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Jobs with green potential in Switzerland: Demand and possible skills shortages*

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Abstract

We use a data-driven methodology to quantify the importance of different skills in performing green tasks. For Switzerland, we estimate the green potential to be 16.7% of the total of employed persons and 18.8% of full-time equivalents in 2017, respectively. Employed persons in jobs with high green potential are, on average, younger, more often men, have a higher level of educational attainment and a higher probability of having immigrated than employed persons in other occupations. Moreover, there is a shortage of skilled labour in the group of jobs with high green potential, particularly pronounced for the occupational groups managers and professionals. In light of the already tense situation for skilled workers in jobs with high green potential and the expected increase in demand for these occupations, increased efforts will be necessary, especially in the area of labour qualification (education as well as post-qualification and upgrading), to meet the demand for skilled workers for the transition to a sustainable economy.

Keywords: green transition, labor market, skills shortage
JEL codes: J23, J24, Q52

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1 Introduction

Environmental awareness has increased in the population in recent years, especially against the background of climate change. These developments have also led to regulatory activities at the political level.[1] Strategies and action plans are aimed, among other things, at increasing resource efficiency in production and achieving a more sustainable economy overall.[2] Research and practice recognize possible interdependencies between a more sustainable economy and the labour market (e.g. Vona, Marin, Consoli, & Popp, 2018). Specifically, the labour market asks for employees with specific skills (knowledge, abilities, skills in the narrower sense and attitudes) that are necessary to perform green tasks. These tasks will be increasingly demanded on the path to a more sustainable economy. Against this background, the question arises to what extent the Swiss labour force already covers these skills.

In order to answer this question, we firstly quantify the green potential of the Swiss labour market in terms of the number of employed persons working in occupations with a high potential to perform green tasks. We identify this potential using a novel approach developed by Rutzer, Niggli, and Weder (2020), relying on machine-learning algorithms. We then characterize this potential along different dimensions such as age, sex, migration status and level of education. Secondly, we assess whether there is an imbalance regarding supply and demand of occupations with high green potential. In order to do that, we construct an index using a set of indicators that reflect different dimensions of a skills shortage.

[1]Based on country case studies Strietska-Ilina, Hofmann, Haro, and Jeon (2011) identify other drivers of greening economies such as changes in the physical environment, technological development, developments of markets for green products and services, and changing consumer habits.

[2]For Switzerland, the Federal Councils Sustainable Development Strategy 2016-2019 (Bundesrat, 2016) can be mentioned in this context. The strategy sets out a number of objectives, one of which aims at improving resource efficiency in production. Specific measures to achieve better resource efficiency are set out in the 2013 Green Economy Action Plan and its development for the period 2016-2019 (BAFU, 2013, 2016).

According to our estimates, in Switzerland in the year 2017, 739'000 persons and 670'000 full-time equivalents (FTE) have been employed in jobs with high green potential. Measured relative to the total number of persons employed and FTE, this is around 16.7% and 18.8% respectively. Employed persons in jobs with high green potential are, on average, younger, more often men, have a higher level of educational attainment and a higher probability of having immigrated than employed persons in other occupations. The distributions are relatively stable over time.

The skilled labour situation in the group of jobs with high green potential is tense, while the situation in the group of other jobs is inconspicuous. Looking at four occupational groups that include occupations with high green potential, results reveal that the need for skilled workers is particularly pronounced for managers and professionals. For technicians and craft & related trades workers, there exist, on the contrary, no indications of a shortage of skilled workers.

In view of the already tense situation for skilled workers in jobs with high green potential and the expected increase in demand for these occupations, increased efforts will be necessary, especially in the area of labour qualification (education as well as post-qualification and upgrading), to meet the demand for skilled workers for the transition to a sustainable economy.

The rest of the paper is structured as follows: Next, we review the literature analysing the impact of a green economy on the labour market. Afterwards, we describe our methodology to estimate the green potential of occupations and how to measure skills shortages. Consequently, we estimate the green potential of the workforce of Switzerland. In doing so, we analyze potential skills shortages of occupations with a high green potential. Finally, we summarize our main findings and conclude.

2 Literature

Recently, the literature has addressed questions about the impact of a green economy on the labour market.[3] Efforts have been made to estimate the size of the green economy in terms of employment and to characterise the corresponding workforce in terms of tasks and skills (Bowen, Kuralbayeva, & Tipoe, 2018; Consoli, Marin, Marzucchi, & Vona, 2016; Vona et al., 2018). The definition of so-called *green jobs* is at the center of each analysis. However, there exists no uniform definition of green jobs (Bowen et al., 2018). For example, ILO (2018, p.53) defines green jobs in a general and formal way as jobs that "[...] reduce the consumption of energy and raw materials, limit greenhouse gas emissions, minimize waste and pollution, protect and restore ecosystems and enable enterprises and communities to adapt to climate change. In addition, green jobs have to be decent." The literature provides different approaches to define green jobs more specifically and with the goal of operationalizability. These definitions are based on industry affiliation, the production methods used or occupations and the associated skills and abilities (Bowen et al., 2018; Consoli et al., 2016; Martinez-Fernandez, Hinojosa, & Miranda, 2010).

A frequently used approach to identify green jobs starts at the industry level and identifies those sectors that produce goods and services that contribute to the protection of the environment or the conservation of natural resources. In particular, the efforts of statistical offices to define the so called *Environmental Goods and Services Sector (EGSS)* and describe it in terms of employment and value added are to be mentioned here (Eurostat, 2016; ILO, 2018). According to the Federal

[3] In this paper, green economy and sustainable economy are used synonymously. A green economy is one "[...] that takes the scarcity of limited natural resources and the regeneration capacity of renewable resources into account, enhances resource efficiency, and hence boosts the overall performance of the economy and quality of life." (BAFU, 2016, p. 10) A broad understanding of natural resources is assumed, including climate, soil, biodiversity, clean air and water, raw materials and mineral resources.

Statistical Office (FSO), the employment in full-time equivalents in the EGSS in Switzerland in the year 2017 amounted to 155'500, which corresponds to 3.9% of total economic employment. This approach has, however, some drawbacks: As noted in ILO (2018), it neglects jobs that improve production processes with respect to their environmental impact irrespective of the goods that are produced. Furthermore, it does not shed light on the skills necessary for carrying out an activity that is expected to contribute to a sustainable economy. But precisely this information is of interest to education policy and practice in order to gear training courses to the needs of a sustainable economy.

Therefore, the literature studying the impact of a green economy on the labour market has recently begun to apply a task-based approach. This approach is conceptually related to a rich literature that analyzes how labour market outcomes (such as employment and wages) are shaped by skills and tasks (Acemoglu & Autor, 2011). According to Acemoglu and Autor (2011, p. 1045), "[...] a task is a unit of work activity that produces output (goods and services). In contrast, a skill is a worker's endowment of capabilities for performing various tasks. Workers apply their skill endowments to tasks in exchange for wages, and skills applied to tasks produce output." Consoli et al. (2016) elaborate on the differences between green and non-green occupations in terms of skill content and of human capital. Their analysis relies on data from O*NET (in particular the classification into green and non-green jobs) and covers the US labour market.[4] The results show that green jobs use high-level cognitive and interpersonal skills more intensively compared to non-green jobs. Green occupations also exhibit higher levels of standard dimensions of human capital such as formal education, work experience and on-the-job training. Vona et al. (2018) point to the frequent reference to green skills in political debates,

[4] Consoli et al. (2016) focus on *Green Enhanced Skills* and *Green Emerging* occupations only. We provide more information about the green economy classification of O*NET in section 3.1.

but also to the lack of a (common) understanding of what these green skills are.[5] They contribute to this debate by identifying green skills by means of a data-driven methodology, relying on the O*NET database. They show that green skills are engineering and technical know-how related to the design, production, management and monitoring of technology. Bowen et al. (2018) estimate, based on the definition of green jobs in the O*NET database, that 19.4% of the US workforce could be part of the green economy.[6] They find considerable variation in the employment share across sectors, with sectors such as accommodation and food services, health care and education services having shares below 5%. On the other side are sectors such as manufacturing, utilities and construction with shares of 50% and above. The view outlined above about tasks and skills will guide our strategy to identify the green potential of the Swiss economy, that is the number of employed persons that work in occupations that have a high potential to perform green tasks (see Section 3.1). Essentially, the idea is that a set of skills can be applied for different (green or non-green) tasks. In this respect, there are no green skills, but skills that are better suited than others to exercise green tasks.

