Report survey and interviews

Project GREEN TECH

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1 Introduction

The GREEN TECH project develops an innovative and cross sectoral European education proGRam to strEngthEN the training of TECHnicians in the field of renewable energy. The project is funded by Erasmus+ and consists of eight partners from five different countries, namely **GIP FIPAG** or Public Interest Grouping for Professional Training and Integration of the Académie de Grenoble (Grenoble, France), **Smart Energy Systems Campus**, a place for innovation and training in the field of energy transition (Grenoble, France) **XABEC** vocational training centre (Valencia, Spain), **PANKO** Panevėžio kolegija/ Panevėžys University of Applied Sciences (Panevėžys, Lithuania), **KBA Nijmegen** research institute (Nijmegen, The Netherlands), **UCLL** Higher Education Institute (Diepenbeek, Belgium), **Université Grenoble Alpes or UGA** (Grenoble, France) and **TENERRDIS**, energy cluster and international centre of excellence for R&D (Grenoble, France).

The GREEN TECH project aims at breaking down the barriers that exist today between individual energy system training courses in order to train more versatile technicians. The consortium wants to create a training course specifically adapted to mechanics, technicians, and engineers (Level 4-6 EQF) who will have to deal with the new energy mix. The course will be composed of six training modules, and each module contains a theoretical part (10h) and a practical part (10h).

- Module 1. An *introduction* describing the context and the multiple stakes,
- Modules 2,3,4. Three modules about the different energy sources and vectors and their specificities *Solar Energy, Wind energy, Green gas (emphasize Hydrogen gas)*,
- Modules 5,6. Two modules describing the necessary connections between them created by the *Network Management and storage* and the *different usages* based on real world industrial use cases.

Objectives of the survey and interviews
As the context of energy transition is still moving and specific to each country, it is very important for the new training course to have a strong link with the current and future needs of the industrial (and educational) world. The main objective of the survey - which will be deployed in all five partner countries - is to learn about the energy transition strategy in every country and to get confirmation of the set of skills needed for the energy transition in every country involved in this project. The objective of the interviews is to get a more in-depth view of this which together with the information from the survey will enables us to adapt the content of the new to be developed training course/modules.

2 Methodology and response

2.1 Methodology

The goal for the survey is to target as many companies and institutions in the energy cluster as possible. Potential companies and institutions of focus are energy providers, energy network/grid/storage companies, companies manufacturing/designing/engineering/installing/repairing/maintaining solar panels, heat pumps, windmills, or other renewable energy devices/equipment, companies offering advice in the field of renewable energy, R&D institutions in the field of renewable energies, colleges and universities with education courses in the field of renewable energies, government agencies and public authorities (local, regional, or national).

It proved difficult to collect contact information (e-mail addresses) from target companies in all five countries involved. Most partners in the GREEN TECH project are colleges/universities and they do have relations with some companies, but no available database of contact information from target companies all over the country. Plus, there is the usual challenges with privacy laws to send contact information between partners. The hurdles made us change strategy. Instead of sending out requests to fill in the survey by the research institute KBA Nijmegen (partner in this project), we decided that every country/partner will send out the requests themselves. As a benefit, a request of a local party is more recognisable to the targeted companies and will likely gain more response. Furthermore, to bypass privacy issues we never used information that wasn't publicly available. The following strategies were used to request companies to fill in the survey:

1. open link to survey in newsletters, on websites, social media et cetera
2. open link to survey in an e-mail sent to companies from our own network
3. open link to survey in an e-mail sent to public e-mail addresses (found on the internet)

All five countries involved used at least two of the three strategies mentioned, where Spain also sent the survey to companies in Portugal and Turkey. The first invitations were sent out in the end of October 2022 and the surveys stayed open through early January 2023. Because of a poor response by early December, every partner sent multiple reminders.

For the interviews we mainly contacted companies in our own network. In The Netherlands mainly educational institutions were interviewed, for one specific reason which is to ask if the end results of project GREEN TECH would be interesting for the Dutch educational system (since the project does not contain a Dutch partner in education). This also gave us the opportunity to ask about similar courses that are in development elsewhere in The Netherlands (which we can learn from).

2.2 Response

Response survey

In total we had 197 respondents who opened the survey, of which 69 respondents filled in only the first question or no questions at all. This means that 128 responses were used to present the findings (see next chapter). Even though a lot of effort has been put into it, the target response for the survey (100 contacted per country) is not met. Our targets proved to be too ambitious, however the total response of 128 is still useful and somewhat satisfactory.

Table 1 – Response survey and interviews per country

	Nr. respondents that opened the survey	Usable response
Lithuania	26	18
France	43	17
Spain	94	74
The Netherlands	33	18
Belgium	1	1
Total	**197**	**128**

More than a quarter of the respondents represent a company which installs/repairs/maintains renewable energy devices/equipment, such as solar panels, heat pumps and windmills. Many companies that designs/engineers or manufactures these devices also responded (resp. 9% and 7% of total response). A big part of the respondents consists of educational institutions (19%) and companies offering advice in the field of renewable energy (10%). Almost one of five respondents say they represent a different kind of company, but looking at their answers they mostly belong to one of the mentioned categories.

Table 2 – Type of company/institution that responded to the survey

I represent …	Response
A company *installing/repairing or maintaining* solar panels, heat pumps, windmills, or other renewable energy devices/equipment	27%
A college or university institution	19%
A company offering advice in the field of renewable energy	10%
A company *designing and engineering* solar panels, heat pumps, windmills, or other renewable energy devices/equipment	9%
A company *manufacturing* solar panels, heat pumps, windmills, or other renewable energy devices/equipment	7%
An energy provider	5%
A R&D institution in the field of renewable energies	5%
An energy network/grid/storage company	2%
A government agency or public authority (local, regional, or national)	2%
Other	19%
	N=128

Response interviews

The target for the interviews was to get 50 done in total, 10 per country. We almost delivered this target, in total 48 interviews were done. Educational institutions were interviewed in The Netherlands. Companies in the energy cluster (like those who were targeted for the survey) were interviewed in the other countries.

