Engineers Finland

The Effects of the Green Transition to the Employment and Educational Requirements of Engineers in Finland

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Millariia Wikman, Lauri Nyrhilä, Solveig Roschier
• Gaia Consulting

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Executive Summary

This report examines the effects of the green transition on the employment and educational requirements of engineers in Finland. The study focuses on three sectors, process industry, construction and energy, and their most significant green transition actions.

The study reveals that the green transition is driving an increased need of engineers within these sectors. The direct effect on employment is estimated to be between 3150 – 4540 FTE/year, depending on the scenario. The greatest employment effect is seen in the construction industry by the energy renovation wave, closely followed by the new battery production and recycling ecosystem in Finland. Rather interestingly in light of the vast national contributions currently being made, the smallest employment effect is caused by the production of green hydrogen in industry.

From the educational requirements point of view, this study suggests that the current educational programs produce engineers with suitable skills for the effects of the green transition overall. However, concerns over the agility of current study programs to respond to signals coming from the industries were raised. The skills that are identified to increase in importance in light of the green transition in this study belong to two specific skillsets: technical skills and meta-skills. It is the meta-skills that are seen to be the most significant skills for future engineers combined with a solid mathematical-scientific core. It is however clear that further in-depth examinations are required into the specific green transition actions, in order to determine the specific skill needs emerging within these areas.

1. Introduction

The green transition is a mechanism that supports societies in their combat against climate change. It supports the structural adjustment of economies and brings new technologies that help build the way for carbon-neutral societies.[1] The key goals outlined in Finland's Green Transition - Recovery and Resilience Plan include making Finland a world leader in the hydrogen and circular economies, emission-free systems and other climate and environmental solutions. The aim is also to improve energy efficiency and accelerate the transition to fossil-free transport and heating.[2]

This report aims at exploring the effects that the green transition has on 1. the employment, and 2. the educational requirements of engineers towards the 2030's. The report is structured into five chapters. Following the introduction, the study first focuses on estimating the direct effects of the green transition on employment numbers of engineers in Finland. The third chapter explores the effect that the green transition has on the educational requirements and required skills of engineers. The findings are gathered and discussed in chapter four. The final section of the report is dedicated to the recommendations made by the commissioner of this study, Engineers Finland. The study has been conducted by Gaia Consulting Oy.

In this study, the effects on employment and educational requirements for engineers when key industries are transitioning towards carbon neutrality and sustainability were approached by choosing a set of significant actions or measures that major Finnish industries are committed to in the coming years as part of their transitioning process. The chosen key industries for further analysis were process, construction and energy industries, which according to Statistics Finland[3] are responsible for around 35 % of total greenhouse gas (GHG) emissions in Finland, and roughly 72 % of total emissions from Finnish industries. From each of these three key industries two major green transition actions were identified:

Process industry:
- Green hydrogen in industry
- New battery production and recycling in Finland

Construction industry:
- Energy renovation wave in existing buildings
- Fossil-free construction materials

Energy industry:
- Resilient electricity grid for increasing renewable energy penetration
- Massive increases in renewable energy production

The scoping of these chosen green transition actions for the purpose of this study is elaborated in more detail in the following chapters.

[1] https://vm.fi/en/green-transition
[2] https://vm.fi/en/green-transition
[3] https://www.stat.fi/til/tilma/2019/tilma_2019_2021-09-30_tie_001_fi.html

2. Effects of the green transition on the employment of engineers

The first key objective of this study is to estimate what kind of effects the green transition will have on the employment numbers for engineers in Finland. The calculations are based on the methodology, assumptions and framing that is elaborated in the following sections. The calculations have been made for the purpose of providing a rough estimation of the expected development of employment. Therefore, the calculations utilize mostly publicly available data, which has been complimented with a few expert interviews from each chosen sector.

2.1. Calculation methodology

The effect on employment has been estimated by analyzing the direct effect an available future scenario would have in the 2030's (base scenario), and then creating an alternative, more optimistic scenario based on the initial one. The direct effect on employment was modelled through a four-step process shown in Figure 1.

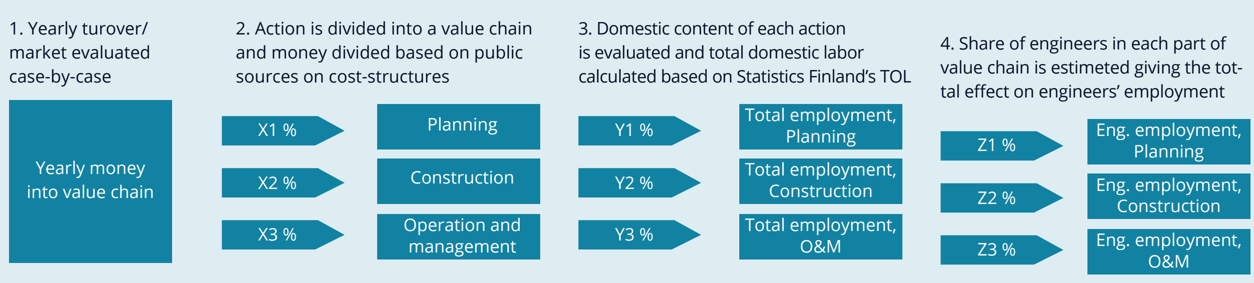

FIGURE 1 The four-step process estimating effect on employment.

THE FIRST STEP of the process was to create an estimation of the size of the market for each green transition action. This estimation acted as an input to the model. The method for estimating the market size varied depending on the green transition action being examined and is described more in detail for each case in section 2.2.

AS A SECOND STEP, a value chain was modelled for each green transition action. Each part of the value chain was paired with a Standard Industrial Classification (TOL) class produced by Statistics Finland[4].

The overall market size (yearly money into the value chain, step 1) was distributed across the value chain based on appropriate data available from public sources. For example, if the value chain resulted in an end-product (such as green hydrogen), the cost-structure of the product was used when determining the relevant parts of the value chain. In cases where no appropriate public data could be found for estimating the structure of the value chain, the share of each part of the value chain was estimated as expert work and validated in the expert interviews.

THE THIRD STEP was to estimate the employment generated in Finland by the value chains. For this, it was first necessary to estimate the share of domestic content of each part of the value chain. The domestic content was estimated based on publicly available data, interviews and the number of companies operating in Finland in the field. The market shares of the different parts of the value chain were then multiplied with the corresponding estimated percentages of domestic content. For each part of the value chain, these numbers were then distributed to materials, equipment, salaries and non-labor costs, using the distribution ratio given for the corresponding TOL class. Further, it was assumed that the direct employment is produced as the result of salaries and non-wage labor costs. By dividing the sum of the labor costs (salaries + non-wage labor costs) with the average salary given for the corresponding TOL class, an estimate was gained of the total direct effect of the green transition on domestic employment for each part of the value chain.

THE FOURTH STEP was to estimate the percentage of engineers in the total employment for each part of the value chain. Table 1 shows the framework that was developed to make the initial estimation. Multiplying the total direct employment for each part of the value chain (step 3) by the share of engineers gives us an estimation of the engineers' direct employment. The initial estimation for each green transition action was then verified in the interviews.

[4] https://www2.stat.fi/en/luokitukset/toimiala/toimiala_1_20080101/

TABLE 1 Framework for estimating the share of engineers for each part of a value chain

Share of engineers	Description	Example
5 %	Action consisting of mostly blue-collar work	Construction with no special planning
25 %	Action consisting of mostly blue-collar work requiring extensive planning	Bridge construction, Constructing power grids
50 %	Sufficient estimation not availalbe	-
75 %	Project planning, other planning	Power production planning
95 %	Indusrty related R&D, Specific planning	Electricity grid visionary work

Finally, **A SCENARIO ANALYSIS** was performed for each green transition action separately. The analysis used the model described above. For each green transition action, a sensitivity variable was identified. Different variables were used, such as the size of the market resulting from export, or increased share of domestic content. The variables used are presented for each case in section 2.2. The analysis produced a base scenario, and an alternative scenario. The results of the scenario analysis are given as a range varying from the base scenario to the alternative, more optimistic scenario.

