Result 4.5

Concept, curricula and teaching materials "Energy Consultant" training program

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Summary of the Project and Introduction

The word *region* is defined as “an area, especially part of a country or the world having definable characteristics but not always fixed boundaries”[1]. The Baltic Sea region (BSR) is particularly unique. While the Baltic Sea is the pivotal point defining much of the region’s characteristics and challenges, the countries are also extremely different. Geographically, they are divided between Northern, Western and Central/Eastern Europe, historically, they have been shaped by the East-West divide after the second world war. Nevertheless, given their proximity to the Baltic Sea, they have much in common.

The EU has acknowledged this by issuing the very first macro-regional strategy, the EU Baltic Sea Region Strategy in 2009. As most countries boarding the Baltic Sea were by then EU member states, it can well be considered the EU’s inland sea. The challenges, such as saving the sea, i.e. ensuring clear water, rich and healthy wildlife as well as clean and safe shipping, and the opportunities for a prosperous region through cooperation measures to increase innovation, deepen the single market by improving transportation systems, connecting energy markets and fighting trans-border crime together, make the region very distinct from other parts of the world. Therefore, “BSR integration is best understood as the way that European integration has been translated into this region, further deepening and leveraging access to the rest of Europe and the markets that the EU provides”[2]

Over the past 25 years, this region has become a densely integrated, e.g. in the areas of trade, investment, labor mobility, transport and energy infrastructure as well as research collaboration. Furthermore, it demonstrates a broad landscape of robust cross-border organizations and collaborative efforts. Nevertheless, “companies do not look at the Baltic Sea Region as one integrated market in terms of their strategies. For most of them, the region remains a group of individually small markets within the EU, each with its different dynamics, rivals, and often even regulatory rules’”[3].

Keeping this in mind, the lack of comprehensive regional data collection is surprising. Therefore, as part of the Erasmus+ funded project “Promoting permeability through dual bachelor's programs with integrated initial and further vocational training” (BA&VET), an analysis of the region’s demography, economy, and labour as well as education market has been conducted. The majority of the data is taken from the Eurostat database of the European Union. When needed additional sources, such as the OECD database have been consulted as well.

Project summary

Objectives: What do you want to achieve by implementing the project?

- Increasing permeability between vocational and higher education
- Recruiting universities for tasks of further education in climate and environ-mental protection
- Providing excellently qualified entrepreneurs, managers and skilled workers and reducing the shortage of skilled workers to meet the challenges in climate and environmental protection
- Strengthening the productivity of SMEs through innovation support and R&D projects
- Promoting cooperation between SMEs and colleges/universities

Implementation: What activities are you going to implement?

- Analyses economy, education and labour markets and qualification needs
- Creation of solution models for 4 project countries
- Development and implementation of Train the Trainer program

[1] Oxford Dictionary
[2] Skilling, David (2018). *The Baltic Sea Economies: Progress and Priorities*. Copenhagen: Baltic Development Forum, p.10.
[3] Ibid., p.11

- Development and implementation of 2 dual three-stage Bachelor's degree programs and 2 further trainings
- Implementation of R&D projects in SMEs
- Quality assurance for training measures and project implementation
- Dissemination, transfer of results and implementation consultation

Results: What project results and other outcomes do you expect your project to have?

- Result report of the analyses of the economy, education and labour markets and qualification needs
- Solution models for four project countries
- Complete train-the-trainer program
- Module manuals with all documentation for two dual three-stage Bachelor's programs in climate and environmental protection
- Two further education programs in climate and environmental protection
- R&D projects implemented in SMEs
- Quality manual and results reports
- Manual, result videos and broad regional transfer of results

Objectives, results and target groups

The main objectives of the project are as follows:

a) Increasing the permeability between vocational education and training and higher education and thus promoting the attractiveness of vocational education and training

b) Strengthening the recruitment of colleges/universities for the important tasks of continuing education in climate and environmental protection

c) Providing highly qualified entrepreneurs, managers and skilled workers who, in addition to good theoretical knowledge, also have practical competences, skills and professional experience in climate and environmental protection and reducing the shortage of skilled workers to cope with the very large tasks in the energy, climate and environmental sector.

d) Attracting entrepreneurs and executives who have all the skills to successfully run a company and perform high-quality tasks in climate and environmental protection

e) Strengthening the productivity and competitiveness of enterprises through knowledge and technology transfer, promotion of innovation and implementation of manageable R&D projects

f) promoting cooperation between SMEs and colleges/universities, strengthening colleges/universities to implement dual courses of study on climate and environmental protection, and promoting entrepreneurship in higher education.

In pursuit of these objectives, the following results will be achieved:

1. Analysis results on the economy, demography, education and labour markets as well as qualification needs in climate and environmental protection

2. Curriculum. Teaching materials, implementation report and evaluation concept and report for teacher training

Module handbook with integrated continuing education, teaching materials, examination regulations, implementation reports as well as evaluation concept and reports for a three-stage dual Bachelor's degree program:

3. Business Administration and Sustainable Management for SMEs

4. Management of Renewable Energy Technology in Buildings

5. Concept for promoting innovation by SMEs and evaluation concept and report

6. R&D projects carried out for SMEs

7. Concepts and report for the evaluation and quality assurance of qualifications and R&D subsidies as well as project implementation, transfer of results, implementations and implementation consultations

The primary target groups of the project are:

a) school leavers who wish to combine vocational education and training with a bachelor's degree and thus receive excellent employment and professional career opportunities.

b) students who are qualified in higher education and university and at the same time in a company and who are highly welcome in SMEs as managers and professionals or as independent entrepreneurs.

c) owners, managers and specialists of SMEs who are qualified in continuing vocational training, acquire tailor-made competences and skills for high-quality activities in climate and environmental protection and achieve a recognized continuing vocational qualification.

d) SMEs that attract suitably qualified young entrepreneurs, managers and specialists, receive innovation funding and carry out R&D projects together with colleges/universities.

The project addresses the following secondary target groups (beneficiaries):

a) colleges and universities which, in order to expand their educational opportunities in climate and environmental protection, receive all the documents and materials for two new dual bachelor's degree programs in order to meet the labour market needs and the conditions of SMEs in particular.

b) chambers and other vocational training institutions which attract strong young people to vocational training, receive curricula for continuing vocational training modules for the qualification of SMEs and their staff, and cooperate intensively with col-leges/universities in teaching and innovation promotion.

c) teachers, advisers and lecturers from chambers, other VET providers and colleges/universities who are qualified in Train the Trainer programs to provide high-quality further training, to carry out dual study courses in cooperation with companies as well as innovation promotion and R&D projects for SMEs at a high-quality level.

About the further Training “Energy Consultant / Energy Service Manager”

A further training program “Energy Consultant” was developed. This training was originally called “Energy Service Manager”. However, as part of the development work, the project consortium decided to give this training the title “Energy Consultant”.

This further training program was integrated into the trial Bachelor's degree course “Engineering in Management of Renewable Energy Technology in Buildings” (see Result 4.1), but is also carried out independently of the degree course as further training for owners, managers and specialists of SMEs. As part of the project, the most important modules of the continuing education program were tested and evaluated in practice and the continuing education program was finalized on the basis of the evaluation results.

FResult 4.4 Concept, curricula and teaching materials further training program "Energy Service Manager/Energy Consultant" comprises the completed further training program, which will be carried out regularly by individual project partners in the future.

The report on the practical testing, the evaluation concept and the evaluation report as well as the number of participating SMEs and qualified persons are shown as Results 4.5 Evaluation concept and reports training program “Energy Service Manager/Energy Consultant” and prospects of further implementing

Curriculum Energy consultant

Satakunta University of Applied Sciences (SAMK), PP2

Compiled by Dr Kari Lilja and Dr Sirpa Sandelin

Introduction

The climate change, lack of fossil combustibles, and pollution, particularly in the form of the greenhouse gas emissions, and the increasing use of renewable energy and improved energy efficiency as solutions to reach the climate goals of Agenda 2030 of UN, as well as goals of respective Agenda of EU, have been topics of discourse for years. In the beginning of 2022, the Russian attack to Ukraine has brough the dependency of EU on Russian energy products – gas, oil, coal, and electricity – as an emerging topic of European energy discourse. In the spring 2022, the European Commission, as a response to the hardships and global energy market disruption caused by Ukrainian war, launched REPowerEU programme. This programme supports activities aiming to save energy, to produce clean energy, and to diversify energy supplies of the European Union (European Commission, 2023).

In addition to REPowerEU -programme, European Commission has in December 2021 launched a proposal for revision of the Energy Performance of Buildings Directive. This revision has not yet taken effect, thus, the revision 2018 of the directive is still valid. (European Commission, 2023a). In July 2021, the European Commission launched a proposal to renew Energy efficiency Directive, as part of the 'Fit for 55' package. This proposal was supplemented by an additional proposal as part of the REPowerEU plan in May 2022. (European Commission, 2023b). The revised directive took effect in 20th September 2023.

The updated energy efficiency directive aims to establish legally binding goal to reduce the final energy consumption by 11.7% by 2030 compared to the 2020 reference scenario. This includes for each member Sof the European Union the requirement to define indicative national contribution based on objective criteria which reflects national circumstances. If the national contributions do not match to the EU target, an ambition gap mechanism is applied by the Commission. Each country should also increase annual energy savings step by step from 0.8 per cent (at present) to 1.3 per cent (2024-2025), then 1.5 per cent (2026-2027) and 1.9 per cent from 2028 onwards. This means an average of 1.49 per cent of new annual savings during the period from 2024 till 2030. When planning the savings and activities, vulnerable customers and social housing should be prioritised within the scope of their energy savings measures. In addition to this, an annual energy consumption reduction goal of 1.9% for the public sector should be introduced, including the obligatory annual 3% buildings renovation duty extended to all the levels of public administration. Directive also introduces a new approach, based on energy consumption, for business to have an energy management system or to carry out energy audits. Furthermore, a new obligation to monitor the energy performance of data centres, with an EU-level database collecting and publishing data, has been launched. Municipalities are enhanced to promote local heating and cooling plans, particularly in larger municipalities, and to increase the efficient energy use in heat and cold supply, also in district heating and cooling systems. (European Commission, 2023b).

As a part of the *Clean energy for all Europeans* package, that aims to help EU meet the emissions reduction commitments stated in the Paris Agreement, the Renewable Energy Directive (2018/2001/EU) took effect in December 2018. The directive, that has been legally binding since June 2021, sets an overall European renewable energy target of 32 per cent by 2030. The directive also contains rules to ensure the use of renewable energy in the transport sector, and in heating and cooling. Common principles and rules for renewable energy support schemes, sustainability criteria for biomass and the right to produce and consume renewable energy and to establish renewable energy communities are set in the directive that, in addition to those, includes rules to remove barriers, to increase investments and to achieve cost reductions in renewable energy technologies, and to empower private citizens and organizations to participate in the move towards clean energy. Due to the Ukrainian war and attempts to break away from dependence on Russian energy, and on fossil combustibles, the Commission has on 2022 proposed to raise the target to 45 per cent by 2030.