So far, we have discussed studies dealing the characterisation of green jobs and the description of green skills. What is still missing is an analysis of the green workforce in terms of possible skills imbalances. According to OECD (2017), the term skills imbalances encompasses skills shortages and surpluses as well as skills mismatches: A *skills shortage (surplus)* refers to a situation in which the supply of workers with a specific set of skills falls short (exceeds) of the demand of workers with that required set of skills for a given job under the current market conditions

[5]OECD and Cedefop (2014, p.16) define green skills as skills "[...] needed by the workforce, in all sectors and at all levels, in order to help the adaptation of the products, services and processes to the changes due to climate change and to environmental requirements and regulations."

[6]Where green economy is understood as economic activity related to reducing fossil fuel usage, decreasing pollution and greenhouse gas emissions, recycling materials, increasing energy efficiency, and developing/adopting renewable energy sources (Bowen et al., 2018, p. 274).

(e.g. pay and working conditions). A *skills mismatch* refers to a situation in which the workers skills either exceed or fall short of the required skills needed for a given job (e.g. mismatch in terms of the demanded qualification level, in terms of the demanded field-of-study or in terms of the demanded set of skills). According to OECD (2017), a skills shortage can induce mismatches as employers recruit mismatched workers. In other words, while skills shortages reflect the incidence and extent of differences between demand and supply of employees with certain skills, skills mismatches reflect the incidence and extent of differences between offered and demanded skills of occupied positions.

In a world with perfect and complete information and in the absence of other market failures, supply of and demand for skills adapt immediately to changes in the environment. Under these circumstances, there would be no room for skills imbalances. In reality, the supply and demand for skills can be unbalanced at least in the short term but also for a longer period of time. One reason for this situation is that there is a time lag between the decision to take up an education or training path and the effective date of entry into the labour market with the acquired skills. Because of lack of perfect information, future employees do not know, or only roughly know, what skills will be in demand in the future when choosing their training. Furthermore, because curricula are fixed for a certain period of time, there may be a gap between demand and supply of (certain) skills. In essence, the supply of skills is inelastic in the short run. Furthermore, incomplete information (information asymmetries between employees and employers), lack of geographical mobility of employees and the macroeconomic situation (weak aggregate demand, technological change) are further reasons for skills imbalances (at least for specific jobs or regions) (McGuinness, Pouliakas, & Redmond, 2018; OECD, 2017).

Why does this matter? Skills imbalances are associated with various negative effects on the economy. These include productivity losses at the level of the economy as a whole. However, negative effects are also suspected at the level of the working population (e.g. persistent wage losses due to a bad match between the skills of an employee and the requirements of the occupied position). The transition to a green economy becomes all the more costly as the shortage of skilled labour becomes more pronounced (OECD & Cedefop, 2014). For this reason, it is important to find out to what extent occupations with green potential are already showing signs of skills imbalances.

There are different approaches to measure skills imbalances. OECD (2017) provides an overview of measures of skills shortages. They can be divided into direct approaches such as employer surveys that ask employers by means of survey techniques directly about the perceived difficulty for recruiting workers to fill job vacancies and explore what specific skills are hard to find.[7] Skills shortages and mismatches can also be studied indirectly by examining job-related indicators. At the level of jobs, there are a few studies that investigate skills imbalances for specific jobs or groups of jobs by using indicators to map different dimensions of the phenomenon (e.g. OECD, 2017).

After this brief review of the literature, the next section deals with the methodological approach and the data we use to estimate the green potential of the Swiss workforce.

3 Methodology and data

The section 3.1 provides detailed information about the identification and measurement of the green potential of occupations. The section 3.2 informs about the

[7] For Switzerland, the Job Statistics of the Federal Statistical Office survey recruitment difficulties per economic division and major region, but not at the level of jobs or skills.

measurement of skills shortages by means of indicators that map different aspects of this phenomenon. Finally, section 3.3 describes the data basis.

3.1 Identification of jobs with high green potential

The identification of jobs with high green potential draws on the recent contribution of Rutzer et al. (2020). This work estimates the green potential of occupations in the US labour market, that is, for occupations classified according the the Standard Occupational Classification (SOC). This approach can be adapted so it can be used to estimate the green potential of Switzerland and other countries relying on a different classification system for occupations, namely the International Standard Classification of Occupations (ISCO). The following section briefly discusses this approach and highlights the modifications that need to be made to apply it to Swiss data. Here we follow the approach of Rutzer and Niggli (2020) and refer to this article for a detailed description of the procedure.

The estimates of Rutzer et al. (2020) of the green potential for SOC occupations are based on data from O*NET. This database provides information about the tasks and skills contained in occupations and b) classifies occupations and (within occupations) tasks as green or non-green.[8] Green occupations are classified either as "new & emerging", "enhanced skills" or "increased demand". While "new & enhancing" occupations have (already) emerged as a result of the evolution towards a green economy, occupations classified as "enhanced skills" are experiencing a change in the composition of skills (new skills are added, existing skills are used to a greater/weaker extent). Furthermore, there are occupations which may not experience any change in the composition of skills, but may nevertheless in "increased

[8]The classification of occupations according to green jobs and other jobs is carried out by experts. The potential for making a contribution to the green economy is assessed. Past and current contributions to the green economy do not play a major role.

demand" when a development towards a green economy takes place. According to the classification provided by O*NET, only green occupations classified as "new & emerging" and "enhanced skills" include green tasks. Table 1 provides four examples of occupations, each classified in one of the three groups. The solar photovoltaic installer is classified as a "new & emerging" occupation. O*NET lists a total of 26 tasks for this occupation, where 26 tasks are classified as "green new tasks". The environmental engineer is classified as "green enhanced" occupation with a total of 28 tasks, where three out of them are green new tasks and 25 existing green tasks.[9] Architects are classified as "green enhanced", with seven new green tasks and 18 non-green tasks.[10] The electrician is classified as an occupation with green increased demand. Of 21 tasks, none are considered as green.

Table 1: Examples of green jobs and tasks according to O*NET

Title	Group	# of tasks			greenness η)
		green		other	
		new	existing		
Solar photovoltaic installer (47-2231.00)	green new & emerging	26	0	0	1.0
Environmental engineer (17-2081.00)	green enhanced skills	3	25	0	1.0
Architect (17-1011.00)	green enhanced skills	7	0	18	0.3
Electrician (47-2111.00)	green increased demand	0	0	21	0.0

On that basis Rutzer et al. (2020) calculate the greenness of an occupation i

[9] Example of an "existing green task": *Design or supervise the design of systems, processes, or equipment for control, management, or remediation of water, air, or soil quality.* Example of a "new green task": *Write reports or articles for Web sites or newsletters related to environmental engineering issues.*

[10] Example of a "new green task": *Design or plan construction of green building projects to minimize adverse environmental impact or conserve energy.* Example of a "non-green task": *Prepare scale drawings or architectural designs, using computer-aided design or other tools.*

as $\eta_i = \#green\ tasks_i/\#total\ tasks_i$. In the examples provided by Table 1 (last column), two occupations have a $\eta = 1.0$ (solar photovoltaic installer, environmental engineer), one a $\eta = 0.3$ (architect) and one a $\eta = 0$ (electrician). It is important to note that there are occupations that do not perform any green tasks, that is jobs with $\eta = 0$, but demand skills similar to occupations that perform green tasks. While these occupations do not bundle green tasks, they nevertheless have the *potential* to perform green tasks based on the skills required. In the literature, these jobs are referred to as *green rival jobs* (Rutzer et al., 2020, and the literature quoted there) as they share similar skills with jobs that contain green tasks. The calculation of this potential is what is at the heart of the identification strategy used in this analysis. E.g. it is not a-priori clear that electricians that perform, according to the O*NET classification, no green tasks (cf. Table 1) belong to the group of jobs with high green potential or not. Indeed, as the calculations later will show, electricians will be classified also as a job with high green potential, because it is associated with skills that are similar to jobs that perform green tasks. In other words, employees that work as electricians are thought to be equipped with skills that are a prerequisite to perform green tasks.

