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

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- First draft -

Abstract

We estimate, based on a data-driven methodology that allows to quantify the importance of different skills in performing green tasks, the green potential for Switzerland in the year 2017 to 10.0% and 11.7% of the total of employed persons and full-time equivalents, 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. 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.

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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 (Vona et al., 2018; BFAU, 2016). 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 that work in occupations that have a high potential to perform green tasks. We identify this potential by using a novel approach developed by Rutzer et al. (2020), predicting the potential of occupations to perform green tasks 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.

We estimate the green potential in Switzerland in the year 2017 to 441'000 persons and 414'000 full-time equivalents (FTE). Measured in terms of total number of persons employed and FTE, the potential is around 10.0% and 11.7% 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

[1] Based on country case studies Strietska-Ilina et al. (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] The Federal Councils Sustainable Development Strategy 2016-2019 (Bundesrat, 2016) should 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; BFAU, 2016).

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.

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 (Consoli et al., 2016; Vona et al., 2018; Bowen 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 method used or occupations and the associated skills and abilities (Martinez-Fernandez et al., 2010; Consoli et al., 2016; Bowen et al., 2018). A frequently used approach to identify green jobs starts at the industry level and

[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." (BFAU, 2016, p. 10) A broad understanding of natural resources is assumed, including climate, soil, biodiversity, clean air and water, raw materials and mineral resources.

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 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 ILO (2018) notes, 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 it is precisely this information that is of interest to education policy and practice in order to gear training courses to the needs of a sustainable economy.

Therefore, the literature for the study of the impact of a green economy on the labour market has recently begun to apply a task-based approach. This approach is conceptually related with a rich literature that analyzes how labour market outcomes (such as employment and wages) are shaped by skills and tasks (Acemoglu and 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 of jobs into green and non-green) and covers the US labour market.[4] The results show that green jobs use more intensively high-level cognitive and interpersonal skills 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, but also to the lack of a (common) understanding of what these green skills are.[5]

[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.

[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

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 with 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 the exercise of green tasks.

So far, the literature has elaborated on the characterisation of green jobs and on 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 (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 mismatch 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.

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).

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 et al., 2018; OECD, 2017).

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 and 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, as e.g. 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 group of jobs by using indicators to map different dimensions of the phenomenon (e.g., Lobsiger et al.

[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.

(2014), Degen et al. (2016)).

3 Methodology and data

3.1 Identification of jobs with green potential

The identification of jobs with high green potential draws on the recent contribution of Rutzer et al. (2020), estimating the green potential of occupations in the US labour market. This approach can be adapted to such an extent that the green potential can be estimated for Switzerland as well. The following section briefly discusses this approach and highlights the modifications that need to be made to apply it to Swiss data.

The estimates of Rutzer et al. (2020) are based on data from O*NET that a) 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".[9] While "new & enhancing" occupations have 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, due to a development towards a green economy, do not experience any change in the composition of skills, but are in "increased demand". 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 "new & emerging" occupation. O*NET describes a total of 26 tasks, 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.[10] Architects are classified

[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.

[9] A similar classification is used by Cedefop (2012).

[10]Example of "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.*

as "green enhanced", with seven new green tasks and 18 non-green tasks.[11] The electrician is classified as an occupation with green increased demand. Of 21 tasks, none are considered as green.

Title	Group	# of tasks			greenness
		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

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

On that basis Rutzer et al. (2020) calculate the greenness of an occupation i as $greenness_i = \#green\ tasks_i/\#total\ tasks_i$. In the examples provided by Table 1 (last column), two occupations have a $greenness = 1.0$ (solar photovoltaic installer, environmental engineer), one a $greenness = 0.3$ (architect) and one a $greenness = 0$ (electrician). It is important to note that there are occupations that do not perform green tasks, that is jobs with $greenness = 0$, but demand skills similar to occupations that perform green tasks, that is jobs with $greenness > 0$.[12] These are occupations that do not perform green tasks, but 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 green potential or not. Indeed, as the calculations later will show, electricians will be

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

[12] There are also jobs that do not perform green tasks and ask for fundamentally different skills as occupations with green tasks (these jobs are called *non-green jobs*).

classified also as 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.[13]

O*NET provides, for each occupation, a quantitative rating for the importance and the level of a total of 114 skills. For each skill, this information is aggregated into a single value by applying a weighting scheme of importance and level (Rutzer et al., 2020).

Using machine-learning algorithms, it is then possible to predict the potential of 3-digit ISCO 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.[14] By transferring data for importance values of skills from the occupation classification in O*NET to the ISCO classification[15], it is possible to apply the trained model to predict the potential of 3-digit ISCO occupations to perform green tasks. Up to now, the green potential is calculated for each ISCO occupation on a continuous scale.[16] In order to assess the green potential in terms of employment, a threshold has to be determined. The

[13]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, see https://www.onetcenter.org/database.html#individual-files): **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** (in the narrower sense) 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 as "Analyzing Data or Information" or "Developing and Building Teams").

[14]In that case a lasso (least absolute shrinkage and selection operator) model was used.

