

Competence of district heating operators

A report from a joint sub project in Wood energy and
Cleantech 2012

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Introduction

Competence is defined as knowledge and skills together. It means an ability to apply your knowledge in practice.

In order to have a common definition we can use definition by
The European Qualifications Framework for lifelong learning. (EQF)

“knowledge” means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. In the context of the European Qualifications Framework, knowledge is described as theoretical and/or factual;

“skills” means the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments);

“competence” means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development. In the context of the European Qualifications Framework, competence is described in terms of responsibility and autonomy.

The purpose of EQF is to obtain transparency in European Union so different competences can be understood and used in the member states

What is a competence profile?

Personal profile – a list of competences that a person has, regardless of how the person have acquired them (exams, courses, experience, formal or informal).

Working place profile – a list of competences needed to perform a good work in a position (operator of a machine, purchaser, researcher, manager) regardless of how the competences fits in with different exams or curriculums.

In order to evaluate or estimate personal competence profiles, different tools have been developed. They are often a combination of theoretical and practical tests. In many cases a grade from an education will give a certain competence profile but it may not be sufficient. A university degree can be a part of a competence profile but will not give information of the “soft” competences like ability to cooperate or the ability to work effectively.

Evaluation or estimation of a working place profile is made by examining the reasonable requirements you have for a job.

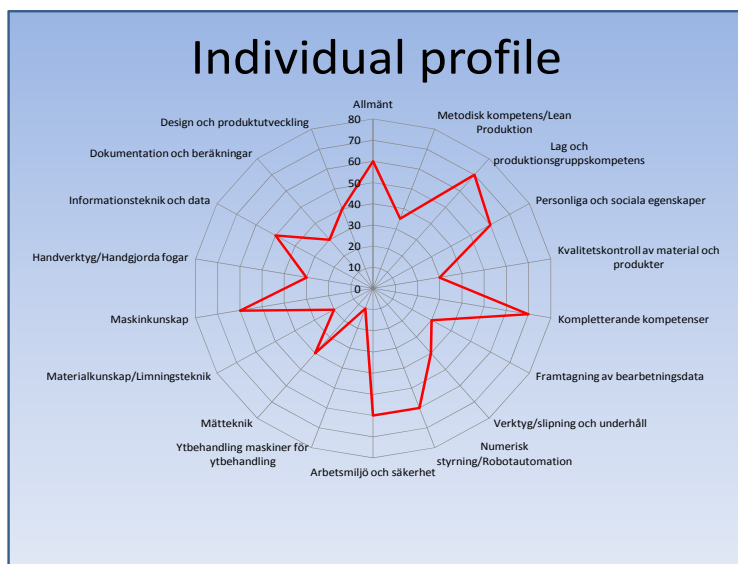
Competence gap

The gap between the competence of a person and the competence demand of a working place gives an indication of the need for competence development

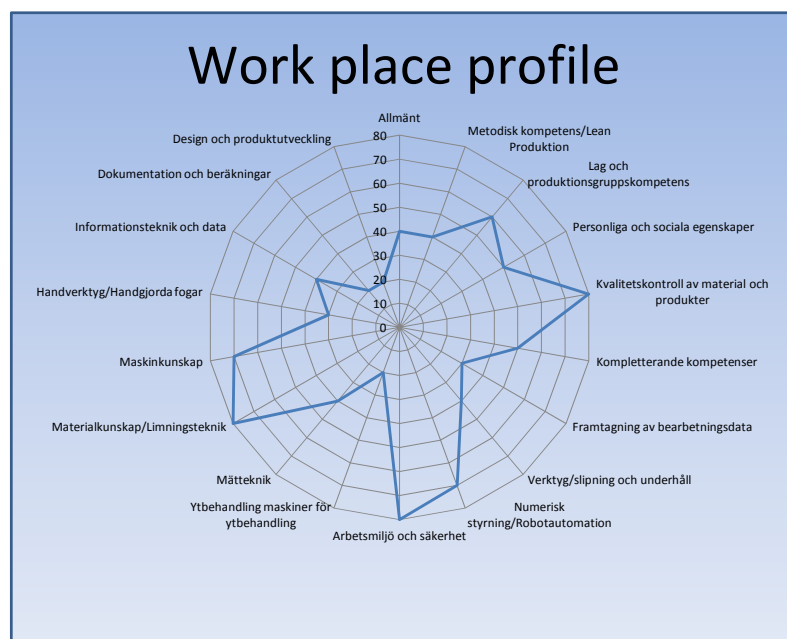
In the attached file there is an example of fields of competences for the wood and timber industry.

