2 Understanding the link between skills and the green transition

The implementation of policies to decarbonise the economy are likely to boost employment in certain low-emission sectors and decrease the number of jobs in resource-intensive and polluting industries, with implications on skill demand. This chapter traces the beginnings of the research agenda on measuring skill changes related to the green transition, and discusses key concepts such as ‘green industries’, ‘green jobs’, and ‘skills for the green transition’. It provides an in-depth overview of the skills assessment and anticipation exercises from five OECD countries.

Introduction

The implementation of net zero policies in the short to medium term calls for large investments in upskilling and reskilling. In some cases, the green transition will change the occupational composition within and between industries. In other cases, tasks within occupations will change. The success of the green transition will depend on the ability of the workforce to develop the necessary skills, including both the skills needed for emerging jobs and the skills needed to perform jobs in a greener fashion.

Some sectors – such as renewable energy, environmental services and manufacturing, energy and resource efficiency – are more at risk of experiencing skills gaps and shortages due to the green transition than others. It is estimated that green policies such as subsidies for the use of recycling goods and production of secondary metals will boost employment in recycling by 48% in 2040 compared to baseline (business as usual) scenario (OECD, 2020[1]). By contrast, material-intensive sectors (such as primary metals, construction and non-metallic minerals) could experience job destruction of approximately 135 000, 67 000 and 85 000 jobs, respectively compared to the baseline scenario. Green policies – achieving environmental objectives in a cost-effective manner through well-designed policy instruments – will not only affect employment through change in the industrial structure, they will also affect employment and skill needs in sectors not directly affected by the green transition (OECD, 2017[2]). Green policies can both create new green firms but also contribute to the shutdown of pollution-intensive firms. This can have ramifications for whole communities where much of the economic activity is centred around one industry or one firm, in some cases causing rapid declines in population as people move to other localities in search of employment even if they did not work in the industry themselves. On the other side, a proliferation of high-technology green enterprises can trigger a spillover effect in other industries, whose workers need to upskill in order to meet the new demands of the green enterprise, e.g. a catering service that now has to provide environmentally friendly food to an enterprise that wants to reduce its carbon footprint. All businesses will have to limit their environmental impact, notably by promoting environmental and sustainability awareness among their workforces.

Even though the impact of decarbonisation policies on employment will vary significantly across sectors, low-skilled workers are expected to be more affected than other workers in terms of job loss and wage cuts than the total workforce, as they account for a significant share of total employment in high-emission sectors, ranging from 30% in the OECD to 90% in the majority of non-OECD countries (Chateau, Bibas and Lanzi, 2018[3]). However, stimulus packages in favour of green industries have been shown to have a positive effect on employment, contributing to the creation of low-skilled jobs, especially in areas with a greater prevalence of pre-existing green skills (National Bureau of Economic Research, 2020[4]), leaving scope for skills policies to support the transition of workers from non-green jobs to green jobs. Therefore, it is important that policy makers have good information on how skill needs and skill supply will need to adapt and change to promote the green transition.

A brief history of the assessment and anticipation of the skills emerging from the green transition

Skills assessment and anticipation (SAA) exercises are studies that generate information about the current and future skills needs of the labour market (skill demand) and the available skill supply (OECD, 2016[5]). They are carried out to develop policies aimed at reducing skill mismatch and shortages and inform stakeholders on how to align the supply of and demand for skills in the context of rapidly changing economic conditions. SAA exercises do not attempt to predict the future with certainty or precision. Rather, they are tools to help prepare or plan for future scenarios constructed from reliable information (Cedefop, European Training Foundation, 2016[6]). SAA exercises – also called skills intelligence – exist in all OECD countries, although there are differences in the approach followed. This report focuses on

approaches to SAA for the green transition (also referred to as green SAA exercises), i.e. the assessment and anticipation of skills needed for the green transition.

Research on green jobs and green skills started to figure more prominently on the global and national agenda in 2008-10, in line with the expansion of the concept of green economy. In fact, emerging from the financial crisis, international organisations started to propose new models of sustainable growth. Several cross-national initiatives received a lot attention from the public, including “Europe 2020: A strategy for smart, sustainable and inclusive growth” in 2010 and the United Nations Conference on Sustainable Development (Rio+20) in 2012 (OECD/Cedefop, 2014[7]).

