Getting Skills Right

Assessing and Anticipating Skills for the Green Transition

UNLOCKING TALENT FOR A SUSTAINABLE FUTURE

OECD

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BETTER POLICIES FOR BETTER LIVES

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Foreword

The increasing frequency of extreme weather events caused by climate change calls for a significant acceleration in the transition towards greener economies and societies. Climate protection efforts and steps to reduce the carbon footprint of the economy have an important impact on labour markets, including on where jobs will be created and lost and the skills that will be in demand. Skills gaps and shortages are already recognised as major bottlenecks in a number of green sectors, which risks constraining innovation and technology adoption. Policy makers can facilitate the shift towards a more sustainable economy through targeted policies on skills, helping workers transition to new industries and fostering investment in skills that are required in sectors with high growth potential. Effective policy action in this area requires better information on the types of skills crucial for the green transition, and the occupations and sectors where these skills are needed.

To shed light on this still unexplored issue, this report sets out to identify effective strategies for turning qualitative and quantitative information on skill needs emerging from the transition to a green economy into relevant policy action. Based on a comparative assessment of the practices in five OECD countries (Australia, Austria, France, Norway and Sweden) as well as in other selected countries, this report explores methodological and governance innovations in carrying out skills assessment and anticipation (SAA) for the green transition as well as the results of these exercises and the challenges involved. Furthermore, the report examines the use of SAA information to guide policy development in the areas of employment, career guidance, adult training, formal education, industrial policies and migration.

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Acronyms and abbreviations

ABS	Australian Bureau of Statistics, Australia
ADEME	Agency for Environment and Energy Management, France
AEMO	Australian Energy Market Operator
ANZSCO	Australian and New Zealand Standard Classification of Occupations
APTC	Australia Pacific Training Coalition, Australia
ASC	Australian Skills Classification
AUD	Australian Dollar
BEIS	Department for Business, Energy and Industrial Strategy, the United Kingdom
BERT	Bidirectional Encoder Representations from Transformers model
BLS	Bureau of Labor Statistics, the United States
CAD	Canadian Dollar
Cedefop	European Centre for the Development of Vocational Training
CGE	Computable general equilibrium model
CoPS	Centre for Policy Studies of Victoria University, Australia
DELWP	Victorian Department of Environment, Land, Water and Planning, Australia
DEWR	Department of Employment and Workplace Relations, Australia
DfE	Department for Education, the United Kingdom
EDEC	Commitments to Employment and Skills Development, France
EGD	European Green Deal
EGFSN	Expert Group on Future Skills Needs, Ireland
EQA	Estonian Qualification Authority, Estonia
ESCO	European Classification of Skills, Competences, Qualifications and Occupations
EUR	Euro
FSC	Future Skills Centre, Canada
GHG	Greenhouse gas
GJT	Green Jobs Taskforce, the United Kingdom
ILO	International Labour Organization
ISCO	International Standard Classification of Occupations
IT	Information technology
JTF	European Just Transition Fund
LCREE	Low Carbon and Renewable Energy Economy survey, the United Kingdom
ML	Machine Learning
NEO	Netherlands Economic Observatory, the Netherlands
NHO	Confederation of Norwegian Enterprise, Norway
NIFU	Nordic Institute for Studies on Innovation, Research and Education, Norway
NLP	Natural language processing
NOS	National occupational standards
NSC	National Skills Commission, Australia
OECD	Organisation for Economic Co-operation and Development
OES	Occupational Employment Statistics
OFCE	French Economic Observatory, France
OJV	Online job vacancy
Onemev	National Observatory for Jobs and Occupations in the Green Economy, France

O*NET	Occupational Information Network
ONS	Office for National Statistics, the United Kingdom
PAGE	Partnership for Action on Green Economy, South Africa
PBL	Environmental Assessment Agency, the Netherlands
PES	Public employment services
PMSOL	Priority Migration Skilled Occupation List, Australia
PTEF	Plan for the Transformation of the French Economy, France
QCEW	Quarterly Census of Employment and Wages
R&D	Research and development
RPL	Recognition of prior learning
ROA	Research Centre of Education and Labour Market, the Netherlands
SAA	Skills assessment and anticipation
SANQ	Qualification Needs Anticipation System, Portugal
SAP	Structural Adjustment Programme
SCGJ	Skill Council for Green Jobs, India
SMP	Skills Mobility Partnership
SPI	Smart Prosperity Institute, Canada
UNEP	United Nations Environment Programme
UNITAR	United Nations Institute for Training and Research
VET	Vocational education and training
WIFO	Austrian Institute of Economic Research
WIL	Work-Integrated Learning

Executive summary

Extreme weather, global heatwaves, and depletion of natural resources have pushed the need to speed up the transition to a greener economy to the forefront of the policy debate. Ensuring a more sustainable world for current and future generations is now more than ever a priority.

Policies fostering greener growth will trigger changes in the labour market with potential job creation in sectors such as renewable energy, organic agriculture, recycling of waste products, but also job losses in emission-intensive industries. They will also lead to considerable changes in skill requirements, both as a result of the emergence of new occupations and changes in skill needs in existing occupations. Even jobs in sectors not directly affected by the green transition will need to incorporate relevant transversal skills such as environmental awareness and sustainability. Policy makers will need to foster the move towards a cleaner economy and limit the personal cost for workers who will have to transition into new jobs or acquire new skills to stay in their jobs. Thus, investing in skills policies to help businesses and workers will be essential. Better skills assessment and anticipation (SAA) can help identify skill requirements both between and within occupations and ensure that the findings translate into effective policies.

This report sheds light on the key issues and methods involved in the design and implementation of skill assessment and anticipation exercises for the green transition and provides structured guidelines for policy makers. It relies on inputs from five OECD countries (Australia, Austria, France, Norway and Sweden), collected through a series of workshops, stakeholder interviews and collaborative consultations. It also incorporates numerous inspiring examples from other relevant countries. The key findings are as follows:

- The use of skills assessment and anticipation methods for the green transition is still somewhat novel. So far, many SAA exercises have been one-off studies or irregular reports that have not been focused on the green transition specifically and have struggled to provide an up-to-date picture of the changing demand for skills. Many general SAA exercises do not incorporate clear green targets, such as decarbonisation or circular economy targets, among their assumptions. So far, there has been limited use of big data in these exercises making the results less detailed and timely.
- Today, even as SAA exercises for the green transition emerge, much research focuses on employment projections, and the skill perspective is relegated to anecdotal observations or rather superficial investigation. One of the barriers to assessing the impact of the green transition on skills demand is the difficulty in defining the skills needed for the green transition.
- In many countries, a lack of nationally determined targets and definitions has resulted in an ecosystem of SAA exercises with large variability in the focus of analysis and results. Many of these exercises are focused on a specific industry or sector rather than the whole economy. This makes it difficult to replicate the methodology for future studies in other industries. However, it is the most narrowly defined SAA exercises with precise targets that are the most likely to influence policies. The most valuable information is gathered at the industry level and many policy initiatives are sub-national interventions featuring local actors.

- The fragmentation of SAA exercises, their irregularity and the complexity of the green transition mean that policy makers find it challenging to use the results from these exercises directly to design policies and programmes. In addition, most countries have a complex governance landscape where responsibility for policies related to skills for the green transition is shared across several ministries and public bodies with many expert stakeholders working in the field, which requires strong co-ordination.

This objective of this report is to provide an initial roadmap to respond to and prepare for changes in skill needs brought about by the transition to a greener economy. Chapter 1 summarises the key findings of the report in succinct guidelines for policy makers and researchers designing and implementing skills assessment and anticipation exercises for the green transition. The following chapters draw a picture of existing green SAA exercises and provide insights for the inclusion of skills intelligence in policy making. Chapter 2 highlights the importance of the skill perspective for the green transition, provides an overview of key concepts, and maps out existing SAA exercises in the participating countries. Chapter 3 delves into issues related to definitions, scoping, governance and funding of SAA exercises, while Chapter 4 discusses the advantages and disadvantages of different methodologies for assessing and anticipating skills. Chapter 5 presents recent innovations in the use of Big Data for SAA exercises for the green transition, while Chapter 6 provides policy makers with an overview of how the results of these exercises can be used to design policies. Finally, Chapter 7 investigates why it is challenging to use SAA results in policy making for the green transition and offers five success factors for doing so.

1 Overview: Guidelines to assess and anticipate skills for the green transition

Policy makers can foster a greening of the economy by avoiding bottlenecks in skill supply and by facilitating job transitions. To do so, they require up-to-date and reliable evidence on changing skill demands related to the green transition. These guidelines provide actionable steps for decision makers to set up approaches for assessing and anticipating skills, and then using the insights generated for policy making that promotes the green transition.

An emerging policy agenda on skills for the green transition

The need to act on climate change is pressing. A reduction of greenhouse gas emissions globally is required to reach carbon neutrality and prevent the steady rise of global average temperatures. Public policies that aim to foster the transition to a cleaner economy and reduce the adverse human impact on the climate and ecosystems are critical to drive the green transition and the pathway to a net-zero economy. At the same time, as individual consumer demands are changing and businesses are taking action to lower their emissions, the green transition will have profound economic and social implications. Job losses are likely to occur in high-emission and polluting sectors, while new jobs will be created in cleaner industries. The green transition will also bring about potentially large changes in the demand for skills. Skills gaps and shortages are already recognised as bottlenecks in green sectors, constraining innovation and technology adoption (Keese and Marcolin, 2023[1]). In this context, governments can take action to promote the development of skills for which the demand is rising due to the green transition, to prepare adult learning and training systems, and to facilitate job transitions.

Research and policy initiatives focusing on skills for the green transition have been undertaken since the 2010s and have received increasing attention in recent years. The policy agenda is relatively novel and comes with significant uncertainty about the effects of green growth on skill needs. The green transformation itself is a complex and evolving process, with technologies and policies continually advancing and changing. The pace of adoption of “green technologies” across sectors and their impact on skills requirements remains therefore difficult to quantify. Many changes in skills demand may be localised and depend on existing economic structures of a region or country.

While the urgency of climate change requires swift policy responses, solid evidence on changes in skill demands due the green transition is still relatively scarce, and so is policy action in OECD countries. Research in this field still suffers from a lack of commonly agreed definitions on what green skills, tasks and jobs actually are. And while there is a range of studies available on how the green transition will affect skills (OECD, 2023[2]; Vona et al., 2018[3]; Kwauk and Casey, 2022[4]) they tend not to be complementary and apply different methods. Policy activity in the area of green skills is often initiated on the ground and is driven, for instance, by forward-looking adult education institutions. At a national level, efforts are often not systematic. Continuously improving and updating the research to generate better evidence will be crucial to make sure that the right skills for the green transition are available where and when they are needed.

Collaboration of all actors is key to foster skills for the green transition

In contrast to the adoption of digital technology and the globalisation of supply chains, which are mostly led by the private sector, many changes related to the green transition are driven by public policy. Governments are key actors in setting long-term objectives and making sure they are complied with. Across the OECD, policy makers will have to ramp up efforts to anticipate and prepare for the changes in the labour market brought about by their environmental policies. They are facing the task of taking a proactive and collaborative approach to generate information on skills needs, which can be used to design evidence-based policies.

In addition to the central role of government, all actors in the skills ecosystem need to take action towards a common goal of facilitating skills development for the green transition. Firms, for instance, can assess changes on their own skills and training needs, and invest in the corresponding training programmes. Adult learning providers play a vital role in offering suitable and targeted training that equips individuals with the right set of skills to support the green transition across sectors. Regional public authorities are well-placed to identify local skills needs, mobilise stakeholder networks, or fund pilot projects on green skills training.

Importantly, collaboration and co-ordination between the government, social partners, and education and training providers is crucial to develop the skills needed for a more sustainable future.

Setting up effective skills assessment and anticipation for the green transition

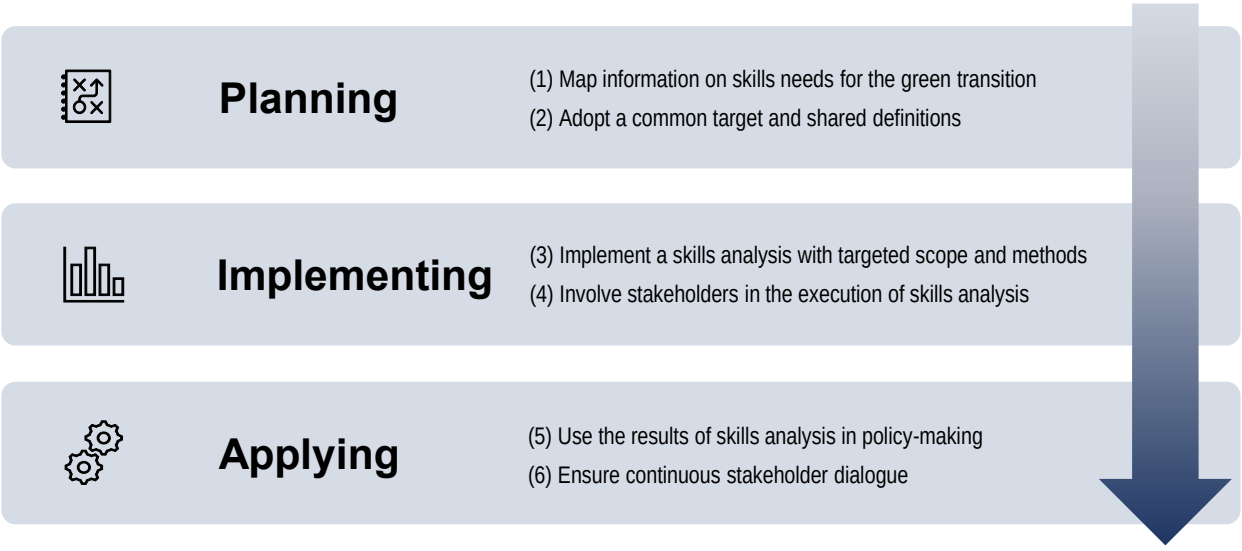
To ensure that workers are equipped with the right skills, policy must be based on solid assessments of skills needs and build on strong links between education and training institutions and firms. The goal of these guidelines is to provide actionable insights for policy makers on how to develop an evidence-base on skills for the green transition and take action to foster these skills.