Once you have decided what competences are relevant for different jobs in the wood energy sector you can start evaluating personal competence profiles and put them in relation to working place profiles.

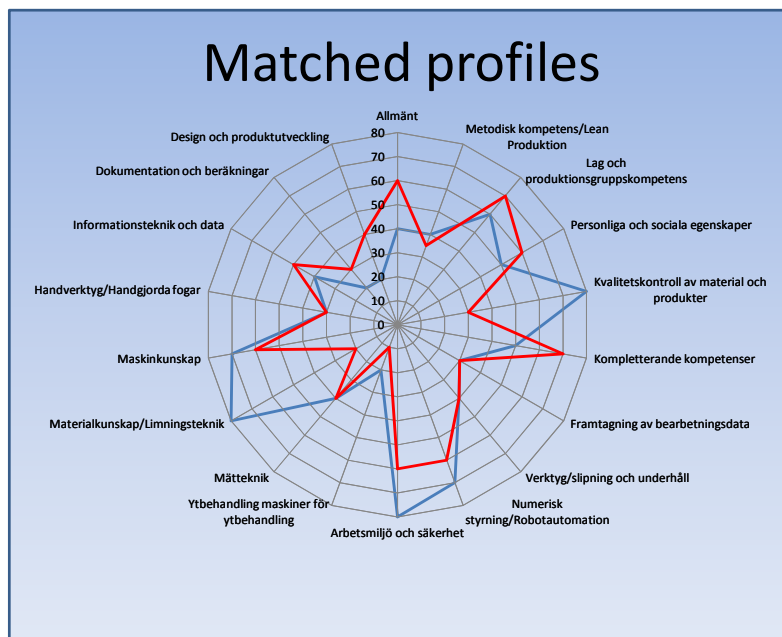
Examples diagrams below



Individual profile



Work place (company) profile



Matched profiles

Method

Finding a competence profile for operating district heating facilities is not like finding the competence for operating a machine. It is more complex than that. There is a mix of competences needed. In a bigger company there are many specialists involved and in smaller companies subcontractors are doing some of the work. In order to get at least an idea of what kind of competencies are needed, interviews has been made in the project area (Tartu, Vidzeme and Östergötland) with different kind of operators; small, medium and big ones.

The results of the interviews are presented region by region and followed by a discussion of differences and similarities. We hope the result can be used when competence issues in the district heating sector is discussed and planned.

Östergötland

Tekniska verken AB

Background

200 employees work with the district heating. The staff includes the central office and at the different plants providing district heating in 7 towns where of Linköping (130 000 inhabitants) is the biggest.

Organisation

- Central staff
- Chemists, Environmental engineers, Production optimisation, Business development
- Maintenance group
- Purchasing organization
- Operating group for each plant

The educational levels of present staff are:

Civil engineers (master's degree)
Environmental engineers (master's degree)
Chemists (master's degree)
Economists (master's degree)
Engineers (diploma level)
Project leaders distribution networks (engineers/civil engineer)

For the moment there are 20 civil engineers. (Master's degree in engineering and profiles to environmental issues).

Demanded educational activities

University course in energy management, business concepts
Knowledge of buildings and heavier energy applications
Higher level of technicians combined with market profiles
Control and regulation technology (computerized)

Good cooperation with University of Linköping and to some extent with vocational high school. (1 and 2 year courses adult training after upper secondary level)

Not so much contact with upper secondary level energy programme.

Recruiting

Recruiting is following a traditional procedure with testing and interviewing.

For a big operator like this high educational level is necessary and also combination with business skills even for staff with lower educational level. All staff will meet different type of customers and then it is important that they are aware of the products and services the company can offer

Lantmännen Agrovärme AB

Agrovärme is running several smaller DH units. In Ödeshög they produce 15-17 GWh in a 3,5 MW boiler with economizer.

A local subcontractor is operating the unit which requires 4 persons on part time bases.

Competence requirement

The competence requirement for the subcontractor is:

boiler course (3 days)

knowledge of control and regulation technology,

electrician licence is almost a requirement (electrician is a very good base since the unit is automatic and most maintenance has to do with control and regulation).

Fuel handling – operating truck, truck licence.