In 2009, the ILO also established the “Green Jobs Programme” to promote the worldwide creation of more and better green jobs (ILO; Cedefop, 2011[8]). The initiative aimed to develop tools to diagnose green jobs’ potential and labour market impacts on a national level and to identify skill needs for green jobs. In order to create more sustainable and decent jobs in the process of green transition, the project has progressively assisted over 30 countries by building relevant expertise and tools, ranging from diagnosing and assessing the situation in each country to sharing valuable knowledge with stakeholders, and providing policy advice. The European Centre for the Development of Vocational Training (Cedefop) has also been working on skills and jobs for the green transition since 2008. In particular, Cedefop has been examining the current status of each European country and suggesting desirable policy directions in relation to the jobs and skill needs that are expanding due to the transition to the green economy (Cedefop, 2022[9]). Together with Cedefop, in 2012 the OECD organised the “Green Skills Forum”, whose objective was to raise policy makers’ and stakeholders’ awareness of the need to make use of skills strategies in order to succeed in the transition to a low-carbon economy (OECD/Cedefop, 2014[7]). The OECD Employment Outlook 2012 identified changes in skills needs due to the green transition, and suggested recommendations for skills-related policies to enable the green transition (OECD, 2012[10]).

In the following years, the topic of assessing skill needs for the green transition lost momentum, even if a few countries put in place relevant initiatives, such as the “Greening of the World of Work” project by the Occupational Information Network (O*NET) of the United States’ Department of Labor in 2009 and the “Measuring Green Jobs” project led by the Bureau of Labor Statistics (BLS) in 2010 (more examples of green SAA exercises at country level can be found in the box below). It is only since 2019 that research on green skills has been in the spotlight again. In fact, in 2019 several important green policy milestones have been achieved, such as the United States re-joining the Paris Agreement and setting a challenging greenhouse gas emission target, and the European Union announcing the European Green Deal (EGD), which is the European Union’s new growth strategy aimed at transforming Europe into a fair and prosperous society where there are no net emissions of greenhouse gases by 2050. Following the launch of the European Green Deal and exploiting skills forecast scenarios by Cedefop, the European Union has produced several insights on the implications of its implementation for employment and skills. The results highlight the expected effects in sectors and occupations, as well as opportunities and challenges for providing effective and timely upskilling and reskilling opportunities (Cedefop, 2022[9]).

Global insights

When did 'green' SAA exercises start getting attention in OECD countries?

Skills assessment and anticipation has been used for the green transition for a little over a decade. The Bureau of Labor Statistics (BLS) received funding beginning in 2010 to develop and implement the collection of new data on green jobs. In particular, the goal was to develop information on: (i) the current number of green jobs and their evolution over time, (ii) the industrial, occupational, and geographic distribution of green jobs, and (iii) the wages of the workers in these jobs. BLS used two alternative approaches to measure green jobs: (1) the output approach, which identifies establishments that produce green goods and services and counts the associated jobs, and (2) the process approach, which identifies establishments that use environmentally friendly production processes and practices and counts the associated jobs. Both activities were conducted through the Quarterly Census of Employment and Wages (QCEW) and the Occupational Employment Statistics (OES) programmes. Based on the results of each approach, BLS periodically published career information on green jobs, which included wages, expected job prospects, what workers did on the job, working conditions, and education, training, and credentials requirements. However, in 2013, BLS terminated all green jobs projects due to across-the-board spending cuts in the context of the Balanced Budget and Emergency Deficit Control Act (Bureau of Labor Statistics, 2022[11]).

In 2016, the European Training Foundation in collaboration with Cedefop and ILO released a guide on anticipating and matching skills and jobs (Cedefop, European Training Foundation, 2016[6]). The publication focuses on foresight and use of different types of data and methods on estimating future skills needs, and a recognition that these types of exercises might be useful for the green transition.

There has been more prolific use of SAA exercises for the green transition since the early 2020s. The United Kingdom launched the Green Jobs Taskforce in 2020 as part of the "Ten Point Plan for a Green Industrial Revolution", whose role is to provide advice on how to support green jobs and accelerate the country's path to a net zero economy. Supported by the Department for Business, Energy and Industrial Strategy (BEIS) and Department for Education (DfE), the Green Jobs Taskforce includes members representing employers, trade unions, and the adult learning sector. In 2021, the Taskforce published the "Green Jobs Taskforce Report", which brought evidence and recommendations on the skills needed for the transition to net zero (Green Jobs Taskforce, 2020[12]). In 2021, Canada's Future Skills Centre (FSC) launched a new skills strategy to support and build a sustainable future for workers, businesses and industries. As part of this initiative, the FSC is collaborating with the Smart Prosperity Institute (SPI) to share knowledge and insights on what it will take for the Canadian economy to meet net-zero targets. The FSC continues to add to the growing knowledge advanced by consortium partners, including the Diversity Institute and the Conference Board of Canada. Building on two-year project, headed by the Diversity Institute, new research published utilises innovative foresight tools to explore the different scenarios and implications for Canadian labour market to get to a net-zero future (Future Skills Centre; The Diversity Institute; Smart Prosperity Institute, 2022[13]).