There is no standard approach to measuring skill needs for the green transition. However, when undertaking an SAA exercise, most decision makers are following the steps outlined in Figure 1.1. The first step is a mapping of available information and the definition of objectives, such as phasing out of emission intensive sectors or emission-based targets. In a second phase, the skills analysis as such is executed to create new, complementary evidence, ideally with a well-defined scope and with the involvement of stakeholders. Lastly, the results generated by the analysis are used in policy making and feed into dialogue with stakeholders and social partners. These steps are developed in the following sections.

One key finding of this publication is the lack of shared international definitions of green skills, tasks and jobs. Rather than focusing only on a relatively small sample of jobs that are in the green economy, the view emerging from desk research and the workshops organised in the context of this report is that policies should focus more broadly on tasks and skills required across different job families as a result of the green transition, and on the consequent imperative to upskill and reskill all adults affected, directly or indirectly, by these changes.

Another important message emerging from the research carried out for this report is that whole-of-economy approaches using mixed methods deliver a good compromise between scalability and actionable insights.

Figure 1.1. Success factors to set up effective skills assessment and anticipation for the green transition



Source: Authors' elaboration.

Phase 1 – Planning

The design of an SAA exercise starts with mapping the existing evidence and deciding on key objectives and terminology. Many crucial decisions are made before the analysis is conducted, so it is important for policy makers and researchers to devote sufficient time to embedding their analysis into the existing landscape of information on skills for the green transition, and how the definitions and policy targets will impact the applicability of its findings.

Map information on skills needs for the green transition

Skills assessment and anticipation exercises are initiated because there is a lack of information on a specific skills or labour issue. As policy making for the green transition is increasingly focusing on skills implications, more and more green SAA exercises are being executed – both by the private and public sector. This contributes to the knowledge creation on skills for the green transition. As the knowledge base expands continuously, researchers can support their SAA exercises by leveraging information already generated. A mapping of existing approaches to assessing and anticipating skills can: 1) provide an overview of the type of skills that have been analysed (e.g. technical skills versus transversal skills), the sectors covered (e.g. industry or whole of economy) and the policy areas that have been explored (e.g. training, migration, employment etc.); 2) shed light on which benchmarks, policy targets and definitions researchers are using when investigating the green transition; and 3) identify relevant stakeholders.

Getting an overview of SAA exercises conducted in the country can be challenging. Few countries have a full mapping of ongoing assessments. This is partly due to the large number of organisations producing skills intelligence, and lack of co-ordination in the field. Several countries have taken action to minimise the information asymmetry. In France, the newly formed General Secretariat for Ecological Planning (*Sécrétariat général de la planification écologique*, SGPE), under the authority of the Prime Minister, will co-ordinate policy planning related to the green transition across government ministries. The Secretariat will build on the mapping of the SAA exercises previously done by the National Observatory of Jobs and Occupations in the Green Economy and will be charged with continuously keeping the list up to date. In Norway, the Committee on Skills Needs has compiled an extensive overview of existing SAA exercises that will contribute to a publicly available evidence base on the green transition. Jobs and Skills Australia are maintaining a public Resource Library under the umbrella of the Clean Energy Capacity Study, which compiles existing research and analysis on the green transition and will be updated throughout the course of the study.

Adopt a common target for skills for the green transition

A plethora of definitions of skills for the green transition and sustainability targets (such as Fit for 55, circular economy, net zero economy etc.) are used internationally. While there is an increase attention paid to labour market policies for the green transition, the field suffers from convoluted definitions and vague objectives, particularly when carrying out skills analysis. The challenge is twofold: on the one hand, researchers and policy makers are struggling with pinning down a definition of skills for the green transition (are they technical skills, knowledge of sustainability, or soft skills?); and, in parallel, definitions tend to vary depending on what the SAA exercise sets as its green target (emission targets, sustainable extraction of raw materials, circularity/recycling of resources, green technology etc.).

Researchers and policy makers point to insufficient guidance from international bodies on green targets and definitions as a challenge when designing and implementing an SAA exercise. Nonetheless, SAA exercises for the green transition can be grouped along some common characteristics.

- SAA exercises featuring quantitative analysis often analyse the labour market impact of several green scenarios, to obtain insights on what scenario might be preferable from the policy maker's perspective.
- A large number of SAA exercises focus on industries or sectors rather than the whole economy, because defining key terms and targets for a narrow industry is often more straightforward. An industry that consumes a lot of energy and therefore needs to become more energy efficient is a simpler concept to pin down compared to the complex and diverse interventions that would be needed to promote sustainability in the whole economy. In addition, there is less diversity in occupations (and skill needs) in one industry compared to the whole economy, making it easier to identify key jobs and skills that need to be targeted.

As the results of approaches to SAA are increasingly being used as an input into policy making, stakeholders in some OECD countries are starting to converge to common targets (often emission-based targets) and definitions at the national level. For example, in Australia, current research is focusing on the 'clean energy transition' in line with the policy priorities of the federal government, while in Austria, several SAA exercises are organised under the Just Transition Plan and have some common targets and definitions. Depending on targets and definitions selected, SAA exercises may focus on industries, occupations or skills as the main unit of analysis.

Phase 2 – Implementing

Policy makers and researchers have to ensure that the SAA exercise is carried out in a manner that produces results which are useful for policy making. Increasing the relevance of the exercise requires careful consideration of both the scope of the analysis and the stakeholders involved.

Use a well-defined scope and sound methodology

What constitutes a "sound" methodology for skills analysis will depend on different factors such as the purpose of the analysis, availability of data, funding and resources, and governance models. However, there are some characteristics that, combined, strengthen the analysis and more useful produce results for policy planning.

The most influential SAA exercises are those designed specifically to focus on the green transition. Often, the green element features as a small part of a broader skill analysis, but this yields too little information on the labour market impact of the green transition to result in any substantial policy change. SAA focused only on the green transition is preferable although it misses out on the potential interactions between the green transition and other drivers of labour market change, such as digitalisation.

Existing 'green' SAA exercises can be divided roughly into two main types: broad analyses intended to create a knowledge base on the topic, and narrow analyses intended to be used for targeted policy making. Both types serve an important role: the broader analyses are often the first generation of studies that kickstart policy thinking around sustainability and the labour market, while targeted studies can provide more disaggregated data to be used in concrete policy planning. Often, what is observed is that policy makers or research institutions will commission wider, whole-of-economy studies that provide an overview of the state of the labour market and the green transition and identify key areas of the economy that can benefit from a more targeted study. Then, a second SAA exercise is carried out, where the scope is tailored to a specific policy objective and can provide more disaggregate and granular information on the skill needs resulting from a specific policy initiative in the context of the green transition.

Of the SAA exercises reviewed, those that used mixed methods were more likely to influence policy. On the one hand, quantitative data allows for the measurement of emerging skill needs by comparing skills across occupations, enabling policy makers to allocate resources for green skills and to regularly update SAA exercises so as to identify trends in green sectors. Quantitative approaches are also easier to scale,

as the same methodology can potentially be applied across sectors, regions and even countries. On the other hand, qualitative data gathering promotes co-operation and support from key institutions and stakeholders, which is crucial during implementation. Qualitative approaches to SAA also take a more holistic approach and allow discussing concepts that are more difficult to quantify, notably they allow for a discussion that is directly focused on skills as opposed to estimating needs in terms of occupations or qualifications. By combining quantitative and qualitative approaches, SAA exercises can have a stronger impact on policy making, stakeholder co-ordination, resource allocation, and efficient service delivery for green transition initiatives.

Skills assessments and anticipation should be ongoing and regularly updated to capture changes in skill needs and the progress of the green transition. This ensures that policies remain relevant and aligned with current demands and challenges. Moreover, validating findings is a necessary step in producing high-quality SAA. Good practices include discussing the findings with external experts during workshops, focus groups or other expert meetings, to ensure that the results, and the assumptions they are based on, are considered plausible before they are published.

Ensure stakeholder involvement in the execution of the SAA exercise

Ensuring stakeholder engagement when carrying out skills assessment and anticipation exercises is crucial for every policy phase, but particularly during the implementation of SAA exercises. While involving stakeholders during the planning phase is a well-established practice and brings together different types of decision makers to find common solutions, it is often not sufficient to convince stakeholders of the validity of the findings. Stakeholders might not be aware of, or not agree with the methodology used in the particular approach to SAA and thus hesitant to use the results. They are also in a good position to contribute to SAA exercises with crucial information and data. As a result, it is key to involve stakeholders even when carrying out SAA.

There are several steps both policy makers and institutions commissioning SAA exercises can undertake to promote stakeholder engagement. Stakeholders can be involved throughout the analysis and validate results to confirm findings and steer the SAA exercise in a useful direction. Stakeholders can serve as industry experts for technical interviews, or test results within their organisations. In Norway, the Commission on Skills Needs assembled a research group comprising representatives of the government, employers' organisations, trade unions, and researchers in various fields that together carried out a SAA exercise for the green transition. The report included a wide range of topics and used many different types of data, enabled by the involvement of a variety of stakeholders. Institutions can also create multi-stakeholder platforms or task forces comprised of representatives from various stakeholder groups, for instance government officials, employer and employee groups, education and training institutions, industry associations, trade unions, and civil society organisations. These platforms provide a forum for dialogue, collaboration, and decision-making on SAA exercises for the green transition, as well as ensuring that each stakeholder understands the skills intelligence produced to better tailor their services and aid all the key actors in the green transition. In Sweden, the Talent 25 000 Council (T25) is a platform comprising industry representatives from the biggest employers in the battery and steel industry in the region, a technical university, and a recruitment and relocation company. The Swedish Public Employment Service (PES) co-operates with T25 and other stakeholders (employers, regions, and municipalities), and as a result has one of the most diverse range of policies and initiatives to tackle the employment needs of the region. Their success is in large part related to the diversity of actors that collaborate to increase employment and skills for the green transition.

Phase 3 – Applying

Once countries have generated evidence on skills changes linked to the green transition, this evidence should feed into stakeholder dialogue and feed into the design and update of policies on skills. Many actors, within and outside government, stand to benefit from the output of SAA exercises.

Using SAA results in policy making

In terms of areas of use, results of SAA exercises on skills for the green transition can potentially inform policy in a range of different areas, including adult training, formal education, career guidance, employment policies, industrial policies and migration policies. Nowadays, general SAA information is already used in these fields, for example, to design training incentives for workers, improve career guidance services, or update occupational standards. In the future, evidence on skills for the green transition can be used more strategically to prepare for expected changes in these areas.

While national-level policies stand to benefit from up-to-date information on skill needs, policy making on skills for the green transition has an important local element, also due to the unequal impact of the green transition across regions. Regional and local actors are well placed to act in a very targeted way to facilitate the green transition. In the area of skills, it is thus crucial that they have access to information on changing skill demand and supply, and that this information is sufficiently disaggregated. Local governments and public authorities, vocational training providers and educational institutions, businesses and community organisations are therefore essential to translate the findings of SAA exercises into concrete application and facilitate the right skills supply for more sustainable local economies.

Ensuring that SAA results are well known to all relevant actors can be achieved by making reports publicly available, sharing their results through online platforms or feeding them into existing labour market information systems to reach decision makers, employment or education professionals, and individuals themselves. The dissemination of SAA results to a wider public is well established in Finland, for example, where the PES runs a web-based system called ForeAmmatti. It provides comprehensive and up-to-date labour market information system that can be used by anyone to better understand regional labour markets, available training, competences required for different jobs, and labour market forecasts.

Ensure stakeholder dialogue

Stakeholder involvement is important for conducting an SAA exercise. It matters even more when putting its findings into practice. SAA provides a common language and shared concepts to address potential skills gaps and may also help to identify policy priorities at a national, regional or local level. Evidence generated through SAA exercises can be most impactful if it feeds into a dialogue with all actors in the skills ecosystem, including government agencies, businesses, training institutions, or civil society organisations. Social dialogue and stakeholder engagement, which in some countries already has a long tradition, helps to align efforts and foster collaboration when implementing evidence-based policies. It may also ensure that relevant initiatives are identified, supported, and well-co-ordinated across different sectors and organisations.