[15]It is important to note that occupations in O*NET are classified by an 8-digit number, where the first six numbers correspond to the Standard Occupational Classification (SOC) system. Skill values for SOC occupations are computed by taking averages. The same procedure is done for the computation of skill levels for ISCO occupations, where a conversion table informs about the relations between SOC and ISCO.

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

threshold was set so that the average greenness of the ISCO occupations corresponds to the average greenness of the original O*NET data.

There are some limitations that must be kept in mind when interpreting the results: First, the estimates of the green potential for Switzerland is based on assessments made by experts for occupations in the US labour market. We assume that these assessments can also be applied broadly to other countries and their labour markets, in particular to the situation in Switzerland. However, it cannot be ruled out that in individual cases these assessments may not be reflected in the reality of the Swiss labour market. Second, occupation classifications (as the ISCO classification) group together similar jobs into one occupation. Research of Tijdens and Kaandorp (2018) point to inconsistent coding practices in international comparison with respect to occupational coding. The statistical offices use different classification tables which allow the different job titles to be allocated to the corresponding occupational groups. In certain cases, it cannot be excluded that similar occupations fall into a different occupational group depending on the country under consideration. We have not examined possible differences in occupational classification between the US and Switzerland in more detail. We assume that in the majority of jobs the classification is sufficiently similar in both countries and that the transfer of job-related information on the use of the ISCO classification is acceptable.

3.2 Measuring skills imbalances

We measure skills imbalances indirectly by means of an indicator system following Degen et al. (2016). We depart from this approach in several respects: First, we use the unemployment rate as defined by the International Labour Organization (ILO) instead of the State Secretariat for Economic Affairs (SECO)-based unemployment rate.[17] Second, we do not use the rate of job vacancies as an indicator to produce our baseline results. From our point of view, both adjustments make sense in the context of this study, as they make international comparisons possible (i.e. with similar calculations for other European countries presented in Lobsiger and Rutzer (2019)). We return to this in a separate sensitivity analysis at the end of the paper

[17]The unemployment rate as defined by the ILO uses the number of unemployed persons as defined by ILO as the numerator, not the number of registered unemployed persons that is used as the denominator for the SECO-based unemployment rate.

and include the rate of job vacancies as an additional indicator and use the SECO-based rate of unemployment instead of the rate of unemployment as defined by ILO. Third, in order to aggregate the information about a skills shortage contained in the different indicators in a single index we follow OECD (2017) instead of Degen et al. (2016). The approach of index formation chosen by the OECD (2017) carries out a transformation of the variables or indicators, which is accompanied by a lower loss of information than the transformation chosen in Degen et al. (2016).

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 (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 economically active persons (l_{it})[18]: $ru_{it} = u_{it}/l_{it}$. The lower the rate of unemployment, the more severe is the skills shortage.[19]

- *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 more severe is the skills shortage 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.

  As already noted,

- *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

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

[19]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.

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, nonskilled workers will be able to meet the demand.

Each of these indicators represents a specific aspect of a skills shortage. 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.[20] 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: $SSI_{it} = \widetilde{ru}_{it} + \widetilde{rm}_{it} + \widetilde{g}_{it} + \widetilde{rd}_{it} + \widetilde{ql}_{it}$.

As already mentioned, we have omitted the indicator vacancy rate in the base estimates. This allows the results to be compared with estimates for other European countries (Lobsiger and Rutzer (2019)). In a sensitivity analysis we will take into account the rate of job vacancies, which is defined as the number of job vacancies (v_{it}) divided by the job base (b_{it})[21]: $rv_{it} = v_{it}/b_{it}$. The higher the rate of job vacancies, the more severe is the skills shortage.

3.3 Data

Our analysis is mainly based on two data sources: On the one hand, we use data from the O*NET database (v21.2). We have already included the most important

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

[21] The job base (b_{it}) consists of employed persons (e_{it}) and job vacancies (v_{it}).

information on O*NET 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 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. The following additional data on job vacancies and the unemployment rate are used for sensitivity analyses: Data on job vacancies is provided by x28 and was collected using a web crawler. Internet pages were systematically searched for job advertisements. Unstructured company- and job-specific information was structured and classified by x28 according to common Swiss and international nomenclatures. For a sensitivity analysis (using the SECO-based unemployment rate instead of the unemployment rate defined by the ILO), the unemployment figures from AVAM were used.[22]

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 441'000 persons were employed in green jobs (that is jobs with an estimated green potential above the specified threshold value), which corresponds to about 414'000 FTE. Measured in terms of total employment, the number of people employed and FTE in green jobs was around 10.0% and 11.7%, respectively.

As Figure 1 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 14.4% in 2012-2017, the growth in employment in the group of other jobs over the same period was only 6.4%. It is worth noting that in absolute terms growth in the group of other jobs was significantly higher at 236,324 than in the group of jobs

[22] AVAM is the information system for job placement and labour market statistics of the labour market authorities.