On 30 March 2023, a temporary agreement to raise the target to at least 42.5 per cent by 2030 but aiming for 45 per cent was reached. After having completed this process, the new legislation should become formally adopted and take effect.

The Renewable Energy Directive, recent Energy Efficiency Directive and future Energy Performance of Buildings Directive are challenging the states, regions, municipalities, enterprises, and private persons. The demand for skilled persons who could conduct energy audits, advice in energy issues like renovations (European Commission, 2023a) and measuring the energy consumption, and design new areal and municipal cooling and heating plans (European Commission, 2023b) will be increased, and in many of the member states, there may be a lack for skilled energy experts.

The latest milestone in mankind's attempt to tackle climate change was COP 28 - UN Climate Change Conference in Dubai, United Arab Emirates (https://www.cop28.com/), where the recommendation to abandon the use of fossil combustibles was approved – on a principled level. Even if the declaration does not contain concrete path to fossil-free world, it confirms the goals of Agenda2030. (UN Press Center, 2023).

The curriculum presented below, will on its part respond to the increasing demand for energy consultants and experts.

Basic concepts connected to training

Before we can continue with curriculum, we'll have to define the basic concepts. In this case, the basic concepts are at least those behind the following terms: renewable energy, energy services, and energy service manager.

There are plenty of good definitions describing both renewable energy and energy services. However, energy service manager is much more complicated term, and definition of concept behind it must be sought from those rare job vacancy announcements, in which employers are searching for a person to such task, and even more rare trainings stating that they are training or that they have trained energy service managers. The following definitions are compiled from several sources, and should be seen as consensus definitions, further than absolute and only one and correct versions.

Renewable energy

Cambridge Dictionary (2023) defines renewable energy as energy that is produced using wind, photovoltaic panels, geothermal heath, waves, etc. Many other definitions contain the same energy sources as examples, and a consensus of the definition could be that renewable energy comes from sources that will not be depleted, i.e., that are renewing all the time.

Energy service(s)

The Energy Encyclopedia of Calgary University defines energy services are the tasks performed using energy. Such services include e.g., space heating, domestic water heating, cooking food, heating raw products for manufacturing, all kind of transportation, lighting, communication, etc. All these can all be achieved by using especial energy service technologies. Each energy sector requires certain amounts of energy to accomplish their services. Most of the modern services require electricity to be able to work. Gasoline and natural gas are used e.g., in industry, transportation, and heating. (University of Calgary, 2023) Another definition states, that Energy Services covers a delivery of useful services to users and habitants of a building. These services can be, for example, heating and hot water, cooling, and providing electricity for the use of e.g., lightning, elevators, all kind of house automation, etc. (Law Insider, 2023)

An important part of energy services is production and delivery or supply of energy. The source of energy effects on greenhouse gas emissions and carbon footprint both directly and indirectly. Direct impact comes from transforming a form of energy to another, e.g., from burning combustibles to produce electricity or

heath. The indirect affect comes from different activities, like manufacturing devices and instruments that produce, transfer, and use the energy, like generators and solar panels, wires, televisions, etc., and the use of these equipment. (University of Calgary, 2023)

Renewable energy technology in buildings

Renewable energy technology in buildings covers both the technology producing the renewable energy, like photovoltaic panels, solar thermal panels and collectors, geothermal equipment, wind power mills, etc., either integrated in the structures, like photovoltaic cells in the wall or roof material, or geothermal collectors in the piles, or separate structures like photo voltage panels on the roof, or windmills in the garden, and technology enabling to store, transfer and use the produced renewable energy.

In wider context of sustainable buildings, also the technology that enables to save energy, like insulation of structures, led lights, etc. can be considered to be a part of sustainable energy solutions in buildings. However, because these solutions can be used both in buildings using conventional energy, and in more sustainable buildings using renewable energy solutions, and because they as structural solutions require quite different competence, skills, and knowledge, compared to topics of renewable energy, they are not included to these curricula.

Energy service manager

In this task, a person is responsible for monitoring the energy consumption of the building to ensure that energy reduction goals are reached and sustained during the use of the building. A person also develops or assists with the development and implementation of policies and procedures that are consistent with those of the organization (University of New Mexico, 2022), municipal, district, region, country, and European Union to ensure efficient and safe energy use and energy-related operations in the building, organization, or wider context.

Tasks and required skills of Energy service manager may vary depending to the organization and country where he is working. Let's take the first example outside EU. University of New Mexico defined the tasks and required skills as follows: "*Under general supervision, manages the delivery of maintenance, construction and commissioning services for energy management and control system, building HVAC digital controls, alarm systems throughout the main campus and branch campuses. Manage the daily activities of a specialized technical workforce comprising expertise in building HVAC systems, building HVAC controls, and controls logic programming. Develop master plans and manages building energy control expansion projects. Interface with Engineering staff and key clients throughout the UNM system of campuses. Ensure that project technical goals are achieved, and costs are accurately tracked. Oversee system commissioning, remote monitoring and tracking of system energy consumption, implementation of control logic changes, and control system modifications.*" (University of New Mexico, 2022). This general description is completed with a long list of specified tasks and requirements of skills.

Another example is taken from Finland, where an industrial company in a branch consuming huge amounts of electricity was searching for energy manager. The tasks of the job were to build electricity market capability, to negotiate electricity agreements, to develop IT-tools needed to analyse and forecast markets and to demand responses from markets, to hold an ownership of electricity purchase strategy, to follow the regulation concerning the manufacturing of products the company produces, and ensure that production is in line with regulation, and to find out new opportunities from the electricity markets. The requirements for a person to be nominated were experience in energy market portfolio management and risk assessments, proven success in negotiating electricity agreements, and good understanding of opportunities of flexibility in the demand response markets as well as strong knowledge of the regulation in the branch. (Finnish employment services, 2023).

Although the position in latter task was named as "Energy manager" the goal of the tasks was to ensure energy services of industrial company. These two examples were from opposite heads of the potential roles

of energy service manager. While the first position was set on very low level and concentrated on practical tasks defined detailed and strict, the second was at top level with a responsibility on development, planning and following of activities including agreements and compliance with regulation. In our training we are approaching the lower, practical level of tasks and responsibilities.

Existing trainings in the branch

Training and education in both renewable energy technology in buildings and energy service management is given in several educational institutes, vocational schools, universities of applied sciences and universities. The following examples give a further view of a contemporary state of studies available, and contents of some examples of curricula.

Local energy manager (LEM)

In Poland, the Mazovian Energy Agency (MAE) had in cooperation with Higher School of Ecology and Management started postgraduate training programme "Local Energy Manager - LEM", in which the target groups were officials, employees, or candidates for employees for municipal offices, local public sector authorities, organizational units of local self-government of the region, and municipal enterprises. The purpose of these postgraduate studies was to collect and develop legal, technical, economic, organizational, and environmental knowledge of the production, distribution, storage, monitoring and marketing of conventional and renewable energy. Improving the energy security at local level, covering primarily planning, management and financing of energy in the municipality, was one of the goals too. Each implementation, where 15-20 specialist conducted courses and exercises, last app. 200 working hours. The topics of the course approached e.g.,

- energy markets,
- innovative financial instruments,
- legal conditions of energy sector,
- environmental conditions of the power industry etc.

Three courses of postgraduate studies were conducted within the framework of project EMPOWER, partially funded by EU. (Project EMPOWER, 2020).

Numerous amounts of training institutes operating with commercial principles are offering courses in energy management, and green and renewable energy. Depending to country and institute, these can be vocational studies or further vocational studies, giving a vocational qualification, or they can be postgraduate studies giving perhaps some diploma or certificate that authorizes person to do certain tasks, or they are just to help professionals to develop their vocational skills, without giving any further qualification. In following paragraphs couple of them will be briefly presented.

Certified Energy Manager (CEM) by AEE

Association of Energy Engineers offers Certified Energy Manager -training. Training gives skills to optimize the energy performance of a facility, building, or industrial plant, to integrate electrical, mechanical, process, and building infrastructure, and to analyse the optimum solutions to reduce energy consumption in a cost-effective approach. According to AEE, training has gained increased recognition within the energy industry and by companies looking to strengthen their competitive position by having responsible energy strategies and sustainable operational practices.

Knowledge to be gained during the course:

- Codes and Standards,
- Energy Accounting and Economics,
- Energy Audits and Instrumentation,
- Electrical Power Systems and Motors,

- HVAC Systems,
- Industrial Systems,
- Building Envelope,
- CHP Systems and Renewable Energy,
- Fuel Supply and Pricing,
- Building Automation and Control Systems,
- Thermal Energy Storage Systems,
- Lighting Systems,
- Boiler and Steam Systems,
- Maintenance and Commissioning,
- Energy Savings Performance Contracting and Measurement & Verification,

(AEE, 2023). Although the origin of this training is in Anglo-American cultural area, the course has been recognised in many countries all over the world.

Bachelor of Science in Renewable Energy Engineering, Lithuanian

Lithuanian Kaunas University of Technology has a programme "Bachelor of Science in Renewable Energy Engineering" which should start on September 2023, and last 4 years. The programme is motivated by the growing needs to maintain balance, to preserve the natural environment, and to restrain climate change. The concept of renewable energy includes in the context of this course solar, wind, water, and other renewable energy sources. Renewable energy technologies are probably the most progressive and rapidly expanding fields of technology at the moment. The Bachelor's in Renewable Energy Engineering programme at KTU will approach the use of ecological types of energy, and deepen the knowledge of use of photovoltaic, solar thermal, windmills, hydro power, biofuel, and heat pump technologies. When performing the practical tasks, students will learn how to design, develop, and use electricity and heat sources, energy devices and apply information technologies. (Kaunas University of Technology , 2023).

Bachelor in energy technology, Finland

Lappeenranta University of Technology (LUT) has established a new bachelor's programme in energy technology in Lahti campus of LUT. The programme has started in August 2023, and the next rolling admission will start in November 2023. Bachelors' studies will take approximately 3 years, and optional master's studies will take approximately 2 years (after a student has graduated bachelor's level). (Lappeenranta University of Technology, 2023).

The content of the training will focus on the most efficient ecological production and distribution of energy and technologies related to it. The training will be based on three key areas of expertise in energy technology:

- Physical phenomena related to energy technology, such as policies that affect the shape and magnitude of energy,
- Energy conversion from one form to another, and
- Machinery and equipment for energy conversion.