Ongoing exchanges with stakeholders provide an opportunity to understand different perspectives, and to identify potential for action. Stakeholders bring unique insights and experiences to the table, which can help to design tailored solutions on the basis of a common evidence basis. By incorporating the results of SAA exercises, stakeholders can collectively develop comprehensive strategies that unlock the skills potential needed for a greener economy. Actively taking part in a collective effort will foster trust and ownership among actors in the skills ecosystem. This ownership may translate into greater acceptance, commitment, and impact of policy action. For example, the PES in Sweden is relying on information from a SAA exercise that assesses the skills impact of a large expansion of sustainable energy companies in the north of the country. On the basis of the evidence that is widely disseminated, the PES co-operates with VET institutions, private firms, local and regional government institutions.

The way forward: A country-level roadmap

All of the countries covered in this report have taken steps to measure how skill needs linked to the green transition are changing. They face similar challenges such as a lack of support, co-ordination and political will, although these challenges have been manifested in different ways. Some countries, such as Australia and France, have more experience conducting skills assessment and anticipation but have not yet seen all results translated into policy response. Others, such as Norway and Sweden, have only recently embarked on exploring skills-related topics for the green transition, but have not yet pushed the policy issue forward enough to see large changes. Austria, which is in the very beginning stage of green-related policy making, can learn much from the experience of its peers in setting up a system for assessing and anticipating skills for the green transition. The following boxes provide an overview of the specificities of each country's SAA exercises along with some priorities for further development.

Australia

Australia has taken several steps in establishing a system for assessing and anticipating skills for the green transition. The push for evidence-based skills policies is supported by the federal government's commitment to reach net-zero by 2050, and the Powering Australia plan which focuses on creating jobs, cutting power bills and reducing emissions by boosting renewable energy. This has sparked public debate, and initiatives to measure labour market changes can be found at both federal and state levels. The most notable exercise, the Clean Energy Capacity Study conducted by Jobs and Skills Australia, is starting to influence policy making. In addition, Jobs and Skills Australia has well-established collaboration with other institutions and existing pathways to use skills-level data in policy making which can be leveraged also when focusing on the green transition. However, translating information on skills changes related to the green transition into policies is still at an early stage in Australia.

Australia could do more to bring employers onboard in planning for the green transition. Though there are a few SAA exercises conducted by private companies and industry-bodies, these have not translated into action. Involving employers in large-scale SAA exercises through tripartite networks would strengthen the work on the green transition not only by pooling together knowledge from all the parts of the labour market, but also by bringing onboard different stakeholders and directly communicating with groups that will have to implement and adjust to the new policies.

Australia should analyse existing evidence to get an overview of what is known on changing skill demands linked to the green transition. Australia has the most SAA exercises of the countries featured in the report, and Jobs and Skills Australia has created a resource library of existing SAA exercises for the green transition. The next step should be to analyse this wealth of information to identify useful information for policy making and key gaps in knowledge on skills for the green transition.

Austria

Compared to the other countries reviewed in this report, Austria has fewer approaches to assess and anticipate skills for the green transition. The implementation of existing SAA exercises has mostly been outsourced to external research centres. While the information generated was validated and discussed in the context of the Just Transition Action Plan in Austria, there seems to be a lack of established mechanisms to feed evidence on green skills back into policy making. At the time of writing, the use of the existing evidence for adult training, career guidance, or employment policies was rare. In two out of three SAA exercises examined for this review, the focus of analysis was industries rather than skills, with a particular focus on renewable energy sectors. A few innovative policy initiatives on fostering skills for the green transition have been started, such as the Environment Foundation (*Umweltstiftung*) or the regional Climate Protection Training Centre (*Klimaschutz Ausbildungszentrum*) in lower Austria, which can provide important lessons to build on in the future.

Austria could do more to understand and prepare for the skill implications of the green transition. SAA can help to understand skills gaps and support the Just Transition process. While most existing studies in Austria focus on certain industries, SAA exercises with a more specific skill focus, and with results differentiated by region, would be valuable.

The tradition of social dialogue in Austria can be leveraged to share knowledge and build collaborations. Austria could build on developed systems of policy co-operation between the government, employers', and workers' interest groups to better disseminate existing evidence on changing skill needs for the green transition. Social partnership would also facilitate collaboration at a local level and help strengthen and scale up approaches to develop relevant skills for the green transition.

France

France has undertaken a range of studies on skills needs related to the green transition, with different methods and approaches. SAA exercises are conducted by a broad range of actors, including NGOs, government ministries and agencies, research institutions, or private companies. Mostly, their focus lies on forecasting the occupational impact of the green transition. Existing studies rely on very diverse assumptions, meaning that they are often not consistent and difficult to compare. The creation of the National Observatory for Employment and Occupations in the Green Economy (*Observatoire national des emplois et des métiers de l'économie verte,* Onemev) in 2020 has brought momentum to the policy agenda. Its responsibility is to produce, collect and disseminate evidence on employment and skills changes linked to the green transition. The *Observatoire* acts as valuable central unit that generates trustworthy information and at the same time collaborates with relevant stakeholders for the green transition, including adult training institutions.

France could make existing evidence on skill needs for the green transition more visible. While many studies on the impact of the green transition on the French labour market have been undertaken, their use in policy making remains relatively limited. More efforts could be made to disaggregate and communicate findings of SAA exercises for the different regions in France in order to make them more practicable for local decision makers and stakeholders in the skills ecosystem.

More emphasis should be placed on the skills implications of the green transition. While many programmes are focused on the green economy, policy action based on evidence about changing skills needs is yet scarce. Focusing on skills changes and requirements linked to the green transition would involve actors in the French skills ecosystem more fully to ensure a close link between employment and training policy.

Norway

Skills intelligence for the green transition is relatively recent in Norway. In the past few years, the 'green' dimension has featured as a part of larger, more general SAA exercises, such as those conducted by the Committee for Skills Needs and the largest employer organisation, the NHO. Efforts to perform more comprehensive assessments had been made by the Federation of Norwegian Enterprise (Virke), but the most substantial analysis came in mid-2023 in the form of a report on the future skills needs of the green transition, developed by the Norwegian Committee for Skills Needs. The report featured comprehensive analysis on online job vacancies and new training programmes. However, due to the relatively recent developments in the field, no major skills initiatives or programmes on the green transition have been implemented so far.

Norway could give greater visibility of the new report on skills needs for the green transition by the Committee of Skills Needs to ensure the results are used in policy making. Further efforts are required by public bodies to develop information systems that disseminate skills and employment-level information generated by SAA exercises. This has the potential to facilitate their use in policy making.

Employer and employee associations should create and adjust existing policies on training and career guidance to reflect the changes in the labour market brought forward by the green transition. Associations in Norway are strategically positioned to build capacity and support employers in adapting to the green transition and ensure their employees are keeping up with changing skill needs through investment in training.

Sweden

Sweden has only very recently turned their attention to the labour market needs of the green transition but has made good progress since. Much of the research has been industry-driven or led by private research organisations. The Swedish Innovation Agency, Vinnova, is emerging as the public body with the most extensive overview of developments in the field. The public employment services in northern Sweden are collaborating with industry players as well as education and training institutions to respond to the impending labour shortages generated by the greening of the battery and steel industry, and have initiated a number of skills and employment-related programmes. By contrast, in other parts of the country, the public employment service does not devote yet significant attention to skills for the green transition.

The Public Employment Service in Sweden should include analysis of the green transition to their existing portfolio of SAA exercises. There needs to be more attention from public bodies on skills for the green transition, and more awareness-raising on the wider labour market impact of moving towards a cleaner economy. Thus far, the public employment service has focused on changes in skills needs related to electrification, batteries, and mining, and there is not sufficient understanding of how the green transition will impact other jobs and industries. Taking a skills approach to analyse labour market developments will help to unlock the information for a wider range of occupations and sectors.

Sweden should improve the co-ordination of work on skills for the green transition. There are currently many actors that have started analysing skills needs and designing small-scale policies to promote the green transition; however, many initiatives suffer from lack of institutional support which undermines the opportunities for scaling up. A central body should help co-ordinate different efforts and ensure information exchange and capacity building among key stakeholders.

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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.

3 Defining targets and scope of analysis for the green transition

Approaches to measure skill changes linked to the greening of the economy differ in scope and the targets they apply. This chapter reviews different targets, for instance, ‘clean economy’, ‘decarbonisation’, or ‘renewable energy’. It distinguishes approaches based on their unit of analysis (industries, occupations, or skills), their focus on current and future skills, and coverage of national or regional labour markets. The chapter also presents different types of governance models of skills assessment and anticipation exercises.

Introduction

In the context of SAA exercises for the green transition, definitions of green policy targets and relevant skills, jobs and sectors are often crucial to qualify the scope of analysis and the results. The previous chapter discusses these definitions more broadly, while this chapter maps out how they are used in SAA exercises run by the countries covered in the report.

Table 3.1 summarises the use of green targets in SAA exercises and national green strategies. Many of these concepts are closely related – for example, countries that define decarbonisation also explicitly define renewable energy. With the exception of the O*NET green economy developed by the US Department of Labor and adopted by Australia, the definitions provided in Table 3.1 are those put forward by international co-operation institutions – such as the United Nations Climate Change Conference and European Union – and adopted, to different extents, in the SAA exercises reviewed in this report. There is no one green target that is dominant in the exercises reviewed.

Table 3.1. Green targets adopted by SAA exercises

	Australia	Austria	France	Norway	Sweden
Circular Economy *Definition: An economic model that incentivises reusing existing products and materials in favour of extracting new resources*					✓
Clean economy *Definition: Similar to net zero economy, but typically used for the energy sector*	✓				
Decarbonisation *Definition: Removal or reduction of carbon dioxide (CO_2) output in the atmosphere*	✓		✓		✓
Low-carbon economy *Definition: Economy based on energy sources that produce low levels of greenhouse gas emissions*			✓		
Net zero economy *Definition: Close to zero balance between amount of greenhouse gas produced and amount removed from the atmosphere*	✓		✓		✓
O*NET green economy *Definition: the economic activity related to reducing the use of fossil fuels, decreasing pollution and greenhouse gas emissions, increasing the efficiency of energy usage, recycling materials, and developing and adopting renewable sources of energy*	✓				
Renewable energy *Definition: Energy from a source that is not depleted when used, such as wind or solar power*	✓	✓	✓		✓
Green transition *Definition: Activities that contribute to reducing the climate and environmental footprint of individuals, business and the society as a whole, to achieve a low-emission society while maintaining biodiversity*				✓	

Note: The O*NET green economy definition was used by Australia for research purposes only, and it has not been officially adopted by the Australian Government.
Source: Authors' elaboration based on desk research and policy questionnaires.

The importance of definitions

The results of the SAA exercises are often reported in terms of industries, and less often quantified in terms of occupations or skills (Table 3.2). SAA exercises that focus on industry, such as Infrastructure Australia or the EDEC in France, still report the results in either net employment, an overview of key occupations or identify a few key skills within the industries reviewed. Other SAA exercises, such as those conducted by the ADEME in France report findings in terms of occupations, regardless of industry, identifying direct green jobs as "jobs with direct production activities to the green economy", indirect jobs as "the activities of suppliers of goods and services linked to the direct production activities", and induced jobs as "job relating to the interactions of the green sector with the rest of the economy" (Ecological Transition Agency (ADEME), 2018[1]). In the analysis on job vacancy data, the Norwegian Committee on Skill Needs identifies green jobs through a big data approach – i.e. identifies green-related keywords (such as "sustainable", "climate", or "renewable") and calculates the share of these postings with green words by industries, occupations, sectors, and counties (Kompetansebehovsutvalget, 2023[2]).

Only four of the SAA exercises reviewed focused mainly on skills. Of those, two SAA exercises identified key skills for the green transition through qualitative methods, while Jobs and Skills Australia and the National Observatory for Jobs and Occupations in the Green Economy use quantitative methods to create a taxonomy of skills for the green transition. There is an additional challenge in defining skills, particularly skills for the green transition, as there is no one commonly accepted taxonomy. It should be noted, however, that most SAA exercises covered feature a discussion of the crossover between skill demands and the green transition, and thereby include an effort to disentangle the understanding of what is a green skill, without necessarily using skills as a unit of measurement. In fact, most SAA exercises feature an analysis at an industry or occupational level with an adjacent qualitative discussion on the skills needs emerging from the green transition.

Table 3.2. Unit of analysis in skills assessment and anticipation exercises

Industries	Occupations	Skills
●●●●●●●●●●●●	●●●●	●●●●

Note: Circles represent individual skills assessment and anticipation exercises. ● Australia, ● Austria, ● France, ● Norway, ● Sweden.
Source: Authors' elaboration based on desk research and policy questionnaires.

In most SAA exercises that use skills as the main unit of analysis, skills for the green transition are identified only once the analysis defines green and green adjacent occupations, after which a skills taxonomy is applied to identify which skills are present in green jobs (Table 3.3). It is through this analysis that the SAA exercises are able to make inference on which skills are necessary to boost the green transition. Jobs and Skills Australia apply a country-specific skills taxonomy to data on green jobs to define green skills, while Deloitte makes use of the O*NET taxonomy. The Austrian Energy Agency defined skills through occupations by identifying skills within green occupations and defining skills as key abilities that fit into one of three categories: technical knowledge, know-how, and system knowledge. Some SAA exercises that have a unit of analysis other than skills still have attempted to define them in order to make general statements about the skills needs for the green transition. In one of the SAA exercises conducted by Virke on the circular economy in Norway, green skills are not only knowledge of environmentally friendly materials or recycling, but also transversal skills such as change management, strategic planning, flexibility, system and risk analysis and innovation. The Victorian Skills Authority in Australia defines green skills as "skills needed to support clean economy ambitions, including for new roles expected to support adaption and mitigation", while the Austrian Just Transition Action Plan defines green skills as "skills necessary to i) facilitate a shift from fossil energy sources to renewable energy and more energy efficiency, and ii) install renewable and efficiency equipment".