2.2. Focus and core assumptions

2.2.1. Green hydrogen in industry

Hydrogen is estimated to play a key role in the transition towards a carbon neutral society. Hydrogen demand in the EU is expected to increase drastically, possibly even doubling by 2030 from the levels of 2015[5].

In Finland hydrogen is currently utilized mostly in oil refining, biofuels, chemical, mining, and ore refining industries with an increasing trend, as reported by Business Finland[6]. Currently almost 150 000 tonnes of H_2 are used yearly in these industries and consumption is estimated to increase up to 300 000 tonnes in 2030's when including SSAB's investments in carbon neutral steel production in Raahe. Up to 99 % of dedicated hydrogen production is produced from fossil fuels with steam-methane reforming (SMR) or partial oxidation. This fossil-based hydrogen is called grey hydrogen. To reach carbon neutrality, grey hydrogen needs to be replaced with carbon-neutral hydrogen production such as water electrolysis with renewable energy (green hydrogen). Depending on the definition, carbon neutrality could be achieved to some extent by utilizing carbon capture and storage and/or utilization.[7]

[5]Business Finland 2020, National Hydrogen Roadmap
[6]Business Finland 2020, National Hydrogen Roadmap
[7]Business Finland 2020, National Hydrogen Roadmap

In this study, green hydrogen is assumed to completely replace grey hydrogen in industry, resulting in a new green hydrogen market and production units. Also, the national or EU-wide hydrogen grid is excluded from the analysis due to uncertainties in its realization[8]. Use of hydrogen in other sectors, such as energy production and transportation have also been scoped out of this examination.

In the employment calculation, the market size estimation is based on the assumptions that there is 300 000 tonnes of green hydrogen produced for the use of Finnish industries and that SSAB will start producing carbon neutral steel in Raahe. By using an electricity price of 45 €/MWh (including transmission) and an electrolyser efficiency of 65 % plus 0,7 €/MWh for Capex and O&M, the price of hydrogen results in approximately 3000 €/t. This results in a yearly market of around 900 M€. In the calculation, this market is divided into water production (2 %), electricity production with wind power and electricity distribution (64 %), equipment and operational costs (19 %) and storage and distribution (15 %). As the national (or EU-wide) hydrogen grid is not considered in this calculation, the distribution is assumed to be done mainly through local pipelines and trucks. The estimated domestic content of the value chain varies from 95 % (Transmission and distribution) to 50 % (Electricity production with wind power). Engineers are mostly assumed to be employed in the electricity production and distribution (25 %), and electrolyser manufacturing and operation (25 %) parts of the value chain. The hydrogen employment base scenario is shown in Figure 2.

Money into value chain	Share of total value chain	Value chain	Share of domestic content	Total increase in domestic employment (FTE)	Share of engineers	Increase in domestic employment of engineers (FTE)
Green hydrogen for domestic industries, 900 M€	2 %	Water production	75 %	6	5 %	+0
	57 %	Wind power production	50 %	277	25 %	+69
	7 %	Electricity transmission and distribution	75 %	23	25 %	+6
	19 %	Electrolyser plants	50 %	239	25 %	+60
	15 %	Distribution and storage	95 %	567	5 %	+28

FIGURE 2 Green hydrogen for domestic industries effect on engineers' employment in base scenario.

The alternative scenario increases the market size by a factor of 1.5, due to the possibilities of exporting hydrogen related equipment and producing green hydrogen for the need of the transportation industry as well.

[8]https://gasgrid.fi/2021/04/13/gasgrid-finland-visiomassa-euroopan-laajuista-vetyverkkoa/

2.2.2. New battery production and recycling ecosystem in Finland

The demand of batteries is expected to increase drastically when moving towards carbon neutrality. According to Bloomberg[9] increased global demand of batteries is mostly the result of electrification of transportation, especially passenger vehicles.

Finland is an appealing location for new battery production plants and mineral extraction. In the context of this study, the battery industry in Finland is expected to grow rapidly, creating a 5 B€ battery market in Finland along the battery value chain including recycling, as estimated by the BATCircle, a joint project of actors in the Finnish battery industry[10].

In this study the 5 B€ market is assumed to be focusing on manufacturing battery systems and battery cells with shares of 40 % and 30 % of the entire market as according to the expert interviews conducted. Mineral mining and refining are assumed to remain in Finland, but with a moderate growth, especially compared to the growth of higher value-added products, and thus they have been allocated a 5 % share of the market each. Components along with reuse and recycling are considered to have around 10 % share each. Each part of the value chain is assumed to have only a small share of engineers from the total employment effect, with only 5 % in each part. The base scenario evaluation is shown in Figure 3.

Money into value chain	Share of total value chain	Value chain	Share of domestic content	Total increase in domestic employment (FTE)	Share of engineers	Increase in domestic employment of engineers (FTE)
New battery ecosystem in Finland 5 B€	40 %	Battery systems	100 %	6 669	5 %	+333
	30 %	Battery cells	100 %	9 761	5 %	+488
	10 %	Component manufacturing	100 %	2 271	5 %	+114
	5 %	Metal refining	100 %	224	5 %	+11
	5 %	Mining	100 %	593	5 %	+30
	10 %	Reusing and recycling	100 %	891	5 %	+45

FIGURE 3 Battery ecosystem effect on engineers' employment in base scenario.

Also an alternative scenario was calculated, showing the effect if the entire new ecosystem would focus on only high value-added products, which are battery systems and battery cells, both having a share of 50 %.

[9] http://spotlight.bloomberg.com/story/battery-metals-outlook/
[10] https://lansireitti.fi/akkuklusteri/

2.2.3. Energy renovation wave in existing buildings

The energy use of buildings in use-phase is responsible for around 76 % of the total carbon footprint of the Finnish construction industry, as is shown in Figure 4 below. To reduce energy consumption in old buildings the Ministry of the Environment in Finland has created a long-term renovation strategy for construction. The goal of the strategy is to make the existing building stock "extremely energy efficient". In practice this entails annual repairs and renovations for the value of around 800 M€[11].

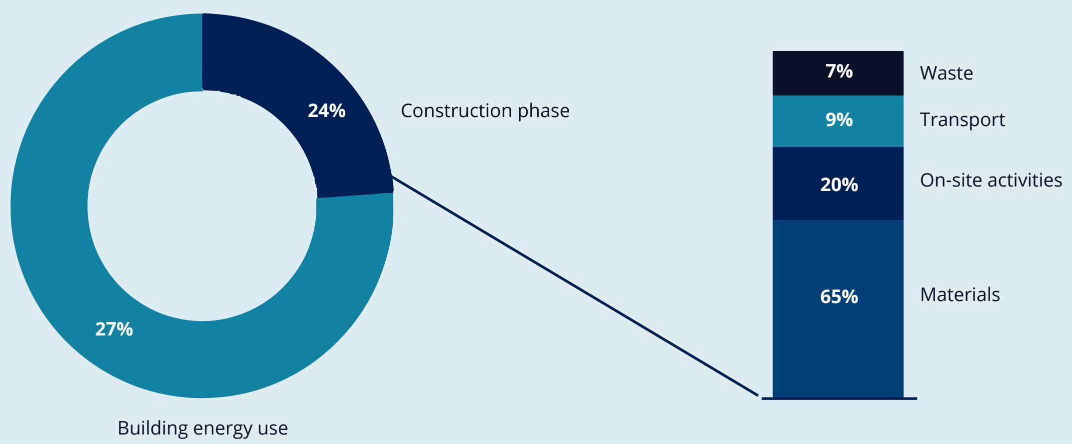

FIGURE 4 Carbon footprint and its composition in the Finnish construction industry in 2017[12]

In this study we assume that the investment of 800 M€ is due to the requirements of green transition and will be resulting in employment opportunities and needs annually. This highlights the effect the green transition already has and will continue to have in the sector. The 800 M€ includes the construction work itself, construction related products and construction related services.

In the employment calculation, an estimation made by the Finnish Construction Industries RT[13] was adapted, since it used the same methodology and calculation basis as this study. According to the Construction Industries study, the total effect of the green transition on the annual employment is around 12 000 FTE/year (full-time-equivalent) distributed to construction related work (50 %), construction related products (31 %) and construction related services (19 %). Furthermore, in this study, the share of engineers was estimated to be 5 %, 5 % and 25 % respectively in these different categories. The effect on employment calculation of the renovation wave in base scenario is shown in Figure 5.