Table 3 – Response interviews per country

	Interviews done
Lithuania	12
France	9
Spain	10
The Netherlands	13
Belgium	4
Total	**48**

3 Findings

3.1 Energy transition strategy

In the survey, we summarized the energy transition strategy for each of the five countries involved, based on public information on the official climate and energy plans from the national authorities. You can read our summaries in the appendix. We then asked what type of challenges are most important to overcome to accomplish this energy transition strategy and to achieve the necessary carbon reduction. From the findings in table 4 we can conclude that for a major part we can overcome challenges if governments really want to. Almost half of the respondents say that governmental/visionary/strategical challenges are the most important to overcome. The world has changed quite drastically in 2022 and its effects on the field of energy are already enormous. Following Russia's invasion of Ukraine, the EU has decided to stop importing all Russian oil, coal, and gas in the nearby future. Combined with the already soaring energy prices for consumers and businesses in many European countries, it is to be expected that the EU and individual member states will speed up their transitions to clean, renewable and sustainable energies. And new government policies could also bring good news for climate objectives too. Which is important, as the latest climate report of IPCC warned that current government plans to address climate change are not ambitious enough - and climate change will increase in all regions the coming decade.

So, at first it might appear that governmental (and behavioural) challenges are overcome following Russia's invasion of Ukraine. However, many hurdles in executing the energy transition strategy still exist, for example in law making, procedures and permit granting. Some respondents also mention that some national governments in the EU still don't acknowledge the necessity and benefits of renewable energy and are still too much linked to large energy companies. And in some EU-countries there is not enough financial means directed to the energy transition. It is stressed that a long-term plan and financial investments are needed on EU and national level. Regarding behavioural challenges: although most people realize by now that change is needed, actual change is still dependent on financial investments, financial situations and subsidies.

Table 4 – The most important type of challenge to overcome in order to accomplish the energy transition and to achieve the necessary carbon reduction

	LT	FR	ES	NL	BG	**Total**
Governmental/visionary/strategical challenges	6	8	29	8	-	**51**
Labour/skills/human resources challenges	4	3	14	3	-	**24**
Technological challenges	2	-	10	2	-	**14**
Behavioural challenges	1	3	5	2	-	**11**
Financial challenges	1	-	4	1	-	**6**
Other	-	-	-	2	-	**2**
Total	**14**	**14**	**62**	**18**	**-**	**108**

The next major challenge is about labour and the challenge is twofold: first there is a shortage of technical professionals and second there is a need to properly train them due to fast changing techniques (new techniques, devices and systems often require an updated skills-set for professionals involved, whether it's about installing, maintaining, designing, advising et cetera). There is also the need for companies involved to change their human resource management and be more willing to invest in training their professionals.

3.2 Priorities for the energy transition strategy

About two thirds of the respondents feel that solar and wind energy are the energy sources that should be prioritized to accomplish the energy transition and to achieve the necessary carbon reduction. There are some differences between countries. France is notable: the respondents from France have – unlike respondents from the other countries – less interest in wind energy and more interest in nuclear energy. About half the respondents from Spain see potential in hydro energy, many more than respondents from other countries. The build of more wind mills won't be easy, neither in residential areas (due to protesting because of noise, shade and PFAS downfall of mill blades) nor offshore (due to protesting from animal activists and fishing industry).

Table 5 – The renewable energy sources to prioritize

	LT	FR	ES	NL	BG	**Total**
Solar	10	9	55	9	0	**83**
Wind	9	2	48	14	0	**73**
Hydro/water/sea (tidal turbine and other)	1	1	35	2	0	**39**
Geothermal	4	2	14	7	0	**27**
Nuclear	2	8	6	6	0	**22**
Biomass	4	4	5	1	0	**14**
Other	1	1	4	3	0	**9**
Total	**N=16**	**N=16**	**N=71**	**N=17**	**N=1**	**N=121***

* aggregating the numbers in every column adds up to a higher number than the total of respondents, because respondents were allowed to give multiple answers.

We presented several technical developments and innovations in our survey and asked which of these are or will be important to accomplish the energy transition and to achieve the necessary carbon reduction. Table 6a makes clear that all of the presented techniques are deemed important. Some of the techniques might be a little less known given the high score of the answer 'neutral'. High Voltage DC, Carbon capture and Nuclear fusion have the highest scores for respondents disagreeing that these are important techniques. Nuclear fusion is known to cause a lively debate and has strong proponents as well as strong opponents. This is clarified by not only having the largest percentage of respondents that disagree it is an important technique (table 6a), but also being in the top when asked what technique is most important (table 6b). Proponents argue that nuclear fusion can create a lot of clean energy. Opponents mention the risks and nuclear waste, but also the long time it takes to build a new nuclear plant.

Table 6a – Important technical developments and innovations (descending order of (fully) agree)

	(Fully) dis-agree	Neutral	(Fully) agree	**Total**
Interconnections between different energy sectors (such as electricity/gas or gas/heat or electricity/heat or nuclear/renewable energy or transport/stationary energy production)	2%	13%	85%	**N=87**
Smart Grids	4%	14%	81%	**N=91**
Energy transport	8%	12%	80%	**N=86**
Battery storage	9%	12%	79%	**N=92**
Microgrids	4%	19%	77%	**N=83**
Smart Metering	7%	16%	77%	**N=88**
E-mobility	9%	17%	74%	**N=87**
H2 storage	5%	22%	74%	**N=88**
High Voltage DC	14%	23%	63%	**N=79**
Carbon capture	17%	22%	60%	**N=81**
Nuclear fusion	21%	23%	56%	**N=84**

Table 6b – Most important technical developments and innovations

	Most important
Battery storage	23%
H2 storage	15%
Interconnections between different energy sectors (such as electricity/gas or gas/heat or electricity/heat or nuclear/renewable energy or transport/stationary energy production)	15%
Nuclear fusion	11%
E-mobility	8%
Energy transport	8%
Smart Grids	5%
Other	5%
Carbon capture	4%
Smart Metering	2%
Micrograds	2%
High Voltage DC	1%
Total	**N=84**

Respondents also shared other techniques and good practices (examples of installation or proof of concept):

- Combination of (small) wind turbine installations and solar panels for households;
- Using batteries of electric cars/transportation as storage units (being part of the energy grid);
- House heating based on H2, for example 'Stad aan het Haringvliet';
- Accumulation for ACS with solar panel systems and geothermal collection wells for energy savings;
- Easy manuals for self-installation of solar panels;
- Generally promoting energy saving for households (also here) and use of electric vehicles;

- Passive energy systems for buildings (better use of natural sunpower and airflow to heat and cool buildings);
- Energy saving and energy creating (after)burner installations (for example for crematoria);
- Use of green hydrogen in the port of Valencia;
- Use of bio-energy, for example Waga Energy and Prodeval;
- Use of waste/residual heat for heating households;
- The energy model of Iceland;
- Ideas originating from The Solar Decathlon, an international university competition organized since 2002 and initiated by the Department of Energy of the United States government. The objective is to have multidisciplinary university teams design and build very high environmental performance housing demonstrators that use the sun as their sole source of energy.