Table 3.3. Selected definition of skills for the green transition

For countries with a skill-unit analysis

Country	Institution	Source
Australia	Jobs and Skills Australia (JSA)	Define skills for the green transition by identifying the skills associated with clean energy through the Australian Skills Classification (ASC). Clean energy workforce defined as: *"…workers involved in developing, generating, storing, transmitting and distributing energy generated from renewable, net-zero emission sources "clean energy supply"; and installing and maintaining the technology that uses clean energy rather than fuels "clean energy use"".*
	Deloitte	O*NET green categories of skills used. Coupled with data on jobs affected by decarbonisation to define three key concepts: i) Induced demand clean economy jobs (decarbonisation affects demand but not skill requirements). ii) Evolving clean economy jobs (decarbonisation affects the demand and the skills of existing occupations. iii) Emerging clean jobs (jobs that will emerge out of decarbonisation activity).
Austria	Austrian Energy Agency	No general definition of green skills used. Examines the future skills needed in 10 qualifications with high relevance for the green transition in the areas of construction, renovation, and renewable energy (Tretter et al., 2022[3]).
France	National Observatory for Jobs and Occupations in the Green Economy	Green skills are identified and defined through the ROME 4.0 model of the public employment service. The ROME model identifies green skills through measuring of skills in vacancies and job applications based on the following definition of green jobs: i) Green jobs: Occupations whose purpose and/or skills implemented contribute to measuring, preventing, controlling, and correcting negative impacts and damage to the environment. ii) Greening jobs: Occupations whose purpose is not environmental but which integrates new fields of green competencies and use eco-gesture in a significant and quantifiable way.

Source: Authors' elaboration based on policy questionnaires.

Global insights

Green jobs and green skills definition in other SAA exercises

Canada

In order to define green jobs and skills, Canada's Future Skills Centre (FSC) first established which industries can be considered green (and are therefore part of the "clean economy"). The FSC's definition of green industries aims to capture the majority of clean economic activities – i.e. clean energy production, energy efficiency, and environmental management. Within these clean economy sectors, FCS identified the relative importance of any given occupation to each sector compared with the overall economy exploiting the so-called concentration quotient (CQ) method.[1] The occupations with CQ values greater than 1 – i.e. occupations that account for a larger employment share in green industries than in the economy overall – are considered green. Green skills are the set of skills used in these green occupations (Conference Board of Canada; Future Skills Centre, 2022[4]).

United Kingdom

The Green Jobs Taskforce (GJT) of the United Kingdom identified green jobs as employment in an activity that directly contributes to – or indirectly supports – the achievement of net zero emissions targets and other environmental goals. To support the practical task of reviewing evidence, and developing recommendations, the GJT initially focused only on jobs in specific green sectors where change will be crucial to meet the net zero target (power, business and industry, homes and buildings,

transport, natural resources, enabling decarbonisation, climate adaptation). Then, it identified the most affected occupations and the required skills according to net zero policy and investment within these sectors. According to Office for National Statistics (ONS) (2021[5]), the advantage of a sectoral approach is that, if necessary, the definition can be made very simple (like "all jobs in the renewable energy sector") as well as it can be easier to find the data required.

United States

Green jobs are defined by the Bureau of Labor and Statistics (BLS) as either: 1) jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources; 2) jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources. BLS undertook separate data collection activities for each component. Firstly, they conducted a "Green Goods and Services survey" to identify whether firms produce green goods and services. They also measured the number of associated jobs in each enterprise, and estimate the occupational employment and wages for those firms identified as producing green goods and services. Secondly, BLS developed a special employer survey on jobs associated with the use of environmentally friendly production processes. Results of their analysis show that green jobs are mostly found in the following sectors: energy from renewable sources, energy efficiency, pollution reduction and removal, greenhouse gas reduction, recycling and reuse, and natural resources conservation (Bureau of Labor Statistics, 2022[6]).

O*NET – an occupational classification database developed under the sponsorship of the Department of Labor in the United States – provides an alternative definition to identify green jobs. O*NET includes three occupational categories, which are expected to change or emerge in each green economy sector: (1) *Green Increased Demand*: the impact of green economy activities and technologies is an increase in the employment demand for an existing occupation, although this impact does not entail significant changes in the work and worker requirements of the occupation; (2) *Green Enhanced Skills*: the impact of green economy activities and technologies results in a significant change to the work and worker requirements of an existing occupation; the essential purposes of the occupation remain the same, but tasks, skills, knowledge, and external elements, such as credentials, have been altered; (3) *Green New and Emerging*: the impact of green economy activities and technologies is sufficient to create the need for unique work and worker requirements, which results in the generation of a new occupation relative to the O*NET taxonomy. Consequently, 215 'Green occupations' has been identified from 12 'Green Sectors', corresponding to these 3 categories, and 1 369 green tasks were identified within green occupations (National Center for O*NET Development, 2022[7]).

European Union

The European Centre for the Development of Vocational Training (Cedefop) defined green skills as the knowledge, abilities, values and attitudes needed to live in, develop and support a society which reduces the impact of human activity on the environment, and classified skills and knowledge concepts as three groups, brown, white, and green jobs (Cedefop, 2012[8]), The definition is applied to big data on job vacancies to separate green skills and knowledge.

Different scope for different initiatives

The scope of the exercises covered in this report varies both within and across countries, thereby leading to very different methods, data, and techniques utilised. In particular, the scope of the SAA exercise is influenced by the issue the exercise seeks to address. For example, the approach to SAA by the Confederation of Swedish Enterprises aims to examine how skill needs are affected by the adjustments that businesses are forced to make due to the green transition, and therefore focuses only on a specific sector and on anticipating future skills needs rather than estimating current ones. The following section highlights the different scope of the exercises covered and discusses: (1) whether SAA exercises for the green transition aim at assessing current skill needs, anticipating future ones, or a combination of both; (2) whether the SAA results, data and background material are publicly disseminated or are kept confidential for governmental purposes only; and (3) whether the exercises focus on a single economic sector/industry or on the whole labour market.

The time horizon of SAA exercises

Whether SAA for the green transition focuses on assessing current skill needs, anticipating future ones or a combination of both depends on the objective of the exercise (Table 3.4). Current skills assessments are aimed at identifying existing mismatches and shortages in the labour market. Vinnova assesses current skill needs without including an analysis of potential future developments. This is because, the objective set for Vinnova by the Swedish Government is to measure skill shortages of relevance to the green transition (Vinnova, 2022[9]). The SAA exercise carried out by the National Observatory for Jobs and Occupations in the Green Economy in France also aims at identifying only current mismatches and labour market needs (Ministry of Ecology, Energy and Territories, 2021[10]).

Forecasts and foresight exercises covering future employment and skill needs are made to produce, respectively precise or broad indications of future trends. Most of the selected SAA exercises in Australia focus on future skill needs (Deloitte Access Economics, 2021[11]; Centre for Policy Development, 2022[12]; RACE for 2030, 2021[13]; Victorian State Government, 2022[14]; Victorian State Government, 2022[15]) but some assess a mix of current and future skill needs. Anticipation exercises can be further categorised based on their time horizon. Broadly speaking, there are short- (six months-two years), medium- (two to five years), and long-term (more than five years) anticipation exercises (OECD, 2016[16]). Among the exercises covered by this study, short-term anticipations are less common compared to medium- and long-term ones. Occupational forecasts made by the Swedish PES anticipate labour demand within specific occupations with a timeframe of one to five years. In Australia, both Deloitte and Race for 2030 anticipate future skill needs over the next five years, with additional forecasts until 2030 or even 2050 (Deloitte Access Economics, 2021[11]; RACE for 2030, 2021[13]). Jobs and Skills Australia's Clean Energy Capacity Study will also produce supply and demand estimates over 10, 20 and 30 years. All other quantitative and qualitative anticipation exercises in Australia have a long-run horizon, focusing on the next 10 to 30 years. This is related to the fact that these exercises are linked to Australia's climate goals of reaching an emission reduction of 45% by 2030 and Net Zero by 2050. GWS and WIFO in Austria also anticipate future skill needs until 2030, linked to climate goals (Großmann et al., 2020[17]; Meinhart et al., 2022[18]).

The advantage of conducting anticipation exercises with shorter time horizons is that they provide more accurate results than longer term exercises. On the downside, the short time span means that they can only provide insights to short-term policy making, e.g. they can inform training provision for those currently unemployed but they are not useful to provide directions for initial education that only fosters skill development for several years down the line. Furthermore, the short- and medium-term anticipation exercises might not differ significantly from the those focusing on assessing current needs. Long-term anticipation exercises, on the other hand, have the advantage that they are useful for longer-term planning and can guide countries when making more structural planning for the labour market and education and training systems. However, longer term forecasts tend to be sensitive to unforeseen structural changes. They also require up-to-date inputs to remain relevant, but they are often updated less often than medium-

term exercises (OECD, 2016[16]). One way to take into account uncertainty is to use scenarios and identify a number of possible outlooks (see the following section).

Combining the approaches of assessing current and future skill needs can be seen in the exercise conducted by NHO in Norway, which asks member companies to estimate how their skill needs will change due to the green transition compared to their current skill needs. The estimations are made according to educational level and subject domains. JSA in Australia is also undertaking a Clean Energy Capacity Study that will include forecasts of future supply and demand for clean energy related roles. The study will provide critical evidence and insights to support workforce planning, policy development and programme design needed to build a strong and vibrant clean energy sector. The Australian New Energy Skills Program is also likely to combine assessing and anticipating current and future skill needs. The programme focuses on increasing the supply of skills that are included in the National Skills Commission's Skills Priority List, which provides a rating of both current and future skill demand in the labour market (National Skills Commission, 2022[19]). The Australian New Energy Apprenticeships Program seeks to encourage apprentices to train in clean energy occupations and qualifications through direct incentive payments to assist with the cost of living. Jobs and Skills Australia's analysis of Australia's clean energy workforce needs will inform the development of refinements to the New Energy Apprenticeships Program, as necessary. Another Australian SAA exercise included in this study that combine current and future skill needs is the one conducted by Infrastructure Australia (Infrastructure Australia, 2021[20]).

Table 3.4. Analysis timeframe in SAA exercises covered by the study

Country	Institution	Current Skills	Future Skills	Current & Future Skills
Australia	Federal Government			
	Jobs and Skills Australia (JSA)			●
	Infrastructure Australia			●
	Department of Employment and Workplace Relations (DEWR)			●
	State Government			
	Victorian State Government		●	
	Independent			
	Deloitte		●	
	RACE for 2030		●	
Austria	GWS		●	
	Just Transition Action Plan			
	Austrian Energy Agency		●	
	WIFO		●	
France	National Observatory for Jobs and Occupations in the Green Economy	●		
	Skill Forecast: Occupations in 2030			●
	EDEC			●
	ADEME			●
	The Shift Project			●
	Scénario négeWatt			●
Norway	Norwegian Committee on Skill Needs			●
	Virke – Circular Economy		●	
	Virke – Virkebarometer			●
	NHO – Skill barometer			●
Sweden	Public Employment Service		●	
	Vinnova	●		
	Confederation of Swedish Enterprises		●	

Source: Authors' elaboration based on policy questionnaires.

Public availability of SAA material

Sharing findings and data from the SAA exercises with the wider public can be beneficial to all: to the institutions carrying out the SAA exercises (direct impact), because sharing facilitates new strategic partnerships and build synergies between institutions who develop similar or complementary exercises; for the data users (indirect impact), who can access data more easily; and for the broader economy (induced impact), since the findings can be used to implement evidence based policy-decisions that go beyond the initial intended use.

In particular, data sharing between private and public actors has several potential benefits, including: i) enhanced transparency, accountability, and empowerment of users, ii) increased business opportunities, iii) user-driven innovation and crowdsourcing, iv) improved co-operation and competition both within and across sectors, and v) increased efficiency (OECD, 2019[21]). Moreover, sharing data can also yield beneficial spill-overs effects, insights, and new areas of use that could not be foreseen by those developing the initial data plan design.

Most of the SAA exercises examined by this study are publicly available, with only a few exceptions. In France, for example, all exercises are publicly available. The results of the EDEC are published as studies by the organisations conducting them and can be found through the EDCD's data base. The National Observatory for Jobs and Occupations in the Green Economy publishes their key figures on employment and green economy on their webpage but the results for the list of green skills and continuing education are not available yet. Furthermore, the results of the exercise conducted by France Stratégie and Dares are also published online. In Norway, the studies by the Norwegian Committee on Skill Needs, NHO, and Virke are publicly available. Both of Virke's reports covered in this Note are free upon request on the employer organisation's webpage but there are other reports that are regulated by a paywall. NHO publishes their survey's yearly results in extensive reports produced by the Nordic Institute for Studies in Innovation, Research and Education which are all available on their webpage. The Committee on Skill Needs has a designated webpage where they continuously publish their work. In Sweden, all material produced by a governmental body is regulated under the principle of public access to information. This means that all official documents produced by the PES and Vinnova must be available to the public. Reports as well as materials that are used to conduct the SAA exercises can be accessed digitally and manually through the various governmental channels. The PES also shares their progress orally with stakeholders by participating in workshops (Swedish Public Employment Service, 2022[22]).