Besides information about tasks, O*NET provides detailed information about job-specific skills for every occupation. Following Vona et al. (2018), skills are understood as knowledge, skills (in the narrower sense) and work activities.[11] O*NET

[11] It is important to note that there is no uniform definition of skills in the literature (OECD, 2017). We stick to the definition used by O*NET as we will base our analyses strongly on this database. For detailed information on the database, see `https://www.onetcenter.org/database.html#individual-files`. The following definitions were taken from `https://www.onetcenter.org/reports/Related.html` (Volume I: Report): **Knowledge** is defined as a "[...] collection of discrete but related and original facts, information, and principles about a certain domain that is acquired through education, training, or experience" (such as "Administration and Management" or "Design"), **skills** (basic and cross-functional) is defined as "[...] capabilities of individuals that are acquired through experience and practice, and are used to facilitate knowledge acquisition" (such as "Mathematics" or "Writing"), **work activities** is defined as an "[...] aggregation of similar job activities/behaviors that underlie the accomplishment of major work functions" (such

provides, for each occupation, a quantitative rating for the importance (IM) and the level (LV) of a total of 114 skills. For each skill s, this information is aggregated into a single value by applying a weighting scheme of importance and level. Following Rutzer et al. (2020), the value of a skill s of occupation i is calculated as $skill_{i,s} = IM_{i,s}^{\alpha} LV_{i,s}^{1-\alpha}$ with $\alpha = 0.7$.

Using machine-learning algorithms, it is possible to predict the potential of SOC occupations to perform green tasks on a continuous scale. For that, a prediction model is trained to predict the greenness of an occupation depending on the values of different skills using data from O*NET. According to the analysis of Rutzer et al. (2020), the Ridge algorithm performs best compared to alternative estimation models (OLS, Lasso, Random forest) in terms of prediction quality (measured by the mean squared error on a holdout dataset).[12] For this reason, the estimation of the green potential for SOC occupations is based on the Ridge regression model. The model uses the information on skills described above as explanatory variables and the greenness η_i of an occupation i, that is the share of green tasks in the total number of tasks, as the dependent variable. The result is a coefficient $\hat{\beta}_s^{ridge}$ for each skill s, which can be used to predict the green potential $\hat{\eta}_i$ of an occupation i:

$$\hat{\eta}_i = \hat{\beta}_0 + \sum_{s=1}^{p} skill_{i,s} \hat{\beta}_s^{ridge}$$

O*NET provides information on the value of a skill s of occupation i ($skill_{i,s}$) according to the SOC on an 8-digit level. In order to estimate the green potential for occupations according to the ISCO-2008 on the 3-digit level, the values of the skills must accordingly be transferred. Here we follow Rutzer and Niggli (2020) (and the work cited therein) and carry out the following three steps: First, the values of a

as "Analyzing Data or Information" or "Developing and Building Teams").

[12] In comparison to OLS, the Ridge regression endogenously shrinks some coefficients towards zero in order to reduce overfitting to the training data.

particular skill s of all occupations i belonging to the same 6-digit SOC occupation are transferred to that 6-digit level SOC occupation by taking a simple (unweighted) average. Second, the $skill_{i,s}$ is then transferred to ISCO occupations, where a conversion table (provided by the US Bureau of Labor Statistics (BLS)) informs about the relations between SOC occupations on the 6-digit level and ISCO occupations on the 4-digit level. In the case of multiple matches, a simple (unweighted) average is used. The transfer of job information prepared for the US labor market to the European context can be seen as a limitation of this approach. However, following scientists in other works (e.g., OECD, 2017), we assume that this transfer is by and large permissible. Firstly, environmental issues arise not only in Switzerland, but internationally. Secondly, we assume that a skilled worker in both the USA and Switzerland must, with a few exceptions (e.g. in terms of nomenclature), have the same skills in order to be able to carry out the tasks assigned to her. For example, electricians must have the skills to estimate the necessary material quantities on the basis of planning documents and to install switches and sockets. Third, the $skill_{i,s}$ for ISCO occupations on the 3-digit level are computed by taking simple (unweighted) averages of all values of a particular skill s of all 4-digit occupations that belong to a 3-digit occupation. On that basis, it is then possible to apply the trained model to predict the potential of 3-digit ISCO occupations to perform green tasks.

A summary of the results is shown in Table 2. It lists the ten occupations with the highest green potential estimates. As one can see, Engineering professionals have the highest green potential with a value of 1, followed by Physical and earth science professionals with a value of 0.76 and Production managers in agriculture, forestry and fisheries with a value of 0.76. The green potential of all occupations used in this study are shown in Table 5 in the Appendix.

Table 2: Occupations with highest green potential

ISCO	Occupation	Green Potential
214	Engineering professionals (excluding electrotechnology)	1.00
211	Physical and earth science professionals	0.76
131	Production managers in agriculture, forestry and fisheries	0.76
210	Science and engineering professionals, nos	0.75
312	Mining, manufacturing and construction supervisors	0.75
215	Electrotechnology engineers	0.73
132	Manufacturing, mining, construction, and distribution managers	0.72
216	Architects, planners, surveyors and designers	0.71
112	Managing directors and chief executives	0.68
314	Life science technicians and related associate professionals	0.68
...	...	...

Note: Own calculations based on Rutzer et al. (2020).

So far, the green potential is calculated for each ISCO occupation on a continuous scale.[13] In order to assess the green potential in terms of employment, a threshold has to be determined. The choice of the threshold is further explained in Chapter 4.1.

3.2 Measuring skills shortages

We measure skills shortages indirectly by means of an indicator system (e.g. Degen, Ragni, Bieri, & Marti, 2016; OECD, 2017, where the first reference is specific for the Swiss labor market).

It has to be kept in mind that the indicators used reflect the incidence and extent of a skills shortage. Indicators for measuring skills mismatches (e.g. qualification mismatch or a field-of-study mismatch, see OECD, 2017) are not considered. We compute the following indicators for job i and year t:

- *Rate of unemployment*: The rate of unemployment (ru_{it}) is defined as the number of unemployed persons (as defined by ILO) (u_{it}) divided by the eco-

[13]We normalize the green potential of occupations on a scale between 0 and 1, whereas the value of 1 (0) is attributed to the occupation with the highest (lowest) estimated green potential. The values for the other occupations are then calculated relative to the values of the occupations with the highest and lowest green potential.

nomically active persons (l_{it})[14]: $ru_{it} = u_{it}/l_{it}$. The lower the rate of unemployment, the stronger the indications of a shortage of skilled workers.[15]

- *Rate of immigrant workers*: The rate of immigrant workers is defined as the number of immigrant workers in the labour force (immigrated in the last 10 years) (m_{it}) divided by the employed persons (e_{it}): $rm_{it} = m_{it}/e_{it}$. The higher the rate of immigrant workers, the stronger the indications of a shortage of skilled workers among the domestic workforce.

- *Employment growth*: In order to calculate employment growth, the number of employed persons in the year under review (e_{it}) is compared with the number of persons in employment in 2010 (e_{i2010}): $g_{it} = e_{it}/e_{i2010}$. Employment growth can further exacerbate an already tense skilled labour situation.