Other than technological innovation, our respondents made remarks like the following to accomplish the energy transition:
- If we want to stop climate change, than we need to act fast which means we should focus on implementing existing techniques faster (and not depend too much on developing new techniques or wait many years before a new nuclear plant will be built);
- Focus on using less energy and more emphasis on re-usage, circular economy etcetera;
- Self-production of energy, local production and local storage.

So, a change of behaviour and a more sober energy usage is also deemed necessary alongside technical developments according to our respondents. They say that this can be achieved by:
- Raising awareness and by sensitization and education (about the necessity for renewable energy, but also the technical possibilities and the return on investment of renewable energy) and doing so broadly via public media and also in schools;
- Education on the beauty of nature (raising incentive to save nature and reduce energy usage);
- Higher prices on fossil fuels and CO_2-tax, and lower prices on renewable energy;
- Providing enough financial advantage (from governments) for consumers and companies to be willing and able to change (tariffs, taxation, subsidies).

3.3 Professionals and skills needed to realize the energy transition

Climate change, reduction of our carbon footprint and realizing the energy transition are challenges that need solving from multiple sides. It's about governmental vision and willingness, about funding, a different mindset and lower energy usage, education and taking strategic action, broadly implementing existing techniques and developing new techniques as mentioned in the paragraphs before. But is also clear that there is a shortage of technical employees in Europe. It is even said by a Dutch respondent that the *"growing shortage in human capital defines the pace of the energy transition"*. A report from December 2022 in The Netherlands specifies which jobs are needed for the energy transition. Furthermore the needed professionals also need good training to realize the energy transition. Many new techniques have been introduced in the past years, more and more different techniques are being interconnected. This challenges the existing workforce: it seems likely that both currently employed and new to be employed technical professionals are and will be in constant need to update their skillset and knowledge of new technological developments. That's why we're developing training modules in our project GREEN TECH for the technical employees that (currently or potentially) deal with the energy transition. First ideas (a blueprint) per module were presented to the respondents in our survey and in the interviews to get a better understanding of what knowledge and skills are needed, for whom it is needed and to get practical feedback on the proposed training modules. The blueprint of the six modules can be found in the questionnaire in the appendix.

The skills and competences that are needed

According to our respondents, both practical and theoretical skills and competences are lacking by a relevant part of (technical) professionals that in some form deal with the energy transition. Practical competences are for example missing about interconnections and system integration, cross-craft skills in building, and about IT. Some respondents also state that there is no specific training available to their knowledge about renewable energy techniques: for example about thermal building, hydrogen as energy source, bio gas, maintenance and adjustment of heat pumps, manufacturing of wind turbines and solar panels. Practical and also theoretical knowledge and understanding of the latest technological developments is lacking, and also about the ability to work with high-pressure and/or toxic or flammable fluids. Furthermore, theoretical competences are missing about bureaucratic procedures, subsidy possibilities, laws/rules and permit granting but also broad knowledge and understanding about nature, ecology, CO_2 and its problems, energy transition and its possibilities. Soft skills are also lacking according to 42 percent of the respondents, but are also deemed to be less important in the bigger picture.

Table 7 – Skills/competences that technical professionals are currently lacking (descending order of (fully) agree)

	(Fully) disagree	Neutral	(Fully) agree	**Total**
Practical skills/competences	14%	11%	75%	**N=91**
Theoretical skills/competences	17%	17%	67%	**N=90**
Soft skills (such as adaptability, communication)	28%	30%	42%	**N=88**

Feedback on the proposed training modules

The proposed training modules are believed to be potentially suited for mechanics (who install, repair and maintain) as well as for technicians and engineers (who draw, diagnose, test and design energy products and systems, and who manage projects). Which -in education levels- means the modules are suited for different levels, especially EQF-4, EQF-5 and EQF-6 (even to EQF-2 and EQF-3 depending on the country and its educational system). We say 'potentially suited', since only a *blueprint* of the modules were given. Furthermore, respondents mention during interviews that the level of understanding as well as the level at which you teach is different for different type of professionals (depending on their educational background and work experience).

There is disparity in skills needed between manufacturing, connection and design. In addition it matters whether the goal of the modules is to give basic knowledge versus deep level knowledge and exactly knowing how-to and apply it in real life. Also, given the wide range of topics it is viewed that not all modules or all of the content of a module will be relevant for a single type of professional. Although more and more interconnections are made, you won't find a professional that deals with all these techniques in one job. That being said, the common belief is that all professionals dealing with energy transition, building and engineering benefit from at least *basic knowledge* of renewable energy and the latest technological developments in the field. And that is what the modules are intended for.

Table 8 – The proposed modules are suited for:

	(Fully) disagree	Neutral	(Fully) agree	**Total**
…mechanics (install, repair and maintain)	9%	15%	77%	**N=82**
…technicians (drawing, diagnosing, and testing)	6%	20%	74%	**N=85**
…engineers (same as technicians plus designing and overseeing/managing projects)	2%	17%	80%	**N=82**

Each of the six training modules is planned to contain a theoretical part (10h) and a practical part (10h). Below is given a short summary of the first ideas of the content of the six modules. Many respondents call the blueprint of the modules pretty complete (although dependent of the target audience), but also several suggestions for improvement were made by our respondents in the survey and interviews. These suggestions are added after the summary per module (summary in blue, suggestions in white).

Module 1: Introduction

- the global currently existing energy mix; data regarding demand of energy and production of fossil and renewable energy
- the anticipated energy mix in the EU as set by the 2030 and 2050 targets
- awareness of challenges regarding renewable energies, for example about how fast-growing renewable energy sources (wind, solar) present storage challenges

  - broad knowledge and understanding about nature, ecology, CO_2 and its problems, energy transition and its possibilities
  - personal security in working with energy, high voltage et cetera
  - the importance of recycling or reuse and also efficiency (insulation) in the process of saving energy
  - self-production (possibilities for households: solar panels, wind energy, heat pumps, combinations)
  - basic knowledge on the workings of the energy market (buying and selling; demand and supply)
  - maintenance
  - awareness of the calculation of the total yield of the conversion chain, the importance of co-generation, the digital energy consumption
  - relevant laws and rules (but might be too country-specific)
  - attention to the different user groups of energy: transport, industry, homes, other