The only exercise that is not (or will not be) publicly available is the New Energy Skills and Training Gap Analysis in Australia (Victorian State Government, 2022[14]). The findings of this exercise remain fully internal and no part of the report can be accessed by the public. On the other hand, the remaining SAA exercises from Australia are available to the public or will be when they are finalised.

The coverage of SAA exercises

SAA exercises can differ in their geographical coverage which can be either national or regional.[2] National exercises use aggregated data to assess and anticipate skill needs and are used to guide broad policy decisions that span over multiple sectors and labour markets. By contrast, the regional coverage uses a more disaggregated level of data and can identify within-country variation. National and regional approaches are not mutually exclusive and can be used in the same SAA study.

Furthermore, the national and regional coverage can be divided into either a whole-of-economy approach or a sectoral approach. Sectoral approaches focus on skills that are needed in a specific industry while the whole-of-economy approaches are conducted across industries. The Skills Committee of Norway is an example of an SAA exercise that has a national coverage and a whole-of-economy approach. As part of the Just Transition Action Plan in Austria, WIFO conducted an SAA exercise that combines the national, regional and sectoral approach. WIFO analysed the impact of CO2 reduction policies on employment at the national level, and break this down by 20 sectors and 19 regions (Meinhart et al., 2022[18]). In Sweden there are two exercises that have overlapping approaches: the exercise by Vinnova and the PES. Both

exercises focus on skill needs within the industry sector but the SAA exercise by PES is regional while the approach by Vinnova is national. Most of Australia's exercises included in this report are conducted at the national level, the state level and/or regions within one particular state (e.g. (Deloitte Access Economics, 2021[11]; Victorian State Government, 2022[14]; Victorian State Government, 2022[15])). All the SAA exercises covered in this study have been compiled in Table 3.5 to get a better overview of their coverage.

Table 3.5. The coverage of the SAA exercises in the study

	National	Regional	National & Regional
Whole-of-Economy		● ●	●
Industry/Sector	● ● ● ● ● ● ● ● ●	● ● ●	● ● ● ● ●
Whole-of-Economy & Industry/sector	● ●		● ● ● ● ● ●

Note: Circles represent individual skills assessment and anticipation exercises. ● Australia, ● Austria, ● France, ● Norway, ● Sweden.
Source: Authors' elaboration based on policy questionnaires.

Global insights

Whole-of-Economy & Sectoral approach: FSC (Canada)

In 2022, the Future Skills Centre in Canada (FSC) conducted an SAA exercise looking at how labour and skills demands would be affected if Canada was to meet a decarbonisation target. The focus was on both whole-of economy implications and impacts by sector. In particular, using a macroeconomic analysis model called *gTech,*[3] the FSC anticipated changes in employment and wage rates in all sectors of the Canadian economy according to three different decarbonisation scenarios.[4] Assuming stable employment shares of occupational groups by sector, based on data from the 2019 Labour Force Survey, the changes in employment by sector were then converted into changes in employment by occupation. Subsequently, skills with high importance and frequency in those occupations were identified and scored by linking the information with the O*NET database. Through this scoring work, the skill needs for each green occupation were identified.

Another notable feature of the Canadian example is that, in parallel to a nation-wide analysis, FSC also developed a more disaggregated, regional study, concentrating on the four provinces with the largest labour markets in Canada, namely, Ontario, Alberta, British Columbia, and Quebec. This regional investigation assessed which sectors in each region would be impacted more than others and offered recommendations on local-level efforts to prepare their respective workforces to the green transition (Future Skills Centre, 2022[23]).

Sectoral approach: UWV (The Netherlands)

In the Netherlands, the *Uitvoeringsinstituut Werknemersverzekeringen* (UWV) – the public employment agency – in co-operation with *Sociaal Economische Raad* (SER) – an advising body for the Dutch Government and Parliament on social and economic policy – conducts an SAA exercise focusing specifically on the construction and building fields in order to help the sector smoothly adapt to the green transition. In particular, the exercise forecasts the occupations and skills in the construction industry that are expected to expand and contract following a net-zero policy. Unlike most SAA exercises focusing on the whole economy, the UWV project has the advantage of providing more detailed estimates, such as the jobs that are needed compared to the number of current vacancies in the sector (Employment Insurance Agency (UWV), 2022[24]).

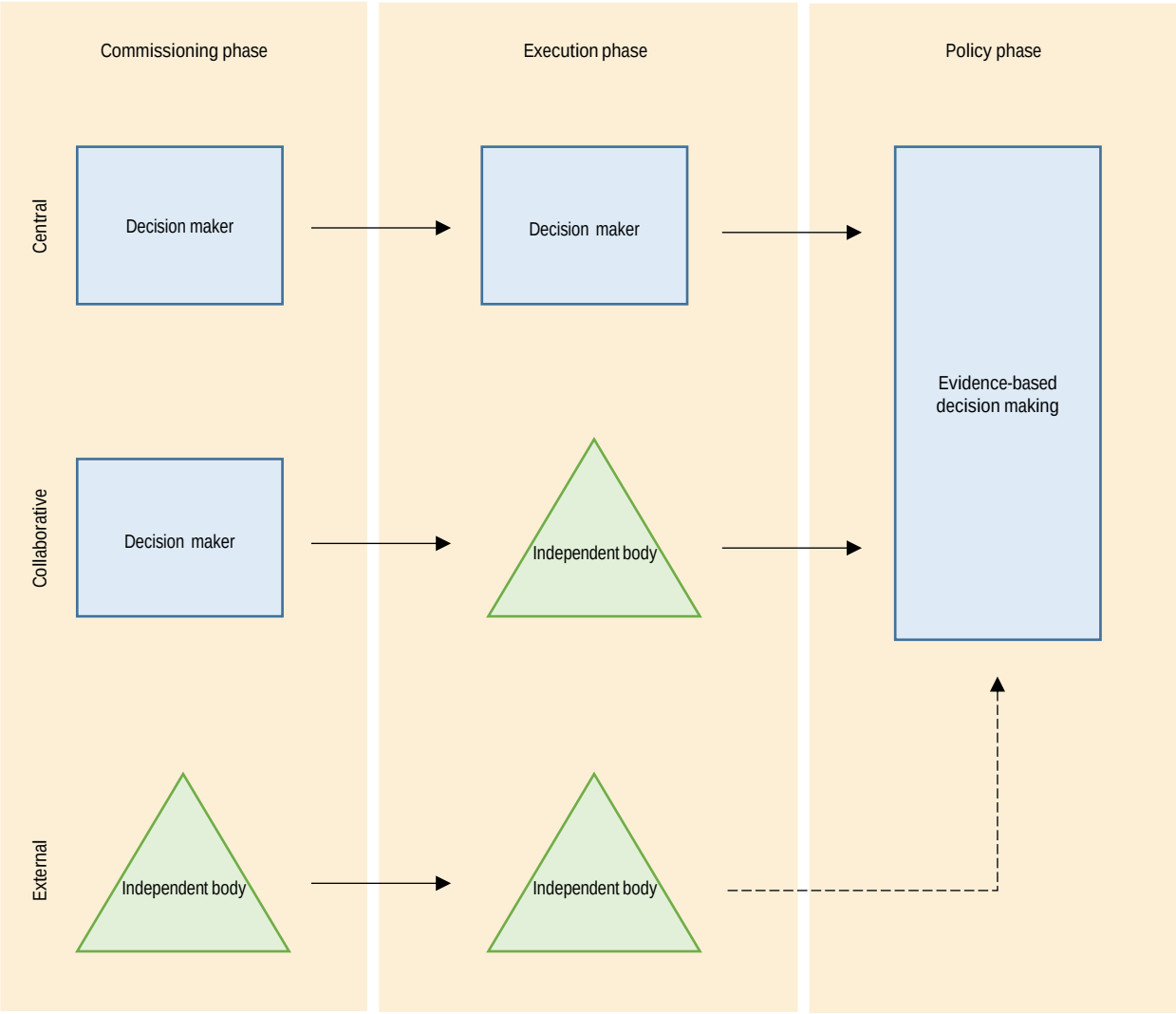
The diverse landscape of governance structures

Governance frameworks of SAA systems for the green transition are widely heterogeneous across OECD countries. This is largely motivated by the complexity of policy making that involves such exercises, as it lies in the intersection of various policy domains, such as labour, education, environment, industry, etc.

Building on governance principles for SAA exercises mapped out by the OECD (OECD, 2016[16]), this report proposes three models for understanding the governance structures of green SAA exercises: the central model, the collaborative model or the external model (Figure 3.1). Each of these governance models is divided into three phases: (1) the commissioning phase, during which the decision is made to conceptualise and carry out a green SAA exercise; (2) the execution phase, where the SAA exercise is carried out; and (3) a policy phase, when the results of the SAA exercise are integrated into a policy-oriented decision-making process. Incorporating the results in the policy phase is not limited to governmental and public bodies, but also refers to policy undertaken by industry organisations, trade unions, training providers, employer organisations and other organisations and institutions of a similar nature.

What differentiates the three models is the main actor involved in each phase. There are two types of actors in the SAA process: decision makers and independent bodies. A decision maker is any public, private or hybrid organisation or institution that has the power to implement policies based on the results of the SAA exercises. For the public sector, this includes ministries and governmental agencies that will ultimately use the results of the SAA exercise to create policies or adjust their public services. Private decision-making actors include trade unions, industry organisations, or private training providers that can change their industry-wide policy based on results, or where the results inform the way the private institution operates, such as private training providers or industry organisations that can adjust which training they provide based on skills needs found in the SAA exercise. In addition, collaborative initiatives – such as public-private task forces that combine both public and private decision-making bodies also fit into this category of actor. By contrast, an independent body is an actor in the SAA ecosystem that does not create policies itself but can affect policy making through the execution of SAA exercises, making them independent of the decision-making process. Independent bodies are typically research institutions, universities or consulting firms that produce content for the end-user (decision-making body) but are not influenced by the policy agenda surrounding the approach to SAA.

Figure 3.1. Governance models for skills assessment and anticipation



Source: Author's elaboration based on OECD (2016[25]), *Getting Skills Right: Assessing and Anticipating Changing Skills Needs*, https://doi.org/10.1787/9789264252073-en.

The SAA exercises covered in this study all fall into one of the three governance models outlined in Table 3.6.

- In the central model, every governance phase is executed by a decision maker, and the results directly feed into the policy-making process, which is also executed by a decision maker. An example of this would be when a national ministry commissions an SAA exercise in-house, executes the exercise and creates a new policy based on the results. The central model is, for instance, used in the Swedish SAA exercise conducted by the PES which is motivated by the policy agenda to transform the mining industry and meet the climate goal of net-zero emissions by 2045 (Swedish Public Employment Service, 2022[22]). However, there is room for several different decision makers to be a part of the SAA process in the central model. This is for instance when a national ministry commissions an agency or industry body to carry out an SAA exercise, and the results feed into the work of both the ministry and the agency/industry body in the policy phase. Furthermore, a decision-making body can also be a non-governmental institution such as an employer organisation. The institution's aim is to adopt

internal policy-decisions based on the results of SAA which makes them a decision-maker. This does not exclude the results from also feeding into external policy processes as well. Virke's SAA exercise covering the circular economy is an example of this approach, where results are used in both internal and external policy processes.

- Under the collaborative governance model, the SAA exercise is commissioned by a decision maker and executed by an independent body, while the results are fed back into the policy area of the decision maker who commissioned the exercise. This is seen for example when national ministries or governmental agencies commission universities, independent research institutions or consulting firms to carry out an SAA exercise. These results will then inform the ministry/agency's policy-making process. In this model, the work of the body carrying out the SAA exercise is independent from the policy agenda of the commissioning body, and can therefore explore the benefits and drawbacks of government policy in a wider context. Two examples of the collaborative model are found in Norway, where NHO commissioned the execution phase of their SAA exercise to an independent research institute called the Nordic Institute for Studies in Innovation, Research and Education (NIFU) (Rørstad, Børing and Solberg, 2023[26]), and the Ministry of Education commissioned a green SAA study to the Norwegian Committee on Skill Needs (Kompetansebehovsutvalget, 2023[2]).
- An external governance model occurs when an SAA exercise is both commissioned and executed by an independent body. In this case, the results of this approach to SAA do not always reach policy makers, unless the findings gather media attention or if the government has a system for tracking SAA exercises entirely run by independent bodies. This happens, for instance, when universities carry out skills-related research projects that are not commissioned by the government. In such cases, the decision-making bodies need to have a good overview of the SAA ecosystem to track new findings and integrate the results in the policy-making process. An example of an external governance model is the work carried out by Deloitte on behalf of the Climate Council in Australia. The Climate Council is an independent and community-funded organisation for climate change communications, made up by climate scientists, health and renewable energy experts. The Climate Council commissioned a report by Deloitte – a consulting firm – and used the results to get climate stories into the media and promote climate solutions (Deloitte Access Economics, 2021[11]).

