areas of Energy Management are:
  - Commercial and industrial energy management in production and logistics (small, medium and large sized)
  - Energy management for residential construction and of residential buildings

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Recap: Module III

- Utilizing waste as “energy supply” is usually referred to as:
  - **Waste-to-energy** (WtE), or
  - **Energy-from-waste** (EfW)

- WtE is the process of generating energy in the form of electricity and/or heat from the **primary treatment** or the **processing of waste** into a fuel source.

- As products and materials already had an energy input in some form to become waste, waste-to-energy is considered as a **form of energy recovery**.

Recap: Module III

There are **several methods** used globally to turn waste into energy:

- The most common one is **incineration** (or **combustion**) of waste.
- Other methods include:
  - **Thermal technologies**
    - Gasification
    - Pyrolysis
    - etc.
  - **Non-thermal technologies**
    - Anaerobic digestion
    - Fermentation
    - etc.

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Recap: Module III

- The energy content in wastewater from households, trade and industry is considerable.
- However, in Member States of the EU including Austria, wastewater is hardly used and not really seen as a viable energy source.
- An example for this is with wastewater treatment plants (WWTP). Their main function is to remove contamination from wastewater. However, research suggests that it can serve as a source of energy internally in the WWTP and also externally in infrastructure.
- Results show that the amount of thermal energy available in WWTP exceeds the internal demands of the WWTP.

Recap: Module III

- A general approach that does not require a WWTP but might also be utilized in small or private facilities would be to use heat exchangers in order to extract thermal energy contained in wastewater.
- Subsequently, heat pumps can be used to bring it to the required temperature level, e.g. for heating or cooling purposes.
- All year wastewater temperatures are around or above 10°C.
- Therefore, it is optimally suited for the use of heat pumps as this corresponds roughly to the annual average heat of groundwater (12 °C) which is also utilized with heat pump technology.

Recap: Module III

How can heat be utilized/ extracted/ transferred from wastewater?

It can be recovered …

- in buildings from, e.g. raw wastewater
- from sewers, e.g. from raw wastewater
- Or in a sewage treatment plant, e.g. from the treated wastewater

This wastewater heat utilization can have effects on sewer systems and the sewage treatment plants.

Recap: Module III

- Heat pump technology is one of the most environmentally friendly methods of heating and hot water preparation.
- It reduces climate-damaging CO_2 emissions and energy consumption.
- It requires hardly any maintenance and, with correct planning and optimum operation, provides many times the electrical drive power used in terms of thermal energy.

Recap: Module III

- The most common design of a heat pump involves four main components:
  - a condenser
  - an expansion valve
  - an evaporator
  - a compressor

- The heat transfer medium circulated through these components is called refrigerant.

Recap: Module III

Heat pumps have different operating modes:

- **Monovalent**
- **Bivalent**
- **Monoenergetic**

Module IV - Practical Application and Utilization

Instruction for the Seminar Paper

- Every participant investigates his/her company and writes a seminar paper.
- This paper and its findings are presented in a short presentation (15 – 30 minutes) on the last day of this course.
- The paper is conducted in self study with support of the trainer
  - E.g. e-mail or via the online tool.

Module IV - Practical Application and Utilization

Instruction for the Seminar Paper

Requirements for the paper:

- **Length between 20 and 30 pages** (excluding title and content page)
- **Short description of the company** (size, main business)
  - Including a space and cost analysis
- **Usage/Consumption of Energy** (including type of energy)
- **Usage/Consumption of Waste and/or Wastewater**
- **Potentials for technologies/types of Waste and/or Wastewater Utilization**

Deadline: XXX

Module IV - Practical Application and Utilization

Instruction for the Seminar Paper

Requirements for the paper:

- **Font/size:** Arial, 11 pt., 1.5 Linespacing
- **Sources:** Everything available
  - E.g. Internet, Books, Papers, Interviews, Colleagues, etc.
  - Module I – III Slides.

- **Support:** The Trainer will be available once/twice a week where he/she will answer questions send via the request tool in the online tool or via e-mail.

Module IV - Practical Application and Utilization

Instruction for the Seminar Paper

Presentation:

- **PowerPoint** (or similar tool) **presentation**
- **15 to 30 Minutes long**
- **15 Minutes for feedback of other participants**

- **Support:** The Trainer will be available once/twice a week where he/she will answer questions send via the request tool in the online tool or via e-mail.

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Module IV - Practical Application and Utilization

Evaluation

The trainer will grade your paper and your presentation.

Your grade will be based on the combined grade

If you are successful you will receive a diploma for the successful participation in this course.

Module IV - Practical Application and Utilization

Good Luck to you!

Contact information:

XXX