- *Replacement demand*: The replacement demand compares the employed persons of the cohort of 50-59 year old ($e_{it}^{50/59}$) with the employed persons of the cohort of 25-34 year old ($e_{it}^{25/34}$): $rd_{it} = e_{it}^{50/59}/(e_{it}^{25/34} + e_{it}^{50/59})$. A value of over 50% means that in the next few years more people will leave the labour market than have just entered it. This can be interpreted accordingly as an indication of an (increased) demand for skilled labour in the future.

- *Qualification level*: For the calculation of the qualification level, the employed persons with a diploma on the upper secondary or tertiary level (e_{it}^{*}) are compared with the total number of employed persons (e_{it}): $ql = e_{it}^{*}/e_{it}$. The underlying hypothesis is that the higher the qualification requirements, the less likely it is that in the event of an increased demand for skilled labour,

[14] The economically active persons consists of employed persons (e_{it}) and unemployed persons (u_{it}), i.e. $l_{it} = e_{it} + u_{it}$.

[15] For the following calculations, $1 - ru_{it}$ is used so that an increase in the value can be interpreted as an increase in scarcity for each indicator.

nonskilled workers will be able to meet the demand.

Each of these indicators represents a specific aspect of a skills shortage.[16] In order to map the information on the incidence and the extent of a skills shortage in a single value, the indicators are combined into an index. For that task, the indicators have to be standardized (indicators may have different scales) and aggregated.

The standardisation of the indicators is carried out by subtraction of the mean and the division by the standard deviation for each indicator: For indicator x_{it} for occupation i in year t, the standardized value results as follows: $\widetilde{x}_{it} = (x_{it} - \bar{x}_t)/s_t$, where $\bar{x}_t$ is the mean of x and s_t the standard deviation of x.[17] To aggregate the individual indicators to a composite index, a weighting procedure has to be chosen. We use an equal weighting of all indicators: The composite index for occupation i in year t (SSI) is derived from the sum of the standardised indicators: $SSI_{it} = \widetilde{ru}_{it} + \widetilde{rm}_{it} + \widetilde{g}_{it} + \widetilde{rd}_{it} + \widetilde{ql}_{it}$.

3.3 Data

Our analysis is mainly based on two data sources: Firstly, we use data from the O*NET database (v21.2). We have already described it in Chapter 3.1 when discussing the identification of jobs with green potential. Secondly, the estimates are based on data from the Swiss Labour Force Survey (SLFS) for the years 2012-2017. The SLFS provides information on the structure of the labour force and employment

[16]Estimates of skills shortages for Switzerland from Degen et al. (2016) are based on the unemployment rate as defined by the State Secretariat for Economic Affairs (SECO), using as numerator the number of registered unemployed persons instead of the number of the unemployed persons as defined by the International Labour Organization (ILO), and the rate of job vacancies as an additional indicator. Modifying our estimates in this direction reveal no significant differences compared to the results presented in this paper. The corresponding results are available upon request.

[17]In the standardisation process, the occupational groups were weighted according to the estimated number of people employed in the respective occupational groups.

behaviour patterns. Specifically, in addition to general socio-economic information, the SLFS contains information on employment (including information on the job exercised according to the ISCO nomenclature), unemployment, highest educational attainment and migration status.

After these conceptual considerations we turn to the results in the following chapter.

4 Results

4.1 Green potential

Using the estimates of the green potential of ISCO occupations, we calculate the green potential in terms of the number of employees and full-time equivalents (FTE) for Switzerland. In 2017, around 739'000 persons were employed in green jobs (that is jobs with an estimated green potential above the specified threshold value), which corresponds to about 670'000 FTE. Measured in terms of total employment, the number of people employed and FTE in green jobs was around 16.7% and 18.8%, respectively.

This and the following estimates are based on a threshold value for the estimated green potential of 0.5. Figure 1 shows the cumulated employment share (in %) in dependency of the green potential. The mean green potential (measured by the median) is 0.27. The threshold value at 0.5 thus indicates that the green potential includes workers in occupations that have more than one and a half times the median green potential. These are thus occupations with a green potential that is well above average. Nevertheless, in the following analyses we will also consider how sensitively the results react to changes in the threshold value. We will apply a lower threshold value of 0.45 and an upper threshold value of 0.55. As Figure 1 shows, these thresholds result in cumulative shares of about 20% (threshold value = 0.45) and 11% (threshold value = 0.55).

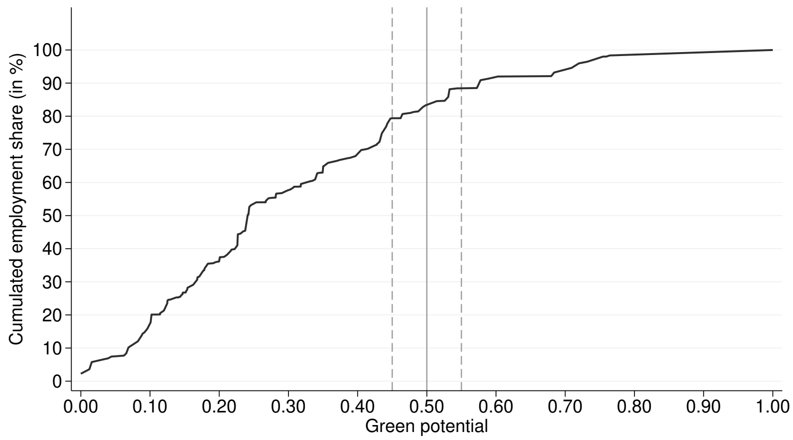


Figure 1: Cumulated employment share (in %). Source: Own calculations based on SLFS 2017 (FSO).

As Figure 2 shows, employment growth in the group of jobs with high green potential was stronger in the time period 2012-2017 than in the group of other jobs: While the number of employees in the group of jobs with green potential grew by 19.4% in 2012-2017, the growth in employment in the group of other jobs over the same period was only 5.1%. It is worth noting that in absolute terms growth in the group of other jobs was significantly higher at 179,363 than in the group of jobs with high green potential at 119,938.

We have also compared those employed in jobs with high green potential with those employed in other jobs in terms of age structure, gender, level of education and migratory status[18] (see Figure 3): Employed persons in green jobs are, on average, younger, more often men, have a higher level of educational attainment and a higher probability of having immigrated than employed persons in other occupations.

The employment share of jobs with high green potential is distributed differently

[18]We differentiate between employed people that immigrated in the last 10 years (no matter what nationality) and people that have not immigrated or immigrated over 10 years ago.