Within the selection of SAA exercises covered by this report, there is a high representation of the central governance model (Table 3.6). This should come as no surprise given that the stakeholders contributing to the report's research are governmental decision-making bodies, and whose work would automatically fall under the category of central or collaborative governance model. The benefit of a central governance model is that the results are directly integrated in the policy process, and the scope of SAA exercises can be designed to better fit the purpose of the policy. For example, the SAA exercise commissioned by the National Observatory for Jobs and Occupations in the Green Economy in France is designed to answer specific questions about green jobs and skills for the Ministry of Ecological Transition to carry out policies for the green transition (Ministry of Ecology, Energy and Territories, 2021[10]).

The benefits of the collaborative governance model are that the independent bodies that execute the SAA exercise can bring new ideas and perspectives to the policy issue through influence on scope and execution of the exercise. This allows for a new layer of validation, as the results by the independent body can be compared to results gathered through the central governance model. Certain actors in collaborative SAA exercises are considered independent bodies even if they are governmentally funded, because of the level of independence in research and removal from decision-making abilities in the policy phase. The independent body can also be a private actor such as in the case of the Virkebarometer in Norway, where Virke is commissioning the execution phase to the private analysis bureau Opinion (Virke, 2021[27]).

The external governance model is the least common among the SAA exercises reviewed for this study. One of the reasons may be that SAA exercises may be costly to execute. Another reason could be a selection bias, as the exercises covered in this report have been mainly identified through public stakeholders. Indeed, as previously discussed, there is limited government overview of SAA exercises that are conducted by independent bodies. Mapping existing independent SAA exercises is beneficial, as it allows the decision makers to tap into a wider source of information and prevent duplication of efforts between the decision makers and independent bodies.

Table 3.6. Governance structures applying for the SAA exercises

Country	Institution	Central	Collaborative	External
Australia	Federal Government			
	Jobs and Skills Australia (JSA)		●	
	Infrastructure Australia	●		
	Department of Employment and Workplace Relations (DEWR)	●		
	State Government			
	Victorian State Government	●		
	Independent			
	Deloitte			●
	RACE for 2030	●		
Austria	GWS		●	
	Just Transition Action Plan			
	Austrian Energy Agency	●		
	WIFO		●	
France	National Observatory for Jobs and Occupations in the Green Economy	●		
	Skill Forecast: Occupations in 2030	●		
	EDEC	●		
	ADEME	●		
	The Shift Project			●
Norway	Norwegian Committee on Skill Needs		●	
	Virke - Circular Economy	●		
	Virke - Virkebarometer		●	
	NHO - Skill barometer		●	
Sweden	Public Employment Service	●		
	Vinnova	●		
	Confederation of Swedish Enterprises		●	

Source: Authors' elaboration based on policy questionnaires.

Global insights

Central Model: Future Skills Centre (Canada)

With funding by the government of Canada's future skills programme, the Future Skills Centre (FSC) has been undertaking SAA for the green transition since 2021. With the goal to support Canada's green transition and share knowledge and insights on the creation of new and sustainable jobs with workers and employers, FSC conducts research on green SAA exercises through a consortium partnership with various public and private research institute, including the Smart Prosperity Institute (SPI), the Diversity Institute and the Conference Board of Canada (Future Skills Centre, 2023[28]).

Collaborative Model: Green Jobs Taskforce (United Kingdom)

The United Kingdom has formed the Green Jobs Taskforce to foster the transition towards a high-skill, low carbon economy. The Department for Business, Energy and Industrial Strategy, and the Department for Education convened this Taskforce of 17 individuals from diverse backgrounds in industry, academia, unions, industry, education and skills sector. All the members of the task force directly participate in research and report publication, and the results are publicly announced and proposed to the government after intensive internal deliberation (Green Jobs Taskforce, 2021[29]).

External Model: Basel University (Switzerland)

Basel University in Switzerland undertook a vast research programme on green SAA exercises in 2020, thanks to funding by the Swiss National Science Foundation. The researchers' aim was to estimate the green potential of 322 ISCO occupations through machine learning algorithms. By comparing the occupations with high green potential with the current state of labour shortage among European countries, they provided the information not only on promising green occupations but also on the preparedness of the European workforce to move toward a green economy (Niggli and Rutzer, 2020[30]).

Stakeholder involvement in SAA exercises

The intersectional approach of SAA exercises implies that there are potentially a multitude of stakeholders present throughout the process. Stakeholders can be engaged both horizontally and vertically. Horizontal engagement is achieved through direct collaboration across governmental departments, such as the Ministry of Labour, the Ministry of Education or the Ministry of Economy. For example, in France the "Skills Forecast: Occupations in 2030" is co-conducted by France Stratégie, an institution attached to the Prime Minister's Office, and Dares, a team located under the Ministry of Employment (France Stratégie, 2022[31]). By contrast, the vertical dimension of engagement applies to different levels of government which include regional, sub-regional, and non-state actors, such as the private sector (OECD, 2019[32]).

In particular, collaborations between the public and the private sectors are often sought after. Indeed, it can be challenging to get an accurate snapshot of the skill landscape if the particular approach to SAA is not conducted with the help of key players "on the ground". Social partners have unique knowledge on these matters: employers have an idea about what skills they need in order to develop their business, and trade unions have information about the skills and training needs of their members. Inclusion of social partners can be vital for the successful execution of SAA exercises, but also for dissemination of findings and implementation of evidence-based policies and actions. This point is not lost in the field of anticipating training needs. In fact, according to a recent OECD survey, employers and employer organisations are involved in SAA exercises in 7 out of 10 participating countries, while trade unions are involved in 6 out of 10 cases (OECD, 2019[33]). Governments can organise the voices of social partners through skills councils

(also called sectoral councils and sector skills councils), and use these councils to anticipate skill needs and plan adult learning programmes and training programmes to address these needs (OECD, 2016[25]).

In the countries under analysis in the present report, public-private partnerships usually focus on a specific sector, such as the renewable energy sector in Australia or the mining industry in Sweden, although innovative practices are gradually emerging. For example, in Norway the Committee on Skill Needs brings together a wide range of stakeholders – 4 representatives of employer organisations, 4 representatives of trade unions, 9 independent researchers, and 1 representative of the county councils – with the goal of creating a common knowledge base that all members of the Committee can adhere to. Similarly, in Sweden providers offering Higher Vocational Education (*Yrkeshögskolan*) – such as universities, local authorities or private training companies – collaborate with employers and industry representatives to understand how the labour market needs are changing and design relevant education programmes (so-called YH-model).

Yet, while engaging stakeholders is essential to pursue shared policy objectives, it comes with distinct challenges. In Sweden the private actors of the mining industry are providing information on future skill requirements that will be needed to meet the demand of the green transition. The PES then co-ordinates the actors of Vocational Education and Training (VET), universities, and other parts of the educational system, on a local and regional level, to ensure that information is received and that relevant actions are taken in to consideration (Swedish Public Employment Service, 2022[22]). The involvement of multiple stakeholders requires a governance system that helps co-ordinate the contribution of each stakeholder to the SAA process as well as mitigate gridlocks that may arise from conflicting interests. Conflicting interest may result in disagreements about appropriate policy actions affecting the efficiency of the outcomes. Co-ordination among stakeholders is also one of the main obstacles to information being used in making informed policy decisions (OECD, 2016[16]; OECD, 2019[32]). Moreover, data on skills are often fragmented and collected by many different stakeholders. For example, in Australia's SAA exercise RACE for 2030 there are nine different stakeholders involved in data collection and research. In order to oversee the process, maintain consistency and co-ordinate information flows, the project is managed by the Energy Efficiency Council and the Australian Power Institute.

Funding of SAA exercises

Most SAA exercises are funded either publicly or privately, but a few less frequent financing schemes are based on a combination of public and private funds. The rationale behind this cost sharing is that skill forecasts and investments benefit both private and public domains, and hence the funding should be distributed accordingly. There is no blueprint on how this is achieved but it should rather be based on the domestic prerequisites within a country and guided by the balance between equity and efficiency (OECD, 2019[32]). The EDEC SAA exercises in France are financed jointly by the Ministry of Labour and the institutions that carry out the exercise (which in some cases are private organisations). There is only one exercise in this study that is funded through crowdfunding which is the "People Powering the Future" produced by Deloitte and commissioned by the Climate Council in Australia. Accordingly, the funding is dependent on private donations and philanthropy.

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Notes

[1] The concentration quotient (CQ) measures the relative importance of any given occupation to each clean economy sector compared with the overall economy. The CQ formula is: Occupation's share of sectoral employment / Occupation's share of national employment. Values greater (lower) than 1 indicate that a given occupation is more (less) important to the clean economy than the overall economy.

[2] Regional, in this context, is taken to mean a national sub-region, such as states, provinces, municipalities or any other geographically defined sub-national area.

[3] The gTech is a computable general equilibrium (CGE) model that represents transactions between all sectors of the economy as measured by Statistics Canada National Accounts. It captures all sectors' activity, gross domestic product, trade of goods and services, transactions, and behavioural aspects, thereby managing to provide a forecast of how government policy affects many different economic indicators.

[4] Scenario 1 (Electrons) is a lower-carbon-intensity future, Scenario 2 (Resources) involves a heavier continued reliance on carbon-intensive activities while achieving net-zero emissions through alternative approaches, such as the use of carbon capture technologies. Scenario 3 (Blended) aims at reducing overall GHG emissions by 75%, with the remaining 25% accounted for through the purchase of carbon offsets implemented in other jurisdictions.

4 Choosing methods and data to assess skill needs for the green transition

Both qualitative and quantitative methods can be used to estimate current and future skill needs related to the green transition. This chapter discusses the specific advantages and disadvantages of quantitative, qualitative, and mixed method approaches and how they can be applied. The insights are supported by examples of approaches to measuring changing skill needs in the green transition from countries around the world.

Introduction

Broadly speaking, there are two sets of methods for estimating current and future skill needs: (1) quantitative methods that use data and statistics, such as labour market statistics and employer surveys, to estimate current and future skill needs; and (2) qualitative methods that use written or oral input from experts, collected through interviews, surveys, desk research or workshops. 'Mixed methods' approaches combine quantitative and qualitative methods and data. Both qualitative and quantitative methods have advantages and disadvantages, and the choice depends on the specific policy use (OECD, 2016[1]; Cedefop, 2008[2]; ILO, 2017[3]). The same holds for the choice of data sources, output variables and experts to include in SAA, which depends on the definitions and scope of the exercise.

This section focuses on how the different methods can be applied when estimating the impact of the green transition on current and future skill needs, as well as on the specific advantages and disadvantages to using each methodology. Overall, the SAA exercises covered in this report are quite evenly split between quantitative and qualitative exercises. Most countries use a mix of the two and in many cases, the same SAA exercise combines qualitative and quantitative methods (see Table 4.1).

Table 4.1. Methods used in green SAA exercises

Country	Institution	Quantitative	Qualitative
Australia	Federal Government		
	Jobs and Skills Australia (JSA)	●	●
	Infrastructure Australia		●
	Department of Employment and Workplace Relations (DEWR)	●	●
	State Government		
	Victorian State Government	●	●
	Independent		
	Deloitte	●	
	RACE for 2030		●
Austria	GWS	●	
	Just Transition Action Plan		
	Austrian Energy Agency		●
	WIFO	●	●
France	National Observatory for Jobs and Occupations in the Green Economy	●	●
	Skill Forecast: Occupations 2030	●	
	EDEC	●	●
	ADEME	●	
	The Shift Project	●	●
	Scénario négeWatt		●
Norway	Norwegian Committee on Skill Needs	●	●
	Virke – Circular Economy		●
	Virke – Virkebarometer		●
	NHO – Skill barometer		●
Sweden	Public Employment Service	●	●
	Vinnova		●
	Confederation of Swedish Enterprises		●

Source: Authors' elaboration based on policy questionnaires.

Quantitative methods and data

Quantitative approaches to SAA involve analysing various indicators of current and/or past demand and supply of workers and their skills, in order to project future trends under given assumptions. For green SAA exercises, this typically involves employment projections that take into account the fact that the green transition increases the demand for specific occupations or industries (e.g. in the green energy sector) while decreasing demand in others (e.g. in fossil fuel sectors). Several statistical and econometric techniques are exploited in quantitative SAA exercises, although the most frequent are the following:

- Time series models, which make use of historical trends, for instance on the number of workers by occupation, and extrapolate these trends to project the future supply.
- Regression models, which assume that the forecast variable (such as the demand for renewable energy workers) is related to other variables (such as the level of decarbonisation), and create forecasts based on those assumptions.
- Computable general equilibrium (CGE) models, which are used to analyse the economy-wide effects of potential shocks and scenarios, such as the change in industry composition due to change from carbon-intensive to carbon-neutral economy.

Other examples of quantitative SAA models are optimisation models, generic mathematical models, stock-and-flow models, input-output models, social accounting matrices, and simulation models (Safarishahrbijari, 2018[4]). Additionally, with the increasing availability and quality of Big Data, techniques such as machine learning and natural language processing are increasingly being used, for instance to map out skill requirements in occupations, to identify green jobs using vacancy data, or to identify education and training programmes that teach the skills that will be needed for the green transition. The following section focus entirely on the use of Big Data for green SAA exercises.

Some of the key advantages of using quantitative methods for green SAA exercises are that they can cover large numbers of occupations and sectors at the same time, are relatively easily repeated, and do so in a consistent and transparent way across occupations, sectors and years. Most SAA exercises using quantitative methods follow a whole-of-economy approach. This is important due to the fact that: i) there is a relatively high level of uncertainty about greening policies and their impacts may require more frequent updating (see next sections for more information), and ii) the green transition likely impacts more than 'green jobs' alone. For instance, Deloitte in Australia uses CGE, input-output and mixed time series models to estimate the impact of different levels of decarbonisation and a shift towards a net zero economy on all jobs in the (local) labour market (Deloitte Access Economics, 2021[5]; Centre for Policy Development, 2022[6]).