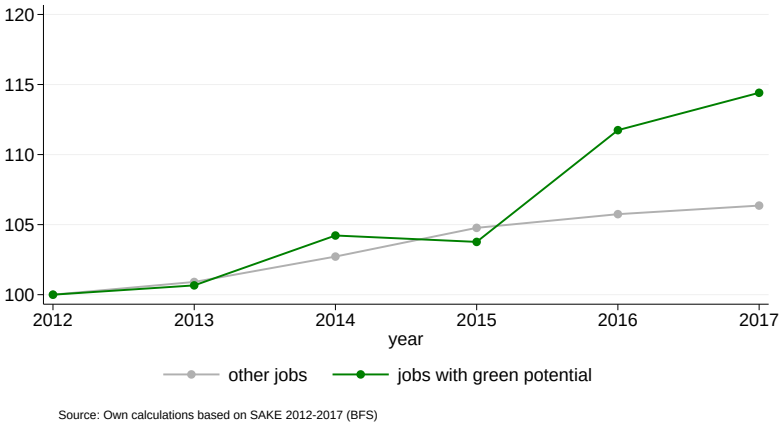


Figure 1: Employment growth in jobs with green potential and other jobs

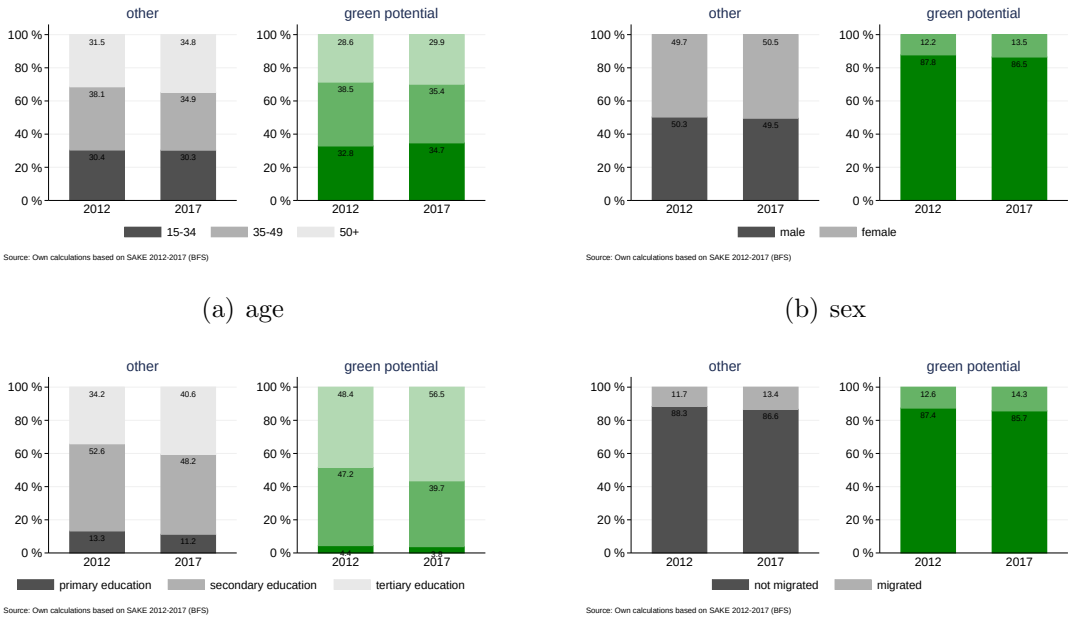
with high green potential at 55,581.

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[23] (see Figure 2): 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 distributions are relatively stable over time.

The employment share of jobs with high green potential is distributed differently across industries. In 2017, the highest shares of employees in green jobs to the total labour force are found for manufacturing, construction, energy and professional, scientific and technical activities (with shares between 20% and 50%) (see Figure 3). 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%.

For the sake of comparison, Figure 3 shows the shares of green employment when defining green jobs using EGSS (covering employment in industries that produce goods and services contributing to the protection of the environment or the conservation of natural resources). 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 two sectors that were still among the four most important sectors (professional,

[23]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.