The programme leads to the degree of Bachelor of Science in Technology, B.Sc. (Tech.), which is 180 ECTS credits, consisting of

- General studies, 77 ECTS credits, including studies in mathematics, physics, engineering design, mechanics, control systems, programming, and electricity.
- Intermediate specialisation studies, 51 ECTS credits, focusing the topics on thermodynamics, heat transfer, nuclear power engineering, power plant engineering and energy economics.

- Minor studies, 20 ECTS credits, including optional studies to be selected from energy economics, sustainability science, practical engineering, innovation and entrepreneurship, and Chinese business, culture, and technology.
- Language studies, 19 ECTS credits, including basics in Chinese, Finnish, and English.
- Elective studies, 3 ECTS credits - any course at LUT.
- Bachelor's thesis, 10 ECTS credits.

Those continuing their studies after a bachelor's degree in energy technology, can choose one of LUT's master's programmes in energy technology: Energy Conversion, Nuclear Engineering or Sustainable Energy Systems. (Lappeenranta University of Technology, 2023).

Bachelor of Engineering (Polytechnic), Energy and Environmental Engineering, Finland

Satakunta university of Applied Sciences has Bachelor programme in energy and environmental engineering. Within the framework of this programme, it is possible to specialize environmental or energy issues, including renewable energy. The programme consists of basic studies required for every Bachelor of Engineering, and professional studies that are partially elective. By choosing certain modules and courses a student defines his / her specialization branch. Summary of curriculum can be found from Appendix A.

Other trainings

In Finland, the topics connected to renewable energy are included in trainings approaching environmental and energy issues both in vocational, further vocational, and higher education (Energiateollisuus ry, 2023). The Finish directory of studies and examinations lists on 19th September 2023 21 study programmes and courses at different levels approaching the renewable energy and two courses with key words "renewable energy manager" (Finnish National Agency for Education, 2023). However, the issues dealt with varies from level to level and programme to programme, and for example, issues approaching the implementation of low voltage photovoltaic systems are not necessary paid enough attention (Lilja, 2022).

Renewable energy installer

One example of training, that is solely targeted to renewable energy, is training for renewable energy installer. This training is regulated by the Energy Authority of Finland, and when writing this, there are three trainers approved by the authority:

- Ami-foundation: heat pump systems
- Municipal education and training consortium Tavastia: Solar heat systems and photovoltaic systems
- Sähköinfo Ltd: photovoltaic systems.

The Energy Agency approves organizations that organize training leading to the Certified Installer certificate. The installers' certification system includes small-scale biomass burners and stoves, solar electricity and solar thermal systems, low-level geothermal systems, and heat pumps. The prerequisite for approval by the Energy Agency is the applicant's sufficient teaching staff, facilities suitable for teaching, and the necessary technical equipment and tools. So far, this certification system is voluntary. (Energy Authority, 2023)

Energy manager

Finnish education institution Taitotalo (AEL-Amiedu Ltd) offers Energy manager – training programme for enterprises, stating, that savings a company can achieve by the project works of participants had been 232 897 € / company (average). The goal of the training is to provide the latest methods for improving the company's energy efficiency and reducing energy costs. Training consists of following topics:

- Energy projects and the basics of energy theory 2 days.
- Energy procurement and management 2 days.
- Building energy efficiency, heating, ventilation, and lighting 3 days.

- Compressed air, process heat and steam, combined heat, and power production 2 days.
- Electricity and cooling 2 days.
- Energy production - renewable forms of energy, presentation of project work and exam 2 days.

The basic principle of the training is that the learned things are immediately applied in practice. The training consists of face-to-face lessons conducted by experts in the field, practical assignments, and analysis of the energy situation of your own company, as well as a project to improve energy use. After successfully completing the training, you will receive a European Energy Manager (EUREM) certificate for your competence.

During the training a student gets

- ready-made calculation tools,
- best practice type checklists,
- expert support for the energy efficiency development project during training, and
- a good basis for coordinating the procurement and use of energy.

According to Taitotalo, the training program serves as a good preparation for FISE Oy's Energy Certificate issuer qualification requirements exam. (AEL-Amiedu Oy LTD, 2023).

Other energy-related trainings can be found, for example, from Motiva Ltd (https://www.motiva.fi/en).

Curriculum

The following curriculum is to be developed and tested:

- A7 Creation of curricula and teaching materials for Further Training program “Energy Consultant”

There is an existing curriculum to be used as a base of new curriculum:

- The curriculum for further training course "Energy Service Manager", which was developed within the framework of project VESTE.

The common requirement for curriculum is, that the training programmes meet the legal regulations that exist in some countries concerning the qualification required in certain tasks, e.g., qualification of "Energy Consultant" in Finland, Estonia, Germany, and Poland, and that in the training, the local legislation and regulation is considered. For example, in Germany and Poland, there is a requirement that for energy renovations of buildings applying for public funding, an expert opinion must be provided by a qualified and accredited expert, and in Finland, buildings exceeding certain size, must, before the building permission is granted, have an energy certification provided by authorized energy specialist.

Energy consultant

Concerning the curriculum of Energy Service Manager (suggested work name), following requirements were set in advance:

Graduates should be able to

- assess buildings from an energy point of view,
- plan complete energetic refurbishment measures and to determine the costs for a realization,
- prepare calculations for refinancing the investments, and to
- provide comprehensive advice to investors.

These skills are just a small part of those required from energy service manager in the industry (see examples presented above), thus, even if the curriculum were widened with some other issues like carbon

footprint calculations, renewable energy, and energy efficiency, the name that would better describe the contents of training, would be “Energy Consultant”.

Target group

The course is targeted further training for specialists to transfer subject-specific contents on improving energy efficiency and on use of renewable energies for residential buildings. Target group is specialists having appropriable qualification in fields close to energy efficiency of buildings, e.g., in construction engineering, electrical engineering or environmental engineering. The appropriability of each qualification must be solved considering the country-specific regulation and instructions.

Curriculum “Energy service manager” as a base for training

The curriculum “Energy service manager”, made in the project VESTE, can be taken as a base for new curriculum. In Germany, where the legal requirements differ from many other countries, this can be even recommendable. However, the curriculum “Energy service manager” needs at least the following modifications and updates to match the contemporary requirements of EU-directives, needs of enterprises, and educational purposes:

- In the introduction, the newest revisions of directives and other literature should be considered.
- The target group(s) of the training could be defined considering the country-specific differences.
- In the qualification requirements and teaching materials, the revised versions of directives should be considered.
- The need and permission to make country-specific, regional, and local modifications, i.e., localizations, should be clearly stated.
- Instead of dividing the course into two parts, to be able to consider skills and knowledge possibly gained in earlier experience and trainings, it is recommended, that the topics would be divided into modules as presented in the next chapter. Dividing the course into modules enables students to concentrate on topics and issues that they need in addition to their earlier studies to complete the requirements of qualification in question.

It is recommended, that teachers who are going to use the curriculum “Energy service management” as a base for the new course, will proof thoroughly the up-to-dateness of topics, issues and materials proposed in the curriculum.

Modular curriculum “Energy consultant”

The materials found in the links are examples, suggestions and tips, and can be replaced e.g., with localized material and completed with additional materials. It is also worth noting, that most of the materials produced by EU can be found in all EU-languages.

Module	Content	Notes
Motivation 5 hours Goal: Student understands why the energy issues are important and finds a connection between topics of this course, local legislation, directives and programmes of European Union, sustainable development goals and UN Agenda 2030	• UN Agenda 2030 and sustainable development goals, • Climate change, • Greenhouse gases, • Lack of fossil energy sources, • European Union, Country-specific, regional, and local issues, • Introduction to renewable energy.	Depending to the background of the trainees, this can be left away or shortened. However, the students should be aware of the context in which they are practicing their profession as energy consultants.

Examples of sources, materials, and further readings	Basic slide set for introduction: Why energy issues are important.pptx Further information on - Taxonomy - Energy efficiency - Optimization - Sufficiency - Climate change - Biodiversity - Greenhouse effect - Fossil combustibles - Programmes of European Union NOTE: These materials can be used also in other modules approaching these topics.

Legislation and regulation, 25 hours, with following submodules - EU-legislation, - Local legislation and regulation **Goal:** Student knows the framework of the EU, understand the relationship between directives and country-specific regulation, and knows the legislation and requirements applied to qualified energy consultant and to jobs and tasks of QEC.	**Content** • Agenda 2030 and EU, • Directives approaching energy efficiency, climate change and sustainability, latest revisions, • Other directives that are close to the energy issues, • Country-specific legislation, • Regional and local regulation.	**Notes** Country-specific topics may take more time, depending to the complexity of legislative and regulative system of the country. However, in countries, where the qualification is required in energy-connected tasks, it is recommended, that local legislation and regulation is weighted, and if necessary, more than 25 hours will be allocated for this module.
Submodule **EU-Legislation** https://energy.ec.europa.eu/index_en New Energy Efficiency Directive (Entered into force September 2023) Renewable Energy Directive (Entered into force November 20th 2023) Energy Performance in Buildings Directive 2021, New version is under the work. Electricity Market Directive Critical Entities Resilience Directive Energy Related Products Directive Etc.	Submodule **Country-specific and local legislation and regulation** Teachers in each country should include here the legislation and requirements of their own country and region, e.g., rules of each state in Germany.	

Energy efficiency, 200 hours, submodules - Calculations and classifications, - Insulation, avoiding the heat and cool leakages, - Technology in buildings, - Designing the energy-efficient buildings - Other issues	**Content** • Principles of energy efficiency calculations, • Principles of energy efficiency classification, • Energy efficiency calculations, • Tools for energy efficiency calculations.	**Notes** If there are country specific, regional, or local exceptions in calculation rules, these should be highlighted. Common information about energy efficiency: Energy efficient buildings Buildings - Energy System