Module 2: Solar energy

- PV modules (system)
  - Fabrication of PV modules
  - Series and parallel connections in PV modules
  - PV module parameters
  - Designing grid-connected PV systems
  - Designing stand-alone PV systems
  - Installation on roof, on ground
- Location issues
  - The position of the Sun
  - Irradiance on a PV module
  - Direct and diffuse irradiance
- Components of PV systems
  - Maximum power point tracking
  - Power electronics
  - Batteries
  - Charge controllers
  - Cables
- Solar thermal energy
  - Solar thermal basics
  - Solar thermal heating
  - Components of ST system
  - Installation
- PVT systems

- safety protocols and risk prevention (working with electricity and working at height for example), working with fork lift (license), protection against over temperatures in thermal solar energy installations and protection for regular PV energy systems
- installation on more surfaces than roof and ground (for example on water) and also the impact of the installation (ecology, heat stress)
- duration and degradation of PV panels; the importance of the quality of PV panels and DC cables and installation/connections
- calculation tools
- inverters, inverter technologies, oversizing
- integration batteries with energy management systems EMS (not only in module 5)
- application of direct current/voltage and smart grids (not only in module 5)
- installation: support structures including ballast plan, wiring techniques, direct current, fuse box reinforcement
- some argue to not include PVT systems (PVT needs support from another heat production system. PVT is not similar to PV but more to air conditioning and because the module is mainly about understanding the concept of systems it might be better to not include it or to just broadly mention it)

Module 3: Wind energy

- How to organize the assembly of wind power facilities, define the resources, the necessary times, and the execution control systems.
- How to manage the commissioning, operation, and maintenance of wind power facilities, based on the interpretation of technical information.
- How to operate remote control systems for the management of wind installations, adapting the operation of the unit to the atmospheric conditions and the requirements of the network.
- How to carry out local operation and maintenance in wind power facilities, following the safety and regulatory risk prevention protocols.
- How to prepare reports and other technical documents necessary for the management of the assembly, maintenance, and operation of wind power facilities.
- How to evaluate occupational and environmental risk situations related to the assembly, operation and maintenance of wind turbines and wind installations, prevention measures for the different types of risks.

  - the struggle before wind turbines are allowed to be placed somewhere (incl. legal struggle, support base amongst citizens, environmental impact studies, risk assessments studies, financing)
  - transportation of wind turbine components
  - control and monitoring tools
  - wind generator typology
  - installation sizing example
  - facts and fiction on small wind turbines near housing (“in practice, these yield little or no benefit”)
  - if the module also focuses on installation, then include information about working at height (basic practices with work at height, climbing and how to tie or belay, getting into a harness, et cetera)

Module 4: Green gas (emphasize Hydrogen gas. Green gas is not always associated with H_2)

- The module deals with the production of hydrogen as an energy vector by means of water electrolysis with electricity supplied from renewable low carbon energy sources.
- The module will give the theoretical basis needed to understand the working process of the different equipment used for such a production.

  - explain how green gas can contribute; explain in what situations hydrogen can be usefully applied and where not (no really applications in cities yet, mainly in transport and industry)
  - only electrolysis is mentioned: there are 18 different production technologies
  - behaviour and challenges of gas H; the dangers and risks associated with hydrogen; the issues of materials compatible with hydrogen; the AVC balance sheet of so-called green "H2 solutions"
  - materials used and assembly of networks for hydrogen supply facilities; equipment costs
  - operating systems
  - conversion of existing engines and burners to green hydrogen
  - detail the elements of conversion and compression leading to storage; yields of the conversion chain, efficiency of conversion (not only in module 5)
  - seawater-to-hydrogen technique
  - biomass and methanization; take biomass and biogas into account before training on H2 and unproven technologies.
  - security and regulatory risk prevention protocols (safety, handling, assembly and installation)
  - elements of a hydrogen feed installation for combustion engines
  - facilities for feeding with fuel cells

Module 5: Network management and storage

- Energy conversion
  - link between generation, storage, and usage.
  - Transport and distribution
  - AC and HVDC Grids
- General energy storage concepts
  - Batteries
  - Hydrogen
  - Pumped hydro
  - Thermal
  - Mechanical
  - Molecules as a carrier
  - Carbon Capture CCS and CCU
- Energy management
  - Smart grids
  - Micro grids
  - Smart Metering
  - Monitoring

- management of renewal and recycling of all the components used
- working together with network providers
- cost/benefit analysis of various concepts; be effective and efficient in the use of essential processes that are readily available (such as batteries)
- total chain of energy from producing to using, incl. energy loss in conversion, transport and storage
- individual and collective smart metering; monitoring and cloud storage
- heating and cooling networks: global approach and importance of smoothing
- urban heating networks / knowledge about heat exchangers
- residual heat utilization
- aquifer thermal energy storage or ATES: storage and recovery of thermal energy in the subsurface
- gas networks (CH4)
- content too ambitious for this small training: if everything is covered, everything will be overlooked (for example, what does "general concepts" represent?); maybe remove energy management
- make carbon capture CCS and CCU optional
- battery is not a storage but a converter
- relevant laws and rules (but might be too country-specific)

Module 6: Different usages

- This module aims at illustrating the final usage of renewable electricity produced from wind turbine and photovoltaics.
- This module makes the bridge between the production of the energy and the strong constraint to damp in overall the carbon dioxide emission in particular by means of the hydrogen vector.

- perhaps focus here on interconnections like wind turbines in sea with hydrogen projects
- perhaps an overview of possible decentralized uses that can be made of energy sources
- energy efficiency and sobriety in the use of energy
- be able to evaluate the financial payback and utility of systems compared to other sources
- experimenting and testing; also localizing optimal spots for wind turbines, solar panels etcetera
- the point of this module is not clear; isn't everything covered in the other five modules?

Overall, what theme, topic or module is missing?