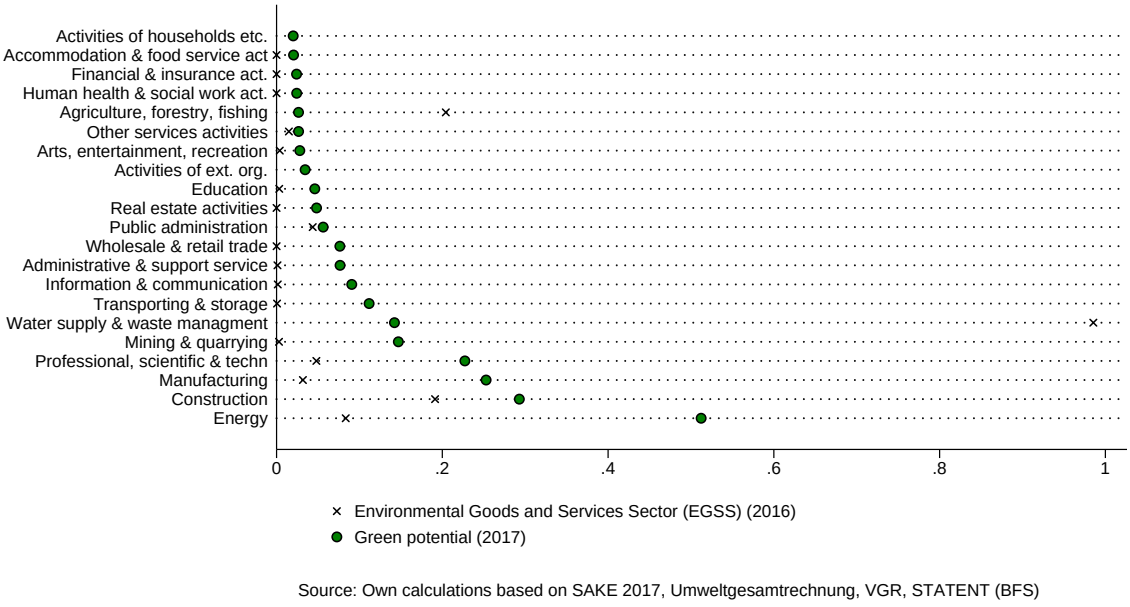
(a) age

(b) sex

(c) education

(d) migration

Figure 2: Characterisation of green and non-green jobs



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 green potential) as a percentage of total employment (both measured in FTE) (indicated by dots) and b) the share of jobs (filled) in green industries as a share of the job base (marked by crosses).

Figure 3: Green employment as a percentage of total employment by industry

scientific & technical activities, manufacturing) 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 green potential if it is expected to be in higher demand because of the transition to a green economy.[24] Second, a job is classified as one with 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 imbalances

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 2 shows estimates for the five indicators considered 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), 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. As Figure 2 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 0.74 than the group of other occupations with -0.01.

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,

[24] 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, or because of the evolution of new jobs their existence can be traced back to green economy activities and technologies.

Group	ru	rm	g	rd	ql	SSI
high green potential	3.4%	14.3%	115.6%	43.2%	96.2%	0.68
other	4.5%	13.4%	109.8%	53.0%	88.7%	-0.08

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).

Table 2: Descriptive statistics skills shortage indicators (2017)

occupations with green potential have a higher migration rate than other occupations. 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.[25] We have thus estimated the number and share of employees by country of origin of the migrated employees. The results are summarized in Table 5 in the appendix. Around 85% 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 78%, this proportion is significantly lower for immigrant workers in the group of other jobs. Immigrant workers from Germany ranked first in both occupational groups. Followed by other (non-EU) countries for the group of other jobs and France for the group of jobs with high green potential. Employed persons from France are slightly more important in the group of occupations with green potential than in the group of other jobs.

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 3. 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

[25]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 this analysis according to his or her citizenship, not according to his or her last place of residence before immigration.

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 indication of a shortage of skilled workers therefore most pronounced can be observed for "professionals" in the group of jobs with high green potential. Employees in this group amount for 2.5% of total employment.

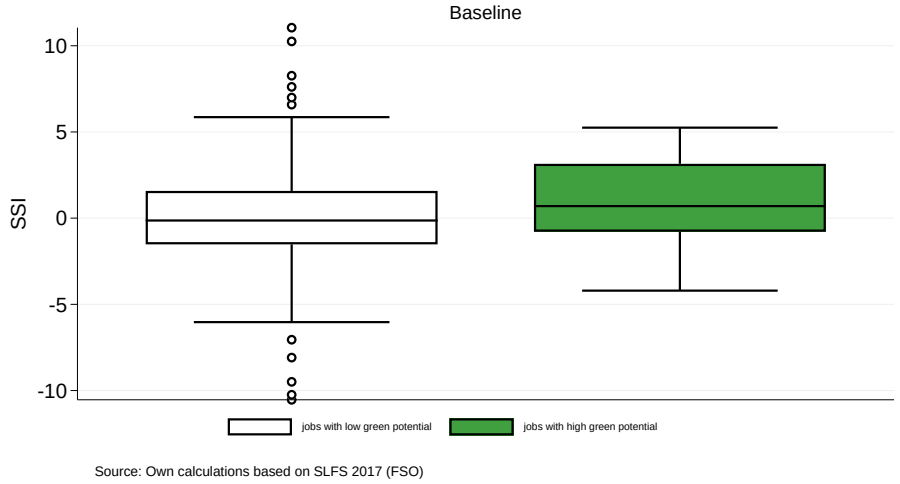
	other		high green potential	
Occupational group	index	share	index	share
Managers	3.2	8.2%	2.2	1.4%
Professionals	1.0	22.9%	3.2	2.5%
Technicians and associate professionals	0.4	14.7%	-0.4	4.6%
Skilled agricultural, forestry and fishery workers	0.3	2.9%	x	x
Plant and machine operators and assemblers	-0.3	3.8%	x	x
Service and sales workers	-1.4	16.0%	x	x
Elementary occupations	-1.5	4.4%	x	x
Clerical support workers	-1.6	7.8%	x	x
Craft and related trades workers	-2.1	9.4%	-1.7	1.5%

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**: **132** Manufacturing, mining, construction, and distribution managers, **131** Production managers in agriculture, forestry and fisheries; **Professionals**: **214** Engineering professionals (excluding electrotechnology), **211** Physical and earth science professionals, **215** Electrotechnology engineers, **210** Science and engineering professionals (nos); **Technicians and associate professionals**: **312** Mining, manufacturing and construction supervisors, **311** Physical and engineering science technicians, **313** Process control technicians, **314** Life science technicians and related associate professionals, **310** Science and engineering associate professionals (nos); **Craft and related trades workers**: **741** Electrical equipment installers and repairers, **740** Electrical and electronic trades workers (nos), **742** Electronics and telecommunications installers and repairers.