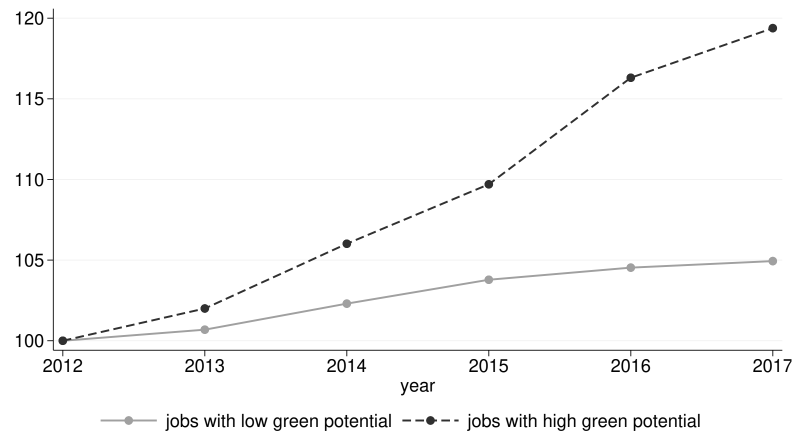
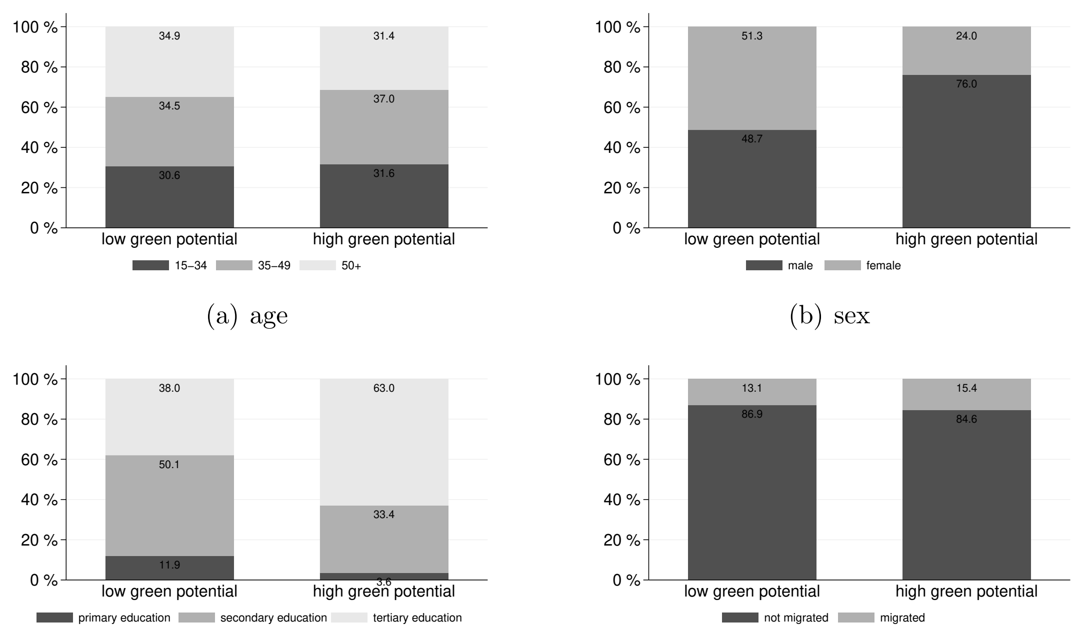


Figure 2: Employment growth in jobs with low and high green potential, 2012-2017. Source: Own calculations based on SLFS (FSO).



(a) age

(b) sex

(c) education

(d) migration

Figure 3: Characterisation of green and non-green jobs. Source: Own calculations based on SLFS 2017 (FSO).

across industries. In 2017, the highest shares of employees in jobs with high green potential to the total labour force are found for energy, construction, manufacturing and professional, scientific and technical activities (with shares above 20%) (see Figure 4). On the other hand, accommodation and food service activities, financial and insurance as well as human health and social work activities have the lowest shares well below 10%.

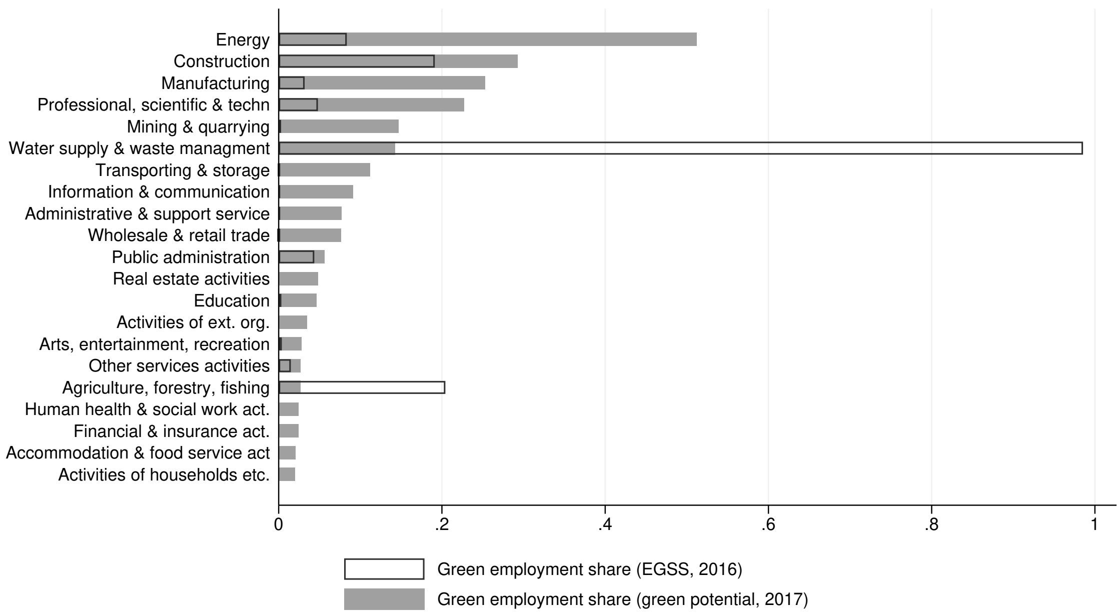


Figure 4: Green employment as a percentage of total employment by industry. Note: The figure indicates for each industry a) the share of green employment (made up of employed workers who pursue a job that has been identified as a job with high green potential) as a percentage of total employment (measured in FTE) and b) the share of jobs (filled) in industries belonging to the Environmental Goods and Services Sector (EGSS) as a share of the job base (measured in FTE). Source: SLFS 2017 (FSO), EGSS 2016 (FSO).

For the sake of comparison, Figure 4 shows the shares of green employment when using the definition of the EGSS, covering employment in industries that produce goods and services contributing to the protection of the environment or the conservation of natural resources. As described in the literature review in Chapter

2, such an industry approach is often used to quantify green employment. Using this alternative definition produces quite different results: Three sectors dominate, namely water supply and waste management, agriculture, forestry and fishing, and construction. In comparison, the shares for three sectors that were still among the four most important sectors (energy, manufacturing, professional, scientific & technical activities) in terms of green potential are now significantly lower. These differences reveal the impact of the two different approaches to identify green jobs. The approach used in this study differs from the EGSS approach in two important aspects: First, an occupation is classified as one with high green potential if it is expected to be in higher demand because of the transition to a green economy.[19] Second, a job is classified as one with high green potential if it is associated with skills that are important for the exercise of green tasks; regardless of whether green tasks are already being performed or not and whether the job being carried out already contributes to a green economy or not.

4.2 Skills shortages

The following section presents a descriptive analysis of the skills shortage indicators, differentiating between jobs with high green potential and other jobs. The results for groups of jobs are computed as a weighted average of the values on the 3-digit level of ISCO, where the number of employees are used as weights. Table 3 shows estimates for the five indicators for the group of jobs with high green potential (*green potential*) and the group of other jobs (*other*). There are differences in all indicators between the two occupational groups. The group of jobs with high green potential shows a lower rate of unemployment (ru), a higher rate of immigrant workers (rm),

[19] Either because the demand of an existing job will increase or it's skill requirements will significantly change because of green economy activities and technologies.

a higher employment growth (in the period 2012-2017) (g), a lower replacement demand (rd) and a higher qualification level (ql). Four out of five indicators thus indicate a shortage of skilled workers. The exception is the replacement demand that is lower than 50% for the group of jobs with high green potential. This is because, as Figure 3 indicates, employees in jobs with high green potential are on average younger than employees in other jobs. The results of the indicators are reflected in the results of the skills shortage index (SSI): the group of jobs with high green potential has a higher value of 1.29 than the group of other occupations with -0.26.

Table 3: Descriptive statistics of skills shortage indicators (2017)

Group	ru	rm	g	rd	ql	SSI
high green potential	3.6%	15.4%	121.3%	45.7%	96.4%	1.29
low green potential	4.6%	13.1%	108.2%	53.3%	88.0%	-0.26

Note: ru rat of unemployment, rm rate of migration, g employment growth, rd replacement demand, ql qualification level, SSI Skills shortage index. *Source*: Own calculations based on SLFS 2017 (FSO).