- nuclear energy
- biomass and biogas (taking advantage of resources that are otherwise wasted, we have the possibility of using waste to obtain energy. Take these into account before training on H2 and unproven technologies)
- geothermal energy (Iceland as example of a working energy model with little visual impact)
- thermodynamics (steam cycles)
- solar thermal power plants
- DC transport
- less theory, more practical
- there is a lot of ground to cover, too much for a short training. Important are the techniques, and then the development phase, the realization phase and the exploitation phase
- each module will not make it possible to be a specialist, but must give the basics as an introduction course. It will not be possible to cover everything
- analysing and making a business case to determine the optimal solution in different settings (calculation the cost of energy and investment amortization calculations)
- learning and understanding the needs of energy producers and consumers
- passive energy techniques
- sober energy consumption
- circular economy
- to emphasize on the goal of closing the carbon cycle, explain the bridges between renewable energy > storage > biomass > chemistry > industries using massive electrical energy (foundries…) > consumers goods (e or H2 cars)
- how to implement the practical part of the modules into a MOOC?
- how to connect a training in the working life of technical professions?
- good practices as mentioned in paragraph 3.2 below table 6b

Modules made of building blocks

Earlier we mentioned that the content of the modules is seen as relevant and pretty complete, but the level of understanding is highly dependent on the target audience. It is dependent on the skills and knowledge the trainee already possesses and on the type of professional he or she is (or will become). That is, an engineer has different needs in knowing than an mechanic. The proposed modules are meant to give a broad overview and basic knowledge. It is not a deep dive into specifics, which makes it relevant to all types of professionals and levels of education. That being said, amongst the respondents there were still concerns how modules developed on an EU-level can be implemented in study programs across different EU-countries. A certain 'translation' seems necessary after a MOOC of these modules is done, which is detailed a little further in this report. The MOOC is just the start to accomplish a working training program across European countries. To tackle the potential issues of differences between education systems in different EU-countries and to tackle the various needs of different type of professionals, it is recommended to us to use the lesson that was learned in the Erasmus+-project DCT-REES (14 universities from 4 countries worked together to develop a new educational program on Direct Current technologies for South African universities, in order to supply the country with adequately trained professionals it needs to overcome its challenges in the field of electrical engineering). The solution found there

is to focus on developing small units of validated knowledge which are called 'building blocks'. These building blocks are universally applicable and will be a sound base for education makers in which they can pick those blocks that are interesting for them and implement it to their study program (no matter whether they want to create a minor, optional subject, a Life Long Learning training course). In that way the proposed modules can be applied in training programs for various types of professionals and various levels of education. The idea of creating modules need not be abandoned, but the modules should consist of building blocks.
A detailed explanation on building blocks formerly known as 'notes' can be found here: https://www.dut.ac.za/dct-rees/educational-output/

Lastly, it is important to standardise (and validate) the way the modules/building blocks are described, so it can be easier implemented in all EU-countries. In a different EU-project the Cedefop's unit of learning outcomes (ULO's) are used. A European handbook for defining, writing and applying learning outcomes can be found here.

Developing a MOOC is only the start!

During the interviews it became clear that – however much it is appreciated that more content will be created – developing a MOOC is only the start. The end goal of course is that professionals will be studying the material of the MOOC. On the road to the end goal multiple challenges might be faced, as our respondents gave insights to. For example:

1. Getting the interest of educational institutions across EU-countries to get them to know the to-be-developed MOOC and to get them to turn the MOOC into training courses or to implement (parts of) the MOOC into existing study programs.
2. Transferring the MOOC into a training program that is usable in a EU-country and preferably connected to the national system of education/degrees. To make this easier for all EU-countries, the description of the training modules should be standardised. For example using Cedefop's unit of learning outcomes (ULO's).
3. Translating the MOOC to the native language of any EU-country where the MOOC will be used.
4. If training is about skills to be used in practice, some work tasks might require formal certification in order to be allowed to work on it (arranging certification of training with formal entities per EU-country). Also, the education provider needs practical location.
5. Getting enough teachers, that also need to be sufficiently up-to-date with the material (need for train-the-trainers training). Given the wide range of topics in our six proposed modules, it takes probably more than one teacher to teach the entire course.
6. Getting the interest of companies and professionals and their willingness to facilitate and participate in training.

3.4 Learn from other projects and education material that is already made!

From the interviews we learnt that lots of education material on the same or similar topics already exists or is in development. This is in itself not surprising, given the urgency of the climate challenge and the need for energy transition. It is also clear that no particular person has a clear overview. Therefore, we provide a list of interesting training programs, courses, materials and projects that we learnt about in our interviews. Most of them are situated in The Netherlands, because for this purpose only Dutch respondents were asked. It is by no means a complete list (nor are we trying to make it complete later) nor is it checked extensively on the relevance of each example. It does provide us information to build upon and also gives us opportunities to link our project to other projects.

Solar energy

- Private educator in The Netherlands Chapter.works has several training programs and courses to retrain professionals for a job in the energy transition: 'Solar panel mechanic', 'EV mechanic', 'Heat pump mechanic', 'Charging station mechanic'.
- There is a VET-certificate in The Netherlands called 'Componenten aansluiten voor duurzame energietechniek' in which one is trained in installing solar panels, charging stations, heat pumps etcetera.
- A course in The Netherlands called 'VP Laagspanning Meterkast' about low voltage in fuse boxes.

Wind energy

- Erasmus+-funded project called 'T-shore' (2022-2025). The project will develop and establish a European network of VET-schools and training centers in offshore wind energy. The aim is to create innovative approaches for skills provision in the offshore renewable energy sector by linking offshore-energy-hotspots spread across Europe and stimulate innovation and collaboration between VET providers, industry and research institutes.
- In the Dutch VET-training programs a student can choose an optional subject called 'Onderhoud aan windturbines', 240 hours of training about maintaining wind turbines.
- https://online-learning.tudelft.nl/ contains open online courses for all topics mentioned in the blueprint concerning wind energy.

Green gas / hydrogen gas

- GreenskillS4H2, an European funded project lead by Drenthe College and NHL Stenden, in which more than 25 partners in The Netherlands are developing training material for training providers, companies and individuals wishing to be trained and work in the field of renewable hydrogen production, distribution and energy system integration. Within GreenskillS4HS the plan is use material from other European funded projects or link the project to current European projects. Examples are:
    - TeacHy (FCH JU project, 2017-ongoing). The project aims to develop a European Course Curricula for an MSc Course in Fuel Cells.

- HySkills (Erasmus project, 2020-ongoing) which aims to develop a modular training course enhanced with practical training focused on the subject of green hydrogen (H2) safety skills.
- Hy2Green (Erasmus project, 2017-2020) which gathered organisations from 4 countries to offer a specific training program for new professionals adapted to the new energy models based on ICTs.
- NET Tools (FCH JU project, 2017-2020) develops an e-infrastructure and provides digital learning e-tools via an outstanding e-laboratory and information service for educational issues and training within FCH technologies. The project developed a technical infrastructure to develop e-content materials but also complete courses including squeezes, videos, slide shows, calculations, data-tables, formulas, simulations etc.
- HyResponse (FCH JU project, 2013-2016) and HyResponder (FCH JU project, 2020-2022) developed and implemented a train the trainer programme in hydrogen safety, to provide trainings in hydrogen safety for responders throughout Europe.
- FCH Observatory (FCH JU public procurement, 2019-ongoing) provides data (statistics, facts and analysis) and up to date information about the entire hydrogen sector.
- FCHgo (2019-2020) and HySchools (2017-2020) are projects dedicated to promote ecological awareness and technological knowledge of hydrogen and fuel cells by developing educational materials for teachers and students at school level.