Goal: Student knows the issues impacting the energy efficiency of the house, and is capable to do energy calculations, energy classifications, and give energy rehabilitation recommendations in accordance with laws and instructions.	• Envelope of building, new and existing buildings, • Doors and windows, • Technology in buildings, including e.g., heating, cooling, lightning, and equipment, • Other issues,	Energy efficiency in buildings Research approaching the energy efficient buildings. Holistic approach to energy efficiency (contains lot of interesting research and documents).
Calculations and classifications 25-30 hours depending to the need of calculation exercises.	• Principles of energy efficiency assessments and calculations, • Principles of energy efficiency classification, • Energy efficiency calculations, country-specific versions are recommended. • Tools for energy efficiency calculations. **Note:** Introduce, present and use those calculation models and classification schemas that are valid / legal in your country / region.	
Insulation, avoiding the heat and cool leakages 100 hours	• Envelope of building, new and existing buildings, ▪ Insulation, tightening: materials and technical issues • Doors and windows, • Other structures, • Improving the energy efficiency of constructions, • On point of view of existing building and energy rehabilitation.	
Technology in buildings 25-30 hours	• Heating, cooling, lightning, appliances, and equipment, • Building Automation and Smart Home concept as tools to improve energy efficiency.	
Designing the energy-efficient buildings 25-30 hours	• Envelope of building, new and existing buildings, • Doors and windows, • Other structures, • On point of view of designing new energy efficient building.	
Other issues 25 hours	• Basics of Carbon handprint / Carbon footprint calculations if the optional module (see below) is not included.	
Renewable energy 50h, submodules - Renewable energy as a concept - Renewable electricity - Renewable heat and cool - Renewable combustibles, - Legislation and regulation - Special issues **Goal**: Students know the renewable energy sources, can find most suitable solutions for each case, and are ware of the local regulation concerning the	**Contents** • Principles of renewable energy, • Renewable energy sources, • Renewable energy technologies, • Possibilities to use renewable energy in buildings, • Impacts of renewable energy on energy efficiency calculations.	**Notes** Key concepts: see the Powerpoint presentation “Why energy issues are important”, slides 6-10

implementation of renewable energy systems.		
Renewable energy as a concept	Definition	
Renewable electricity	Photovoltaic (Solar electricity) Windmills Wave mills Tidal power Hydroelectric power plant Note: Hydroelectric pump power plants can be used in storing power. Geothermal electricity plants Hydrogen cells Hybrid energy systems	
Renewable heat and cool	Solar heat Geotherm heat and cool Heat and cool accumulators Heat pumps	
Renewable combustibles	Hydrogen Biofuels Wood Biomass Waste: Although there is a goal that as big part of waste as possible should be recycled or reused, certain part of waste ends up to the waste incineration plant.	
Legislation and regulation	Teacher should be able to give clear image of country- and region-specific requirements concerning the installation of renewable energy systems, including fire protection, qualification requirements etc.	
Special issues	Country- or region-specific issues or issues that are important for just this group of students. For example, if students are immigrants, special issue could be how to apply these skills and knowledge in their own home countries.	
Energy efficiency certificates 40 h, submodules - Legal base of certificates, - Reading the plans and collecting data, - Documenting, - Conclusions and recommendations **Goal:** Student knows the legal requirements and official instructions concerning the certificate, can assess values and information required, makes the correct calculations, and is able to write the certification in the role of impartial and independent expert.	Legal requirements (deepening the lessons of 1st module), The advantages of certificates, How, why, and when to write certificate, How, why, and when to use certificate, Modernization and rehabilitation: general and detailed recommendations, advantages, and risks. Tools for writing certificates	Lot of "calculating and concluding" exercises is recommended. Due to strict connection to national legislation, the material and tools should be country-specific, basing on directives of the European Union.

Special issues (hours depending to topics), submodules according to topics.	E.g., designing energy efficient electricity, lightning, heating, cooling, improving the insulation of building - risks and advantages, etc.	According to needs and interests of trainees, and if locally required to gain qualifications or accreditations.
Carbon footprint (Optional) 60 h, submodules - Concepts of carbon footprint and carbon handprint, - Calculations and tools, - Content of certificates **Goal:** To understand the concept of carbon footprint, to be able to do carbon footprint calculations, and to write carbon footprint certifications if required.	Concept and principles of carbon footprint, Carbon footprint calculations, Impacts of renewable energy on carbon footprint, Carbon footprint certificates, Advantages of carbon footprint calculations and certifications	Including a brief explanation of carbon handprint. Obligatory in Finland in certain cases. Country specific, regional, or local exceptions in calculation rules should be highlighted. Lot of calculating and concluding -exercises is recommended.

- The qualification requirements should be adaptable in different countries.

Additional module: Skills required for a consultant.

Graduates of the "Energy Consultant" training programme must have extensive consulting skills. If the participants have little/no experience and competences in consulting, it is essential that an appropriate additional module is taught, which is listed below.

Introduction

There are three concepts that are often confused with each other: Counselor (US) or counsellor (UK), consultant and advisor. Oxford Dictionary defines counsellor as a person who is *trained to give guidance on personal or psychological problems*, e.g. "*a marriage counsellor*". In many countries, counsellor is considered as practitioner who must have certain qualification and permission or license to be able to practise his / her profession. Consultant is defined by Oxford Dictionary as a *person who provides expert advice professionally*[4], and advisor as a p*erson who gives advice in a particular field*. According to these definitions, a person giving advice in energy issues can be called either as consultant or as advisor.

What kind of skills and personal characteristics should a consultant or advisor have to be successive in his / her work? The answer to this question was approached by searching different kind of texts describing what people expect a consultant or advisor knows, what he can do, and what kind of person he is. Among the material there were workplace announces from worldwide consultancy companies, blogs and articles written by HR Managers and leaders of same companies telling what kind of expert according to their opinions could be successive consultant, and biographies and scientific articles telling the stories of more or less successive consulting processes in real business. Out of these texts, 168 terms describing skills and characteristics were identified. These were sorted according to their fundamental sense.

The most important skill was found to be communication, often enclosed to adjective “strong” (*Figure 1*). This should not be any surprise. Communication skills, both written and oral, with all their variations, are the most important tool for any advisor, consultant and other professionals giving advice, granting certificates, and writing other documents. Language used should be neutral, objective, precise and correct.

[4] Note: In British English, consultant has other meaning too: a hospital doctor of senior rank within a specific field.

No reasonable cause for suspect due to carelessly chosen words, to an arrogant tone of voice, or to uncertain habitus should be given.

A surprise was, that experience, expertise, and knowledge in core topics were not mentioned, at least not directly. Technical skills were among the ten most mentioned skills, but it was difficult to conclude, whether this meant particularly skills in certain technology, or technical skills in common. This ambiguity is most probably arisen from the fact, that the basic requirement for consultants in workplace announces has in common been that those searching the job have graduated and have adequate experience in certain branch or tasks. Furthermore, in the results, no references to legislation and regulation nor liabilities and insurances were found. However, the regulation under which the consultant woks, and liabilities derived from the legislation may cause a remarkable personal risk for professional advisor and should therefore be included into the training.

In addition to having strong communication skills, consultant and advisor should also be able to find and solve problems, to show the leadership, and to manage schedules, tasks, and change (*Figure 1*). He / she should have teamworking and collaboration skills and be good in project management, process thinking and planning.

Concerning the personal characteristics, the difference between the two most named properties and rest of properties were not as clear as in skills. Analytical and creative nature were mentioned the same number of times, and the number of times the following 8 characteristics were found, was much closer to top than in skills (*Figure 2*). Combining some properties that are close to each other, successive consultant seems to be analytical and critical, creative, and adaptable but meticulous. He / she is business- and customer-oriented, emphatic, and has emotional intelligence. Good consultants are often system oriented, and they should be enterprising, independent, and unbiased, as well as logical and observative without forgetting social dimension.

In this module, we concentrate on training the most important skills. However, skills and personal characteristic walks hand in hand, thus it is good, in beginning of the module, to introduce the characteristics and discuss about how to recognize own style and development needs, and how to develop certain characteristics. However, it is good to bear in one’s mind, that intervention in personal characteristic is very sensitive, and is in many countries subordinated under the legislation and regulation concerning the psychologic counselling and therapies.