Let us briefly return to the topic of migration. At least since the entry into force of the Agreement of the Free Movement of Persons with the EU/EFTA countries in 2002, Switzerland has shown a high level of immigration into the labour market from EU countries. As the results show, occupations with high green potential have a higher migration rate than occupations with low green potential. Due to the importance of migration for the Swiss labour market in general and occupations with high green potential in particular, it is interesting to see which countries the migrant workers come from.[20] We have thus estimated the number and share of employees by country of origin of the migrated employees. The results are summarized in

[20] It should be noted that the analysis does not focus on the country of origin (i.e. the country from which the employed person immigrated) but on the nationality of the immigrant. In this sense, an immigrant employed person is classified in the analysis according to his or her citizenship, not according to his or her last place of residence before immigration.

Table 6 in the appendix. Around 86% of those in employment who have migrated to Switzerland in the last 10 years and work in a job with high green potential come from the EU. At around 77%, this proportion is significantly lower for immigrant workers in the group of other jobs. Immigrant workers in occupations with high green potential come primarily from Germany, other (non-EU countries), France and Italy.

In a next step, we analyse the incidence and the extent of skills shortages on a less aggregated level, namely for occupational groups according to the 1-digit level of the ISCO classification. The results are shown in Table 4. The column *index* reports the value of the skills shortage index and the share of employed persons in the group under consideration in the total number of employed persons. There are no jobs with high green potential in the occupational groups ”clerical support workers”, ”elementary occupations”, ”plant and machine operators and assemblers”, ”service and sales workers” and ”skilled agricultural, forestry and fishery workers”. In three out of four occupational groups at least the incidence of a skills shortage is the same for the group of jobs with high green potential and for the group of other jobs: For ”managers” and ”professionals” the index shows an above-average, and for ”craft and related trades workers” below-average demand for skilled workers for both groups. For ”technicians and associate professionals”, the index indicates a skills shortage only for the group of other jobs, not for the group of jobs with high green potential. The highest index value and, therefore, an indication of a shortage of skilled workers can be observed for ”managers” in the group of jobs with high green potential. Employees in this group amount for 4.8% of total employment.

Next, we extend the investigation to the 3-digit level according to the ISCO classification. This is the lowest possible observation level, because information about the (predicted) greenness of occupations is available only on the 3-digit level. Table

Table 4: Skills shortage index (2017) by occupational groups according to the 1-digit level of the ISCO classification

	low green potential		high green potential	
Occupational group	index	share	index	share
Managers	2.7	4.8%	3.4	4.8%
Professionals	1.1	18.7%	1.4	6.7%
Technicians and associate professionals	0.4	15.3%	-0.5	4.0%
Skilled agricultural, forestry and fishery workers	0.3	2.9%	—	—
Plant and machine operators and assemblers	-0.3	3.8%	—	—
Service and sales workers	-1.4	16.0%	—	—
Elementary occupations	-1.5	4.4%	—	—
Clerical support workers	-1.6	7.8%	—	—
Craft and related trades workers	-2.1	9.6%	-1.2	1.3%

Note: The table shows the results on the level of ISCO 1-digit occupational groups. The following 3-digit occupational groups are part of the 1-digit occupational groups (only for occupational groups with green potential): **Managers**: **100** Managers (nos), **110** Chief executives, senior officials and legislators (nos), **111** Legislators and senior officials, **112** Managing directors and chief executives, **130** Production and specialized services managers (nos), **131** Production managers in agriculture, forestry and fisheries, **132** Manufacturing, mining, construction, and distribution managers, **142** Retail and wholesale trade managers, **143** Other services managers; **Professionals**: **210** Science and engineering professionals (nos), **211** Physical and earth science professionals, **213** Life science professionals, **214** Engineering professionals (excluding electrotechnology), **215** Electrotechnology engineers, **216** Architects, planners, surveyors and designers, **242** Administration professionals; **Technicians and associate professionals**: **311** Physical and engineering science technicians, **312** Mining, manufacturing and construction supervisors, **313** Process control technicians, **314** Life science technicians and related associate professionals; **Craft and related trades workers**: **741** Electrical equipment installers and repairers.

5 in the Appendix provides a list of occupations on the 3-digit level according the ISCO classification with the predicted greenness for each occupation. As mentioned in section 3.1, we applied a threshold value to separate occupations in two groups, namely jobs with high green potential (predicted greenness above the threshold value) and other jobs (predicted greenness below the threshold value). The box plots in Figure 5 summarize the distribution of the values of the skills shortage index by means of selected statistics. The comparison of the two box plots shows that the group of jobs with high green potential is more homogeneous with respect to the values of the skills shortage index (lower dispersion) and on average (measured by the median, indicated by the horizontal line in the box) has a higher value for the skills shortage index than the group of other jobs (1.55 compared to -0.23).[21]

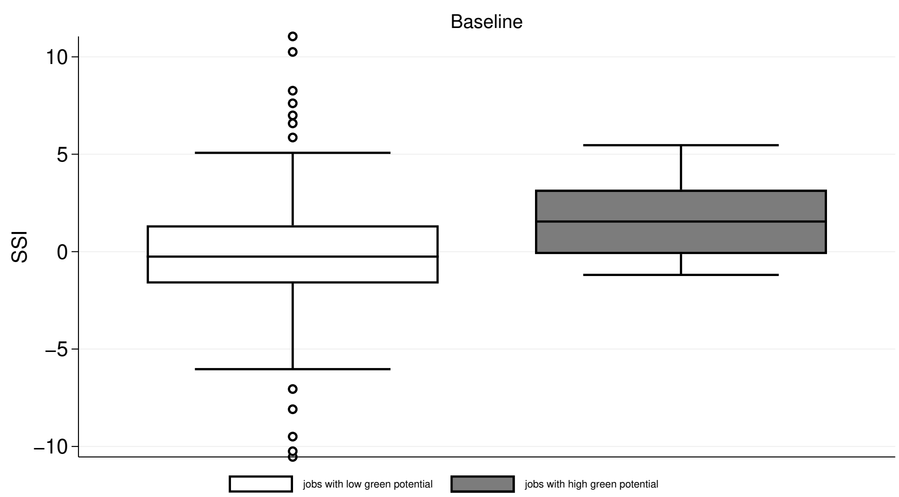


Figure 5: Skills shortage index by occupational groups (ISCO 3-digit) for the year 2017. Note: The box contains 50% of the values. The height of the box is determined by the quartiles. The maximum length of the whiskers is 1.5 times the height of the box. Outliers, defined as values above the upper and below the lower adjacent values, are marked by dots. Source: Own calculations based on SLFS 2017 (FSO).

A comparison of the predicted greenness and the values for the skills shortage

[21] Measured by the weighted average, the average SSI in the group of occupations with high green potential is 1.29 and in the group of occupations with low green potential -0.26, see Table 3.

index shows that there is a positive but rather low correlation between the two variables (see Figure 6, the estimated correlation coefficient is 0.195.).

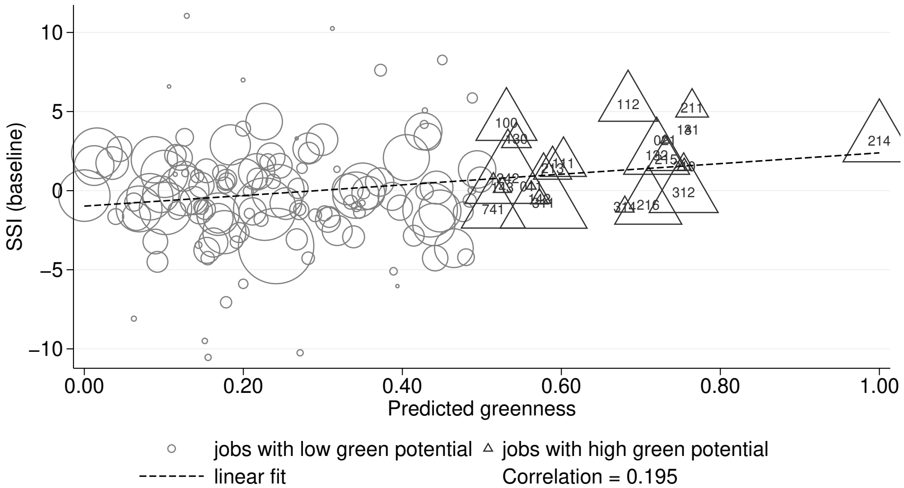


Figure 6: Skills shortage index (SSI) by occupational groups (ISCO 3-digit) and predicted greenness (2017). For each job with high green potential, the figure indicates the ISCO-Code (3-digit). Table 5 in the Appendix provides the job titles to each ISCO-Code. The size of the markers was determined on the basis of the size of the occupational groups (measured by the number of employed persons).