[12] https://www.rakennusteollisuus.fi/globalassets/ymparisto-ja-energia/vahahiilisyys_uudet/rt_4.-raportti_vahahiilisyyden-tiekartta_lopullinen-versio_clean.pdf
[13] https://www.rakennusteollisuus.fi/globalassets/suhdanteet-ja-tilastot/rakentamisen-yhteiskunnalliset-vaikutukset-2012.pdf

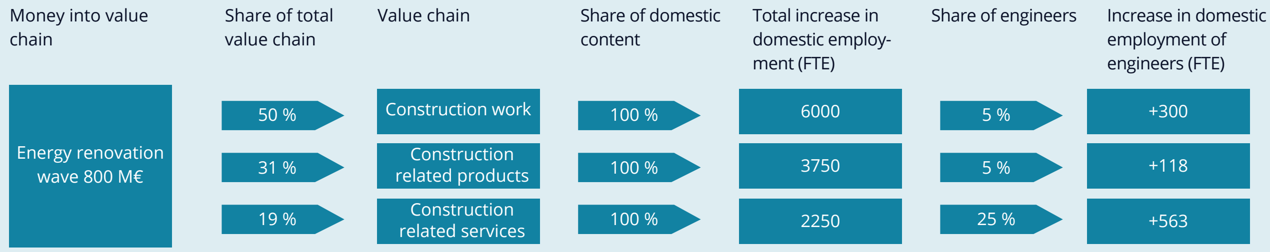

FIGURE 5 Energy renovation wave employment estimation[14].

In the more optimistic scenario calculated for this study the total amount of work going into the construction related services was doubled, depicting the increased need for engineering related expert work for GHG calculation, certification and modelling of constructions.

2.2.4. Fossil-free construction materials

As can be seen in Figure 2, construction materials make up around 16% of the carbon footprint of the construction industry. This consists mostly of carbon intensive materials, such as cement and steel. There are significant developments ongoing towards carbon neutral steel in Finland as SSAB, which is one of the biggest carbon emitters in Finland, has announced that it will bring fossil free steel into the market in 2026[15]. In the case of fossil-free cement there are still significant R&D investments needed in the calcination process, which is responsible for more than the half of global CO2 emissions from the cement manufacturing, to make the material carbon neutral[16].

Since the carbon neutral steel as construction material is covered in the calculation for the effects of green transition actions for hydrogen in industry, only fossil-free cement is considered for the employment calculations in the context of this study. According to the expert interviews it was concluded that after the commercialization of fossil-free cement the result will be an adjusted production and value chain of the conventional material, rather than increased additional production of new material. This implies that the direct employment numbers for engineers remain stable. Thus, a more detailed calculation for fossil-free construction materials in the context of this study was not executed.

[14] The domestic content was evaluated in the source material and is therefore 100 % in this evaluation when using the 12 000 FTE result as a base. The assumptions that result in the total employment apply even though it was not calculated in this particular study.
[15] https://www.ssab.fi/fossiilivapaa
[16] https://www.mckinsey.com/industries/chemicals/our-insights/laying-the-foundation-for-zero-carbon-cement

2.2.5. Resilient electricity grid for increasing renewable energy penetration

The increasing demand of electricity and share of solar photovoltaics and wind power in the national electricity transmission and distribution system poses increasing amount of requirements in terms of flexibility, resiliency, and capacity to the system. As an answer to these requirements, the Finnish transmission system operator Fingrid and local distribution companies invest annually in forecasting, planning, upgrading and maintaining the quality and capabilities of current and future requirements.

In this study we focus on the effect that continuous, large investments to the energy system have on employment. This highlights the effect the green transition currently has and will keep on having as it progresses further.

The employment calculation for this green transition action is based on adding up Fingrid's 200 M€ yearly investments[17] into the national electricity transmission network with a total of 700 M€ yearly investments into local electricity distribution networks[18]. This totals to 900 M€ yearly investments that respond to the increasing demand for electricity transmission and distribution. In the calculation, this is divided into visionary work of future requirements (2.5 %), planning the changes to answer the requirements on the grid (2.5 %), construction work (47.5 %) and component manufacturing (47.5 %). An additional 5 % was added to operation and asset management, as suggested in the expert interviews to depict the work intensity of an increasing number of different assets. This results in a total market of 945 M€ that acts as the basis for the calculation.

The visionary work, planning, construction and asset management and operation were considered to be mostly domestic (between 75% and 95%), whereas the components were considered to be supplied partly from abroad (25 %). Visionary work and planning were estimated to be done almost entirely by engineers (95 %), whereas the manufacturing of components and construction was more blue-collar work (share of engineers between 5 % and 25 %). 50 % of the asset management and operational tasks were considered to be done by engineers. The effect on employment the resilient energy grid investments is estimated to have for engineers, is displayed in Figure 6.

[17] https://www.fingrid.fi/kantaverkko/kehittaminen/kehittamissuunnitelma/
[18] https://energiavirasto.fi/verkkotoiminnan-julkaisut

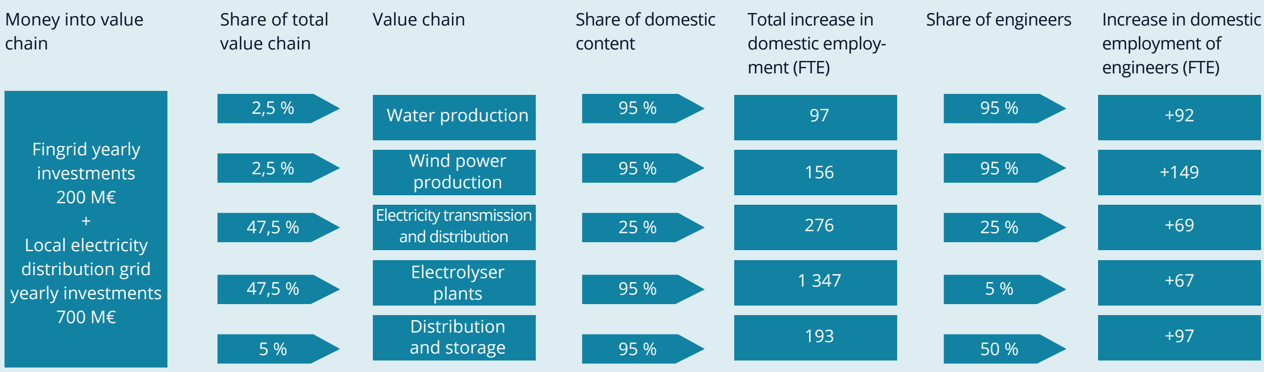

FIGURE 6 Resilient electricity grid effect on engineers' employment in base scenario.

In the sensitivity analysis, additional asset management and operation was recognized as a variable resulting in more complex electricity systems, large-scale sector integration and increasing number of assets resulting again in more intensive operation and management of the assets. Accordingly, this variable was doubled from an initial 45 M€ used in the base scenario to 90 M€ in the optimistic scenario.

2.2.6. Massive increases in renewable energy production

The Finnish Energy low carbon road map by AFRY[19] estimates in their low-carbon scenario that annual production of solar PV, onshore wind and offshore wind will increase by around 27 TWh in Finland by 2035. This creates new possibilities for the electricity markets and may possibly require some adaptation and a more fluid PPA (power purchase agreement) market.

In this study we highlight the effect the increasing number of renewable wind and solar electricity production has on the employment resulting from new investments and operation and management of the production units. The investments underway in Finland to additional nuclear production were excluded from this study since any future investments in the technology are unclear.

For the employment calculation, the baseline growth scenario was adapted from the Finnish Energy Low-Carbon roadmap[20]. From that roadmap, 27 GWh of total new renewable energy was assumed to be divided as follows: solar PV annual production increase was assumed to be 2 TWh, onshore wind 20 TWh, and offshore wind 5 TWh. Subsequently, a unique value chain was formed for each of these energy production methods.