➢ https://online-learning.tudelft.nl/ contains open online courses for the topics mentioned in the blueprint concerning green gas / hydrogen gas.

Network management and storage

➢ Finished Erasmus+ project 'DCT-REES'. DCTREES aimed to develop a new educational program on Direct Current (DC) technologies for South African (SA) universities, in order to supply the country with adequately trained professionals it needs to overcome its challenges in the field of electrical engineering. Project was led by Haagse Hogeschool in The Netherlands. Training content can be found here.

➢ Project 'Flexibel Meshed DC Grid' from the Dutch foundation 'Stichting Gelijkspanning Nederland'. The objective of this project is to develop the necessary network technology for the efficient operation of bipolar meshed DC distribution grids with bidirectional power flow and flexible demand. This enables a more cost-efficient way of distributing electric energy.

➢ Dutch VET-school 'Koning Willem I College' has a farm in Oosterhout transformed to a field lab for the topic energy storage. Dutch university for applied sciences (EQF-6) 'Avans hogeschool' owns a field lab called Smart energy delivery lab.

➢ https://online-learning.tudelft.nl/ contains open online courses for the topics mentioned in the blueprint concerning network management and storage.

Overall and other

➢ A book about renewable energy technologies has been published in Dutch by teachers from Dutch universities for applied sciences for students in higher education. The story about energy transition consists of five chapters: part A about energy use and sober usage; part B about different technologies to use renewable energy (wind, water, sun, biomass and geothermal); part C about electric storage technologies, hydrogen technologies, heat storage systems and heat pumps; part D about the transport and distribution of electricity, heat and gas; part E about energy balance and system integration.

- A similar book is available for VET-students in The Netherlands: https://www.duurzaammbo.nl/lesmateriaal/techniek/duurzame-energietechniek
- Multiple online training modules in the field of construction, installation and energy in The Netherlands are called buildup skills and can be found here and are also accessible on the Buildup skills advisor app. There is an open digital library accessible on https://new.ozone.nl/user/login.
- Several European MOOCs can be found on many topics, also related topics, on https://platform.europeanmoocs.eu/courses.php. TU Delft also has several MOOCS available about energy transition: https://www.tudelft.nl/extension-school/portfolio/energy-transition
- EU academy: EU policies, initiatives and programmes aimed at energy, combating climate change and protecting the environment. Link.
- EnTEC or Energy Transition Expertise Centre: a virtual centre with its main objective is to monitor and analyse trends in technologies and innovations that are relevant for the energy transition, in the energy sector but also in other relevant sectors, in particular transport and mobility, industry, the digital sector and cities, homes and buildings. The centres work is also related to the overall aim of creating a (more) sustainable society.
- In The Netherlands, a new flexible full VET-training is in development by private educator Spring Institute and public educator Technova College (part of ROC A12) called 'Mechanic energy transition'.
- In the Dutch VET-system a student can choose the optional subject 'Renewable energy', in which one is trained to help think about and cooperate on forms of energy other than fossil. Based on his broad knowledge at executive level, he can design and make calculations for issues related to alternative forms of energy. In this way, it offers tools for commissioning and/or monitoring the process of, for example, biodigesters, geothermal heat extraction, etc.
- Education fund WijTechniek in The Netherlands provides several courses in the field of energy transition, for example 'Duurzame energie' about the principles behind renewable energy, a course 'Energietransitie' for companies in the energy sector to learn how energy transition translates to a transition of the company strategy.
- A new Interreg-funded project 'Energiek Onderwijs' in the making in The Netherlands and Belgium, which aims to map all training programs, modules and courses related to energy transition, led by Avans hogeschool.
- Similar project is 'LLO-katalysator' in The Netherlands to map all Life Long Learning modules in VET and higher education (EQF-5/6) about the theme energy transition.
- Multiple VET-colleges in the north of The Netherlands are working together to develop training modules on topics related to renewable energy. This so-called Energy College has several links to modules on their website: https://energycollege.org/items/?_type=link
- In The Netherlands there is an associate degree program (EQF-5) called 'Energietransitie engineer', in which the student becomes a broad professional that knows and recognises the latest developments and renewable techniques and is able to apply them in the real world.

- Technical University of Delft offers various training programs in the field of renewable energy (wind energy, green gas, network management), also MOOC's on related topics in English: https://online-learning.tudelft.nl/.
- Project Energy Switch in the Dutch province South-Holland where companies, local government and educational institutions together take on the responsibility to train future employees in the energy transition. Energy Switch provides insight into the range of education and training for practically trained professionals to system designers and managers.
- In The Netherlands there are several VET-trainings about installing heat pumps. Full initial VET-training programs 'Airco/warmtepompmonteur' and 'Monteur koude- en klimaat-systemen', partial VET-training to acquire a certificate 'Installeren en in bedrijf stellen van hybride warmtepompen' and 'Componenten aansluiten voor duurzame energietechniek' and also courses by the field itself called 'Warmtepomp installaties' and 'F-gassen voor warmtepompmonteurs'.
- Private educator in The Netherlands Technicom has several training programs for professionals working in power plants, for example 'Energietechniek' to learn the processes in power plants.

Appendix – Questionnaire project GREEN TECH

1. I represent …
   a. An energy provider
   b. An energy network/grid/storage company
   c. A company designing and engineering solar panels, heat pumps, windmills, or other renewable energy devices/equipment
   d. A company manufacturing solar panels, heat pumps, windmills, or other renewable energy devices/equipment
   e. A company installing/repairing or maintaining solar panels, heat pumps, windmills, or other renewable energy devices/equipment
   f. A company offering advice in the field of renewable energy
   g. A R&D institution in the field of renewable energies
   h. A college or university institution
   i. A government agency or public authority (local, regional, or national)
   j. Other, namely …

Short summary energy transition strategy

Belgium (11.6 million inhabitants)

- In 2020, oil accounted for 46% of total energy demand in Belgium, followed by natural gas (27%), and a small share (3%) from coal. Renewables accounted for 13%.
- Coal-fired generation was phased out in 2016 and Belgium is a global leader in offshore wind, with 2.23 GW in 2020 and plans for 5.7 GW or more by 2030.
- Belgium's National Energy and Climate Plan sets a 2030 target to reduce greenhouse gas emissions from the energy sector by 35% from 2005 levels (-21% in 2020) and to reach 27% renewables in gross final energy consumption, and to significantly reduce energy demand.
- Belgium remains reliant on fossil fuels. Nuclear energy covers over half of electricity demand, while the federal government plans to phase out most nuclear generation by 2025. Almost half of Belgium's gas imports come from Dutch gas fields, which will stop production in mid-2022.
- Electrification is being held back in Belgium by tariff structures that significantly increase the cost of electricity. In some regions, heating homes with electricity is 50% more expensive than with natural gas or fuel oil, even though electric heating is more efficient and less polluting.
- The Belgian federal government decided March 2022 to extend 2 gigawatts of nuclear capacity by 10 years and to introduce a EUR 1.2 billion package to accelerate energy transitions and protect consumers from high energy prices.