This whole-of-economy approach allows taking into account that some jobs that are not directly related to implementing the green transition may be affected too. It also allows researchers and policy makers to address fears that decarbonisation will result in large and permanent job losses, by estimating what share of total employment is affected. For example, the GWS estimates that while the transition to a new, lower-emission economy by 2030 has far-reaching structural effects on the Austrian labour market, it will lead to a net-increase in total employment by 0.3% (Großmann et al., 2020[7]). Similarly, Deloitte estimates that most workers in Queensland (Australia) will not be directly impacted by the economic transformation underway due to decarbonisation (Deloitte Access Economics, 2021[5]). A whole-of-economy approach can also take into account that workers who lose their job as a result of the green transition may continue to work in other jobs and sectors. By analysing skill similarities across occupations using O*NET, Deloitte shows that more than 80% of the tasks required in clean economy jobs are already being performed by workers in Queensland (Australia) today, because an electrician working in a coal mine can, for instance, relatively easily work as an electrician in another growing industry, given his current skill set (Deloitte Access Economics, 2021[5]).

Most countries using quantitative methods to conduct a green SAA exercise generally build on existing, broader SAA exercises that rely on data regularly collected by national statistics offices, such as flows in and out of employment by occupation and sector, trends in wages by occupation, trends in hours worked by occupation, vacancy surveys, employer surveys, surveys of recent graduates, and administrative data (e.g. data on enrolments in and graduation from various levels of education). This is exemplified in the Swedish exercise by the PES that will incorporate their SAA exercise within existing tools such as occupational forecasts which are made by the Swedish PES and currently based on register data from Statistics Sweden (Swedish Public Employment Service, 2022[8]). In France, the "Skill Forecast: Occupations in 2030" SAA exercise has been carried out since the 1990s, and an analysis on the transition to a low-carbon economy was added in 2012 (France Stratégie, 2022[9]).

The crucial challenge in adding a green element to an existing SAA exercise is to identify jobs, sectors or skills relevant to the green transition within existing data, according to the specific definition and scope of the exercise. As the ILO has previously pointed out, it can be extremely difficult for research into skills for green jobs to use only standard classifications (ILO, 2015[10]), because they often do not (yet) include a green category, and when they do, it is often at such a granular level that it requires vast amounts of data. In France, the National Observatory for Jobs and Occupations in the Green Economy has identified green occupations through a review of the national nomenclatures of existing occupations, and cross-referencing these with statistical data sources (Ministry of Ecology, Energy and Territories, 2021[11]). For many countries, particularly those that have fewer resources, it may not be possible to have enough data of sufficient quality to conduct analyses at such granular level. Nevertheless, Briggs et al. (2020[12]) show that, within a specific industry, it might be possible to carry out informative and fruitful quantitative analyses on green jobs or skills at a more aggregate level. Not only do the authors conduct their analysis on renewable energy jobs in Australia at the detailed occupational level, but they also apply it to the 1-digit occupational level within the mining sector and renewable energy sector.

Other challenges specific to quantitative approaches to SAA in general are: (i) they typically require high levels of technical capacity such as econometric and statistical skills, (ii) they may give a false impression of certainty, and – most importantly – (iii) it can be difficult to estimate skill needs *per se* (OECD, 2016[1]). The latter shortcoming is particularly challenging. Indeed, quantitative green SAA exercises typically focus on occupations or qualifications, rather than skills, although it is possible to translate occupational-level findings into skill-level results using a mapping of skills in occupations. For instance, O*NET produced a list of "green occupations", JSA in Australia developed the Australian Skills Classification including skills and tasks related to environmental management, and ESCO provides a list of "green skills" in occupations in the European Union. France's National Observatory for Jobs and Occupations in the Green Economy is in the process of extrapolating a definition of green skills from the group of identified green occupations, in order to quantify those skills and in turn identify greening occupations – that is, occupations not directly involved in the green transition, but affected by it nonetheless (Ministry of Ecology, Energy and Territories, 2021[11]). Even if a specific mapping does not suit a study's purpose perfectly, it may be possible to adapt it. For instance, Deloitte adjusted O*NET's green jobs classification (which are coded in SOC) and mapped it onto the Australian ANZSCO occupational classification system, in order to identify green skills in Australia (Deloitte Access Economics, 2021[5]).

Global insights

Quantitative methods in the Netherlands

In the Netherlands, the Research Centre of Education and Labour Market (ROA) and the Environmental Assessment Agency (PBL) – which is the national institute for strategic policy analysis in the field of the environment – conducted an SAA exercise for the green transition in 2022 at the request of the Economic and Social Council and several ministries involved in climate policy (e.g. Ministry of Economic Affairs and Climate Policy). ROA and PBL applied quantitative forecast models to provide insights into possible bottlenecks in the labour market for achieving green targets. In particular, the PBS-ROA model forecasted employment shortages in 63 sectors and 12 provinces over the next five years (up to 2026) based on a scenario in which each economic agent implements all necessary measures and investments to achieve a greenhouse gas reduction goal. Using additional data from the Labour Force Survey, the ROA School Leavers Information System, as well as benchmark estimates from the Ministry of Education, the SAA exercise also provided useful information on skills and adult learning needs (PBL Netherlands Environmental, 2022[13]).

Qualitative methods and data

Qualitative methods often involve gathering groups of experts and/or stakeholders to collect their informed views on how the skill needs in the labour market are likely to evolve in light of the green transition. These may include focus groups, stakeholder consultations, foresight methods, Delphi methods, and analyses of open-ended questions in surveys. Participants and respondents may include representatives of employers and industries, education and training providers, academics and experts on green technologies, and trade unions.

One of the key advantages of using qualitative methods for green SAA exercises is that they facilitate analyses of future employment and skill needs that might not (yet) be observable in quantitative data. This is crucial for green SAA exercises, considering that the green transition may create demand for entirely new occupations. For instance, based on interviews and workshops with employers and industry associations, governmental and intergovernmental organisations, academics, consultants and non-governmental organisations, RACE for 2030 concluded that sections of the standard Australian occupation and industry codes may need additional categories in order to reflect the changes in the workforce caused by the green transition (RACE for 2030, 2021[14]). Additionally, with the help of an external expert panel and extensive stakeholder consultations, the Victorian Skills Authority in Australia is identifying new skills and roles that are needed to support its clean economy ambitions (Victorian State Government, 2022[15]).

Since skills are difficult to quantify, qualitative approaches to SAA are typically also well suited for analysing skill needs directly, without going through forecasts of green jobs demand (OECD, 2016[1]). This is particularly important for green SAA exercises, because the green transition will likely affect not only the level of employment in certain occupations, but also the skill requirements and tasks within occupations. For instance, in order to identify how tasks within the trade and service industry will be affected by the green transition in Norway, Virke conducted 18 qualitative interviews with representatives from the sectors of procurement, logistics, and design (Virke, 2020[16]). As part of the Austrian Just Transition Action Plan, the Austrian Energy Agency analysed which future skills will be needed in the areas of construction and renovation, electricity from renewable sources and renewable heat (Tretter et al., 2022[17]). They did so based on desk research and a workshop with educational providers where the respective future competencies were ranked according to their short- to medium-term effectiveness. RACE for 2030 conducted literature reviews, interviews with subject matter experts representing industry associations and

education providers, workshops with various stakeholders and employer and industry surveys, to investigate the skills and workers that are required by 2030 to deliver a clean energy transition to net zero by 2050 in Australia (RACE for 2030, 2021[14]). Their study highlighted that not only does the green transition change the demand for specific technical skills such as those of wind turbine blade technicians, but it also calls for non-technical cross-cutting skills such as project management, raising awareness, communicating and convening dialogue across a range of sectors and disciplines, and fostering a shared vision and commitment between diverse actors.

Qualitative SAA exercises can also link skill needs to shortages and training needs. For example, in Sweden, the Confederation of Swedish Enterprises conducted surveys among 25 representatives of business organisations and 11 interviews with industry and company representatives across the labour market (including manufacturing and basic industries, construction and various service industries), in order to identify whether skills shortages are hindering the industry's green transition and where potential skill gaps lie (Confederation of Swedish Enterprise, 2021[18]).

Another advantage of qualitative approaches to SAA found in previous studies is that they are typically easier to set up with limited resources (OECD/ILO, 2022[19]). In many low and middle-income countries, conducting skills anticipation exercises is made challenging by weaker institutions, limited capacity, and poor governance systems. Additionally, many of these countries collect only basic labour market statistics and require significant investment to develop robust data sources. In these cases, qualitative exercises such as sector surveys can help provide useful information and fill data gaps when necessary.

Notwithstanding the advantages of qualitative green SAA exercises, there are also a number of drawbacks. First, qualitative methods typically focus on one specific sector or group of occupations. This is due to the fact that qualitative considerations are often sector specific and gathering and engaging experts can be time consuming, which makes a whole-of-economy approach less feasible. While the focus on specific sections of the economy can provide more in-depth insights, important dynamics such as transitions between declining occupations and industries towards those that are growing as a result of the green transition would be overlooked. Additionally, qualitative SAA exercises are more subjective and less systematic and more difficult to replicate and can therefore yield inconsistent responses between experts or when the exercise is repeated. This can be problematic, considering the relatively high level of uncertainty and the resulting need for regular updating of the results (see next sections).

Global insights

Qualitative methods in South Africa

In 2016, the Partnership for Action on Green Economy (PAGE) launched the Green Skills Programme, which involved conducting various qualitative assessments of the learning needs and opportunities related to the green economy. The research team consisted of experts from international organisations and universities, as well as from South African Ministries. The team conducted two surveys – one with 96 experts to verify the key levers that stimulate the transition to a green economy, and another one with 106 key actors to identify learning needs and opportunities. Twelve in-depth interviews were conducted with senior level individuals with exceptional experience in green economy and policy across green sectors, such as education for sustainable development, water, conservation and natural resource management, cities and mobility/transport, waste management and cleaner production and energy. PAGE also reviewed 170 existing vocational training courses, in order to assess the capacity of the training providers to offer courses that are in-line with demand, both in terms of number of classes and their topics, as well as the success factors and challenges that are faced in the green training space. Finally, the review conducted three cases studies of green economy policy actions, to identify and assess their success factors or enablers, as well as gaps and risks, with the objective of mapping

out competencies that are associated with taking actions needed to guarantee the success of green economy policy actions.

Various consultations and advice were provided from the phase of research design to the phase of drawing results through a roundtable and the finalising workshop with experts and stakeholders, including the Department of Environmental Affairs, International Labour Organization (ILO), and United Nations Institute for Training and Research (UNITAR). The review resulted in targeted recommendations to strengthen the green economy through planning, policy development, governance, management of skills and training provision, and human capacity management (South Africa - Partnership for Action on Green Economy, 2016[20]).

Mixed methods

Using a combination of quantitative and qualitative methods is generally viewed as best practice, because one method can be used to validate and complement the other thereby leveraging the advantages of each method, which should lead to the most robust and reliable results (OECD, 2016[1]; Cedefop, 2008[2]; ILO, 2017[3]). Although mixed method approaches to SAA are usually less common because they require vast amounts of data and technical expertise, as well as time investments from groups of experts, several exercises included in this study adopt this approach.

The Norwegian Committee on Skill Needs, which consist of experts and social partners, discusses the results from quantitative forecasts as well as qualitative results, for instance from interviews with environmental managers in the trade and service industry to evaluate their future green skill needs (Norwegian Committee on Skill Needs, 2020[21]). As part of the Just Transition Action Plan in Austria, the WIFO analyses 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[22]). The Powering Australia Plan involves quantitative employment forecasts in three sectors (electricity, industry carbon farming, and transport), as well as surveys and focus groups with key stakeholders such as states and territories, industry and unions, in order to identify the occupations, skills and training pathways that are needed to transition to a clean energy economy (Department of Employment and Workplace Relations, 2022[23]). In 2020, the UTS Institute for Sustainable Futures gathered input from an industry-wide survey, as well as from interviews and expert consultations about workforce numbers, current skill shortages and recruitment issues, and the use of apprentices and trainees (Briggs et al., 2020[12]; Institution for Sustainable Future, 2020[24]). The surveys (supplemented with other data sources when necessary) were used to derive factors critical for the Australian green energy transition, such as deferral and state government energy policies, the pace of innovation and adaption of digital technologies, and Australian and international action on climate change. These factors are applied to scenarios developed by the Australian Energy Market Operator (AEMO) in its 2020 draft Integrated Systems Plan to estimate job creation into the future (Institution for Sustainable Future, 2020[24]). The Victorian State Government uses these scenarios and projections in their New Energy Skills and Training Gap Analysis, supplemented by desktop research and stakeholder consultations, for instance through an industry workshop, industry surveys and interviews with State Government and industry representatives such as the wind, solar, bio-energy and battery industries (Victorian State Government, 2022[25]). The Department of Education and Training of Victoria is also developing a 10-year clean economy workforce development strategy, based on a mixed methods approach that is managed by the Victorian Skills Authority. General equilibrium models that forecast industry and occupation trends, are supplemented with extensive stakeholder consultations to identify new skills that are required to support the green transition (Victorian State Government, 2022[15]).