Table 3: Skills shortage index (2017) by occupational groups according to the 1-digit level of the ISCO classification

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 4 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 4 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 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 (0.49 compared to -0.13).[26]

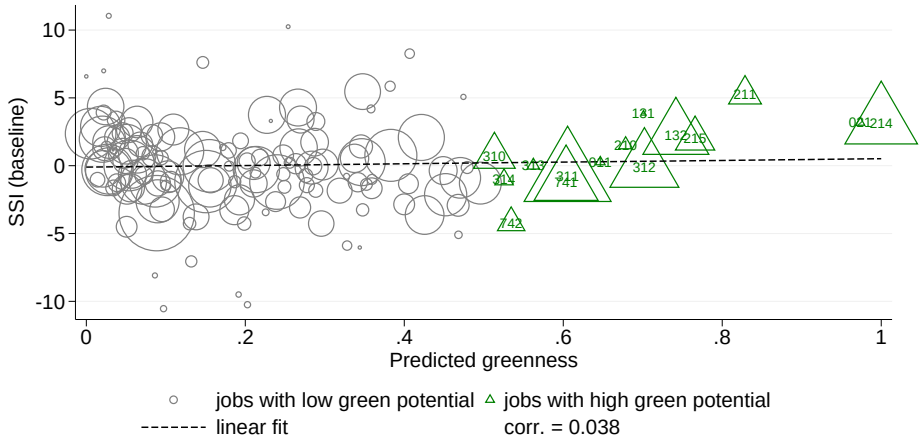


Note: The box contains 50% of the values. The height of the box is determined by the quartiles. The maximum length of the whiskers is 1.5 times the height of the box. Outliers, defined as values above the upper and below the lower adjacent values, are marked by dots.

Figure 4: Skills shortage index by occupational groups (ISCO 3-digit) (2017)

A comparison of the predicted greenness and the values for the skills shortage index shows that there is a positive but almost negligible correlation between the two variables (see Figure 5, the estimated correlation coefficient is 0.038.).

[26]Measured by the weighted average, the average SSI in the group of occupations with high green potential is 0.68, in the group of other occupations -0.08, see Table 2.



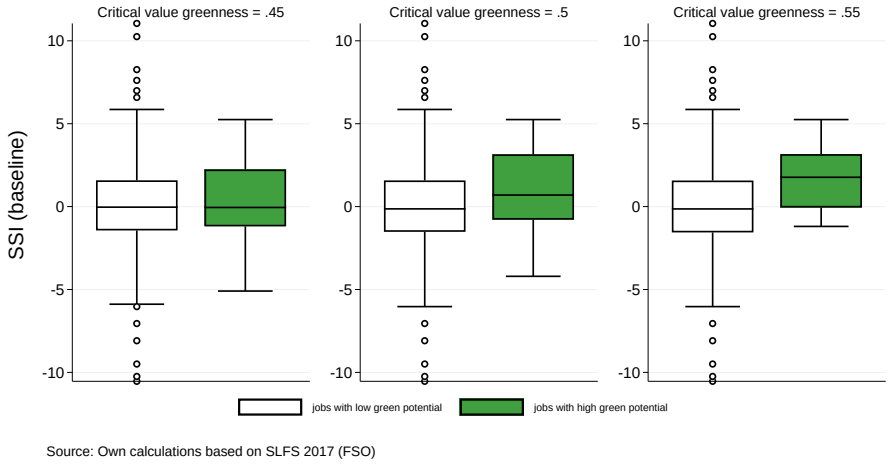
Source: Own calculations based on SLFS 2017 (FSO)

Note: SSI = Skills shortage index. For each job with green potential, the figure indicates the ISCO-Code (3-digit). These are the following occupations: **214**: Engineering professionals (excluding electrotechnology), **211**: Physical and earth science professionals, **215**: Electrotechnology engineers, **132**: Manufacturing, mining, construction, and distribution managers, **312**: Mining, manufacturing and construction supervisors, **131**: Production managers in agriculture, forestry and fisheries, **210**: Science and engineering professionals (nos), **311**: Physical and engineering science technicians, **741**: Electrical equipment installers and repairers, **313**: Process control technicians, **740**: Electrical and electronic trades workers (nos), **742**: Electronics and telecommunications installers and repairers, **314**: Life science technicians and related associate professionals, **310**: Science and engineering associate professionals (nos).
The size of the markers was determined on the basis of the size of the occupational groups (measured by the number of employed persons).