Spain (47.4 million inhabitants)

- Since 2015, Spain has solved a long-standing issue of tariff deficits in its electricity and gas sectors and closed all of its coal mines. Spain has placed the energy transition at the forefront of its energy and climate change policies.

- Spain is progressing toward its 2030 targets, especially in the electricity sector. After a slump between 2013 and 2018 due to a lack of financial incentives, investments in renewables took off again starting in 2019. The share of renewables in the national electricity mix grew from 33% in 2010 to 44% in 2020.
- The current Spanish framework for energy and climate is centred on the massive development of renewable energy, energy efficiency, electrification, and renewable hydrogen.
- The government aims to expand renewables installations in homes and businesses, as well as promote the use of renewables for industry and heating. It also intends to support the production of advanced biofuels, renewable gases, and hydrogen.
- Yet, Spain's total energy mix is still heavily dominated by fossil fuels. Especially the transport, industry and buildings sectors still have considerable work ahead to meet the country's targets for decarbonisation and higher shares of renewables.

France (67.4 million inhabitants)

- France benefits from decarbonised electricity and the lowest per capita emissions of advanced economies thanks to the role of its – ageing - nuclear energy, which accounted for 71% of its power mix in 2019, and the role of hydro power (10%). The French government postponed the planned reduction in the share of nuclear electricity to 50% from 2025 to 2035.
- Over the past 10 years, wind and solar photovoltaic (PV) electricity generation have increased, driving the share of renewables in electricity generation from 14% in 2010 up to 23.4% in 2020. Hydropower represents half of renewable electricity generation. France aims at a share of 23% renewables in gross final energy consumption by 2020 but had 17.2% in 2019 and 19.1% in 2020. The gap with the 2023 targets is massive: France would need to add 6.4 gigawatts (GW) of wind capacity (i.e., 40% of total cumulative capacity to date) and almost double the solar PV capacity in just 3 years. And France still relies on oil and gas for 2/3 of its energy consumption.
- The French 2030 greenhouse gas emissions targets (-40%), adopted in 2015, remain unchanged; the second carbon budget was revised upwards in 2020, lowering the effort required up to 2023, and not meeting the EU Green Deal objectives (-55%).
- The government's 2030 Investment Programme and its economic recovery plan are among the most ambitious globally in terms of clean energy transitions, with innovative funding schemes to encourage building retrofits and low-carbon transport.
- Yet, France has a highly skilled energy industry. While nuclear and the oil and gas sectors account for the majority of employment today, the renewables sector, notably wind and solar, has seen dynamic growth in jobs and investments.

Lithuania (2.8 million inhabitants)

- By 2030, Lithuania aims to reverse import dependency and produce 70% of its electricity needs domestically. Regional supply security is top priority. The Baltic states have ceased electricity imports from Belarus in 2020 and are targeting the full synchronization of their power systems with that of Continental Europe by 2025.
- Thanks to the expansion of renewable energy sources (working towards 45% in 2030 and 80% in 2050), notably bioenergy and wind, the carbon intensity of electricity and heat generation has decreased over the past 10 years.
- The Ignalina nuclear power plant was shut down at the very end of 2009, yet domestic clean power generation is rising fast. Biomass provides 80% of district heat, onshore wind is growing, and the country's unique net metering system is driving fast growth in clean distributed energy. Renewables will become the main source of energy in electricity, heating and cooling, and transport sectors.

- Despite decoupling the emissions from economic growth, Lithuania's total energy-related CO2 emissions have increased 9% since 2000, notably from transport, which accounts for the lion's share of the country's emissions.
- Energy consumption is rising in contrast with the government's aim of reducing it by 60% by 2050. Therefore, a long-term renovation strategy has recently been adopted, as well as the promotion of e-mobility, electrification, biofuels, and related infrastructure under a new Alternative Fuels Law.

The Netherlands (17.4 million inhabitants)

- In 2018, natural gas and oil were the most important fuels in the Dutch energy supply. In 2018, the total primary energy supply came from natural gas (42%), oil (37%), coal (11%), biofuels and waste (5%), and small shares from nuclear, wind, solar, hydropower and geothermal.
- The electricity mix will change significantly towards 75% of electricity demand coming from renewable sources by 2030. In 2019, this was nearly 15 %. The energy transition will be largely supported by wind energy, onshore and offshore (70%) and solar (25%) by 2030.
- Gas from Groningen covers a large share of the Netherlands' heating and industrial energy demand and is a key source of regional gas supply. In line with its climate targets and in response to safety concerns over earthquakes caused by the production, the government plans to end its production there.
- 78% of the heat produced in the Netherlands comes from burning natural gas. The transition of heat supply in the built environment is slower than electricity production, even though the number of heat pumps has increased extremely in recent years. And a national insulation programme has started April 2022.
- To combat climate change, the Dutch government wants to reduce the Netherlands' greenhouse gas emissions by 49% by 2030, compared to 1990 levels, and a 95% reduction by 2050. These goals are laid down in the Climate Act on May 28, 2019. Yet, the Netherlands is not on track to meet this 2030 target. In 2019, the Netherlands emitted an average of 11,1 tones per capita - significantly higher than the global average of 6,8 tones per capita. And it has a concentration of energy- and emission-intensive industries that will be hard to decarbonise.

2. What is the most important type of challenge to overcome in order to accomplish the energy transition and to achieve the necessary carbon reduction in your country?
   a. Technological challenges
   b. Governmental/visionary/strategical challenges
   c. Labour/skills/human resources challenges
   d. Behavioural challenges
   e. Financial challenges
   f. Other

Please, specify the challenge further: …

3. Which (renewable) energy sources should your country prioritize to accomplish the energy transition and to achieve the necessary carbon reduction in your country (please, choose a maximum of 3 answers)?
   a. solar
   b. wind

c. geothermal
d. hydro/water/sea (tidal turbine and other)
e. biomass
f. nuclear
g. other: detail …

Pre-structured answers for questions 4,6,7 as a 0-5 scale with recurring structure.