An important assumption that we have made for the analysis concerns the threshold for classifying occupations into those with high green potential and those with low green potential. The threshold was previously set at 0.5. In the following, we examine the extent to which the results change with regard to the shortage of skilled workers if this threshold is set to 0.45 and 0.55, respectively. Figure 7 shows the distribution of occupations according to the estimated greenness for the thresholds of 0.45, 0.5 and 0.55. The results show that the mean index value (measured by the median) increases with increasing threshold value, where the value ranges between 0.76 (threshold 0.45) and 1.64 (threshold 0.55).

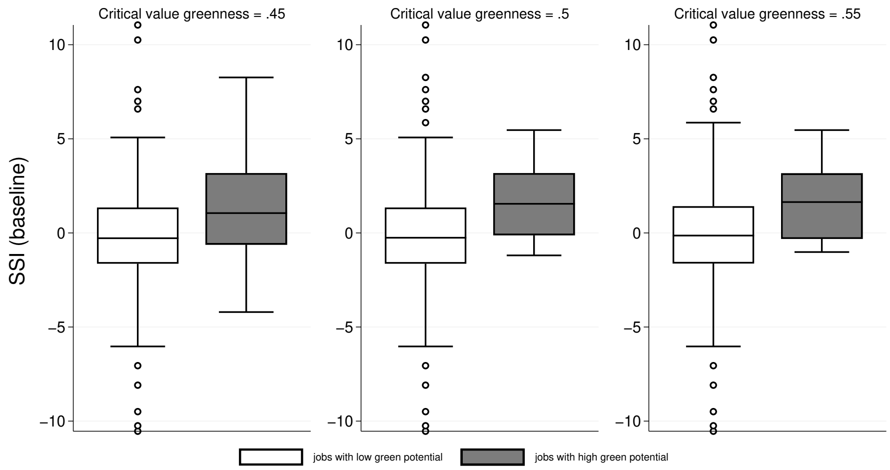


Figure 7: Sensitivity analysis. Note: SSI = Skills shortage index. Source: Own calculation based on SLFS 2017 (FSO).

5 Discussion

We estimate, based on a data-driven methodology that allows quantifying the importance of different skills in performing green tasks, the green potential for Switzerland in the year 2017. The results show that a non-negligible proportion of around 17% of employed people work in occupations with high green potential.

The availability of suitably trained specialists is important for the transformation towards a sustainable economy. Using a composite index of skills shortage indicators, the analysis shows that the skilled labour situation in the group of jobs with high green potential is tense, particularly pronounced for the occupational groups managers and professionals.

How can the relevant skilled workers be provided? Since occupations with high green potential are primarily those with an engineering and technical background, and since these occupations are already on the political radar in Switzerland, there are already initiatives to increase the number of skilled workers in these fields.[22] These initiatives address the determinants of the supply of skilled labour. The key determinants with a negative impact on supply are the number of retirements expected in the coming years, changes of profession and changes into non-employment (before reaching ordinary retirement age), key determinants with a positive impact on supply are migration (including cross-border commuters) and education (at upper secondary and tertiary level). Not all determinants (or measures addressing these determinants) are equally relevant for occupations with high green potential: As the analyses show, workers in occupations with high green potential have a younger labour force structure than those in other occupations. In this respect, retirements of skilled workers are not as relevant as in other occupations. Furthermore, as pointed out in Bundesrat (2018), the labour potential in occupations with strong signs of a shortage of skilled workers is already being exploited to an above-average extent. This will not be any different for occupations with high green potential.[23] Migration to occupations with high green potential is above average. The possibilities of covering the (additional) demand for skilled labour through migration appear to have already been exhausted, all the more so as other countries may also undergo a green transformation of the economy and, thus, will be dependent on appropriately trained skilled workers.[24]

[22] One such initiative is the federal government's initiative for skilled workers (FKI), that aims to improve the development and exploitation of existing domestic skilled labour potentials (Bundesrat, 2018).

[23] The exploitation of the labour force potential can be estimated on the basis of the employment rate and the level of employment. It was not possible to calculate the employment rate for the present analysis on the basis of the available data. Since occupations with high green potential are often technical occupations and accordingly trained persons have an above-average employment rate according to other studies (Degen et al., 2016), we assume that this is also the case for occupations with high green potential. Our own analysis based on the SAKE 2017 shows that employed persons in occupations with high green potential have an above-average level of employment (93% compared to the overall economic value of around 80%).

[24] It was not possible to take a closer look at the phenomenon of changes of profession in the context of this study.

For these reasons, increased efforts will be necessary in the area of labour qualification, to meet the demand for skilled workers needed for the transition to a sustainable economy. For this, information about the skills required in a green economy is crucial, especially for stakeholder in vocational training. Further research should therefore focus on analyzing the specific skills needed to participate in the green economy.

Appendices

Table 5: List of ISCO occupations and their predicted green potential

ISCO	Job title	Predicted greenness
214	Engineering professionals (excluding electrotechnology)	1.00
211	Physical and earth science professionals	0.76
131	Production managers in agriculture, forestry and fisheries	0.76
210	Science and engineering professionals, nos	0.75
312	Mining, manufacturing and construction supervisors	0.75
215	Electrotechnology engineers	0.73
132	Manufacturing, mining, construction, and distribution managers	0.72
216	Architects, planners, surveyors and designers	0.71
112	Managing directors and chief executives	0.68
314	Life science technicians and related associate professionals	0.68
110	Chief executives, senior officials and legislators, nos	0.65
111	Legislators and senior officials	0.60
213	Life science professionals	0.59
311	Physical and engineering science technicians	0.58
142	Retail and wholesale trade managers	0.57
130	Production and specialized services managers, nos	0.54
242	Administration professionals	0.53
100	Managers, nos	0.53
143	Other services managers	0.53
741	Electrical equipment installers and repairers	0.51
740	Electrical and electronic trades workers, nos	0.50
310	Science and engineering associate professionals, nos	0.50
122	Sales, marketing and development managers	0.49
212	Mathematicians, actuaries and statisticians	0.49
313	Process control technicians	0.49
120	Administrative and commercial managers, nos	0.48
742	Electronics and telecommunications installers and repairers	0.48
754	Other craft and related workers	0.48
723	Machinery mechanics and repairers	0.46
140	Hospitality, retail and other services managers, nos	0.46
710	Building and related trades workers, excluding electricians, nos	0.45
711	Building frame and related trades workers	0.45
333	Business services agents	0.44
731	Handicraft workers	0.44
712	Building finishers and related trades workers	0.44
332	Sales and purchasing agents and brokers	0.43
133	Information and communications technology service managers	0.43
622	Fishery workers, hunters and trappers	0.43
240	Business and administration professionals, nos	0.43
612	Animal producers	0.43
121	Business services and administration managers	0.43
931	Mining and construction labourers	0.41
620	Market-oriented skilled forestry, fishery and hunting workers, nos	0.41
251	Software and applications developers and analysts	0.41
343	Artistic, cultural and culinary associate professionals	0.40

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Table 5 – *Continued from previous page*