Identifying skill needs associated with the green transition

The green transition is a complex concept. It covers the realms of business, science, innovation, societal development, education and more. It is an interaction between firms, workers and policy makers, towards one goal – away from environmentally unsustainable economies towards green, low carbon and resilient economies. Green growth policies aim at improving environmental quality and economic growth at the same time, and foster growth without harmful environmental outcomes (OECD, 2011[14]). The employment

and skills implications of a phenomenon so complex as the green transition are difficult to grasp. In particular, the main challenge in measuring skills for the green transitions is providing a clear definition of what constitutes a "green" skill. A large share of skills assessment and anticipation studies actually focus their analysis on sectors, and define the industries themselves as green. Other studies focus, instead, on occupations, and advance various definitions of what constitutes a green job. Only very few countries adopt a real skills approach and define a number of "green tasks" which are tasks that are considered fundamental to reducing the impact of human activity on the environment.

Green industries

Many studies on the impact of green policies on labour markets are centred around one industry or sector. For instance, both the renewable energy industry, sustainable waste management, and e-mobility are systematically considered "green industries", and have received great attention from international organisations, private institutions and researchers alike (ILO, 2012[15]; Baldwin et al., 2021[16]; IRENA and ILO, 2022[17]). As there exist no international nor national definition of "green industries", they are typically hand-picked by policy makers based on national industrial plans. Their links with a cleaner economy are due to the fact that they either produce sustainable goods and services or adopt production processes that are comparatively less polluting.

A key characteristic of this type of SAA exercises is that, once they have defined an industry as green, they also implicitly identify all jobs and skills within that industry as green, or, at least, important to achieve a cleaner economy. For example, studies that define ecotourism as a green sector consider hotel receptionists – which are not by themselves a typical green occupation – key actors in the green sector, with the direct consequence that their employment should be encouraged. This top-down approach to identify what are the skills associated with the green transition has the advantage that it adopts largely consensual definitions of green industries, avoiding the development of complex statistical methodologies or having to agree on a definition of what constitutes a green job. By contrast, its implications on employment and skills policies are limited, as such SAA exercises are rarely able to analyse changes in skills needs beyond a handful of key skills and do not often provide sufficiently disaggregated information to develop targeted policy actions.

Green jobs

A smaller number of SAA exercises attempt the difficult task of defining green jobs. Once again, there is no unique internationally recognised definition of green jobs, so existing studies had to come up with various methods and approaches (see, for example, Box 2.1 for the United Nations' terminology). Tasked by the G7 Labour and Employment Ministers in 2022, the ILO and OECD proposed that green jobs should be defined in line with the guidelines of the International Conference of Labour Statisticians (ICLS) as employment in the environmental sector while also measuring the quality of these jobs (Keese and Marcolin, 2023[18]). A further taxonomy proposed by OECD (forthcoming[19]), three main categories of definitions can be distinguished: process definitions, output definitions and policy-driven definitions.

Both the process and output approaches define green jobs in their relation to "brown jobs" – that is, jobs that generate pollution or greenhouse gas emissions (process approach) or jobs that produce goods and services that have the potential to generate harmful impacts on the environment across their lifecycle from production to consumption (output approach). In other words, if a job does not have the characteristics to be classified as a "brown job", it is defined as a "green job". These two approaches, though relatively easy to understand, have the drawback of oversimplifying green jobs as just "jobs that do no environmental harm". Alternative definitions, instead, rely on examining the labour market changes due to green policies. Indeed, the policy-driven approach defines green jobs as jobs that arise or grow in demand due to implementation of green policies. From this perspective, green jobs are jobs created following government policies to reach pre-defined green policy targets, such as lower emissions.