Fuel selection at high load and low load (Forest wood chips , RT chips, or sawdust)

The staff handling the boiler has to be a well matched team. It is very important that they can solve the problems and work together when necessary.

Fuel delivery is handled by Agrovärme not the subcontractor.

Competence development for subcontractor is handled by Agrovärme in form of conferences and dialog on what kind of education is needed.

Recruiting

It is hard to find correct competence. There is now a generation of staff with background in the marine (engine officers, chiefs) that will be retired and they had a broad general competence of these type of units. Sometimes firemen are employed.

Ydre municipality

Pellet boiler supplying buildings in the village of Österbymo. Back up boilers; 1 small pellet boiler and 1 oil boiler. 2010 fuel consumption was 1378 tons of pellets and 23 m3 of oil.

Organisation

Own staff (3-4 employees) combines boiler operation with other activities in the municipality such as attending the sewage plants and clean water supply for the villages in the municipality.

Main work is to check boiler function, provide fuel, call for expert help (electrician or other). The boiler is surveyed from distance by a consultancy firm who checks normal function and alarms if something is wrong. This firm also measure the heat supply at each customer.

Competence of staff

Most important is safety awareness and safety knowledge in order to know what to do if you are alerted in the middle of the night. In a small unit like this with shared workload it is important to know when to take in subcontractors for different operations e.g. electricity or licence welding.

The staff suggests courses and other activities to keep competence up to date. It is good if you have worked for 1 – 1,5 years before you take a course so you have something to refer to.

Conclusions Östergötland

The upper secondary level energy programme (see appendix) covers most skills in order to work at a district heating facility. It seems that a close contact between the district heating operators and the vocational training is necessary to keep the education up to date and corresponding to the needs of the DH operators. The curriculum is so general formulated that it would be possible to fit in most of the requests on the local level.

Control and regulation technology and business skills may not be up to the level required by the operators and can therefore be carried out on a higher educational level. It seems that these skills are too advanced for the upper secondary level. Tekniska verken participate in one reference group for this type of education.

The “soft” personal characteristics and abilities such as ability to cooperate and take initiatives are very important (maybe just as important as the technical skills). Especially for smaller district heating facilities. The main problem is to attract students to the educations both upper secondary level and additional higher education. This issue will be addressed in the pilot projects.

Vidzeme

Introduction

In total there are 127 parishes in Vidzeme planning region. In almost all parishes there is at least one boiler house. These are mainly wood log, wood chip and pellet small size boiler houses with installed capacity between 0.2-4.0 MW. There are also natural gas boiler houses in four municipal districts (Valmiera city, Cesis, Valmiera parish and Ligatne district). The installed capacity of these systems varies between 0.24 and 54.2 MW.

In order to understand the competences needed for employees working in district heating companies in Vidzeme planning region, three interviews were conducted in October 2011. Three different size operators were selected: large size (Alūksne district heating company – 15 MW), medium size (Liepa district heating company – 6.7 MW) and small size (Kalsnava district heating company – 2.5 MW). Interviews were based on the questionnaire (see Annex 1).

Alūksne

Background

There are five wood chips, sawdust, pellets, wood logs and coal boiler houses operating in Aluksne. The total installed capacity of all boiler houses is 15 MW. Total heated area is more than 121 thous. m².

An interview with the head of the production department of the district heating company “Simone” Mr. Guntis Melecis was made.

Staff

There are 33 persons employed by district heating company to operate five boiler houses. These are manager, technicians, accountant, tractor drivers, operators, constructor, welders and blue collar workers.

Results of interview

Mr. Melecis during the telephone interview pointed out following issues:

- In each district heating company it is important to employ energy engineer. At the moment Simone has not hired such a specialist. Another professional to be hired is high quality electrician that would have knowledge in automation.
- Most of the employees should be able to use computer, electrician should have knowledge to use electronics and administration should be able to communicate and have also business planning skills.
- Employees operating wood chip and other biomass boiler house first of all should be trained. However there are no particular requirements set when the persons are hired, except for boiler operators.
- There is transition period of one to three months for new employees. During this period employees are evaluated and final decision is taken after.
- There is no cooperation with any educational institution. Also capacity building is offered rarely.
- Usually experienced employees train the new employees.

Liepa

Background

Boiler house of Liepa is medium size wood chip boiler house operated by the municipality. Installed capacity is 6.7 MW. Annually company produces 14.5 GWh of heat energy.