[19] AFRY 2020, Finnish Energy, Low carbon roadmap 2020
[20] AFRY 2020, Finnish Energy, Low carbon roadmap 2020

As demonstrated by Figure 7, the solar PV value chain consists mostly of PV modules (45 %), Balance of system hardware (22 %) and soft costs, such as planning and permitting (16 %). The domestic content apart from installation (85 %) is considered to be very low, at 5 – 25 %. The share of engineers in each step is also low (5 % - 25 %) apart from the soft costs (75 %).

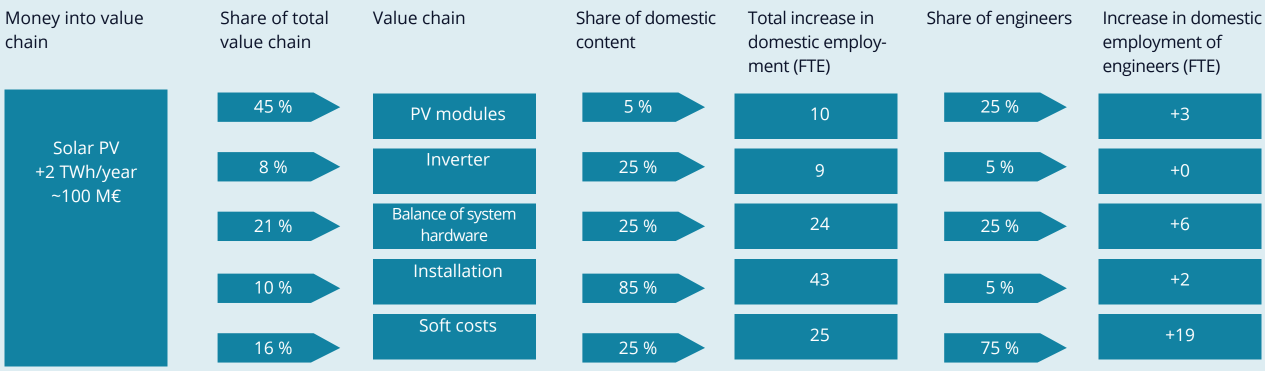

FIGURE 7 Solar PV production effect on engineers' employment in base scenario.

The offshore wind value chain's most significant parts, in the context of this calculation, are the turbine production (28 %), installations (19 %) and operation and management including decommissioning (30 %). The domestic content for the components and the tower itself is considered to be low (25 % – 5 %), but high for the operation and management, planning and construction (85 %). Most engineers are assumed to be working in project planning (75 %) and operation and management, which also includes electricity market participation (50 %), as shown in Figure 8.

Money into value chain	Share of total value chain	Value chain	Share of domestic content	Total increase in domestic employment (FTE)	Share of engineers	Increase in domestic employment of engineers (FTE)
Offshore wind +5 TWh/year ~400M€	4 %	Project planning	85 %	75	75 %	+56
	28 %	Turbine	5 %	9	25 %	+2
	10%	Cable and substations	50 %	80	5 %	+4
	8 %	Site construction	85 %	181	5 %	+9
	19 %	Turbine installation	85 %	345	25 %	+86
	30 %	O&M and Decommissioning	85 %	34	50 %	+17

FIGURE 8 Offshore wind production effect on engineers' employment in base scenario.

For onshore wind, the most significant parts of the calculation in the context of this study were considered to be the turbine and tower (42 %), as well as O&M and decommissioning (30 %), with the first one having a low (5 %) and the latter one high (85 %) domestic content, as demonstrated in Figure 9 that depicts the base scenario modelling. Similarly, project planning (75 %) and operation and management (50 %) were considered to be most engineer-intensive parts of the offshore wind value chain.

Money into value chain	Share of total value chain	Value chain	Share of domestic content	Total increase in domestic employment (FTE)	Share of engineers	Increase in domestic employment of engineers (FTE)
Offshore wind +20 TWh/year ~600M€	9 %	Project planning	85 %	292	75 %	+219
	11 %	Foundation	85 %	372	5 %	+19
	21%	Turbine	5 %	11	5 %	+3
	21 %	Tower	5 %	29	25 %	+7
	8 %	Grid gonnection	85 %	165	25 %	+41
	30%	O&M and Decommissioning	85 %	51	50 %	+26

FIGURE 9 Onshore wind production effect on engineers' employment in base scenario.

In the sensitivity analysis, the amount of new onshore wind being produced was identified as a key variable. Accordingly, an alternative scenario was created, where the increased onshore wind power would be +50 TWh. This scenario is adapting the direct electrification scenario in 2035 made by Sitra[21].

[21] https://media.sitra.fi/2021/09/30131131/sitra-sahkoistamisen-rooli-suomen-ilmastotavoitteiden-saavuttamisessa.pdf

2.2. Focus and core assumptions

The effect on engineers' employment of each green transition action is shown in Table 2 for the base and alternative scenarios along with the market figures that were used in modelling along the value chain. The results indicate that the green transition will have a total estimated additional direct employment effect of around a range of 3150 – 4540 FTE/year for engineers. However, it is important to highlight that there can be a multitude of indirect employment effects for each of the chosen green transition actions that may significantly increase the overall employment needs for engineers from the presented estimation.

TABLE 2 The results of yearly effect on employment calculation and alternative scenarios.

Green transition action	Money into value chain in base sce-nario (M€)	Base scenario effect on engineer's employment (FTE/year)	Money into value chain in alternative scenario, (M€)	Alternative sce-nario effect on engineers' em-ployment (FTE/year)
Green hydrogen in industry[22]	900	94	1350	141
New battery production and recycling ecosystem in Finland	5000	1020	5000	1230
Energy renovation wave in existing buildings	800	1050	800	1613
Resilient electricity grid for in-creasing renewable energy penetration	945	473	990	570
Massive increases in renewable energy production	1100	520	2000	991
TOTAL	**8745**	**3158**	**10140**	**4545**

[22] The effect of Green hydrogen in industry included 69 and 104 FTE of electricity production with renewables depending on the sce-nario, which was subtracted from the total since it is already included in the "Massive increases in renewable energy production"

THE SINGLE LARGEST EFFECT IS FORMED BY THE ENERGY RENOVATION WAVE with an increasing effect of 1050 – 1610 FTE/year. Even though it is the smallest market, the construction industry, and in this particular case the energy renovation action, has least automated stages of production. Therefore, also the estimated employment per investment into the value chain is clearly larger than it is with the other explored green transition actions. By assuming that the construction services would revolve more around certification, carbon footprint calculation and modelling, the effect on engineer employment is increased by almost 560 FTE/year. Engineers are heavily employed in construction related services, but are also present in construc-tion product manufacturing and construction itself. It needs to be noted that these yearly investments are an ongoing action in green transition, and currently already employ a large number of engineers.

THE SECOND LARGEST EFFECT COMES FROM THE NEW BATTERY PRODUCTION AND RECYCLING ECO-SYSTEM IN FINLAND resulting in 1020 – 1230 FTE/year. According to this model, by focusing on the higher value-added products around 200 new jobs are created additionally to engineers with the same market size than would be the case in the original scenario where other pieces of the value chain were included. The created jobs may include new demand on all parts of the value chain, depending on future focus of the Finnish battery industry.

THE THIRD LARGEST EFFECT IS FROM THE MASSIVE INCREASE IN RENEWABLE ENERGY PRODUCTION, where the effect on employment is 520 – 990 FTE. In the alternative scenario the market is nearly doubled by increasing the amount of onshore wind produced, which results also in almost doubling the requirement for engineers in the field. Most employment opportunities arise from project planning of different production units, as well as engineering regarding wind turbines and their installations. Operation and management of assets also employs a number of engineers that are counted as part of the electricity market.

THE FOURTH LARGEST EFFECT ON EMPLOYMENT COMES FROM INVESTING IN RESILIENT ELECTRICITY GRID with an effect of 470 – 570 FTE/year. By assuming that the increased complexity and number of assets increases the need for asset management and operation, the employment is increased by 100 FTE/year. Engineers are heavily employed throughout the entire value chain, but especially in visionary work, electricity grid planning and asset management and operation. This, much like the energy renovation wave, is an ongoing transformation resulting from the green transition and already employs a large number of engineers.