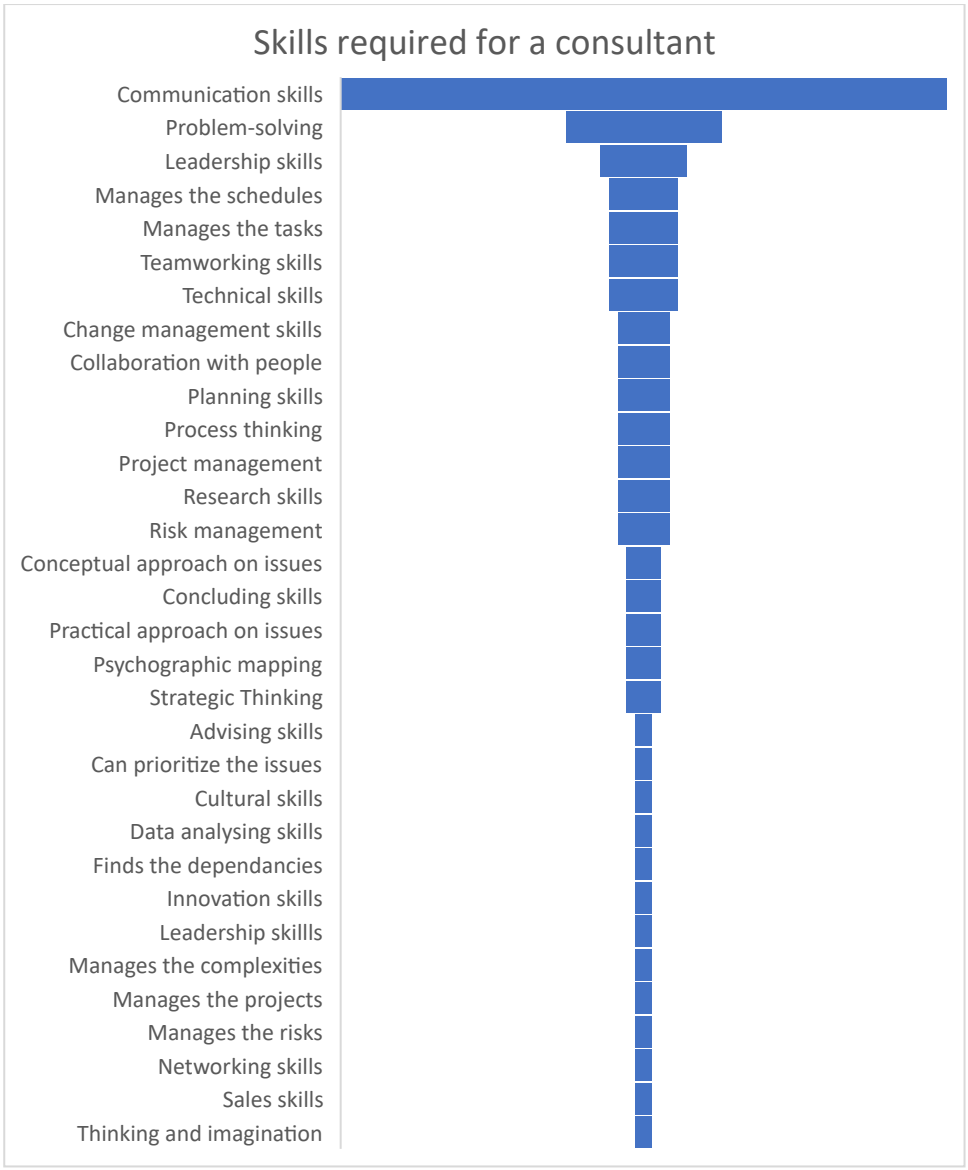

Figure 1: Skills required

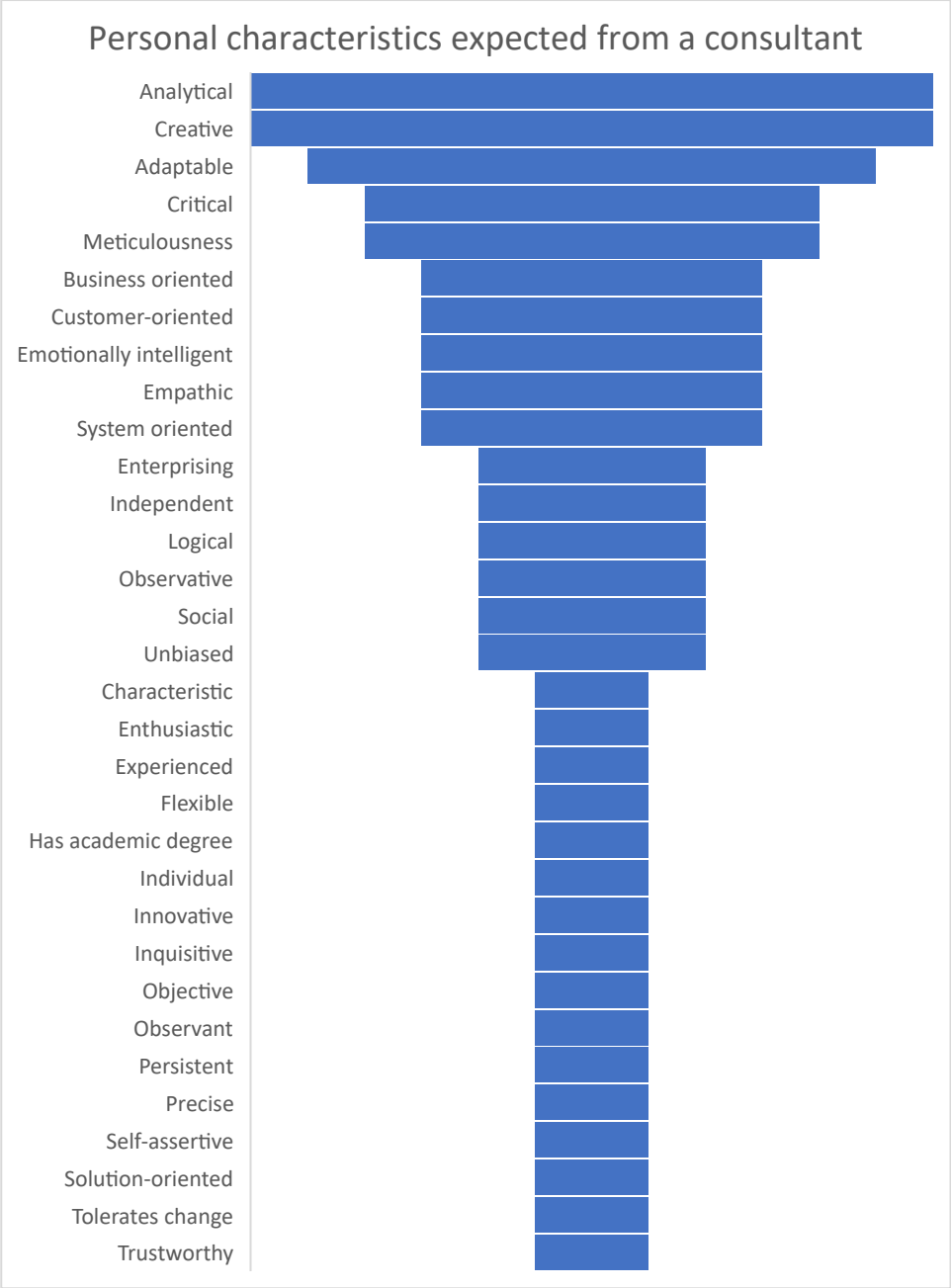

Figure 2: Personal characteristics

Structure of the module

The length of the module is 30 hours containing:

- Brief discussion about country-specific legislation and regulation that controls the work of consultants and advisors, as well as the rules connected to duties and responsibilities, insurances, liabilities, and third-party liabilities,
- Lessons and assignments on communication skills, oral (verbal) communication, written communication, reporting and writing certificates,
- Lessons and assignments on problem solving, leadership and change management, self-management, i.e., planning and management of schedules and tasks, teamworking and collaboration, and system and process thinking.

It is recommended to have visiting lecturers, like experienced consultants and attorneys who have practical examples for ex. in writing documents and certificates, errors in certificates etc.

Topic	Description	Notes
Legislation, 2 – 3 hours	Local legislation, regulation, insurance rules, liabilities, and third-party liabilities	County-specific material should be chosen by either lecturer, or an attorney specialised in topic
Communication, 15 hours	Oral (verbal) communication 4 hours, written communication 4 hours, other forms of communication (e.g. body language, social medias, silent messages...) 2 h, Assignments and practical tasks 5 hours	Communication is very language- and culture-specific, thus, it is recommended to use local materials. However, below this table you will find some Anglo-American materials as a tip.
Other important skills 1-2 hours per topic, total 12 hours	• problem solving, • leadership, • change management, • self-management, i.e., planning and management of schedules and tasks, • teamworking and collaboration, • system and process thinking.	There is almost unlimited number of ways to approach these issues. Below you will find some examples of different approaches.

Communication skills

Guide to written communication Written communication skills How to Improve Written Communication Skills How To Improve Written Communication Skills 2 Which Written Communication Skills Are Important Practical guide to effective written communication	Verbal communication skills Applying Oral Communication Skills in Your Career and Everyday Life Oral Communication The Importance of Oral Communication Verbal and Nonverbal Communication Nonverbal Communication and Body Language Nonverbal Communication: The Unspoken Dialogue The importance of nonverbal communication skills

Other skills

How to improve problem solving skills

Problem Solving and Learning

Gamifying Online Training in Management Education to Support Emotional Engagement and Problem-solving Skills

How to Improve Your Leadership Skills

How to Develop Exceptional Leadership Skills

Learning leadership skills in a simulated business environment

How to develop change management skills

People Skills: Developing Soft Skills — A Change Management Perspective

Developing Change Management Skills

Self-Management Skills: Definition, Examples and Tips

Self-Management Skills: List, Definition, Tips & Techniques

Improve Your Self-Management Skills to Enhance Your Career Development

What are collaboration skills

Collaboration Skills: Examples and Ways to Improve Them

Teamwork Skills: Definition, Types and Tips for Improvement

Why teamwork is important and how to develop your skills

Quick Guide: Process Thinking in Operations Management

The Importance of Process Thinking

System thinking: an introduction

What Is System Thinking and Why Is It Important?

Study and teaching material

The study- and teaching material should be more common, up-to-date, and available in English. For example, following sources are recommended. However, it is worth noting, that some of the publications below have been done on point of view of the revisions 2018 of the directives, and new instructions basing on revisions 2023 of the directives are probably under work at the moment. Thus, follow the branch and development!

- **Legislation and instructions**
  - Energy Efficiency Directive, updated 13th September 2023 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ%3AJOL_2023_231_R_0001&qid=1695186598766
  - Energy Performance of Buildings Directive (Note: will probably be revised very soon) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.156.01.0075.01.ENG
  - Renewable Energy Directive (Note: Check the latest amendments and agreements https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32018L2001
  - Energy efficient building directory of EU https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings_en
  - Finnish national building code https://ym.fi/en/the-national-building-code-of-finland
  - Carbon handprint of buildings: https://ym.fi/documents/1410903/40549091/Raportti+-+Definition+and+methods+for+the+carbon+handprint+of+buildings.pdf
  - Low-carbon built environment https://ym.fi/documents/1410903/40549091/Tukiohjelma-09052022-EN.pdf/087725fb-36eb-0606-b79d-67dd345de72b/Tukiohjelma-09052022-EN.pdf?t=1651731751727
  - Reuse of structural elements https://ym.fi/documents/1410903/38678498/Reuse+of+structural+elements.pdf/232736f5-472a-a252-06f1-d3c614b5bf1b/Reuse+of+structural+elements.pdf?t=1605598230958
- **Common issues and background**

- Energy efficiency in buildings by United Nations Industrial Development Organization (rather old, but gives a background) https://www.unido.org/sites/default/files/2009-02/Module18_0.pdf
- Handbook of energy efficiency in buildings (2018) https://www.sciencedirect.com/book/9780128128176/handbook-of-energy-efficiency-in-buildings
- Optimizing energy use in buildings (2021) https://www.wbdg.org/design-objectives/sustainable/optimize-energy-use
- Special Issue "Energy Efficiency in Buildings: Both New and Rehabilitated", 2020. Note that some of the papers have been written before the 2018 revisions of energy directives. https://www.mdpi.com/journal/energies/special_issues/efficiency_buildings
- Cost-optimal level of energy efficiency in buildings (Note: bases on the 2018 revisions of directives) https://energy.ec.europa.eu/system/files/2018-06/se_2018_cost-optimal_en_version_0.pdf

- **Energy efficiency assessments and certificates**
  - Assessing energy efficiency (Note: from 2017) https://inspire.ec.europa.eu/sites/default/files/presentations/6.usecase3_elmethods_17s_gerardmor.pdf
  - A guide to energy performance certificate (Note: UK, 2017) https://www.carbonreduction.eu/assets/files/2017_A_guide_to_energy_performance_certificates_for_the_marketing__sale_and_let_of_dwellings.pdf
  - Definition and methods for the carbon handprint of the buildings https://ym.fi/documents/1410903/40549091/Raportti+-+Definition+and+methods+for+the+carbon+handprint+of+buildings.pdf
  - Calculating the total heat loss in buildings https://www.open.edu/openlearn/nature-environment/energy-buildings/content-section-2.4.1 Note: Each country may have its own rules on how the official energy efficiency assessment should be done, calculated, and documented.
  - Carbon footprint calculator (Common) https://www.carbonfootprint.com/calculator.aspx. Note: Each country may have its own rules on how the official carbon footprint assessment should be done, calculated, and documented.
  - Carbon footprint calculator for buildings https://www.brightest.io/carbon-calculator-building-real-estate/. See the note above.
  - How to calculate carbon footprint (some free calculators) https://www.buildings.com/smart-buildings/article/10189039/how-to-calculate-your-carbon-footprint. See the note above.
  - Energy performance certificates https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/certificates-and-inspections_en
  - Method for the whole life carbon assessment of buildings https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/161796/YM_2019_23_Method_for_the_whole_life_carbon_assessment_of_buildings.pdf?sequence=1&isAllowed=y

- **Taxonomy of European Union**
  - EU Taxonomy Overview – Note: Commercial site but contains a brief overview of taxonomy.
  - EU Taxonomy Navigator – by European Commission
  - EU Taxonomy compass
  - EU taxonomy for sustainable activities - Finance
  - About CSRD-reporting duties
  - CSRD in nutshell

- The wholistic approach of European Union
- Even the analytics notes the Taxonomy: The EU Sustainable Finance Action Plan (Morningstar)
- Who is the EU-Taxonomy for?