ISCO	Job title	Predicted greenness
811	Mining and mineral processing plant operators	0.39
720	Metal, machinery and related trades workers, nos	0.39
610	Market-oriented skilled agricultural workers, nos	0.39
200	Professionals, nos	0.37
250	Information and communications technology professionals, nos	0.37
600	Skilled agricultural, forestry and fishery workers, nos	0.36
243	Sales, marketing and public relations professionals	0.36
813	Chemical and photographic products plant and machine operators	0.35
613	Mixed crop and animal producers	0.35
700	Craft and related trades workers, nos	0.35
252	Database and network professionals	0.35
621	Forestry and related workers	0.34
241	Finance professionals	0.34
721	Sheet and structural metal workers, moulders and welders, and related workers	0.34
315	Ship and aircraft controllers and technicians	0.33
611	Market gardeners and crop growers	0.33
634	Subsistence fishers, hunters, trappers and gatherers	0.33
713	Painters, building structure cleaners and related trades workers	0.32
300	Technicians and associate professionals, nos	0.32
835	Ships' deck crews and related workers	0.31
722	Blacksmiths, toolmakers and related trades workers	0.31
752	Wood treaters, cabinet-makers and related trades workers	0.31
352	Telecommunications and broadcasting technicians	0.30
134	Professional services managers	0.30
933	Transport and storage labourers	0.29
350	Information and communications technicians, nos	0.29
232	Vocational education teachers	0.28
141	Hotel and restaurant managers	0.28
330	Business and administration associate professionals, nos	0.28
225	Veterinarians	0.27
730	Handicraft and printing workers, nos	0.27
961	Refuse workers	0.27
821	Assemblers	0.27
351	Information and communications technology operations and user support technicians	0.27
834	Mobile plant operators	0.27
930	Labourers in mining, construction, manufacturing and transport, nos	0.27
261	Legal professionals	0.25
335	Regulatory government associate professionals	0.25
820	Assemblers, nos	0.24
331	Financial and mathematical associate professionals	0.24
750	Food processing, wood working, garment and other craft and related trades workers, nos	0.24
522	Shop salespersons	0.24
262	Librarians, archivists and curators	0.24
231	University and higher education teachers	0.23
632	Subsistence livestock farmers	0.23
830	Drivers and mobile plant operators, nos	0.23
411	General office clerks	0.23
630	Subsistence farmers, fishers, hunters and gatherers, nos	0.23
800	Plant and machine operators and assemblers, nos	0.23
221	Medical doctors	0.23

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Table 5 – *Continued from previous page*

ISCO	Job title	Predicted greenness
810	Stationary plant and machine operators, nos	0.22
921	Agricultural, forestry and fishery labourers	0.22
833	Heavy truck and bus drivers	0.22
751	Food processing and related trades workers	0.21
950	Street and related sales and service workers, nos	0.21
951	Street and related service workers	0.21
952	Street vendors (excluding food)	0.21
521	Street and market salespersons	0.21
960	Refuse workers and other elementary workers, nos	0.21
900	Elementary occupations, nos	0.21
340	Legal, social, cultural and related associate professionals, nos	0.20
520	Sales workers, nos	0.20
541	Protective services workers	0.20
814	Rubber, plastic and paper products machine operators	0.20
220	Health professionals, nos	0.20
223	Traditional and complementary medicine professionals	0.20
260	Legal, social and cultural professionals, nos	0.19
732	Printing trades workers	0.19
633	Subsistence mixed crop and livestock farmers	0.19
812	Metal processing and finishing plant operators	0.19
226	Other health professionals	0.18
816	Food and related products machine operators	0.18
832	Car, van and motorcycle drivers	0.18
524	Other sales workers	0.18
818	Other stationary plant and machine operators	0.18
513	Waiters and bartenders	0.18
430	Numerical and material recording clerks, nos	0.17
831	Locomotive engine drivers and related workers	0.17
514	Hairdressers, beauticians and related workers	0.17
512	Cooks	0.17
500	Service and sales workers, nos	0.17
432	Material-recording and transport clerks	0.16
941	Food preparation assistants	0.16
815	Textile, fur and leather products machine operators	0.16
631	Subsistence crop farmers	0.15
932	Manufacturing labourers	0.15
265	Creative and performing artists	0.15
753	Garment and related trades workers	0.15
817	Wood processing and papermaking plant operators	0.15
342	Sports and fitness workers	0.15
222	Nursing and midwifery professionals	0.15
431	Numerical clerks	0.15
912	Vehicle, window, laundry and other hand cleaning workers	0.14
510	Personal service workers, nos	0.14
910	Cleaners and helpers, nos	0.14
224	Paramedical practitioners	0.14
264	Authors, journalists and linguists	0.14
320	Health associate professionals, nos	0.13
324	Veterinary technicians and assistants	0.13
230	Teaching professionals, nos	0.13

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Table 5 – *Continued from previous page*

ISCO	Job title	Predicted greenness
321	Medical and pharmaceutical technicians	0.13
233	Secondary education teachers	0.12
235	Other teaching professionals	0.12
516	Other personal services workers	0.12
511	Travel attendants, conductors and guides	0.11
400	Clerical support workers, nos	0.11
323	Traditional and complementary medicine associate professionals	0.11
410	General and keyboard clerks, nos	0.10
911	Domestic, hotel and office cleaners and helpers	0.10
515	Building and housekeeping supervisors	0.10
325	Other health associate professionals	0.10
523	Cashiers and ticket clerks	0.09
441	Other clerical support workers	0.09
263	Social and religious professionals	0.09
234	Primary school and early childhood teachers	0.08
420	Customer services clerks, nos	0.08
412	Secretaries (general)	0.07
422	Client information workers	0.07
413	Keyboard operators	0.06
962	Other elementary workers	0.06
531	Child care workers and teachers' aides	0.04
421	Tellers, money collectors and related clerks	0.04
341	Legal, social and religious associate professionals	0.04
530	Personal care workers, nos	0.02
322	Nursing and midwifery associate professionals	0.02
334	Administrative and specialized secretaries	0.01
532	Personal care workers in health services	0.00

Table 6: Citizenship of immigrant workers in Switzerland

	other		high green potential	
country	employees	percent	employees	percent
Other	105'392	23.0%	15'491	14.2%
Germany	99'243	21.7%	31'258	28.7%
Italy	58'055	12.7%	12'990	11.9%
Portugal	57'516	12.6%	(5'765)	(5.3%)
France	36'099	7.9%	14'697	13.5%
Spain	16'766	3.7%	(6'157)	(5.7%)
Hungary	9'801	2.1%	(2'766)	(2.5%)
Poland	9'515	2.1%	(2'879)	(2.6%)
Romania	8'612	1.9%	()	()
Austria	8'341	1.8%	(2'914)	(2.7%)
United Kingdom	7'803	1.7%	(3'256)	(3.0%)
Slovakia	(7'700)	(1.7%)	(984)	(0.9%)
Belgium	(5'940)	(1.3%)	(966)	(0.9%)
Greece	(4'788)	(1.0%)	(2'202)	(2.0%)
Czech Republic	(4'504)	(1.0%)	()	()
Bulgaria	(3'108)	(0.7%)	()	()
Netherlands	(3'057)	(0.7%)	(1'189)	(1.1%)
Croatia	(2'992)	(0.7%)	()	()
Ireland	(1'672)	(0.4%)	()	()
Sweden	(1'455)	(0.3%)	()	()
Slovenia	(1'292)	(0.3%)	()	()
Lithuania	(1'103)	(0.2%)	()	()
Latvia	()	()	()	
Finland	()	()	(935)	(0.9%)
Denmark	(496)	(0.1%)	()	()
Estonia	()	()	()	()
Luxembourg	()	()	()	()
Malta	()	()	()	
Cyprus	()	()	()	
Total	457'935	100%	108'896	100%

Source: Own calculations based on SLFS 2017 (FSO).

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