THE SMALLEST EFFECT ON EMPLOYMENT STEMS FROM MANUFACTURING GREEN HYDROGEN FOR INDUSTRY with an effect of 160 – 250 FTE/year, or 90 – 140 FTE/year. This figure does not include the energy production in the value chain to prevent double counting, as it is already included in the calculations for renewable energy production. Green hydrogen production also produces the least engineer employment per Euro in the value chain, which is explained by its largely automated process of production. Besides electricity production, engineers are mostly employed in activities related to manufacturing, sales and operation of the electrolyser units.

WHEN COMPARING THE ESTIMATED DIRECT EFFECT ON EMPLOYMENT OF AROUND A RANGE OF 3150 – 4540 FTE/YEAR WITH THE CURRENT ANNUAL OUTPUT OF NEW ENGINEERS, THE NEED FOR NEW ENGINEERS BECOMES EVIDENT. Around 8300 new engineers enter the job market on an annual basis, with roughly 5500 Bachelors of Engineering[23] and 2800 Masters of Science in Technology graduating nationally. However, it has been estimated that up to 20 % of Master of Science in Technology[24] graduates hold a primary degree of Bachelors of Engineering. This implies that with the current figures, up to 560 graduates annually may be double counted in the overall figures.

WHEN COMPARING THESE TWO NUMBERS IT MUST BE HIGHLIGHTED THAT THE ESTIMATED EFFECT ON EMPLOYMENT IS THE TOTAL ANNUAL FTE REQUIREMENT FOR ENGINEERS DIRECTLY CREATED BY THE ACTIONS CONSIDERED IN THIS STUDY. The estimation therefore does not equal an annual increase in the actual number of engineers being employed. The annual FTE requirements are also not expected to increase linearly in reality, but instead new jobs will be created as investments increase and the markets are formed towards the 2030's. The yearly investments into the resilient electricity grid and energy renovation on buildings are already ongoing and have therefore already created new employment.

WHEN KEEPING THIS IN MIND, IT IS SAFE TO SAY THAT THE NEED FOR ENGINEERS WILL GROW IN THE FUTURE REGARDLESS OF THE SCENARIO, CREATING PRESSURE ON THE TRAINING OF NEW ENGINEERS. The green transition to mitigate climate change requires large amounts of engineering efforts and capabilities. One of biggest variables in most of the actions is the share of domestic content in each part of the value chains. The current estimations are based on the current situation and estimations by the experts interviewed. New major actors in all parts of each value chain may arise in Finland and in other countries which can change the balance significantly in some cases.

[23] The Union of Professional Engineers in Finland / Vipunen - Education Statistics Finland
[24] Statistics Finland - https://pxnet2.stat.fi/PXWeb/pxweb/fi/StatFin/StatFin__kou__opiskt__yop/?tablelist=true

3. Required skills in light of the green transition

3.1. Analysis background

The second focal point of this report is to understand the effect that the green transition has on the needed skills for technical field experts in the chosen three sectors and their examined actions. The examination has been done through a total of nine semi-structured interviews along with utilizing public information sources such as national and international industry reports, Finnish government reports and initiatives, news articles and university webpages.

The interview subjects were selected for each sector as follows: one university representative, one representative from a university of applied sciences and one industry representative. The interviewed organizations per sector can be found in Figure 10 below.

FIGURE 10 Interviewed organizations.

The skills emerging from the study have been categorized into two sets of skills, technical skills and meta-skills. A framework was developed bottom-up from the interview findings to highlight the different nature of the identified skills. The technical skills in this report refer to the sets of abilities and knowledge needed to perform specific tasks, whereas meta-skills, or transversal skills as they are called by OECD[25] and UNESCO[26], are industry independent cognitive skills that can be used in a wide variety of situations.[27] [28] Technical skills have been further divided into three pillars, with the first pillar representing the core technical skills required by the green transition and two other pillars that depict other technical skills required by the green transition.

[25] https://www.oecd.org/education/oecd-skills-outlook-e11c1c2d-en.htm
[26] http://www.ibe.unesco.org/fileadmin/user_upload/Publications/IBE_GlossaryCurriculumTerminology2013_eng.pdf
[27] https://telma-lehti.fi/tyoelaman-metataidot%E2%80%AF
[28] https://www.erto.fi/palvelut/tyo-ja-elama/toissa/4344-naeitae-metataitoja-tarvitset

In addition to exploring the needed skills, the interviews examined the perceived strengths and weaknesses of the current educational programs in light of the identified skills. A light gap-analysis was compiled to demonstrate these strengths and weaknesses.

3.2. Required skills per sector

PROCESS INDUSTRY

The green transition has a significant impact on the process industry, as is demonstrated by high growth in employment figures in section 2. But not only is the high national ambition level set for the green hydrogen and battery industries driving up the demand for employees, it is also impacting the required skills. Both actions require a various mix of expertise ranging from engineers to chemists and from process designers to sales and marketing[29]. All in all, many of the associated positions require higher education or long-term on-the-job training.[30] [31]

For the highly educated experts in the technical field, two distinctive skillsets emerge: technical skills and meta-skills. The first pillar of technical skills is the core knowledge of materials (production, qualities and recycling) and energy (sources, production and storage). This pillar forms the foundation and continues to be relevant in the green transition.

The second pillar of the technical skills required in the process industry relates to systems-thinking. The emission reductions of the green transition will demand systems-level optimization, especially between the process industry and the energy sector. The forming green hydrogen and battery markets will form systems, that are tightly interlinked with other sectors on multiple levels. As a result, technical experts within the process industry will need to be able to develop understanding of sector integration and life-cycle of materials, as well as the utilization of side-streams and waste.

The third pillar of technical skills for the process industry includes complementary areas of expertise that are becoming essential as a result of the green transition. These skills include conventional knowledge areas such safety, digital solutions and modelling, in addition to newer additions of circular economy, environmental impact assessments, and footprint and handprint calculations.

[29] https://yle.fi/uutiset/3-11891559
[30] Bezdek, R. 2019, The hydrogen economy and jobs of the future, Renew. Energy Environ. Sustain. 4, 1 (2019);
[31] https://yle.fi/uutiset/3-12108531

As the complexity of challenges increases, a single person can no longer handle the entire field. The importance of teamwork is therefore growing, simultaneously driving up the im-portance of meta-skills. Technical experts can no longer rely on merely their solid tech-nical expertise, but will require skills such as teamwork, resilience and continuous learning in order to succeed in the labor market.

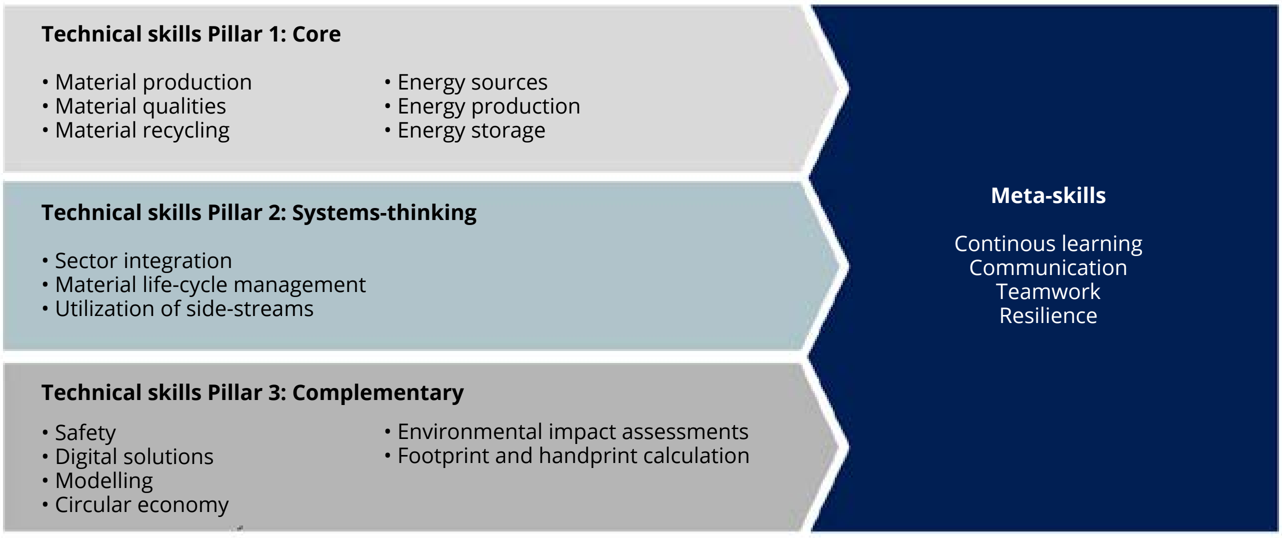

FIGURE 11 Required skills in the process industry sector.