Although this comes at the expenses of having to overcome the difficulties of defining what a "green job" is, moving from a sectoral approach to occupation-based analyses provides more granular insights on how to boost the green transition. For example, employment and skills policies aimed at fostering the presence of environmental engineers – an often-cited green job – go well beyond targeting the needs of a few green sectors, as environmental engineers work both in green industries (like in the solar energy business), but they are also heavily present in non-green sectors (e.g. in construction).

Box 2.1. The United Nations' definition of green jobs

According to the United Nations, the green transition, or a green/greening economy, is the process of reconfiguring businesses and infrastructure to deliver better returns on investment or natural, human and economic capital, while at the same time reducing greenhouse gas emissions, extracting and using fewer natural resources, creating less waste and reducing social disparities (UNEP; ILO; IOE; ITUC, 2008[20]). Green jobs are therefore jobs that reduce the environmental impact of enterprises and the economy, ultimately to levels that are sustainable. This definition covers work in agriculture, industry, service and administration that contributes to preserving or restoring the quality of the environment while also meeting the criteria for decent work – adequate wages, safe conditions, workers' rights, social dialogue and social protection (UNEP; ILO; IOE; ITUC, 2008[20]). The United Nationals definition highlights the importance of not only capturing the contribution of a job to a greener economy but also the quality of those jobs.

Skills for the green transition

A drawback of limiting the focus of the analysis on green jobs, even if differentiated by sector or occupation, is that they are not homogenous in terms of skill requirements, since they can require low, medium or high qualifications and involve a broad set of skills. For this reason, it is important to distinguish between jobs and skills, as skill analysis offers an even more disaggregated level to examine and unpick the complex dynamics of the greening of the economy. Attempts at understanding skills and their key in unlocking the green transition have been undertaken by several institutions, researchers and governments. Already in 2011, the International Labour Organization synthesised and contextualised the drivers of the green transition in the labour market, their effect on skill requirements and the responsiveness of national training systems (ILO; Cedefop, 2011[8]). The report concluded that the skill development was rarely included in strategies for green growth. Over the past decade, progress in the area of SAA exercises for the green transition has been made. Guidelines for carrying out SAA exercises have been published (ILO, 2015[21]), and studies have been produced to record the implementation of such practices (Cedefop, 2019[22]). Unfortunately, strategies, policies and initiatives that focus explicitly on skills for the green transition are still rare. Yet, the few assessments currently available all point to the fact that skills for the green transitions are in very high demand in the labour market (Rutzer, Niggli and Weder, 2020[23]) and that there is not going to be sufficient human capital to meet climate targets in the future if there are no efforts to boost skills (LinkedIn, 2022[24]).

In spite of their clear advantages, there is one substantial obstacle to adopting a skills-based approach: namely, defining what makes a skill relevant for the green transition. Conceptually, there is still a debate in the literature on whether it is relevant or not to talk about "green skills". A number of institutions have put forward, including recently, different definitions of green skills. For instance, Cedefop (2013[25]) defines green skills as "the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society". In 2022, the European Commission has released the GreenComp – a European sustainability competence framework aimed at providing a consensual definition of what sustainability as a competence entails, for the benefit of education and training providers (Bianchi,

Pisiotis and Cabrera Giraldez, 2020[26]).[1] Even academics have recently been using the term "green skills" in their research (see, among others, Vona et al. (2018[27]) and Kwauk and Casey (2022[28])).

However, a growing number of studies – including those undertaken by the ILO (such as ILO (2011[8])) – argue that skills cannot be green *per se*. They are the competence and abilities that individuals possess (such as finger dexterity, oral communication, repairing skills) that are used to carry out tasks that contribute to a greener economy. It would be more precise to talk about "skills for the green transition", "skills for lower carbon emission", "competencies for the green shift", and so on, as occasionally done by some of the SAA exercises reviewed in this report, since they are skills that are applied in certain green context (such as installing machines for hydrogen energy) or to achieve a specific sustainability target (such as recycling).

Overall, a characteristic of the skills linked to the clean economy is generally accepted, regardless of the actual definition of green skills used: namely, the fact that jobs can have different degrees and combinations of skills that determine how green the job is (OECD/Cedefop, 2014[7]). Building on this assumption, green jobs and skills are not only associated with environmental outputs, but can be found in a range of industries and sectors that are being, directly and indirectly, affected by the change in the natural environment and policies that foster environmental production. A simplified example is the food service industry increasing use vegetarian ingredients and food "scraps" in preparing meals, even if occupations in this industry do not directly deal with environmental preservation.