Figure 5: Skills shortage index (SSI) by occupational groups (ISCO 3-digit) and predicted greenness (2017)

4.3 Sensitivity analysis

An important assumption that we have made for the analysis to date 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 6 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.



Note: SSI = Skills shortage index.

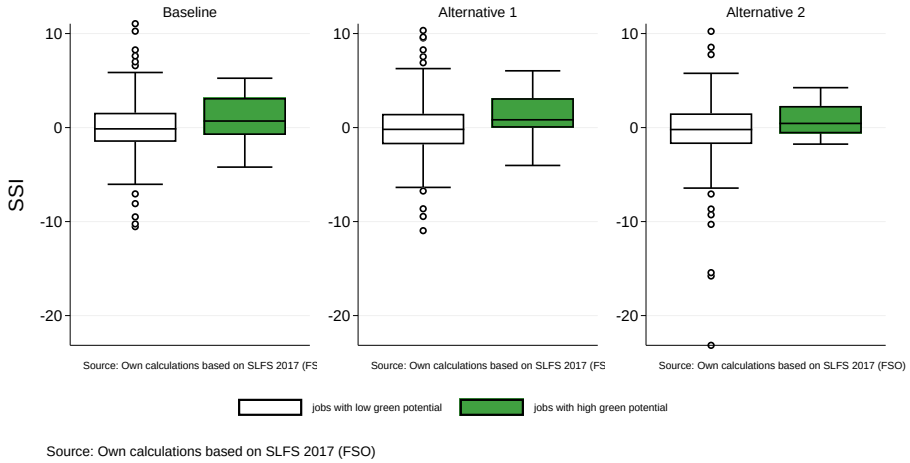
Figure 6: Sensitivity analysis I

The SSI can be modified and extended in (at least) two dimensions: Firstly, the index can be expanded to include the rate of job vacancies. Secondly, the unemployment rate as defined by SECO can be used instead of the ILO unemployment rate. The effects of these two adjustments on the distribution of the SSI over the occupational groups are shown in the Figure 7.

The effects of including the rate of job vacancies is shown in the middle box plot. The mean SSI measured by the median (horizontal line in the box) and by the weighted average rises in the group of occupations with high green potential from 0.49 to 0.68 and 0.68 to 1.15 respectively. In contrast, the mean SSI for the group of other occupations falls from -0.13 to -0.20 (median) and from -0.08 to -0.13 respectively. The difference in the mean SSI between the two groups thus becomes greater. This can be explained by the fact that the group of occupations with high green potential has a higher average vacancy rate than the group of other occupations (5.0% compared to 2.8%). The higher value indicates a tighter skilled labour situation.

If, instead of the unemployment rate according to the ILO, the unemployment rate as defined by SECO is used, the mean SSI hardly changes at all (box plot on the left). Measured by the median, the SSI in the group of occupations with high green potential falls slightly from 0.49 to 0.39, and measured by the weighted average, the SSI falls from 0.68 to 0.66. By comparison, the SSI in the group of

other occupations also falls (from -0.13 to -0.19 measured by the median or -0.08 to -0.12 measured by the weighted average), although the decline is less marked than in the group of occupations with high green potential.



Note: SSI = Skills shortage index. Baseline = SSI with rate of unemployment (ILO), rate of immigrant workers, employment growth, replacement demand, qualification level; Alternative 1 = SSI with rate of unemplyment (ILO), rate of job vacancies, rate of immigrant workers, employment growth, replacement demand, qualification level; Alternative 2 = SSI with rate of unemployment (SECO-based), rate of immigrant workers, employment growth, replacement demand, qualification level.

Figure 7: Sensitivity analysis II

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 10% 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.

Measures to improve the situation with regard to the availability of skilled workers can start at various points. Basically, these measures go in the same direction as the initiatives that have already been taken in Switzerland. This is hardly surpris-

ing, since occupations with green potential are primarily technical occupations that are already on the political radar. 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. The FKI focuses on four fields of action: Post-qualification and upgrading in line with the needs of the labour market; improving the reconciliation of work and family life (in order to increase the participation of women in the labour market); creating good conditions for gainful employment up to retirement age and beyond; promoting innovation in products and services (and thus reducing the personnel intensity) to mitigate the shortage of skilled labour (Bundesrat, 2018). The analysis on the subject of migration has shown that occupations with high green potential have an above-average migration rate. Against this background, and in view of the efforts made by the countries of origin of migrant workers to make the economy more sustainable as well, the possibilities of covering the (additional) demand for skilled labour through migration appear to have already been exhausted. Furthermore, as Bundesrat (2018) points out, 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 green potential.[27] For this reason, increased efforts will be necessary, especially in the area of labour qualification, to meet the demand for skilled workers for the transition to a sustainable economy.

[27]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; Lobsiger et al., 2014), 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%).