CONSTRUCTION

As displayed by the calculations in Section 2, the construction sector is expected to see a vast growth in employment as a result of the energy renovation wave caused by the green transition. This same wave of change can be seen to affect the required skills of engineers in Finland. The biggest changes, however, are not linked directly to the two Actions of energy renovations or fossil free construction materials but are a more general consequence of growing environmental concerns of investors.

Forming the core of the required technical skills are a solid understanding of mathemat-ics, physics and mechanics, in addition to extensive knowledge of materials, and the de-sign, construction and maintenance of buildings. As opposed to the other sectors systems thinking and systems engineering is categorized as a core skill for the construction industry, as the field has always required the ability to see the built environment as a system with a vast number of players coming together. These skills continue to form the foundation upon which the skills required by the green transition are built.

[29] https://yle.fi/uutiset/3-11891559
[30] Bezdek, R. 2019, The hydrogen economy and jobs of the future, Renew. Energy Environ. Sustain. 4, 1 (2019);
[31] https://yle.fi/uutiset/3-12108531

The second pillar of technical skills include skills required for low carbon construction. The importance of life-cycle thinking is increasing, as attention is being drawn to ensuring longer lifespan of buildings and the entire built environment. The environmental certification of buildings has, according to our interview findings, increased in the last few years. Not only has the demand for knowledge of certifications and carbon footprint calculation increased as a result, but skills related to low carbon materials and processes have risen in demand as well. Specific skills include the optimization of site activities to reduce carbon emissions and energy use, in addition to material life-cycle management to develop and use low carbon alternatives and minimize waste.

The third pillar consists of skills related to digitalization. The green transition is pushed forward by rapid digitalization, that is visible also in the construction industry. In the latest research on digitalization by the Confederation of Finnish Construction Industries RT, 99% of responders estimated that their digitalization would increase or at least stay the same[32]. With the growing utilization of programs, such as simulations and modelling, skills for data handling and IT are rising in demand.

In addition to technical skills the construction industry is seeing an increased need of meta-skills, such as continuous learning and communication skills. The construction industry continues to demand the ability to think long-term and continuously stay up-to-date with the latest knowledge. As the complexity of construction grows, the ability to transfer knowledge between various fields of experts rises in importance.

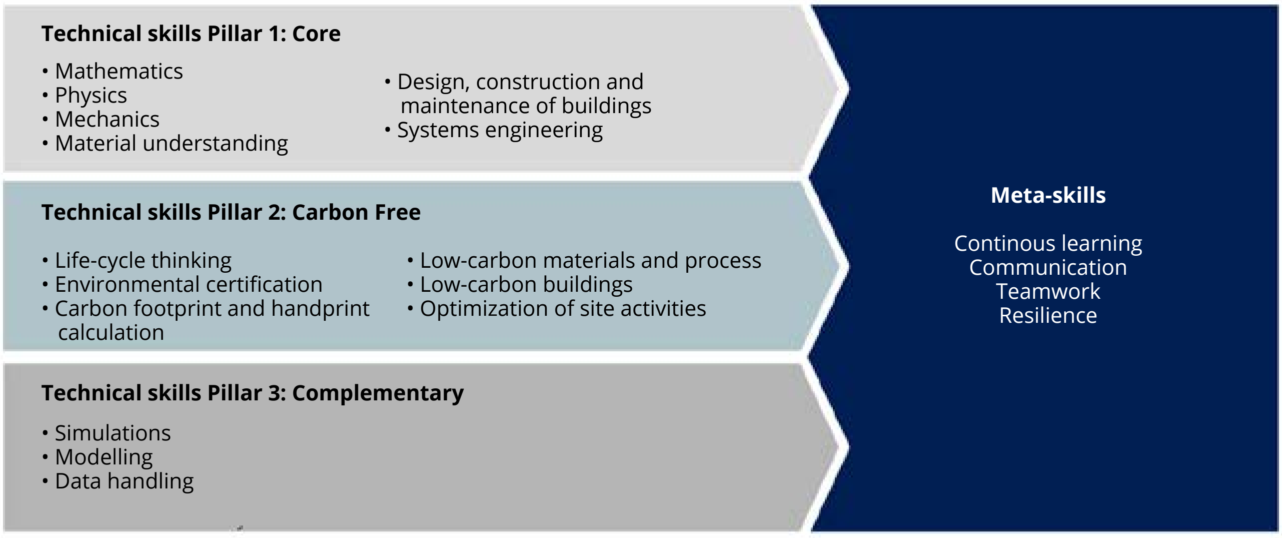

FIGURE 12 Required skills in the construction sector.

[32]https://www.rakennusteollisuus.fi/Ajankohtaista/Tiedotteet1/2020/rakennusalalla-kasvuhakuiset-yritykset-panostavat-digitalisaatioon/

ENERGY

When examining the required skills for the two green transition actions for the Energy sector, Action 5 Resilient Electricity Grid for Increasing Renewable Energy Penetration, and Action 6 Massive Increases in Renewable Energy Production, the same two distinctive types of skills as in the previous sectors emerge: technical skills and meta-skills.

Although the green transition is bringing about rapid changes to the sector, the new solutions are built upon existing technologies and knowledge. A solid mathematical-scientific understanding together with core skills in electrical engineering continue to form the foundation of the required technical skills needed in the transforming energy sector.

The second pillar of the technical skills relates to systems-thinking. One of the greatest changes within the energy sector is the way the green transition ties different sectors closer together. This increasing complexity calls for the understanding of the energy system as a whole. Especially as the production of renewable energy increases, skills related to understanding different production methods and their linkages becomes imperative. The established system forms an asset that also requires specific skills, such as asset management, utilization and planning as well as an understanding of the larger national preparedness to which the energy system is linked.

The third and final pillar of technical skills in the energy sector is data and information processing. Automation that is prevalent in the production of renewables and the growing complexity of the energy system signal a growing need for technical experts with data skills. Pro-gramming and coding along with data processing and visualization will be sought-after skills as a result of the green transition.

However, a single expert is not necessarily expected to cover all pillars. Instead, it is the collection of experts with different profiles who collectively form the skills set required by organizations. System-level engineers are demanded for their ability to solve the bigger picture, whereas substance-specialists are required to sort out the details.

However, what is common for all, is the need for over-arching meta-skills that enable well-functioning teams, knowledge sharing and continuous development. It is these meta-skills that are seen to be even more important than technical skills for technical experts. The intensifying speed of change causes rapid changes to knowledge requirements. Therefore, the ability to learn on the job and tolerance for change are staples for all technical experts. Additionally, as the importance of teams increases, communication and teamwork skills become increasingly important.