An interview with the deputy of executive director of Priekulji region council Mr. Ralfs Saļmo was made.

Staff

The boiler house is operated by the municipality. There are 7 part time and full time persons employed: procurement specialist, accountant, energy specialist, technician, electrician, plumber and tractor driver.

Results of interview

Mr.Saļmo indicated several important aspects regarding competence building in district heating company:

- Additionally to the employed workers, there is need of highly qualified boiler operator that has knowledge of combustion processes and could ensure higher efficiency of the boilers.
- It would be useful if employees (when applicable) have following skills: ability to use computer, knowledge in electronics, licence for works with high voltage equipment, welding skills and skills in business planning.
- It is of high importance that employees understand combustion processes and are able to regulate the boilers according to the quality of wood chips. This leads to higher efficiency.
- When new persons are hired for work in boiler house, it would be important to evaluate their ability critically assess situation, their level of responsibility and if they follow instructions. Moreover, if they could come up with new ideas and possibilities.
- At this stage there are three other aspects evaluated when person is hired for work in boiler house. These are desire to work, ability to be trained to use boiler house equipment and skills to use them. Previous experience is of great importance when persons are employed.
- At this stage there is no cooperation with educational institutions. Furthermore there is no offer regarding high quality labour force.
- There is no building capacity organised for the employees. There are only annual courses for boiler operators.
- It is a common practice that experienced employees train the new arrivals.

Kalsnava

Background

There is small scale boiler house installed in Kalsnava parish. The boiler house is operated by the municipal company "Kalsnavas komunālais uzņēmums". Total installed capacity of two woodchip and sawdust boilers is 2.5 MW.

An interview with the representative of the company Mr. Edvins Cipulis was made.

Staff

The boiler house is operated by the municipality. There are 9 part time and full time persons employed: administrator, manager, accountant, truck driver, boiler house operator, electrician, and mechanic and tractor driver. Company combines boiler operation with other activities in the municipality like water supply, wastewater collection and treatment, transportation, waste management and real estate management.

Results of interview

Mr. Cipulis enlightened several aspects:

- There are enough personnel employed in the company to ensure operation of the boiler house.
- Mostly skills of computer and electronics are needed for the respective employees as well as business planning skills for manager and accountant.
- Boiler operator should have knowledge how to regulate the supply of woodchips depending on fuel quality.
- There are few general requirements set when company hires new employees. These are health check, secondary education background and skills to use equipment and licences (when applicable). Additionally references from previous employers are assessed.
- To hire new personnel, company announces vacancy. Until now there has been always an interest.
- Company cooperates with two educational institutions: East Vidzeme training centre located in Aluksne (training for plumbers and training on safety) and BUTS training centre in Madona.
- Employees are often sent to the training courses (with fee). However the most common practice also here is the knowledge transfer from experienced workers to recently employed.

Vocational education programs in Vidzeme planning region

Training centre BUTS offers following vocational education programmes:

- Learning of welding and plumbing works;
- Learning of electricians;
- Heating systems:
 - Professional programme for heat combustion;
 - Operation of high pressure boilers;
 - Professional programme for operation of automatised heat networks;
 - Professional programme for maintenance of heat systems;
 - Operation of low pressure boilers;
- Energy:
 - Third professional qualification level for electricians;
 - Electrical safety.

East Vidzeme training centre offers training courses only for plumbers and also general training on safety. There are several other training centres located in Vidzeme, e.g. Professional education development competence centre of Vidzeme region. However these centres do not offer training courses and vocational education programmes related to energy issues.

Conclusions

There are similar issues to be tackled in all three district heating companies. Interviews showed that actually there are very few requirements set before selecting new employees like previous experience. There is high interest for available vacancies however seldom engineers or specialists with technical background are applying for the position.