- 5 : fully agree
- 4 : agree
- 3 : neutral
- 2 : disagree
- 1 : fully disagree
- 0 : no opinion

4. Which technical developments and innovations are or will be important to accomplish the energy transition and to achieve the necessary carbon reduction in your country?
   a. Battery storage 0 – 1 – 2 – 3 – 4 – 5
   b. H_2 storage 0 – 1 – 2 – 3 – 4 – 5
   c. Nuclear fusion 0 – 1 – 2 – 3 – 4 – 5
   d. Carbon capture 0 – 1 – 2 – 3 – 4 – 5
   e. E-mobility 0 – 1 – 2 – 3 – 4 – 5
   f. Smart Metering 0 – 1 – 2 – 3 – 4 – 5
   g. Microgrids 0 – 1 – 2 – 3 – 4 – 5
   h. Smart Grids 0 – 1 – 2 – 3 – 4 – 5
   i. High Voltage DC 0 – 1 – 2 – 3 – 4 – 5
   j. Energy transport 0 – 1 – 2 – 3 – 4 – 5
   k. Interconnections between different energy sectors (such as electricity/gas or gas/heat or electricity/heat or nuclear/renewable energy or transport/stationary energy production) 0 – 1 – 2 – 3 – 4 – 5
   l. Other, namely… 0 – 1 – 2 – 3 – 4 – 5

5. Which one is the most important in your opinion?

6. Which skills/competences do the technical employees in your country lack in order to implement the beforementioned technologies and to accomplish the energy transition?
   a. soft skills (such as adaptability, communication) 0 – 1 – 2 – 3 – 4 – 5
   b. theoretical skills/competences 0 – 1 – 2 – 3 – 4 – 5
   c. practical skills/competences 0 – 1 – 2 – 3 – 4 – 5
   d. Other, namely … 0 – 1 – 2 – 3 – 4 – 5

Please, specify the skills/competences that lack the most: …

The consortium wants to create a full course, specifically adapted to mechanics, technicians, and engineers (Level 4-6 EQF) who will have to deal with the new energy mix. The course will be composed of six training modules, and each module contains a theoretical part (10h) and a practical part (10h). Below is given a short summary of the first ideas of the content of the 6 modules.

A. Introduction
    - the global currently existing energy mix; data regarding demand of energy and production of fossil and renewable energy
    - the anticipated energy mix in the EU as set by the 2030 and 2050 targets
    - awareness of challenges regarding renewable energies, for example about how fast-growing renewable energy sources (wind, solar) present storage challenges
B. Solar energy
    - PV modules (system)
        - Fabrication of PV modules
        - Series and parallel connections in PV modules
        - PV module parameters
        - Designing grid-connected PV systems
        - Designing stand-alone PV systems
        - Installation on roof, on ground
    - Location issues
        - The position of the Sun
        - Irradiance on a PV module
        - Direct and diffuse irradiance
    - Components of PV systems
        - Maximum power point tracking
        - Power electronics
        - Batteries
        - Charge controllers
        - Cables
    - Solar thermal energy
        - Solar thermal basics
        - Solar thermal heating
        - Components of ST system
        - Installation
    - PVT systems
C. Wind energy
    - How to organize the assembly of wind power facilities, define the resources, the necessary times, and the execution control systems.
    - How to manage the commissioning, operation, and maintenance of wind power facilities, based on the interpretation of technical information.
    - How to operate remote control systems for the management of wind installations, adapting the operation of the unit to the atmospheric conditions and the requirements of the network.
    - How to carry out local operation and maintenance in wind power facilities, following the safety and regulatory risk prevention protocols.
    - How to prepare reports and other technical documents necessary for the management of the assembly, maintenance, and operation of wind power facilities.
    - How to evaluate occupational and environmental risk situations related to the assembly, operation and maintenance of wind turbines and wind installations, prevention measures for the different types of risks.
D. Green gas (emphasize Hydrogen gas. Green gas is not always associated with H_2)
    - The module deals with the production of hydrogen as an energy vector by means of water electrolysis with electricity supplied from renewable low carbon energy sources.

- The module will give the theoretical basis needed to understand the working process of the different equipment used for such a production.

E. Network management and storage
   - Energy conversion
     - link between generation, storage, and usage.
     - Transport and distribution
     - AC and HVDC Grids
   - General energy storage concepts
     - Batteries
     - Hydrogen
     - Pumped hydro
     - Thermal
     - Mechanical
     - Molecules as a carrier
     - Carbon Capture CCS and CCU
   - Energy management
     - Smart grids
     - Micro grids
     - Smart Metering
     - Monitoring

F. Different usages
   - This module aims at illustrating the final usage of renewable electricity produced from wind turbine and photovoltaics.
   - This module makes the bridge between the production of the energy and the strong constraint to damp in overall the carbon dioxide emission in particular by means of the hydrogen vector.

7. In your opinion, are the proposed modules suited for:
   a) mechanics at EQF-level 4 (install, repair and maintain)? 0 – 1 – 2 – 3 – 4 – 5
   b) technicians at EQF-level 6 (drawing, diagnosing, and testing)? 0 – 1 – 2 – 3 – 4 – 5
   c) engineers at EQF-level 6 (same as technicians plus designing and overseeing/managing projects)? 0 – 1 – 2 – 3 – 4 – 5

8. Module 1: what would you add/deduct/alter to the content (a specific subject, technique or theory)?
9. Module 2: what would you add/deduct/alter to the content (a specific subject, technique or theory)?
10. Module 3: what would you add/deduct/alter to the content (a specific subject, technique or theory)?
11. Module 4: what would you add/deduct/alter to the content (a specific subject, technique or theory)?
12. Module 5: what would you add/deduct/alter to the content (a specific subject, technique or theory)?
13. Module 6: what would you add/deduct/alter to the content (a specific subject, technique or theory)?

14. What training module (or theme) is not included and should be included in your opinion? Please explain why it is needed.

15. Can you name one or more good practices (examples of installation or proof of concept) that is promising to accomplish the energy transition and to achieve the necessary carbon reduction in your country (you may also provide a link to a website where more information can be found)?

16. We believe that - besides technological innovation - a change of behaviour and a more sober energy usage is needed. What is the best way to encourage this (for example education, higher energy prices)?

Thank you very much!