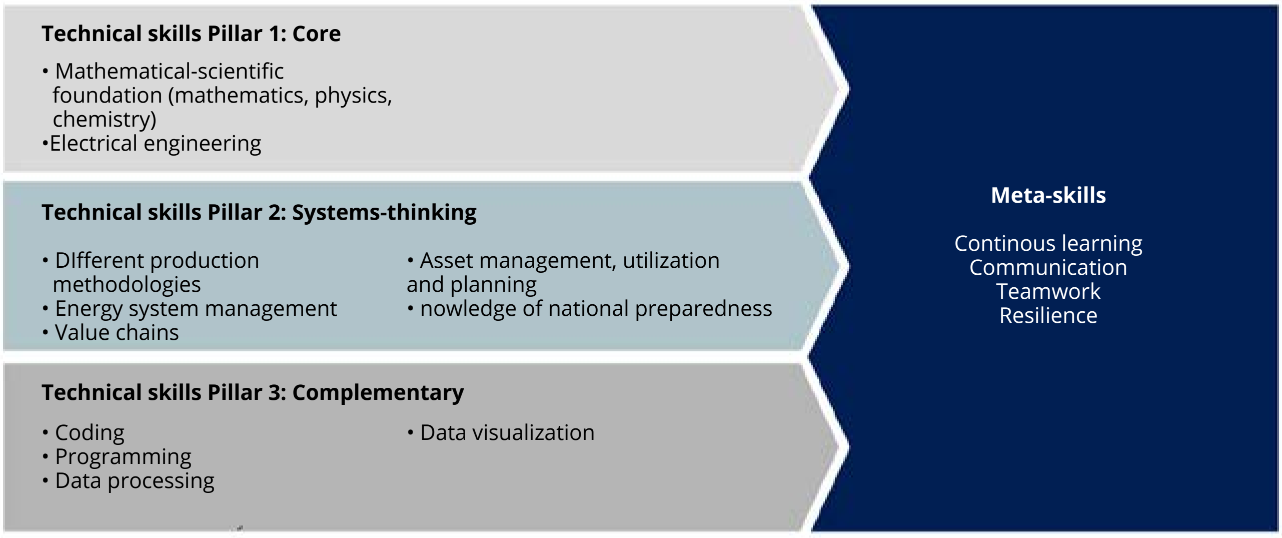

FIGURE 13 Required skills in the energy sector.

3.3. Strengths and weaknesses of the current educational programs

Overall, the current educational programs are seen to equip engineering students with the required skillsets displayed in section 2. Currently a total of 91% of recent graduates evaluate the competences developed during studies to meet their own expectations[33]. Likewise, the interview findings indicate that the study programs in Finland ensure that students are well equipped to enter the workforce, even in light of the green transition.

As demonstrated by the previous section, it is the core technical skills that continue to provide the foundation upon which the specific expertise required by the green transition builds. The educational programs are seen to build a sufficient understanding of the mathematical-scientific basis combined with the essential meta-skills that enables graduates to develop and deepen their knowledge in employment.

[33] TEK Graduate Survey 2020

PROCESS INDUSTRY

The high ambition level set by Finland and the recent contributions to the battery and hydrogen economies are reflected also in the need to develop study programs related to these fields. Entirely new programs have been set up to ensure a large enough supply of experts with the right set of expertise in the future. These programs include various levels of expertise ranging from retraining programs to new professorships.

Both battery and hydrogen economies are extensive fields and an overview of the required set of skills is still lacking on a national level. An education investigation by the Hydrogen cluster is currently under development, which will shed further light to the educational needs stemming from the hydrogen economy. The agility of educational programs to bring new teaching modules at a tight schedule was seen important in order to be able to respond to the emerging capability requirements.

The same concerns also rise from the battery industry's point-of-view. The findings of this study suggest, that the current scope of degree programs does not enable a broad enough skillset required by the industry. These findings are corroborated by a forthcoming report commissioned by the Ministry of Economic Affairs and Employment of Finland, as a part of the national Battery Strategy, regarding the educational needs and attraction of the battery industry (to be published in Spring 2022). The required teaching modules exist, but they all do not necessarily fit into the scope of the current programs. Separate module packages attached to existing programs could provide an answer to enable students to develop the required skillset and head towards the industry.

CONSTRUCTION

The study programs in the construction sector have aimed to provide students with a comprehensive understanding and skillset required by the complex nature of the industry. Based on our interview findings, this has resulted in the programs holding a wide array of subjects and study modules that are seen to provide students with good coverage of the different aspects of construction. However, simultaneously it has led the programs to be full to the brim, to the point where readjustments to the needs presented by the green transition are slow and difficult.

A need to streamline existing study programs to incorporate new skills required by the green transition emerges from the findings of this study. According to the interviews, carbon calculations and environmental certifications are currently often visible as thesis subjects. However, the teaching of these subjects as part of the study programs is currently seen to be limited, and thus ensuring that students have the skills required in light of the green transition is seen to be reliant on the proactivity of individual students.

In light of this study, the greatest challenge in the educational programs of the construction sector relates to ensuring that the latest knowledge is being applied. Although the programs are seen to equip graduates with a solid set of knowledge as they enter the workforce, the greatest challenge lies in ensuring that their knowledge-base stays up-to-date throughout their careers. Retraining and upskilling programs that ensure continuous learning were seen as an agile way to react to emerging needs of companies and the larger industry.

ENERGY

The educational programs for the energy sector are seen to provide engineers with a skillset that matches the needs highlighted in the previous chapter rather well. The biggest strengths are seen to be the close ties that the programs have with companies and their practical ap-proach that equips the students with the technical and meta-skills needed by companies.

The biggest weaknesses that emerge from this study are related to the programs’ speed of change and losing focus from the core technical skills. The two-year cycle at which the programs are updated was not seen to be sufficient enough in light of the rapid changes caused by the green transition. The need to increase energy storage studies was brough up as an example of current development needs in the programs. Despite the need for agility in the programs, core technical skills should continue to form the basis of the programs.

4. Summary and Conclusions

4.1. Summary

The green transition is causing profound shifts in society, and in the examined three sectors of process industry, construction and energy, in particular. This study set out to examine the effects of the green transition to the employment and educational requirements of engineers in Finland. The findings of this study indicate that the green transition will drive up the demand for engineers in Finland. The total increase in employment is estimated to be between 3150 – 4540 FTE, depending on the scenario. The greatest employment effect is seen in the construction industry by the energy renovation wave, closely followed by the new battery production and recycling ecosystem in Finland. Rather interestingly, the smallest employment effect is caused by the production of green hydrogen in industry, despite the vast national contributions. However, it should be noted that the figures for green hydrogen do not include the re-newable energy production associated in order to avoid double counting.

When examining the educational requirements emerging from the green transition, there is great similarity between the three sectors examined. The skills that are identified to increase in importance in light of the green transition in this study are largely pre-existing. The emerging skills could be identified to belong to two specific skillsets: technical skills, which represent the more specific abilities and knowledge required to perform specific tasks, and meta-skills, that are industry independent cognitive skills that can be used in a wide variety of situations.

The findings highlight the growing significance of meta-skills: Continuous learning, communication, teamwork and resilience were seen to be even more important than specific technical skills. However, the mathematical-scientific core remains as the foundation for engineers to build their specific skillset required by their sector. It is clear that further in-depth examinations are required into the specific action areas in order to determine these specific skill needs.

4.2. Conclusions

The key findings of this study can be summarized into three main conclusions:
1. The green transition is driving an increase in the demand of engineers
2. Growing complexity requires multi-skilled teams with complementary capabilities
3. The importance of meta-skills is highlighted by the green transition

By the 2030's the green transition is estimated to require thousands of additional engineering FTEs annually. There are nevertheless several variables that can have profound effects on the exact figures. For example, it remains uncertain to what extent green hydrogen will be adopted in the European market by the 2030's and whether or not Finland will be able to attract higher added value sections of the value chain within the batteries industry. Nevertheless, the need for engineers is increasing as a result of the green transition, which will put pressure to increase the number of graduating engineers.

One of the rather novel findings of this study relates to the notion that as the green transition increases the complexity of the sectors, multi-skilled teams that combine complementary knowledge will become increasingly important. This may reverse the trend of needing to ensure that a single expert is multi-capable and holds a wide variety of skills. What this study points out is that engineers will need to have a strong basic understanding of mathematical-scientific subjects that acts as the foundation and enables smooth communication within the multi-skilled teams.

The need for meta-skills is emphasized most by the green transition. It is these meta-skills that enable a person to interact with others and stay up-to-date in the latest knowledge. The increased importance of these multi-skilled teams is reflected in the growing need to be able to share knowledge and build upon other's thinking.

Although the current study programs are seen to equip students with a good skillset to match the needs of the green transition, there is a need to re-examine the contents and structure of study programs to strengthen specific skillsets. Steps have already been taken in some sectors, as new programs and modules have been introduced for example in the battery and hydrogen contexts. However, the programs are currently largely seen to lack the agility to respond timely to the new emerging needs of the markets. Separate study modules and focused retraining programs are seen as a potential solution to incorporate the emerging needs coming from the green transition to studies.