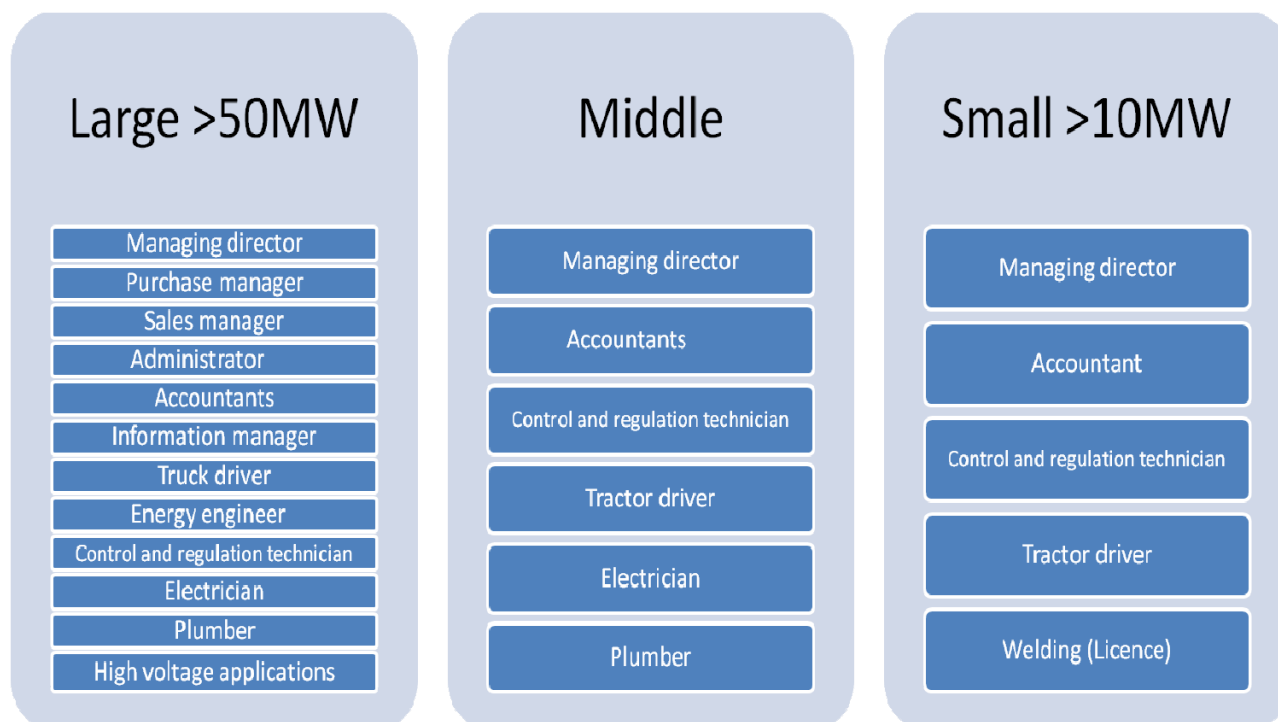
In the meantime two of the three boiler houses do not implement qualification and competence building measures. In general experienced employees train the new workers though experienced member of the staff rarely increase his/her qualification.

Tartu

Introduction

Overview of professions in various DH power plants

From figure above we can follow what kind of professions is represented in variously sized power plants and from here it is possible to find out what kind of competence could be needed at all.



Company: Fortum Tartu CHP

Employees: 100

Interviewed profession: Sales manager

Installed capacity: 50Mw + 25 MW (electricity) Total (distributed on different boilers)

Fuel

Woodchips, peat (the company owns peat fields in Tartu region)

Outsourcing

The complicated repairs in the CHP are obtained from the mother-company in Finland (Fortum OY)

The repairs of the district heating network pipes is obtained from other piping companies.

Competence needed

- Lack of skills in system diagnostics.
- The chemistry of the burning process is a complicated question.
- The competence in industrial boiler operating is not on a high level.
-

Occurring technical problems

- Freezing risk of the feeding system in winter - the demand of woodchips is ~90m3 in 10 minutes in winter time at the high consumption period.
- If the fuel is too wet, the weight overloads the conveyor belt.

More

Truck drivers for wood chips are not needed in this facility, because the woodchips are delivered by the suppliers directly onto the conveyor that leads to the bunker and from there to the furnace.

In Estonia we have a lack of industrial engineers for large scale district heating facilities.

Company: Elva district heating

Employees: 14

Interviewed profession: managing director

Installed capacity: 15,1MW Total (distributed on different boilers)

Fuel

Woodchips, sawdust, wood waste

Outsourcing

- The repairs of electronics is obtained from professional companies.
- The competence in automatics is gained from the company that reconstructed the boiler plants to wood fuelled facilities.

Competence needed

A competence controlling is conducted to the boiler operators during mandatory competence controls, since the boiler size exceeds a certain limit.

- Automation
- Possible future solutions to produce electricity

Occurring technical problems

- Some small problems with feeding system

More

- The fluctuation of personnel is very low. Almost all the workers have worked there for at least 10 years. The level of income is since now not a big problem.
- The town municipality helps in legal questions and at the paperwork.
- There has been no critical need for additional training.