Appendices

A List of occupations

Table 4: List of ISCO occupations with predicted greenness

ISCO	Job title	Predicted greenness
214	Engineering professionals (excluding electrotechnology)	1.00
21	Non-commissioned armed forces officers	0.97
211	Physical and earth science professionals	0.83
215	Electrotechnology engineers	0.77
132	Manufacturing, mining, construction, and distribution managers	0.74
312	Mining, manufacturing and construction supervisors	0.70
131	Production managers in agriculture, forestry and fisheries	0.70
210	Science and engineering professionals, nos	0.68
11	Commissioned armed forces officers	0.65
311	Physical and engineering science technicians	0.61
741	Electrical equipment installers and repairers	0.60
313	Process control technicians	0.56
740	Electrical and electronic trades workers, nos	0.55
742	Electronics and telecommunications installers and repairers	0.53
314	Life science technicians and related associate professionals	0.53
310	Science and engineering associate professionals, nos	0.51
711	Building frame and related trades workers	0.50
813	Chemical and photographic products plant and machine operators	0.48
622	Fishery workers, hunters and trappers	0.47
216	Architects, planners, surveyors and designers	0.47
811	Mining and mineral processing plant operators	0.47
721	Sheet and structural metal workers, moulders and welders, and related workers	0.47
712	Building finishers and related trades workers	0.45
720	Metal, machinery and related trades workers, nos	0.45
723	Machinery mechanics and repairers	0.43
620	Market-oriented skilled forestry, fishery and hunting workers, nos	0.42
251	Software and applications developers and analysts	0.42
710	Building and related trades workers, excluding electricians, nos	0.41
754	Other craft and related workers	0.41
931	Mining and construction labourers	0.40
634	Subsistence fishers, hunters, trappers and gatherers	0.39
242	Administration professionals	0.38
212	Mathematicians, actuaries and statisticians	0.38
610	Market-oriented skilled agricultural workers, nos	0.36
621	Forestry and related workers	0.36
722	Blacksmiths, toolmakers and related trades workers	0.36
612	Animal producers	0.36
252	Database and network professionals	0.35
600	Skilled agricultural, forestry and fishery workers, nos	0.35
112	Managing directors and chief executives	0.35
812	Metal processing and finishing plant operators	0.35
613	Mixed crop and animal producers	0.35
213	Life science professionals	0.35
31	Armed forces occupations, other ranks	0.34
821	Assemblers	0.34
250	Information and communications technology professionals, nos	0.34
110	Chief executives, senior officials and legislators, nos	0.33
814	Rubber, plastic and paper products machine operators	0.33
700	Craft and related trades workers, nos	0.33
752	Wood treaters, cabinet-makers and related trades workers	0.32
820	Assemblers, nos	0.30
611	Market gardeners and crop growers	0.30
731	Handicraft workers	0.30
130	Production and specialized services managers, nos	0.29
810	Stationary plant and machine operators, nos	0.29
111	Legislators and senior officials	0.29

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Table 4 – *Continued from previous page*

ISCO	Job title	Predicted greenness
240	Business and administration professionals, nos	0.29
243	Sales, marketing and public relations professionals	0.28
352	Telecommunications and broadcasting technicians	0.28
315	Ship and aircraft controllers and technicians	0.28
350	Information and communications technicians, nos	0.27
133	Information and communications technology service managers	0.27
834	Mobile plant operators	0.27
122	Sales, marketing and development managers	0.27
100	Managers, nos	0.27
631	Subsistence crop farmers	0.26
351	Information and communications technology operations and user support technicians	0.26
800	Plant and machine operators and assemblers, nos	0.26
143	Other services managers	0.26
835	Ships' deck crews and related workers	0.25
933	Transport and storage labourers	0.25
630	Subsistence farmers, fishers, hunters and gatherers, nos	0.25
120	Administrative and commercial managers, nos	0.25
921	Agricultural, forestry and fishery labourers	0.25
332	Sales and purchasing agents and brokers	0.24
732	Printing trades workers	0.24
750	Food processing, wood working, garment and other craft and related trades workers, nos	0.23
930	Labourers in mining, construction, manufacturing and transport, nos	0.23
121	Business services and administration managers	0.23
912	Vehicle, window, laundry and other hand cleaning workers	0.23
816	Food and related products machine operators	0.22
241	Finance professionals	0.21
142	Retail and wholesale trade managers	0.21
633	Subsistence mixed crop and livestock farmers	0.21
333	Business services agents	0.21
751	Food processing and related trades workers	0.21
730	Handicraft and printing workers, nos	0.20
818	Other stationary plant and machine operators	0.20
815	Textile, fur and leather products machine operators	0.20
830	Drivers and mobile plant operators, nos	0.19
140	Hospitality, retail and other services managers, nos	0.19
713	Painters, building structure cleaners and related trades workers	0.19
817	Wood processing and papermaking plant operators	0.19
961	Refuse workers	0.19
432	Material-recording and transport clerks	0.19
900	Elementary occupations, nos	0.18
831	Locomotive engine drivers and related workers	0.18
300	Technicians and associate professionals, nos	0.17
632	Subsistence livestock farmers	0.17
960	Refuse workers and other elementary workers, nos	0.16
343	Artistic, cultural and culinary associate professionals	0.16
512	Cooks	0.16
331	Financial and mathematical associate professionals	0.15
910	Cleaners and helpers, nos	0.15
411	General office clerks	0.15
200	Professionals, nos	0.15
833	Heavy truck and bus drivers	0.15
430	Numerical and material recording clerks, nos	0.14
932	Manufacturing labourers	0.14
524	Other sales workers	0.13
330	Business and administration associate professionals, nos	0.13
515	Building and housekeeping supervisors	0.12
141	Hotel and restaurant managers	0.11
753	Garment and related trades workers	0.11
261	Legal professionals	0.10
521	Street and market salespersons	0.10
950	Street and related sales and service workers, nos	0.10
951	Street and related service workers	0.10
952	Street vendors (excluding food)	0.10
520	Sales workers, nos	0.10
941	Food preparation assistants	0.10
441	Other clerical support workers	0.10
410	General and keyboard clerks, nos	0.09
262	Librarians, archivists and curators	0.09