Moreover, as pointed at by OECD (2014[29]), "skills to support innovation and adaptability will be as important [to the green transition] as technical skills, as industries will gradually adapt to the need to better harness and dispose of resources". This suggests that not only will technical skills specific to renewable and green industries be required, but also transversal skills, such as technological skills, management skills, skills on innovation and change management and communication skills. This is because the green transition is not only dependent on technological innovations and sector-specific innovation, but also skills needed to inspire, manage and persuade businesses, workers and consumers to change their behaviour and consumption patterns.

With many different definitions of green transition, green strategies, green goals and green jobs, defining green skills for the purpose of running an SAA exercise is a major challenge. In addition, there is an element of uncertainty as to what climate-mitigation policies will be required to reach climate goals, bringing further uncertainly as to what skill needs are likely to emerge from those policies. As one of the aims of this report is to map definitions, it does not put forward a new definition of skills for the green transition. Going forward, when mentioning green skills or skills for the green transition generally (i.e. not in connection to a specific SAA exercise), this report will rely on the concepts outlined above, all of which have a similar understanding of what constitutes the green transition, green jobs and green skills.

A growing ecosystem of green SAA exercises

The labour market consequences of the green transition are reaching beyond the industries most associated with the reduction in emissions (namely renewables and green energy but also gas, oil and mining) and the need for specific in-depth analysis of the resulting changes in skill demand is growing. A multitude of SAA exercises have taken place over the last three years, all focusing on different industries and regions, offering unique and specific approaches to identifying challenges raised by the green transition. For the purpose of this project, a selected number of SAA exercises have been reviewed in-depth to shed light on some of the challenges and opportunities of evaluating current and future green skills needs (Table 2.1).

One key takeaway emerging from the analysis is the lack of co-ordination of the green SAA exercises within countries. There are many stakeholders at play in the green transition, several of which are

attempting to measure and plan for emerging skill needs. The results of these exercises are not aggregated at a higher level, and there is limited national overview of what green SAA exercises have been carried out, their outcomes and how they are used to guide firms, individuals and policy makers in adjusting to the green transition. As a result, exercises often overlap and some, though producing interesting results, are not being used in the decision-making process. For an outsider trying to disentangle what SAA exercises are conducted and whether their results have been used effectively, the SAA ecosystem can seem crowded and disconnected. National mappings of results and their usefulness will be crucial for ensuring evidence-based green policy making.

Table 2.1. Overview of SAA exercises for the green transition featured in the report

Country	Institution	Source
Australia	Federal Government	
	Jobs and Skills Australia (JSA)	Policy questionnaire
	Infrastructure Australia	(Infrastructure Australia, 2021[30])
	Department of Employment and Workplace Relations (DEWR)	Policy questionnaire
	State Government	
	Victorian State Government	Policy questionnaire
	Independent	
	Deloitte	(Deloitte Access Economics, 2021[31])
	RACE for 2030	(RACE for 2030, 2021[32])
Austria	GWS	(Großmann et al., 2020[33])
	Just Transition Action Plan	
	Austrian Energy Agency	(Tretter et al., 2022[34])
	WIFO	(Meinhart et al., 2022[35])
France	National Observatory for Jobs and Occupations in the Green Economy	(Ministry of Ecology, Energy and Territories, 2021[36])
	France Stratégie and Dares – Skill Forecast: Occupations 2030	(France Stratégie, 2022[37])
	EDEC	Policy questionnaire
	ADEME	(Ecological Transition Agency (ADEME), 2021[38])
	The Shift Project	(The Shift Project, 2021[39])
	Scénario négaWatt	(Association négaWatt, 2021[40])
Norway	Norwegian Committee on Skill Needs	(Kompetansebehovsutvalget, 2023[41])
	Virke - Circular Economy	(Virke, 2020[42])
	Virke - Virkebarometer	(Virke, 2021[43])
	NHO - Skill barometer	(Rørstad, Børing and Solberg, 2023[44])
Sweden	Public Employment Service	(Swedish Public Employment Service, 2022[45])
	Vinnova	(Vinnova, 2022[46])
	Confederation of Swedish Enterprises	(Confederation of Swedish Enterprise, 2021[47])

Source: Authors' elaboration based on desk research and policy questionnaires.

Australia

Australia conducts several green SAA exercises, each with different definitions, scope, governance structures and methods. This is partly due to the administrative structure of its political power, as the Commonwealth of Australia is a federation of six states and two territories, with three levels of government: federal, state and local. A selection of the different green SAA exercises conducted in Australia are described below and categorised as either federal, state or independent.