- **Energy saving and energy efficiency**
  - Home energy assessment Site of US government, contains videos etc., but note the cultural and legal differences!
  - Conduct an energy assessment (Australian version)
  - Energy efficiency agreements and audits 2017–2025 Finnish model to motivate organizations in energy saving.
  - EnerGuide energy efficiency home evaluations Video from Canada
  - Optimization and BIM-based lifecycle assessment integration for energy efficiency retrofit of buildings Note: May require a license. Contact your librarian.
  - Deep learning for assessment of environmental satisfaction using BIM big data in energy efficient building digital twins
  - Top Energy Saving Inventions and Innovations
  - World energy perspective: energy efficiency technologies
  - Energy Efficiency
  - Energy efficiency technologies and benefits
  - Energy Saving and Energy Efficiency Technologies (27 papers presenting different solutions and technologies)
  - How Digitalisation Is Modernising Energy Efficiency After this has been published, both the situations have changed (E.g., COVID19 -pandemic and Ukrainian war), and the role of digitalization has become more and more emphasized, but also the vulnerability of digital tools has become highlighted.
  - Scientific activities of the European Commission approaching
  - - Energy Efficiency
  - - Renewable energy: Biofuel and bioenergy, and Hydrogen, electrolysers and fuel cells for a decarbonised and sustainable Europe
- **Energy efficiency classification – energy labels**
  - New EU energy labels (applicable from 1 March 2021)
  - EU energy labelling requirements
  - How to read the energy label on your household appliances
  - Explaining the New Energy Label for Home Appliances
- **Optimization**
  - Economic optimization of new energy technologies in the context of low carbon economy
  - Energy Optimization Technologies in Smart Homes
  - Research on Optimization Method of Integrated Energy System Network Planning
  - Energy Optimization for Smart Cities Using IoT
  - Energy Network Optimization Technology
- **Sufficiency**
  - https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter09.pdf
  - The limits of energy sufficiency: A review of the evidence for rebound effects and negative spillovers from behavioural change
  - Energy sufficiency Why, what, and how?
- **Biodiversity**
  - https://www.worldwildlife.org/pages/what-is-biodiversity
  - EU Biodiversity Strategy
  - Finnish National Biodiversity Policy
- **Climate change**
  - Basics of Climate Change | US EPA
  - Understanding climate change
  - https://climate.ec.europa.eu/climate-change_en

- Climate change: the greenhouse gases causing global warming
- https://www.un.org/en/climatechange

- **Greenhouse effect**
  - What is the greenhouse effect?
  - The greenhouse effect
  - Greenhouse Effect
  - Greenhouse effect | Definition, Diagram, Causes, & Facts
- **Fossil combustibles**
  - Fossil fuel | Meaning, Types, & Uses
  - Fossil Fuels
  - Glossary:Fossil fuel
- **Programmes of European Union**
  - https://energy.ec.europa.eu/index_en - Energy sites of the European Union
  - REPowerEU European Commission's plan to make Europe independent from Russian fossil fuels before 2030.
  - European Green Deal
- **Insulation**
  - Materials and Methods of Thermal Insulation of Buildings
  - Thermal insulation for buildings
  - Building envelope thermal insulation - Energy Efficiency
  - Thermal insulation of buildings - principles, types, and materials
  - Thermal Insulation: Meaning, Purpose, Techniques and Materials
  - Properties of Thermal Insulators
  - Insulation materials and their thermal properties
  - Thermal Insulation Materials, Collection of scientific articles
  - What are U-, R- and Lambda Values?
  - What are u-values?
  - Calculating u-value of a wall
  - Calculating the U-value of a Surface
  - Reducing space heating demand
  - U-values of different materials
- **Doors and windows**
  - Heat loss and heat gain
  - Energy efficient windows and doors
  - Improving the Energy Efficiency of Existing Windows
  - Windows and Doors
  - Energy performance of door solutions
  - Energy efficient doors: a complete guide
  - Reducing Heat Loss and Drafts through Windows and Doors (Video)
- **Other structures**
  - Foundation piles as heat wells
  - Geothermal piles
  - Commercial example of geothermal pile
  - Performance of Piled Foundations Used as Heat Exchangers
  - In-roof solar panels: What you need to know about
  - BIPV modules and solar panels (Commercial site)
  - Special Issue of Energies "Building Integrated PV System" – collection of 7 articles
  - Building-Integrated Photovoltaics: Walls and Roofs that Generate Power and Save Energy
  - Building-Integrated Photovoltaics - Fraunhofer ISE

- Waste heat recovery technologies and applications
- Clean district heating and cooling system
- Industrial Waste Heat Recovery
- How Do Heat Recovery Systems Work?
- Heat recovery: Overview
- How do heat recovery systems work
- Heat recovery ventilators (Video)

- **Improving the energy efficiency of constructions**
  - Example of EU's actions: Energy efficiency in buildings
  - Improving energy efficiency in buildings: Review and compiling (May require a license – contact your librarians)
  - Improving energy efficiency in buildings (Note: partly commercial material)
  - How to improve the energy efficiency of new build projects (Commercial site)
  - Construction – a collection of researches and articles approaching energy efficient buildings at SITRA's site (SITRA = The Finnish Innovation Fund Sitra)
  - Promoting energy efficiency standards and technologies to enhance energy efficiency in buildings
  - Artificial intelligence improves the energy efficiency of buildings
  - Energy efficient building design (Note the differences in culture, legislation, and climate)
  - Design essentials for an energy-efficient building
  -
- **Energy rehabilitation of existing buildings**
  - Accelerating the energy efficiency renovation of residential buildings — a behavioural approach
  - Efficient Home Design
  - Evaluating and Enhancing the Energy Efficiency of Representative Residential Buildings by Applying National and International Standards Using BIM
  - Enhancing Resilience in Buildings Through Energy Efficiency
  - Mapping of Existing Technologies to Enhance Energy Efficiency in Buildings in the UNECE Region
  - Long-term strategy for energy rehabilitation in the building sector
  - Renovation of existing buildings
  - Drivers of and Barriers to Energy Renovation in Residential Buildings in Spain—The Challenge of Next Generation EU Funds for Existing Buildings – Note: Although the culture and legislation may differ from those of Northern Europe, there are similarities in barriers and drivers.
  - Deep Energy Renovation of Traditional Buildings
- **Devices and appliances**
  - Heating, Ventilation, and Air Conditioning (HVAC)
  - Energy Efficient HVAC Systems (Special edition of Energy and Buildings, may require a license, contact your librarian)
  - A Guide to HVAC Energy Efficiency
  - Improving energy efficiency of HVAC systems in buildings: a review of best practices
  - Buying energy efficient home appliances
  - Explaining the New Energy Label for Home Appliances
  - Appliances & equipment – IEA
  - Cooking appliances - European Commission
  - How to read the energy label on your household appliances – Note: According to text should concern the classification 2021, but there were no date at site.

- A call to action on efficient and smart appliances – Analysis
- Energy-efficient products - European Commission
- Trends in Research on Energy Efficiency in Appliances and Correlations with Energy Policies
-

- **Intelligent buildings and Smart home**
  - How to Use Smart Home Technology to Increase Energy efficiency in Your Home (Note: Commercial site)
  - Smart home technology and its impact on home energy efficiency (Note: commercial, concentrates on one product, but principles can be applied more common.)
  - Energy Impacts of Smart Home Technologies
  - Smart Home Efficiency
  - Smart Home Energy Management: Use Cases and Savings Opportunities (Note the cultural and legal differences)
- **Renewable energy, definition**
  - What is renewable energy?
  - Renewable Energy Definition - Sources, Clean Alternatives
  - Renewable energy concepts for addressing climate change
  - Renewable Energy | Types, Forms & Sources
  - What is Renewable Energy? - Definition, Types & Benefits
  - Renewable Energy
  - Renewable energy sources
- **Photovoltaic energy**
  - Photovoltaic system
  - Solar Photovoltaic Technology Basics
  - Solar Explained—Photovoltaics and Electricity.
  - Photovoltaic energy systems with battery storage for residential areas: an economic analysis (Note: Requires a license – contact your librarian)
  - Solar – IEA
  - Photovoltaic Energy Factsheet
  - Energy pay-back time of photovoltaic energy systems: present status and prospects
  - Photovoltaics report (Fraunhofer institute, 2023)
  - Special Issue "Smart Photovoltaic Energy Systems for a Sustainable Future" – Collection of articles approaching PV systems.
- **Hybrid energy systems**
  - Hybrid Wind and Solar Electric Systems
  - A short recent review on hybrid energy systems: Critical analysis and recommendations
  - Wind, Solar, and Photovoltaic Renewable Energy Systems with and without Energy Storage Optimization: A Survey of Advanced Machine Learning and Deep Learning Techniques
  - Optimizing a microgrid photovoltaic-fuel cell energy system at the highest renewable fraction
  - Off-grid hybrid photovoltaic – micro wind turbine renewable energy system with hydrogen and battery storage: Effects of sun tracking technologies
  - Optimal design of hybrid grid-connected photovoltaic/wind/battery sustainable energy system improving reliability, cost, and emission
  - Collection of literature on hybrid energy systems
  - A Review of Hybrid Renewable Energy Systems: Architectures, Battery Systems, and Optimization Techniques
- **Hydrogen**
  - What is hydrogen?