Company: Rõuge district heating

Employees: 4

Interviewed profession: manager/technician

Installed capacity: 2 MW

Fuel

Woodchips, sawdust, wood waste

Outsourcing

Almost everything is done by manager and technician, but outsourcing

- Special equipment and installations

Competence needed

Any additional skills would be desirable. The main problem is the out of date boiler.

- Electronics, also automation

Occurring technical problems

- Fuel feeding system
- Automation system

More

- Salaries are very low and therefore low motivation
- Investments to new boiler system is needed
- Not enough time to do everything

Summary

Large units

Competence desired.

Civil engineers (master's degree)

Environmental engineers (master's degree)

Chemists (master's degree)

Economists (master's degree)

Engineers (diploma level)

Project leaders distribution networks (engineers/civil engineerEnergy engineer

High quality electrician that would have knowledge in automation.

Skill of operating wood chip and other biomass boiler house

Administration should be able to communicate and have also business planning skills.

Ability to cooperate and take initiatives

Competence deficiencies

System diagnostics.

The chemistry of the burning process

Industrial boiler operating skills

Business skills for all staff

Control and regulation technology

Medium sized units

Competence desired.

Highly qualified boiler operator, knowledge of combustion processes and fuel qualities

Ability to use computer

Knowledge in electronics, licence for works with high voltage equipment,

Welding skills

Skills in business planning.

Desire to work, ability to be trained

Ability critically assess situation, follow instructions. come up with new ideas and possibilities.

Small units

Knowledge of control and regulation technology
Electrician licence (automation, control and regulation).
Fuel handling and fuel selection – operating truck, truck licence.

Well matched team. Solve the problems and work together when necessary.

Combined knowledge (boiler operation with other activities sewage plants clean water supply, estate management))

Safety awareness and safety knowledge

Know when to take in subcontractors for different operations e.g. electricity or licence welding

Competence development

The opportunity for competence development is very different in the regions. In most cases newcomers learn from the staff in place but for further competence development the situations in the regions vary a lot. One common problem seems to be to attract staff with higher education, so the competence development of the staff employed is important to keep up knowledge and be able to follow the technical development in the field of district heating and forest fuels.

One recommendation as a result of this report is to start talks where district heating companies meet the vocational training institutions and other educational providers in order to see what can be done to keep the competence level up to date and fill the competence deficiencies.

Appendix 1. Interview guide of DH competence

Objective

To gather information on what kind of competences is needed in the field of managing and operating district heating facilities, especially with focus on wood energy and clean technology. Relate competences to existing educational offers and propose actions.

Method

Interviews with the management of three district heating facilities, representing small medium and large units. Analysis of interviews. Comparing regions (countries)

Base for interviews

Professions

What different professions do you have in your unit for the moment? Consider all activities (purchasing of raw material, fuel preparation, boiler unit distribution sales)

Example of professions

- Managing director
- Purchase manager
- Sales manager
- Administrator
- Accountant
- Information manager
- Truck driver
- Energy engineer
- Control and regulation technician
- Electrician
- Plumber

What kind of professions would be desirable?
(Combination of skills, new competence etc)

Competences

What competences and what level do you think are important for the different professions we have talked about?

Example of competences.

- Computer knowledge
- Electronics
- High voltage applications (Licence)
- Low Voltage applications (Licence)
- Welding (Licence)
- Control and regulation
- Negotiation skills
- Business planning

What competences do you consider specific to the use of wood fuel?

What is your general requirement (except the special competence) on staff working in your unit?

Example

Propose changes
Cooperative
Critical
See new possibilities
Solve conflicts
Loyal to company
Confident
Follow instructions

Recruiting

How do you recruit staff today?

How do you evaluate the competence of person that applies for a job?

Do you get competent staff from educational institutions (vocational training, technical institutes, and universities)?

Do you have continuous dialogue with educational institutions about curriculum?

Maintaining and develop competence of staff.

How do you keep your staff up to date?

Do you apply in service training?

How do you do this?

Old staff teaches newcomers

Old staff is sent to refreshing courses

To what extent? Is this a costly activity?

Other comments

Appendix 2. Topics and courses related to Wood energy and district heating

Upper secondary (16 – 19 years) Vocational training.