Federal

- **Jobs and Skills Australia** (JSA) provides advice to the Australian Government to underpin Australia's response to current, emerging and future labour market and workforce skills and training needs. For instance, it produces an annual Skills Priority List, annual five-year employment projections by industry, occupation, and skill level, and they have developed a mapping of skills in occupations (the Australian Skills Classification – ASC). The Australian Government has commissioned JSA to undertake a capacity study on the workforce needs for Australia's transition to a clean energy economy. The capacity study will provide critical evidence and insights to support workforce planning, policy development and programme design. JSA will also analyse the impact on skills using the ASC. The Australian Government has committed to embedding a role for JSA's analysis of skills shortages in setting the priorities of Australia's Skilled Migration program. JSA was established in late 2022 and its predecessor agency, the National Skills Commission, published some initial analysis of decarbonisation impacts on skills and jobs in its 2022 report (National Skills Commission, 2022[48]).
- Making an energy system transition may change the demand for labour in specific occupations and sectors. In 2021, **Infrastructure Australia** partnered up with the Australian Energy Market Operator (AEMO) to assess and understand the labour and material requirements for the transmission and generation projects identified in AEMO's 2020 Integrated System. Established in 2008, Infrastructure Australia provides independent advice to governments, industry and the community on how to improve Australia's infrastructure (Infrastructure Australia, 2021[30]).
- The Powering Australia Plan is an extensive plan to reach Australia's climate goals to reduce emissions by 43% by 2030 and reach net zero by 2050. It is underpinned by tailored policy measures for three key sectors of the economy: Electricity, Industry & Carbon Farming, and Transport. The **Department of Employment and Workplace Relations** (DEWR) also developed two programmes in-house (i.e. the "New Energy Apprenticeships Program" and "New Energy Skills Program") to encourage apprentices to train in the new jobs of the future and provide an additional incentive to complete their training. Additional work may be commissioned to forecast future skills needs within the sector (Department of Employment and Workplace Relations, 2022[49]).

State

- Two on-going exercises by the **Victorian State Government** are reviewed in this report. The Victorian Department of Environment, Land, Water and Planning (DELWP) has recently commissioned advisory firm ACIL Allen to conduct the "New Energy Skills and Training Gap Analysis".[2] This involves analysing the need for jobs, skills and training related to large-scale energy generation, distributed energy resources and emerging technologies (including hydrogen, offshore wind, zero emission vehicles and bioenergy) (Victorian State Government, 2022[50]). The Victorian Department of Education and Training is also developing a 10-year clean economy workforce development strategy. This will include extensive stakeholder consultations and regular labour market forecasting, which will be managed by the Victorian Skills Authority – a new government entity tasked with determining future skills more generally, and for a greener economy specifically (Victorian State Government, 2022[51]).

Independent

- **Deloitte** Access Economics was asked by the Climate Council (an independent and community-funded organisation for climate change communications) to analyse the impact of decarbonisation and a shift towards a net zero economy on employment, skills and tasks in all jobs in Queensland. They also investigate alternative career pathways for people whose jobs are disrupted by the green transition (Deloitte Access Economics, 2021[31]).

- **RACE for 2030** is an industry-led collaborative research centre with AUD 68.5 million of Commonwealth funding. One of their research themes is "Developing the future energy workforce", which includes three work packages, each focusing on a specific question: 1) how to measure market size, workforce and employment needed in the future energy workforce, 2) how training and skills can be fit for the future, including the new skills, occupations and training pathways involved, and 3) how to strengthen innovation pathways, including by enhancing collaborations and leveraging policy, strategic capacity-building and diverse investments into energy innovation (RACE for 2030, 2021[32]).

Austria

For Austria, this report focuses on three different SAA exercises. First, it includes a study by GWS about the impact of climate policies on the Austrian labour market, as commissioned by the Federal Ministry of Labour. Then, it presents two analyses undertaken in the context of the Austrian Just Transition Action Plan, an initiative of the Federal Ministry for Climate Action: a study by the Austrian Energy Agency about the competencies for a climate neutral future, and a study by the Austrian Institute of Economic Research (WIFO) about the just transition in Austria.