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Table 4 – *Continued from previous page*

ISCO	Job title	Predicted greenness
231	University and higher education teachers	0.09
431	Numerical clerks	0.09
513	Waiters and bartenders	0.09
522	Shop salespersons	0.09
911	Domestic, hotel and office cleaners and helpers	0.09
413	Keyboard operators	0.09
400	Clerical support workers, nos	0.09
832	Car, van and motorcycle drivers	0.08
511	Travel attendants, conductors and guides	0.08
500	Service and sales workers, nos	0.08
340	Legal, social, cultural and related associate professionals, nos	0.07
962	Other elementary workers	0.07
412	Secretaries (general)	0.07
510	Personal service workers, nos	0.07
335	Regulatory government associate professionals	0.07
541	Protective services workers	0.06
134	Professional services managers	0.06
264	Authors, journalists and linguists	0.06
422	Client information workers	0.06
233	Secondary education teachers	0.05
531	Child care workers and teachers' aides	0.05
260	Legal, social and cultural professionals, nos	0.05
514	Hairdressers, beauticians and related workers	0.05
420	Customer services clerks, nos	0.05
334	Administrative and specialized secretaries	0.05
523	Cashiers and ticket clerks	0.05
342	Sports and fitness workers	0.05
321	Medical and pharmaceutical technicians	0.05
232	Vocational education teachers	0.05
235	Other teaching professionals	0.04
516	Other personal services workers	0.04
230	Teaching professionals, nos	0.04
324	Veterinary technicians and assistants	0.03
421	Tellers, money collectors and related clerks	0.03
530	Personal care workers, nos	0.03
341	Legal, social and religious associate professionals	0.03
320	Health associate professionals, nos	0.03
234	Primary school and early childhood teachers	0.03
532	Personal care workers in health services	0.03
225	Veterinarians	0.03
224	Paramedical practitioners	0.02
221	Medical doctors	0.02
265	Creative and performing artists	0.02
220	Health professionals, nos	0.02
223	Traditional and complementary medicine professionals	0.02
325	Other health associate professionals	0.02
263	Social and religious professionals	0.02
226	Other health professionals	0.02
222	Nursing and midwifery professionals	0.01
322	Nursing and midwifery associate professionals	0.01
323	Traditional and complementary medicine associate professionals	0.00

	other		high green potential	
country	employees	percent	employees	percent
Germany	112'750	22.3%	17'751	28.6%
Other	111'891	22.2%	8'992	14.5%
Italy	63'256	12.5%	7'789	12.6%
Portugal	59'173	11.7%	(4'109)	(6.6%)
France	41'757	8.3%	9'039	14.6%
Spain	20'085	4.0%	(2'838)	(4.6%)
Hungary	11'466	2.3%	(1'101)	(1.8%)
Poland	10'844	2.1%	(1'550)	(2.5%)
Austria	10'109	2.0%	(1'147)	(1.9%)
United Kingdom	9'118	1.8%	(1'942)	(3.1%)
Romania	8'652	1.7%	()	()
Slovakia	(8'048)	(1.6%)	()	()
Belgium	6'484	1.3%	()	()
Greece	(5'436)	(1.1%)	(1'554)	(2.5%)
Czech Republic	(4'550)	(0.9%)	()	()
Netherlands	(3'761)	(0.7%)	(484)	(0.8%)
Bulgaria	(3'108)	(0.6%)	()	()
Croatia	(2'992)	(0.6%)	()	()
Sweden	(1'813)	(0.4%)	()	()
Ireland	(1'672)	(0.3%)	()	()
Slovenia	(1'369)	(0.3%)	()	
Lithuania	(1'215)	(0.2%)	()	()
Luxembourg	()	()	()	
Estonia	(1'113)	(0.2%)	()	
Finland	(989)	(0.2%)	()	()
Latvia	()	()	()	
Denmark	(701)	(0.1%)	()	
Malta	()	()	()	
Cyprus	()	()	()	
Total	504'823	100%	72'325	100%

Table 5: Citizenship of immigrant workers in Switzerland

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