Subject - Energy

The subject of energy technologies dealing with energy technical objects and how the system works and is constructed. The subject is partly based on scientific principles that apply to energy facilities. An environmental perspective is included in the subject because energy technology systems largely affect the environment.

Aim of the subject

The teaching of the subject energy technologies will be aimed at students develop skills in performing the operation, maintenance and servicing of energy installations and the ability to solve practical problems in the area. It will also bring the students develop knowledge of basic physical quantities, the necessary mathematics, basic chemistry. In addition, students have the opportunity to develop knowledge of treatment, sampling and analysis of different types of water used in process industries and in the energy, environmental and water technology. In addition to teaching lead to students developing a theoretical basis in the energy sector.

In teaching the students the opportunity to develop an understanding of efficient and sustainable energy and ecological approach. Students should also be given the opportunity to develop knowledge of both conventional and alternative energy systems and to develop safety awareness, professional identity and professional ethics.

Through experimentation, laboratory, and an investigative approach, students are given the opportunity to develop the ability to solve problems related to operation, maintenance and servicing of energy installations. Through practical exercises, students are given the opportunity to develop technical skills, and manage technical equipment.

The teaching of the subject energy technologies will provide students with opportunities to develop the following:

1. Knowledge of different energy technology facilities.
2. Knowledge of the structure, function and principles of various energy technology solutions.
3. Knowledge of different energy sources and fuels, and energy-bearing media properties.
4. Ability to perform duties in various energy installations as well as work with regard to safety, quality and environment.
5. Ability to optimize and perform verification and operational procedures and energy conservation measures in various energy plants.
6. Ability to solve physical or chemical water problems through laboratory work.
7. Ability to handle materials and tools.
8. Ability to document and evaluate your own work.
9. Ability to interact with others and use technical language.
10. Ability to work under national laws or regulations.

Courses on the subject (1 week full time study – 25 points)

- ♣ Energy 1, 100 points.
- ♣ Energy 2, 100 points,
- ♣ Renewable Energy, 100 points,
- ♣ Water and Process Chemistry, 100 points.

Energy 1, 100 points

Course code: ENEENE01.

The teaching of the course will address the following core content:

- ♣ Basic understanding of systems in areas where energy and efficient energy management.
- ♣ Energy content of various fuels.
- ♣ Renewable energy sources: solar, wind, wave, heat pump, energy, gas, biofuels and alternative fuels for vehicles.
- ♣ Energy consumption in the EU.
- ♣ Process Knowledge of nuclear power, hydropower, thermal power, district heating and cooling.
- ♣ Process Knowledge of water treatment for drinking water and contaminated water, environment and recycling.
- ♣ Handling, assembly, measurement and easier maintenance of energy equipment.
- ♣ Safety in the energy sector.
- ♣ Measurement system for energy and power as well as units and abbreviations for energy and power.
- ♣ Use and care of equipment and tools.
- ♣ safety and professional ethics. And ergonomic.
- ♣ Legal and other requirements.

Energy 2, 100 points

Course code: ENEENE02

The teaching of the course will address the following core content:

- ♣ Properties of energy-carrying media.
- ♣ General pump technology, thermodynamics and hydrodynamikens laws.
- ♣ General Corrosion Science and the properties of different materials.
- ♣ Key variables in the energy sector, such as force, pressure, temperature, energy, power and efficiency.
- ♣ Structure, function, working principles, production conditions and environmental impacts of energy, environment and water installations.
- ♣ Maintenance Practices Energy.
- ♣ Control and operating procedures in different plants.
- ♣ Safety in the energy sector.
- ♣ Calculations and applications of mechanics and thermodynamics of energy installations.
- ♣ Optimization of efficiency and quality of energy, environment and water installations.
- ♣ Use and care of equipment and tools.
- ♣ safety and professional ethics.

Renewable energy, 100 points

Course code: ENEFÖRO

The course renewable energy include paragraphs 1-5 and 7-10 under Aim of the subject.

The teaching of the course will address the following core content:

- ♣ Main components of the various alternative energy facilities and their job.
- ♣ Energy conversion and energy generation in the operation of different facilities.
- ♣ Renewable energianläggningars fuel and waste out of service, safety and environmental standpoint.
- ♣ Fuels and their properties and the combustion process.
- ♣ Renewable energy sources such as biomass, solar, wind and wave power. Natural sources of heat and heat pumps. Renewable energy for vehicle propulsion.
- ♣ Operating and maintenance procedures for different plant types.
- ♣ safety and professional ethics.