4.3. Limitations

This study has been made to provide an overview of the effects of the green transition on the employment and educational needs on three sectors. Several limitations to this study arise from the tight scoping that has been applied to approach the question. The most significant limitations relate to the small number of interviews held and focusing on calculating the direct employment effects.

Nine interviews were carried out as part of this study, three for each chosen sector. Although the interviews were targeted to include one university representative, one representative from a university of applied sciences, and an industrial representative, the voices gathered were limited. Particularly, the representation of companies is missing, and therefore the needs of companies that emerge from the green transition are not directly covered as part of this study. This provides a limitation to the assessment of the current educational programs against the needs presented by the green transition in particular. However, as the number of interviews was limited, a decision was made early on to target industry associations rather than individual companies.

The estimation of the effect to employment has been conducted by calculating only the direct effects. This provides a significant limitation to the results of this study, as the employment figures only grasp the first layer of changes that the green transition has on the employment figures towards the 2030's. This study has attempted to provide a solid overview by breaking down each identified green transition action to a value chain and calculating the employment figures of engineers for each part of the value chain. However, the entire effect on engineer employment is likely to be higher than this study reveals, as each part of the value chains is likely to have extended secondary employment effects.

As this study focuses on evaluating the additional employment figures, it simultaneously omits any possible reductions in employment that are happening as a result of the green transition. Therefore, the figures for employment displayed in this report should be treated as merely additional, and not be taken to represent the overall change of the employment prospects.

5. Recommendations

Written by Engineers Finland

Engineers Finland is aligned with Finlands carbon neutrality goal of 2035 set by Finnish government. Our motivation to procure this report stems from our concern on the lack of analytical approach to the industrial transformation mapped in the low-carbon roadmaps of Finnish industries. The roadmaps provide important information on the investments that are required in different industries to transform to low-carbon or even carbon neutrality. The mapped investment roadmap also provides us with a chance to approximate social impacts of the transformation. Engineers Finland highly underlines the necessity of such an analysis to be made to ensure that necessary policy actions can be conducted in time. It is especially critical to analyze the employment and skill needs of the future, as especially higher education has a long response time to changes. Any changes to higher education today result to a change in the graduate output in about 4-7 years later, and reskilling or upskilling have not so far proven to be fast and accurate tools either.

Due to the scope of the report, strong conclusions on the necessity to train more engineering workforce or to educate engineers with a different skillset cannot be made. This report was intended as a conversation opener and should be viewed as such. However, even this rough estimation raises important questions that should be further analyzed. These include employment and skill requirement changes in other STEM sectors than included in the scope of this report; possibilities of green transition leading to loss of jobs in some sectors; and the potential in reskilling unemployed STEM professionals to match possible employment and skill shortages.

It should also be noted that this study focuses only on the more certain expected transformations in very limited number of industrial sectors. There are many potential, but yet unrealized technologies that might emerge for large scale operations in Finland and create big new demand for STEM professionals. These include for example new nuclear technologies including small modular reactors; carbon capture and storage/utilization; geothermal energy; and large scale energy storages.

Based on the findings of this report, Engineers Finland suggest the following policy actions to ensure that we have an adequate amount of engineering professionals in Finland to ensure a smooth green transition.

Recommendations for the policymakers

- **COORDINATE A SYSTEMIC ANALYSIS ON THE CHANGES IN EMPLOYMENT AND SKILL REQUIREMENTS IN THE GREEN TRANSITION.** The low-carbon roadmaps of Finnish industries provided an important first step on ensuring the private sector is aligned with Finland's carbon neutrality goal. However, the roadmaps in themselves are not enough to ensure that the transition will happen. A logical next step would be to analyze the social impacts of investment pathways described in the roadmaps. This report is only meant to scratch the surface even for the STEM fields to highlight the benefits of analyzing social impacts.
- **ENSURE FURTHER EDUCATION OPPORTUNITIES AND CHANGES IN CURRICULUM TO CLOSE THE IDENTIFIED GAP.** This should be done in collaboration with educational institutions. The results of the systemic analysis on changes in employment and skill requirements in green transition should be in the heart of negotiations between higher education institutions and the ministry of education. Higher education institutions should be steered with both information and financial incentives.
- **ENSURE A STEADY GROWTH OF RDI FUNDING** in the coming years and steer funding to support the transformation to a carbon neutral circular economy. Finland's ambitious carbon neutrality goal can also provide a source of sustainable economic growth but requires research and innovation to produce new and improved solutions.

Recommendations for higher education institutions

- **ENHANCE THE EMPLOYABILITY OF INTERNATIONAL DEGREE STUDENTS BY IMPLEMENTING NETWORKING OPPORTUNITIES WITH PRIVATE SECTOR TO CURRICULUM AND BY CREATING UNIVERSITY-INDUSTRY PARTNERSHIPS WITH PAID THESIS POSITIONS TARGETED TO INTERNATIONAL DEGREE STUDENTS.** The gap in employment rate of Finnish and international graduates is wide and international graduates have a hard time in landing a job in Finland. This is especially due to lack of job experience and networks. The international degree students only spend a couple of years in Finland prior to their graduation and have difficulties to build opportunities for work experience in such a short time. The higher education institutions can integrate work experience and networking with the private sector into the curriculum by creating partnerships with companies. Methods of implementation may vary from case studies integrated to courses, to paid thesis positions in companies.
- **ENHANCE THE PASS RATE OF ENGINEERING EDUCATION WITH BETTER TARGETED SUPPORT MECHANISMS FOR STUDENTS.** The pass rates of engineering education in both universities and universities of applied sciences have been constantly poor for a long time. A study by The Union of Professional Engineers on the causes of low pass rates highlights the need for more support especially in mathematics studies, keeping up motivation and flexibility of studies when students face changes in life situation. Investing in support mechanisms may seem expensive but also having a drop-out rate of close to half of the student intake has economic effects.

- **CONSIDER FASTER PACE FOR CURRICULUM UPDATE CYCLES AND PROVIDE TARGETED SHORT CYCLE EDUCATION MODULES TO MATCH THE NEEDS IDENTIFIED IN GREEN TRANSITION.** The update cycle for curriculum in higher education institutions could be too long in the accelerating pace of the green transition. A curriculum cycle of 1 or maximum of 2 years would serve for a faster response time to change requirements. In addition, higher education should also be equipped to serve short-cycle education modules and other targeted responses to match the reskilling and upskilling needs identified in the green transition.

Recommendations for companies

- **EMPLOY INTERNATIONAL DEGREE STUDENTS AND COLLABORATE WITH UNIVERSITIES TO PROVIDE JOB EXPERIENCE AND NETWORKING OPPORTUNITIES DURING STUDIES FOR INTERNATIONAL DEGREE STUDENTS.** International degree students are generally willing to build their career in Finland after graduation but tend to have difficulties in landing a job in Finland. Companies can benefit from this untapped pool of potential by creating partnerships with higher education institutions to network and collaborate with international degree students. Great ways to scout for talent include providing case studies for courses and paid thesis positions in companies.
- **ANALYZE FUTURE COMPETENCE REQUIREMENTS BROUGHT BY GREEN TRANSITION AND CREATE A HOLISTIC COMPETENCE DEVELOPMENT ROADMAP FOR THE COMPANY.** Green transition creates a demand both for new employees and reskilling existing workforce. The reskilling needs should be assessed holistically and close the identified gaps in collaboration with educational institutions. Engineers are generally willing to educate themselves further if they are encouraged to do so and the employer supports it. Investing in the reskilling of employees is also beneficial to employer brand and in having a more committed workforce

About Engineers Finland

Engineers Finland is an registered association of engineering organizations operating in Finland. We currently represent approximately 150,000 engineers and other professionals and supervisors in technology. Engineers Finland was established om the 8th of May 2019. The purpose of Engineers Finland is to promote the common educational, industrial and labor market goals of its member organizations nationally and internationally.

We aim to work closely with Nordic engineering organizations on the following themes:
• Systematic exchange of labor market and wage data
• Support for continuous learning
• Promoting R&D investment
• Joint development of union membership services

The member organizations of Engineers Finland are:
• DIFF - Ingenjörerna i Finland
• The Union of Professional Engineers in Finland
• Academic Engineers and Architects in Finland TEK
• Tekniska Föreningen i Finland TFIF

Engineers Finland