- **GWS** examined which measures are necessary to reach certain levels of CO2 reduction (including measures to change consumer behaviour such as taxing climate-damaging behaviour). It also analysed the impact of the required measures on employment across the labour market. The GWS is a private, independent economic research and business and policy consultancy organisation (Großmann et al., 2020[33]).
- The **Austrian Energy Agency** is a non-profit scientific organisation that is also the national energy efficiency monitoring body. It analysed which future skills will be needed in the areas of construction and renovation, electricity from renewable sources and renewable heat, and whether this requires adjustments in ten relevant apprenticeships and further training courses. They also developed a methodology for the practical adaptation of training content (Tretter et al., 2022[34]).
- **WIFO** – the Austrian Institute of Economic Research – analysed the impact of a transformation towards climate neutrality and sustainability on the labour market, by combining desk research with input-output analysis and a workshop with experts on environmental and labour market policies in order to put the sectoral results into a regional context (Meinhart et al., 2022[35]).

France

Five SAA exercises from France are covered in this study and they are conducted by the National Observatory for Jobs and Occupations in the Green Economy (Onemev), DARES and France Stratégie (Skills Forecast: Occupations 2030), the Agency for Environment and Energy Management (ADEME), the think tank Shift Project, and a group of SAA exercises organised under the Commitment to Employment and Skills Development (EDEC) programme.

- The **Onemev** exercise is conducted in collaboration with different partners and placed under the Ministry of Ecological Transition. It focuses on identifying green and greening occupations, jobs facing shortages, and green skills, as well as identifying continuing education related to the green transition. The project is currently in the phase of identifying greening jobs based on a classification of green skills (Ministry of Ecology, Energy and Territories, 2021[36]), that is, occupations whose purpose is not directly environmental but which still integrates new fields of green competencies.
- Skills Forecast: Occupations 2030 is an SAA exercise established in 1990 that has incorporated the green dimension in its forecast model. The exercise is governed by **France Stratégie** (Prime minister's service) and **Dares** (statistical body of the Ministry of Labour), in collaboration with several public institutions. The exercise provides a quantitative outlook for occupations to 2030,

and measures job creation, recruitment need and skills mismatch, including labour market effects of the transition to a low-carbon economy (France Stratégie, 2022[37]).

- The Commitment to Employment and Skills Development (**EDEC**) is a series of SAA studies partially funded by the Ministry of Labour and conducted by professional sectors, branches and skill operators (OPCO). The EDEC studies report on the impact of the ecological transition on occupations, skills and training needs, and each EDEC study produces an action plan for employment and skills (Ministry of Labour, 2019[52]).
- The Agency for Environment and Energy Management (**ADEME**) has developed a range of SAA exercises to simulate scenarios for the green transition. ThreeME, for instance, is a macroeconomic model designed to evaluate the economic and employment impacts of green energy policies. It has been designed by ADEME together with the French Economic Observatory (OFCE) and the Netherlands Economic Observatory (NEO). ThreeME is based on 37 economic sectors, which allows to simulate the impact of different green public policies, such as the introduction of a carbon tax (Netherlands Economic Observatary (NEO), 2022[53]). The model has also fed into the report "Transition(s) 2050" by the French Government (Ecological Transition Agency (ADEME), 2021[38]).
- The **Shift Project**, a French nonprofit think tank, has published an SAA exercise that aims to assess changes in demand and supply in sectoral employment and skills until 2050 according to the trajectory proposed by the Plan for the Transformation of the French Economy (PTEF). The SAA is not based on predictions from a model, but takes a mixed-method approach that relies on assumptions about public policy and behavioural changes linked to the PTEF, such as an increase of renovations in the building sector (The Shift Project, 2021[39]).
- In 2021, the **négaWatt** Association published its fifth SAA exercise on the energy transition and its implication on the labour market. NégaWatt utilises scenario models to achieve carbon neutrality by 2050 and be in line with 17 sustainable development goals as defined by the United Nations. Their study focuses on the societal implications of reduction in energy consumption, and features estimates of job creation and destruction across France, by sectors (Association négaWatt, 2021[40]).

Norway

In Norway, the SAA exercises covered by this study are conducted by the Norwegian Committee of Skills Needs, as well as by two employers' organisations: Virke and the Confederation of Norwegian Enterprise (NHO).