- What is hydrogen energy?
- Techno-economic assessment of green hydrogen production by an off-grid photovoltaic energy system
- Hydrogen as an Alternative Fuel
- Hydrogen Fuel Basics
- Hydrogen – IEA
- Hydrogen - Energy - European Union
- Use of hydrogen
- Renewable hydrogen: what are the benefits for the EU?
- Hydrogen Fuels – collection of scientific articles

- **Hydrogen fuel cells**
  - Hydrogen Fuel Cells | EESI
  - Hydrogen fuel cells and combustion engines (Commercial site)
  - Hydrogen in Transportation | US EPA
  - An overview: Current progress on hydrogen fuel cell vehicles. Note: May require a license – contact your librarian.
  - PEM Fuel cell and electrolysis cell technologies and hydrogen infrastructure development – a review. Note: May require a license – contact your librarian.
  - Dynamic simulation and lifecycle assessment of hydrogen fuel cell electric vehicles considering various hydrogen production methods. Note: May require a license – contact your librarian.
- **Wind Mills**
  - Wind Energy Basics
  - Wind – IEA
  - EU wind energy - European Union
  - Wind energy today
  - Recent technology and challenges of wind energy generation: A review. Note: May require a license – contact your librarian.
  - Energy conversion strategies for wind energy system: Electrical, mechanical and material aspects
  - Advancements of wind energy conversion systems for low-wind urban environments: A review. Note: May require a license – contact your librarian.
- **Wave Power**
  - Wave power | Process & Facts
  - Hydropower explained: Wave Power
  - Wave Power – collection of scientific articles
  - Design of Ocean Wave Power Plant with a Two-Axis Vertical Pendulum Mechanism System
  - Impacts of mechanical energy storage on power generation in wave energy converters for future integration with offshore wind turbine. Note: May require a license – contact your librarian.
  - Optimization of the electricity generation of a wave energy converter using deep reinforcement learning. Note: May require a license – contact your librarian.
  -
- **Tidal Power**
  - What is tidal energy?
  - Tidal power | Types & Facts
  - Hydropower explained: Tidal power
  - Tidal energy
  - Tidal current

- Tidal Power – collection of scientific articles
- Tidal devices : EMEC: European Marine Energy Centre

- **Hydroelectric power plant**
  - Hydropower Basics | Department of Energy
  - Hydroelectric Energy
  - How Hydropower Works
  - Hydroelectric power | Definition, Renewable, Advantages ...
  - Hydropower explained
  - Hydropower – IEA
  - Hydroelectric Power – Collection of scientific papers
  - Environmental Impacts of Hydroelectric Power
  - Hydropower and Other Water Energy Technologies | EESI
  - Design and performance assessment of a pumped hydro power energy storage connected to a hybrid system of photovoltaics and wind turbines.
  - Alternative Solutions for Small Hydropower Plants
  - Assessment of climate change impacts on the hydro-wind-solar energy supply system
- **Geothermal electricity plants**
  - Geothermal Electricity Production Basics
  - Geothermal power plants
  - Electricity Generation
  - Geothermal Energy Factsheet
  - Geothermal Power Generation – Fuji Electric
  - Geothermal Power Plant – Collection of scientific papers
- **Solar heat**
  - Active Solar Heating systems
  - Solar Water Heaters
  - Solar Heating
  - Advice on installing solar water heating
  - Solar heating | Benefits, Cost & Installation note: In UK, the legislation and regulation may differ from that of EU.
  - Solar Heating System – Collection of scientific articles
- **Geotherm heat and cool**
  - Geothermal Energy
  - Geothermal Heat Pumps
  - How Geothermal Heating & Cooling Works
  - Geothermal heat pumps
  - Can We Get Geothermal Energy From Volcanoes?
  - Earth needs geothermal energy from volcanoes
  - Geothermal Heat in Iceland
  - Harnessing the power of volcanoes
  - Where geothermal energy is found
  - Geothermal energy use for heating and electricity
- **Heat and cool accumulators**
  - Usage of accumulators in heating systems
  - What is a sand battery? — Polar Night Energy
  - Heating Buildings With Solar Energy Stored in Sand
  - Phase change materials for thermal energy storage
  - What are Phase Change Materials?
  - Heat Accumulators (Commercial)

- The Comparison of Different Types of Heat Accumulators and Benefits of Their Use in Horticulture
- Cooling Modelling of an Electrically Heated Ceramic Heat Accumulator
- STES—Typical Scenarios for Heat Accumulator Cooperation
- Improvement of the cogeneration plant economy by using heat accumulator – May require a license.
- Analysis of the Thermal Performance of Isothermal Composite Heat Accumulators Containing Organic Phase-Change Material
- Life cycle assessment of dispersed phase change material heat accumulators for cooperation with buildings in the district heating system.
- Performance of zeolite-and PCM-based cascade hybrid heat accumulator with cast thermal conductivity enhancers. – May require a license.
- Sand Battery: An Innovative Solution for Renewable Energy Storage (A Review). – May require a license.

- **Heat pumps**
  - Geothermal Heat Pumps
  - Geothermal heat pumps
  - Geothermal Heat Pump Basics
  - A guide to air source heat pumps
  - Air to Water Heat Pump in the UK (Updated 2023 Guide) Note: in UK, the regulation and measure units may differ from those of European Union.
  - Heat Pump Water Heaters Note: in USA, the regulation and measure units may differ from those of European Union.
  - List of scientific open access articles on “air to water heat pump”.
  - List of scientific open access articles on “water to water heat pump”
  - List of scientific open access articles on “ground to water heat pump”
  - List of scientific open access articles on “air to air heat pump”.
- **Biofuels**
  - Biofuel | Definition, Types, & Pros and Cons
  - Biofuel Basics
  - Biofuels explained
  - Biofuel - an overview. Collection of scientific articles approaching biofuels.
  - Biofuel, 2nd overview. Another collection of scientific articles approaching biofuels.
  - Biofuels - Energy - European Union
  - Biofuels - Energy System – IEA
  - Biofuel: Definitions, Examples, and Limitations
  - Bioenergy – IEA
- **Wood**
  - Wood as a renewable source of energy and future fuel
  - About Wood Energy
  - Wood Energy
  - Wood as a renewable source of energy
  - Is wood a green source of energy? Scientists are divided
- **Biomass**
  - The role of biomass in our energy supply
  - The Different Uses of Wood Biomass Energy
  - Biomass explained Wood and wood waste
  - Biomass explained
  - Biomass Energy Basics

  - Biomass - Energy - European Union
  - Biomass Energy - an overview. Collection of scientific articles
- **Waste** Note: Concerning the use of waste, the regulation in USA and in European Union differs very much from each other.
  - Biomass explained Waste-to-energy (Municipal Solid Waste)
  - Waste-to-Energy
  - Energy Recovery from the Combustion of Municipal Solid Waste (MSW)
  - How Waste-to-Energy delivers on renewable energy targets
  - Renewables and wastes - European Commission
  - Emerging waste streams: Opportunities and challenges of the clean-energy transition from a circular economy perspective.
  - List of open scientific articles approaching the waste-to-energy issues
- **Carbon footprint**
  - Carbon footprint | Definition, Examples, Calculation, Effects ...
  - Carbon footprint – an overview
  - Carbon footprint – 2nd overview
  - Spatial consumption-based carbon footprints: two definitions, two different outcomes
  - A Definition of 'Carbon Footprint'. Note: rather old (2007) but contains a good view on how the term "Carbon footprint" has been constructed.
  - Where has carbon footprint research gone?
  - List of open scientific articles approaching carbon footprint definitions.
  - List of open scientific articles approaching carbon footprint calculations.
  - Calculators: There are dozens of ways to calculate carbon footprint and even more calculators and programs arguing to do it on behalf of you. If you are going to use someone of them, check the background, ensure that the philosophy behind the model suits your purposes, and that it is in line with national, local, and branch-specific requirements.
    - Carbon Footprint Calculator
    - Carbon Footprint calculator of WWF
    - Ecological Footprint Calculator
    - Greenhouse Gas Equivalencies Calculator | US EPA

Notes for the teachers

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 regulation the level and skills of the trainees, and the study programme of the students; are they studying construction, finishing, plumber, some examples to be given. Each programme may require different weightings and highlights, and it is on the responsibility of each teacher to consider these special needs.

Target group

The course is targeted further training for specialists to transfer subject-specific contents on improving energy efficiency and on use of renewable energies for residential buildings. Target group is specialists having appropriable qualification in fields close to energy efficiency of buildings, e.g., in construction engineering, electrical engineering or environmental engineering. The appropriability of each qualification must be solved considering the country-specific regulation and instructions.

Work required

In the curriculum, the average work required by each module is measured in working hours to make it easier for teachers to plan the practical application. If the education institute requires ECTS credit units (abbreviated in this presentation as CU) to be used, the hours can be changed to CUs. One credit unit equals 27 hours workload. The curriculum consists of modules totalling 300 – 380 h depending to national

weightings and requirements, and whether the optional module is realised corresponding approximately 12 - 14 ECTS credit units containing class lectures, online studies, individual studies, and assignments.

Teaching methods

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

- Lectures,
- Visiting lecturers,
- Construction site visits,
- On-line studies,
- Videos approaching the topics (Reliability of the source must be evaluated),
- Individual studies and
- Assignments.

Cooperation with the local experienced industry practitioners is highly recommended. All modules can be studied individually, so the modules can be offered also via open studies to all companies and organizations operating at the construction and finishing branches, who intend to develop their skills in using the modern information technology in their business.

Contents of the curriculum

The variation in regulations, circumstances and qualification requirements are quite different in the BSR-countries, thus the material has been written only as a form of framework inside which the local actors should modify the contents of modules according to their own regulations 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 acquire, create, implement, use, and advice effective energy saving methods.

The overall objectives of the curriculum are:

- The student deepens his/her knowledge about sustainability and energy issues.
- The student understands the regulatory framework and knows essential contents of legislation on energy sector on point of view of both industry and consumers.
- The student can explain specific terms that relate to sustainability, energy efficiency and renewable energy.
- The student understands the importance of energy issues and knows how to improve the energy efficiency of buildings.
- The student deepens his/her knowledge about sustainability, energy, and energy efficiency.

The curriculum is divided into modules and submodules. Each module is possible to be replaced with studies, knowledge and skills gained earlier. Teacher and education institute have the duty and right to evaluate whether the skills and knowledge or studies are adequate considering the requirements of the qualification, and student's capability to participate in further studies basing to this knowledge.

About the links

In the curriculum, there are mostly bookmarks to the topic-specific link lists at the end of the document. These lists are neither absolute nor exclusive. Each teacher can search and use materials, that are more compatible with the requirements of his/her country and/or training.

The links to materials have been tested during the period November – December 2023. However, the links may be changed and deleted very fast; thus, it is recommended that links which will be given to students should be checked at the beginning of each course. Some of the links may be behind the paywall and require agreement between the educational institute and publisher to be available. In such case, contact

your librarians. Some of the links refer to documents that have been written for commercial or political purposes. The authors of this document do not take a stand for or against any product, and the research results and opinions found in the links are also the responsibility of the original authors of the documents in question.