- ♣ Use and care of equipment and tools.
- ♣ Laws and other rules applicable to the operation, environment and safety in the use of renewable energy sources and fuels.

Water and Process Chemistry, 100 points

Course code: ENEVAEO

The teaching of the course will address the following core content:

- ♣ Basic chemistry and stoichiometric calculations in the water and the environment.
- ♣ Chemical processes associated with manufacturing processes.
- ♣ Corrosion Science with specialization in water chemistry.
- ♣ Different types of water suitability as raw water.
- ♣ Mechanical, biological and chemical treatment of raw water.
- ♣ Sampling, measurement and analysis and the use of measurement equipment in the water and the environment.
- ♣ Handling of chemicals in a safe and environmentally sound manner.
- ♣ softening and total desalination.
- ♣ Requirements for boiler water, condensate and dilute water.
- ♣ Use and care of equipment and tools.
- ♣ safety and professional ethics.

Subject - Power and heat technology

The power and heat producing industrial complex systems places high demands on reliability. A society's industrial and production of potable water and heating does not allow any disruption of energy supplies. The subject of power and heat engineering deals with why the operation and maintenance of complex power and thermal systems. The subject is based on science, because knowledge of physics, mechanics and thermodynamics are essential for system understanding.

Aim of the subject

Teaching the subject heat and power technology will be aimed at students develop knowledge of the operation, maintenance and servicing of power generation and heating installations. Instruction will also give students the opportunity to develop an understanding of the impact power and thermal plants have air environment, land and aquatic environment. The teaching of the subject will also help students develop the ability to solve problems and take responsibility for the operation as well as environmental. In addition to teaching to help students develop knowledge of current and future energy supply.

Through an explorative and practical work and laboratory work, students are given the opportunity to develop understanding of systems of power and heat technical facilities and the ability to carry out the operation, maintenance and servicing of these.

Teaching the subject heat and power technology will provide students with opportunities to develop the following:

1. Knowledge of the structure and function of heat and power installations.
2. Ability to perform operation and maintenance of various facilities.
3. Ability to perform energy calculations on the plants.
4. Competence in operating efficiency of different systems with regard to the environment and economy.
5. Ability to carry out sampling, analysis and dosage of the media present in the plant.
6. Ability to handle existing tools and instruments.
7. Ability to interact and discuss with a professional language.
8. Knowledge of safety and environmental requirements of different plants.

Courses on the subject

- Heat and Power Technology 1, 200 points, based on the course Energy 2 and course of Water and Process chemicals.
- Heat and Power Technology 2, 200 points, based on the course Heat and Power Technology 1.
- Backup power, 100 points.

Heat and Power Technology 1, 200 points

Course code: KRAKRA01

The teaching of the course will address the following core content:

- Establishment of systems for district heating and cooling.
- Different fuels and associated fuel handling systems.
- Different burner and tuning characteristics.
- Different boiler types for warm and hot water.
- Flue gas cleaning systems and dust extraction.
- Operation and maintenance related to the environment and economy.
- Calculation methods for the optimization of the operation.
- Water treatment equipment and sampling, analysis and dosage of the feed water.
- Tools, instruments and manuals.
- Inspections, inspection and safety regulations for various types of facilities.

Heat and Power Technology 2, 200 points

Course code: KRAKRA02

The teaching of the course will address the following core content:

- The steam thermodynamic properties.
- Different steam boilers function and structure of the way.
- Different types of superheaters.
- Nuclear technology function and operation.
- Steam turbines, condensers, and generators.
- Operation and maintenance related to the environment and economy.
- Energy conversion and energy generation with different operating conditions.
- Calculation methods for the optimization of the operation.
- Water treatment equipment and sampling, analysis and dosage of the feed water treatment.
- Tools, instruments and manuals.
- Inspections, inspection and safety of boiler plants.
- Safety and Environment in energy production.

Backup power, 100 points

Course code: KRARERO

The teaching of the course will address the following core content:

- Structure and function of diesel engine, gas turbine and battery installations.
- Operation and maintenance of diesel engine installations.
- Operation and maintenance of gas turbine plants.
- Operation and maintenance of battery systems.
- Operation and maintenance of small and mobile auxiliary power units.
- Planning, monitoring and test operation.
- Calculation methods for the optimization of the operation.
- Different types of consequences in case of interruption in production.

- Tools, instruments and manuals.
- Phasing of different systems and standards and safety.