- The **Norwegian Committee of Skill Needs** was established in 2017 and has recently published their report on skills needs for the green transition. The report features four key parts. Firstly, the report provides an overview of existing SAA exercises and their findings, mostly conducted by employers' organisations. Secondly, the report provides new information produced by the Nordic Institute for Studies of Innovation, Research and Education (NIFU), including a literature review on definition of green jobs and green skills, a questionnaire survey with semi-structured interviews, and an in-depth study of three sectors. The three highlighted sectors are the petroleum sector (in decline), renewable energy industry (growing industry) and the public sector. Thirdly, the report conducts original analyses, among others on register data or other survey data that has not yet been published, text data for vacancies and studies. Finally, the committee provides their own assessments of the knowledge base and recommendations for further action.
- The Federation of Norwegian Enterprise – **Virke** – has conducted multiple studies aiming at assessing the evolution of skill needs in the labour market. Two of them are particularly relevant for this report. The first exercise is a study on the future skill needs related to circular economy and sustainability. The report is based on 18 qualitative in-depth interviews with representatives from

the sectors of procurement, logistics, and design. The second exercise is called Virkebarometer which is a survey among a representative sample of firms conducted in 2019 and 2021. The results of the exercise identify how companies will be affected by the green transition and to what extent (Virke, 2021[43]).

- **NHO** is the largest employer organisation in Norway with over 30 000 member companies from the private business sector. The organisation conducts a yearly survey among their members and have since 2020 incorporated a green dimension to the survey. The 2020-21 survey was executed by the Nordic Institute for Studies in Innovation, Research and Education and includes several questions about skills needs for the green transition. Given its clear importance for today's economy, NHO will continue to cover the topic of the green transition in their upcoming surveys (Rørstad, Børing and Solberg, 2023[44]).

Sweden

Three SAA exercises from Sweden are covered in this study, conducted respectively by Vinnova, the Confederation of Swedish Enterprise, and the Public Employment Service.

- In early 2022 the government commissioned the Swedish innovation agency – **Vinnova** – to identifying the areas of skill needs which are most important in order to meet the government's climate goals. The exercise is divided in to two parts and the first report, released in May 2022, covers the upskilling of the domestic industry and energy sector (Vinnova, 2022[46])..
- The SAA exercise by the **Confederation of Swedish Enterprise** is commissioned and conducted by the employers' organisation itself. The organisation consists of 49 member associations representing five sectors (namely, construction, transportation, manufacturing, services, trade and hospitality). The exercise was conducted through surveys and in-depth interviews with 28 representatives from different sectors. The aim of the exercise is to map out future skill needs for each of the sectors represented in the organisation (Confederation of Swedish Enterprise, 2021[47]).
- The **Public Employment Service** has conducted an SAA exercise focusing on the industrialisation of fossil-free production and electrification in the north of Sweden,[3] covering the five main companies that operate in the area. The government commissioned the exercise to the PES with the main goal of strengthening the skill supply when big companies are establishing their business within the country. To fulfil the objective of the exercise the PES has established an internal cross-functional working group with representatives from different areas of expertise. There are no skill forecasts made in this report, but it rather gives insights to what tools can be used to foresee them (Swedish Public Employment Service, 2022[45]).

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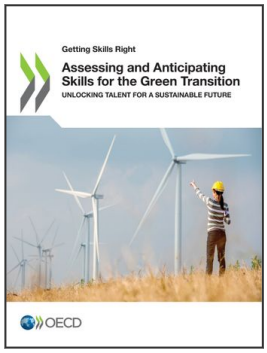
Notes

[1] The GreenComp identifies 12 sustainability competences that empower learners to embody sustainability values: valuing sustainability, supporting fairness, promoting nature, systems thinking, critical thinking, problem framing, futures literacy, adaptability, exploratory thinking, political agency, collective action and individual initiative (Bianchi, Pisiotis and Cabrera Giraldez, 2020[26]).

[2] On 1 January 2023 a number of changes to the structure of Victorian Government Departments was implemented. The Victorian Skills Authority moved from the Department of Education and Training into the new Department of Jobs, Skills, Industry and Regions' portfolio and the Department of Energy, Environment and Climate Action was created, replacing the previous Department of Environment, Land, Water and Planning. The 10-year Clean Economy Workforce Development Strategy now sits under the Department of Jobs, Skills, Industry and Regions portfolio, and the Department of Education and Training has now become the Department of Education.

[3] This is not the only project involving green jobs and green skills undertaken by the Swedish PES. The Kickstart React-EU project will complement and strengthen Swedish labour market policies to aid people who became unemployed during the pandemic back into employment. The project will also contribute to the transition to a low-carbon economy with a focus on green and digital skills.



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