References

AEE. (18. September 2023). *Certified Energy Manager*. Retrieved from AEE Center: https://www.aeecenter.org/certified-energy-manager/

AEL-Amiedu Oy LTD. (19. September 2023). *Energy Manager -koulutusohjelma (in Finnish)*. Retrieved from Taitotalo: https://www.taitotalo.fi/koulutus/energiatehokkuus/997/energy-manager-koulutusohjelma?gclid=EAIaIQobChMIwIGBucy2gQMVGp9oCR3_Jw08EAAYASAAEgIUffD_BwE

Cambridge University Press & Assessment. (15. September 2023). *Renewable energy*. Retrieved from Cambridge Dictionary: https://dictionary.cambridge.org/dictionary/english/renewable-energy

Energiateollisuus ry. (18. September 2023). *Koulutuspolut (In Finnish)*. Retrieved from Energiamaailma: https://energiamaailma.fi/koulutus/koulutuspolut/

Energy Authority. (18. September 2023). *Uusiutuvan energian asentajan koulutus (in Finnish)*. Retrieved from Energiavirasto: https://energiavirasto.fi/uusiutuvan-energian-asentajat

European Commission. (22. September 2023). *REPowerEU*. Retrieved from European Green Deal: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en

European Commission. (22. September 2023a). *Energy performance of buildings directive*. Retrieved from Energy: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en

European Commission. (22. September 2023b). *New Energy Efficiency Directive published*. Retrieved from Energy: https://energy.ec.europa.eu/news/new-energy-efficiency-directive-published-2023-09-20_en

Finnish employment services. (22. August 2023). Open position "Energy manager". *Job markets Finland (https://tyomarkkinatori.fi/en)*. Helsinki: KEHA-Center.

Finnish National Agency for Education. (19. September 2023). *Opintopolku search results*. Retrieved from Opintopolku: https://opintopolku.fi/

Kaunas University of Technology . (18. September 2023). *Bachelor of Science in Renewable Energy Engineering*. Retrieved from Keystone Bachelor Studies: https://www.bachelorstudies.com/institutions/kaunas-university-of-technology/bachelor-of-science-in-renewable-energy-engineering

Lappeenranta University of Technology. (18. September 2023). *BACHELOR'S PROGRAMME IN ENERGY TECHNOLOGY*. Retrieved from LUT University: https://www.lut.fi/en/studies/technology/bachelors-programme-energy-technology

Law Insider. (15. September 2023). *Energy services*. Retrieved from Dictionary: https://www.lawinsider.com/dictionary/energy-services

Lilja, K. (2022). Designing and implementing solar photovoltaic system in secondary residence. *IOP Conference Series: Earth and Environmental Science.* Helsinki: IOP Publishing.

Project EMPOWER. (2020. June 2020). *Local Energy Manager (LEM)*. Retrieved from Good Practices (Project EMPOWER): https://www.interregeurope.eu/good-practices/local-energy-manager-lem-studies

UN Press Center. (13. December 2023). *COP28 Agreement Signals "Beginning of the End" of the Fossil Fuel Era*. Retrieved from COP 28 - UN Climate Change Conference: https://unfccc.int/news/cop28-agreement-signals-beginning-of-the-end-of-the-fossil-fuel-era

University of Calgary. (15. September 2023). *Energy service*. Retrieved from Energy Encyclopedia: https://energyeducation.ca/encyclopedia/Energy_service

University of New Mexico. (15. January 2022). *Energy service manager*. Retrieved from Job descriptions: https://jobdescriptions.unm.edu/detail.php?id=P6005#:~:text=Monitors%20building%20energy%20consumption%20to,safe%20operation%20of%20the%20unit.

APPENDIX A

Satakunta University of Applied Sciences

Energy and Environmental Engineering, Curriculum 2023, day studies, Pori

Education level Bachelor's degree

Credits (ECTS) 240 CU, one credit unit is equivalent to 27 hours student's work.

Duration (years) 4

Main language Finnish

Degree programme EY Energy and Environmental Engineering

Education classification code Bachelor of Engineering (Polytechnic), Energy and Environmental Engineering

Faculty: Technology, **Department:** Built environment

Curriculum

- **EYOPS23PP-CATEGORY-1000 BASIC STUDIES: 60 CU, Content optionality** All compulsory
  - EYOPS23PP-1005 General Basic Studies: 49 CU Compulsory
    - SY170001 Basic Use of Office: 1 CU
    - SY220000 Starting UAS Studies: 1 CU
    - SY220100 Effectual Entrepreneurship: 3 CU
    - SY220200 Workplace Skills: 3 CU
    - SY220301 Svenska i arbetslivet, skriftlig färdighet: 1.5 CU
    - SY220302 Svenska i arbetslivet, muntlig färdighet: 1.5 CU
    - SY220300 Professional Communication: 3 CU
    - SY220303 English for Working Life: 3 CU
    - SY221201 Professional English Skills in Engineering: 4 CU
    - SY220400 Basics of Project Activities: 3 CU
    - SY220900 Research Communication: 2 CU
    - SY221100 Mathematical Tools in Engineering: 3 CU
    - SY221101 Algebra: 4 CU
    - SY221102 Geometry: 4 CU
    - SY221109 Mechanics: 3 CU
    - SY221110 Vibration, Wave and Nuclear Physics: 3 CU
    - SY221105 Thermal Engineering and Fluid Dynamics: 3 CU
    - SY221111 Physics Laboratory 1: 2 CU
    - SY221108 Occupational Safety and First Aid: 1 CU
  - EYOPS23PP-1007 Professional Basic Studies: 11 CU - Compulsory
    - EY230002 Introduction to 2D Modelling: 3 CU
    - EY230003 Basics of Chemistry: 5 CU
    - EY230004 Feasibility Calculations: 3 CU
- **EYOPS23PP-CATEGORY-1001 PROFESSIONAL STUDIES: 65 - 254 CU – partially optional**
  - EYOPS23PP-1008 Basics of Energy, Environmental and Process Technology: 16 CU
    - EY230005 Basic of Energy Technology: 4 CU
    - EY230006 Basics of Environmental Technology: 4 CU
    - EY230007 Basics of Process Technology: 4 CU
    - EY230008 Material and Energy Balances: 2 CU
    - EY230009 Spreadsheet Applications and Technical Reports: 2 CU

- EYOPS23PP-1009 Fluid Dynamics and Heat Transfer: 15 CU
  - EY230010 Fluid Dynamics: 4 CU
  - EY230011 Pumps, Fans and Compressors: 3 CU
  - EY230012 Heat Transfer Technology: 5 CU
  - EY230013 Piping Systems: 3 CU
  - EYOPS23PP-1010 Process and Control Technology: 0 - 15 CU
  - EY230014 Process Control: 5 CU
  - EY230015 Industrial Processes: 5 CU
  - EY230016 Modelling and Design of Processes: 5 CU
- EYOPS23PP-1011 Renewable Energy: 0 - 15 CU
  - EY230017 Solar Energy: 3 CU
  - EY230018 Wind Energy: 3 CU
  - EY230019 Bioenergy: 3 CU
  - EY230020 Hydropower: 3 CU
  - EY230021 Hydrogen Power: 3 CU
- EYOPS23PP-1012 Processes and Devices of Energy Production: 0 - 27 CU
  - EY230022 Steam Processes: 3 CU
  - EY230023 Cooling Technology: 3 CU
  - EY230024 Combustion Technology: 3 CU
  - EY230026 Steam Boilers: 3 CU
  - EY230027 Nuclear Energy: 5 CU
  - EY230028 Heat Pumps: 3 CU
  - EY230029 Basics of Electrical Systems: 4 CU
- EYOPS23PP-1013 Systems of the Centralized Energy Production: 0 - 14
  - EY230030 Heat and Cold Distribution Systems: 4 CU
  - EY230031 Power Plant Technology and Regulations: 3 CU
  - EY230032 Operation and Modelling of a Power Plant: 4 CU
  - EY230033 Electrical and Automation Systems in a Power Plant: 3 CU
- EYOPS23PP-1014 Design of Renewable Energy Systems: 0 - 16 CU
  - EY230034 Hybrid Heat Generation Systems: 4 CU
  - EY230035 Design of a Biothermal Center: 4 CU
  - EY230036 Design of a Solar Energy System: 4 CU
  - EY230037 Design of a Heat Pump System: 4 CU
- EYOPS23PP-1015 Environmental Chemistry and Microbiology: 0 - 15 CU
  - EY230038 Environmental Chemistry: 5 CU
  - EY230039 Environmental Analyses: 5 CU
  - EY230040 Microbiology: 5 CU
  - EYOPS23PP-1016 Water Supply Engineering: 0 - 15 CU
  - EY230041 Water Treatment Technology: 5 CU
  - EY230042 Networks of Water Supply: 5 CU
  - EY230043 Wastewater Treatment: 5 CU
- EYOPS23PP-1017 Environmental Technology: 0 - 15 CU
  - EY230044 Waste and Material Management in Cir CUlar Economy: 5 CU
  - EY230045 Air Pollution Control: 5 CU
  - EY230046 Contaminated Land and Recycling of Soil: 5 CU
- EYOPS23PP-1018 Carbon Neutral Society: 0 - 17 CU
  - EY230047 Life Cycle Assessment and Carbon Footprint: 5 CU
  - EY230048 Energy Efficiency: 4 CU
  - EY230049 Professional Project 1: 3 CU

        - EY230050 Professional Project 2: 5 CU
        - EYOPS23PP-1019 Sustainable Society: 0 - 25 CU
        - EY230051 Quality Management and Management Systems: 5 CU
        - EY230053 Energy and Environmental Economy: 5 CU
        - EY230054 Environmental Legislation: 5 CU
        - EY230055 Healthy and Safe Work Environment: 4 CU
        - EY230056 Built Environment and Spreading of Diseases: 3 CU
    - EYOPS23PP-1020 Advanced Studies in Process Technology: 34 CU
        - SY221103 Differential and Integral Calculus: 4 CU
        - EY230057 Basics of Programming: 5 CU
        - EY230058 Advanced Calculus: 5 CU
        - EY230059 Linear Algebra: 5 CU
        - EY230060 Chemical Thermodynamics: 5 CU
        - EY230061 Chemical Reaction Engineering: 5 CU
        - EY230062 Metallurgical Processes: 5 CU
    - EYOPS23PP-1021 Additional Studies in Metallurgy: 0 - 15 CU
        - MT230401 Materials and Materials Selection: 5 CU
        - MT230402 Production Technology: 5 CU
        - MT230404 Metallurgy: 5 CU
- **EYOPS23PP-CATEGORY-1002 ELECTIVE STUDIES: 15 CU**
    - EYOPS23PP-1004 Elective Studies: 15 CU – Optional studies
- **EYOPS23PP-CATEGORY-1003 WORK PLACEMENT: 30 CU - Compulsory**
        - HASY0500 Practical Training: 5 CU
        - HASY0501 Practical Training: 5 CU
        - HASY0502 Practical Training: 5 CU
        - HASY0503 Practical Training: 5 CU
        - HASY0504 Practical Training: 5 CU
        - HASY0505 Practical Training: 5 CU
- **EYOPS23PP-CATEGORY-1004 BACHELOR´S THESIS: 15.01 CU - Compulsory**
    - EYOPS23PP-1001 Bachelor´s Thesis: 15 CU
        - OSY17060 Beginning and Planning the Thesis: 5 CU
        - OSY17061 Justification of Methods and Presentation of Data: 5 CU
        - OSY17062 Completion and Presentation of the Thesis: 5 CU
    - EYOPS23PP-1002 Maturity Exam: 0.01 CU