Global insights

Mixed methods in India

In 2016, the Indian Skill Council for Green Jobs (SCGJ) conducted a skill gap analysis across three sub-sectors of the renewable energy industry, namely solar, wind and small hydro. Their green SAA exercise was based on quantitative anticipations in parallel with stakeholders' discussions. At the initial stage, extensive consultations with stakeholders in the three fields led to the identification of the key trends and manpower deployment patterns that will be affecting job requirements until 2030. Also policy changes, and legal and technological considerations had been collected in detail and used as basis for the following quantitative analysis.

In a second stage, a skill gap analysis was carried out to anticipate the skill requirements based on the total target capacity of each sub-sector, using the qualitative and quantitative inputs. Compound Annual Growth Rate projections of each sector were made to anticipate their future capacity based on the targets of the Ministry of New and Renewable Energy.[1] Qualitative discussions with stakeholders were organised once again after this stage in order to convert sub-sector capacity anticipations into workforce needs per unit capacity. Finally, based on the qualitative and the quantitative input, the anticipation of skill (workforce) gap was derived for each sub-sector until 2025.

The output of SAA will guide the development of National Occupational Standards (NOS) and Qualification Packs (QPs). NOS define an explicit key feature that is needed to execute a job such as standards of performance or the level of knowledge that is required to carry out a task. Furthermore, the QPs are based on a combination of NOSs that make up the qualifications of a job role. Both the NOSs and the QPs will be incorporated in curriculums of and assessments of training and education (Skill Council for Green Jobs, 2016[26]).

Dealing with uncertainty

Uncertainty is a key challenge when anticipating future skill needs. It is impossible to precisely predict the future, even in a baseline scenario in which the green transition is not taken into account. Additional complications for green SAA exercises are that there is still a lot of uncertainty about the policies needed to reach climate goals, the policies that will be implemented in practice (due to push back, for instance from workers who fear losing their jobs), and the effects that implemented policies will have on labour and skill demand. Moreover, most countries' climate goals are set in the next 10 to 30 years, and the longer the time horizon, the greater the uncertainty. Both under- and over-estimating future skill needs in green SAA exercises can be problematic. For instance, underestimations may hinder a country from reaching its climate goals, while overestimations may increase unemployment and mismatches of workers that are trained to support the green transition.

Among the green SAA exercises included in this study, scenario analyses are by far the most common strategy for dealing with uncertainty, particularly among the quantitative approaches to SAA. For quantitative SAA exercises, scenario analyses imply that the forecasting model is run under different assumptions or hypothetical future events, to show how they affect the forecasted numbers. However, some exercises focus on more than 'green scenarios', since future skill needs (including in 'green jobs') are affected by more than green policies alone. For instance, the Norwegian Committee on Skill Needs (2020[21]) investigates three different scenarios in their quantitative SAA exercise, based on five societal uncertainties that can affect future skill needs, only one of which is related to the green transition, namely 'the population's preference for climate- and environment-friendly solutions'. The other societal

uncertainties that feed into the scenario analyses are: 1) the population's acceptance of adopting new technological solutions, 2) the prioritisation of export-oriented technology industries, 3) the degree of international protectionism, and 4) the population's preference for free time. In France, the Skill Forecast: Occupations 2030 models a baseline scenario for occupations by 2030 based on variables such as demographic and macroeconomic trends, and the green policies that will be implemented (only those already approved are taken into account) (France Stratégie, 2022[9]). Additionally, several alternative scenarios are developed, including a "low-carbon" scenario that assumes substantial acceleration of investment to meet the objectives of the national low-carbon strategy 2030, as well as a "Covid+" scenario, which assumes a stronger impact of the pandemic on social distancing by 2030 (France Stratégie, 2022[9]).

A qualitative approach to scenario development involves asking field experts or policy makers about what the most relevant future scenarios might look like, how likely these scenarios are to happen, and how they would affect labour and skill needs in light of the green transition. In Norway, Virke developed future scenarios during a workshop. Approximately 100 people from various sectors, including finance, research, real estate and technology, as well as government representatives, were asked how they wanted their sector to develop until 2030, and how they think this could be achieved (e.g. skill requirements) (Virke, 2020[16]). For Austria, the GWS developed scenarios of different types of green policies and their CO2 savings potential based on desk research, in co-operation with Austrian partners. After discussing these scenarios with subject matter experts, certain assumptions were adjusted and some scenarios were dropped altogether because they were considered not to be realistically feasible by the year 2030 (Großmann et al., 2020[7]).

For SAA exercises in general, as well as for SAA exercises in the health sector (see OECD/ILO (2022[19])), other common strategies for dealing with uncertainty in the design are to provide ranges or confidence intervals instead of exact numbers, and to repeat the exercise frequently, such as every two or three years. The latter allows the researchers to incorporate emerging insights about changing future trends. For green SAA exercises, frequent repetition would allow the inclusion of green policies as they evolve, as well as emerging insights in their impacts on employment and skill requirements. However, as discussed in the previous Chapter, most exercises included in this study are carried out for the first time, and many are not intended to be repeated.

Finally, validating findings is a necessary step in producing high-quality SAA exercises. Validation usually includes discussing the findings with external experts during workshops, focus groups or other expert meetings, to ensure that the results, and the assumptions they are based on, are considered plausible before they are published. For instance, under the Just Transition Action Plan in Austria, several workshops are conducted including all relevant experts including employers and industry representatives, to discuss the results of the projects (Meinhart et al., 2022[22]). Other exercises are validated by sending the preliminary results to external experts and asking for their feedback, such as in Norway, where the work in progress of the Committee on Skill Needs is sent to experts for quality checks and review. Furthermore, the Committee is also composed in such way to ensure consensus of various actors and institutions as well as performing a first step of the validation process (Norwegian Committee on Skill Needs, 2020[21]). In France, Skills Forecast: Occupations in 2030 performs various validation exercises, including sending a questionnaire to the sectoral observatories and the regional employment and training observatories to validate and adjust their projections (France Stratégie, 2022[9]). In some cases, the validation is performed afterwards, in order to assess the effectiveness of the SAA exercise in reaching its policy objective. In Australia, the New Energy Apprenticeship Program's second phase will be informed by analysis from Jobs and Skills Australia's study on the needs of Australia's clean energy workforce. This will allow changes to the programme based on emerging evidence on what is needed to support the transition to a clean energy economy.

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Note

[1] The compound annual growth rate is the rate of return that would be required for an investment to grow from its beginning balance to its ending balance, assuming the profits were reinvested at the end of each period of the investment's life span.

5 Exploiting big data to measure skills needs for the green transition

Big data can be a valuable source of information for timely and granular labour market analysis. In labour market research on skills, the most commonly used type of big data comes from online job vacancies that are analysed through Natural Language Processing. By means of examples from the public and private sector, this chapter discusses what big data is and how it is currently used in skills analysis linked to the green transition.

Introduction

Big data are increasingly making their way into policy debates as a promising source of information for a more timely and granular analysis of economic phenomena. As mentioned in Chapter 4, a growing number of skills assessment and anticipation exercises exploit big data to get a timely picture of how green skills needs are evolving. This chapter of the report aims to shed light on the main features of big data analyses for the green transition, their drawbacks and success factors. Four case studies are examined in particular: (1) Jobs and Skills Australia's big data work; (2) the study on "clean growth jobs" undertaken by the Department of Business, Energy and Industrial Strategy (BEIS) of the United Kingdom; (3) the green skills classification by ESCO; and (4) LinkedIn's green skills research.

What is big data?

First of all, it is important to clarify key terms and concepts related to big data analysis. While the use of the term "big data" often lacks precision, it usually refers to the large dimension of the datasets, that is coupled with the need to use large-scale computing power, non-standard software, and advanced methods to extract value from such data in a reasonable amount of time (OECD, 2016[1]). For instance, Chen et al. (2012[2]) define big data on the basis of how they perform vis-à-vis the three major challenges in data management: volume, variety and velocity, which are all 'big' in the case of big data.

One of the most commonly used types of big data in labour market research comes from online job vacancies (OJVs) – also referred to as job postings or job ads (Börner et al., 2018[3]; Hershbein and Kahn, 2018[4]; Modestino, Shoag and Balance, 2020[5]). Datasets on OJVs are typically compiled by web scraping online job boards (e.g. Indeed or Monster) and company websites on a regular and frequent basis. Some OJV data sources manage to reflect the quasi-totality of online job postings in a given country or area. Some of the most popular datasets are the ones produced by Lightcast (formerly Burning Glass Techologies) and by LinkedIn Economic Graph. One of the main advantages of these data is that they are a rich source of timely and granular information on skills and job requirements, which are typically difficult to gather via traditional methods such as labour market statistics. Thanks to this novel information, OJV analysis can provide valuable insights on labour market trends and enable the early identification of new or emerging jobs and skills (ILO, 2020[6]).[1] For example, Cedefop has been collecting and refining OJV data from EU member states since 2017, to understand the ongoing evolution of occupations and skills demand (Cedefop, 2019[7]).

The ILO was one the first international organisations to exploit OJVs in the context of the green transition. In 2019, the ILO used real-time big data on job ads from Burning Glass Technologies (now Lightcast) to conduct country studies examining the skill needs and occupational transitions linked to the shift towards low-carbon economies (ILO, 2020[6]). In particular, the ILO used a proprietary multiregional input – output model (EXIOBASE v3) to forecast the demand for each occupation in a green transition scenario, and then applied OJV big data to integrate the skills component. After identifying those industries and jobs that are expanding or decreasing due to the green transition according to their EXIOBASE model, the ILO used skills information from the jobs postings to identify the potential job transitions for workers in declining industries (ILO, 2020[6]).

Despite the clear value-added of data from online job postings for the estimation of current skills needs, several limitations of the approach should be highlighted. First, occupations and sectors where recruitment rarely takes place online are underrepresented in OJV datasets. Construction, fishing, or agriculture, for instance, are likely to be only partly covered. Similarly, at the occupation level, while data on high-skill occupations such as "managers", "professionals", or "technicians and associate professionals" showed good representativeness (Cammeraat and Squicciarini, 2021[8]), vacancies for the most elementary occupations are often not posted online. Furthermore, micro, small and medium enterprises are less likely to post online their job openings, thereby skewing advertisements towards those vacancies in larger firms.

The skills information in job ads does not always reflect the full skill profile of an occupation, since employers tend to include only some of the skills needed in the position, leaving aside either more transversal competencies or those skills that are so inherently linked to a profession that there is no need to include them explicitly in the job advertisement. For example, an online job posting for plumbers might mention "communication skills" but not "pipe installation" or "estimation of material requirements for projects", both activities that takes up most of plumbers' time but are considered so essential that they are taken for granted (ILO, 2020[6]).

Global insights

Measuring mismatch for green jobs in Korea through online job postings

In 2021, Korean researchers in Yonsei University analysed the degree of mismatch between the supply and demand for green jobs, exploiting online job postings from 'Ecojob' website, a green job-related recruiting services platform in Korea. Using web scraping techniques, the researchers obtained information on both the company side (e.g. industry, location, occupation, hire type, salary, experience required for each job advertisement), and jobseeker side (e.g. desired working area, employment type, desired industry and occupation, educational background, qualification). Thanks to this innovative source of data, the authors were able to quantify the degree of mismatch between supply and demand for green jobs in Korea by region, industry, and salary level (Song et al., 2021[9]).

Forecasting jobs for the green transition in Germany

In a study financed by the Federal Ministry for the Environment, Bauer et al. (2021[10]) exploit OJVs to define occupations and sectors that are particularly relevant for the green transition in Germany, and to identify possible labour shortages that could hinder the green transition. Their analysis is split in two parts.

The first part focuses on identifying current occupations and sectors in the "green economy", and is based on a large-scale survey, containing information on the job advertisements posted on the portal www.greenjobs.de and on the job postings of the Federal Employment Agency. Based on desk research, the team manually creates a training set – i.e. a catalogue of keywords to detect occupations related to the "green economy". They then run an automated text analysis (keyword filter) to detect these relevant keywords in the job postings data. This process is repeated and refined through manually testing random samples of occupations identified in the analysis and adding additional keywords or themes that were previously not included in the catalogue. Data on job postings by the Federal Employment Agency have been collected since 2012, which also allows a trend analysis of the development of jobs and sectors relevant to the "green economy". To provide a forecast of the evolution of the identified occupations and sectors in the "green economy", the study uses a macro-econometric input-output model called INFORGE. This approach allows estimating a range of future scenarios – from 2015 to 2025 and from 2025 to 2035 – on the basis of comprehensive economic and employment microdata capturing the complex interlinkages across sectors and activities, such as trade flows, household and government income generation and use, and investment dynamics.

The second part of the analysis provides simulations on the impact of selected green policies on occupations and sectors in the "green economy", namely: (i) an increase in the investment rate in the refurbishment of buildings from 1% to 2%, (ii) a change in individual mobility behaviour towards public transport or non-motorised vehicles, and (iii) a change towards a more digitalised "Economy 4.0".

Based on this two-step approach, the analysis by Bauer et al. (2021[10]) provides a remarkable level of granularity and allows forecasting by combining a big data approach with a macroeconomic model. However, this comes at the expense of high complexity and dependence on predetermined assumptions, which may strongly impact the projections.

How does skills analysis with big data work?

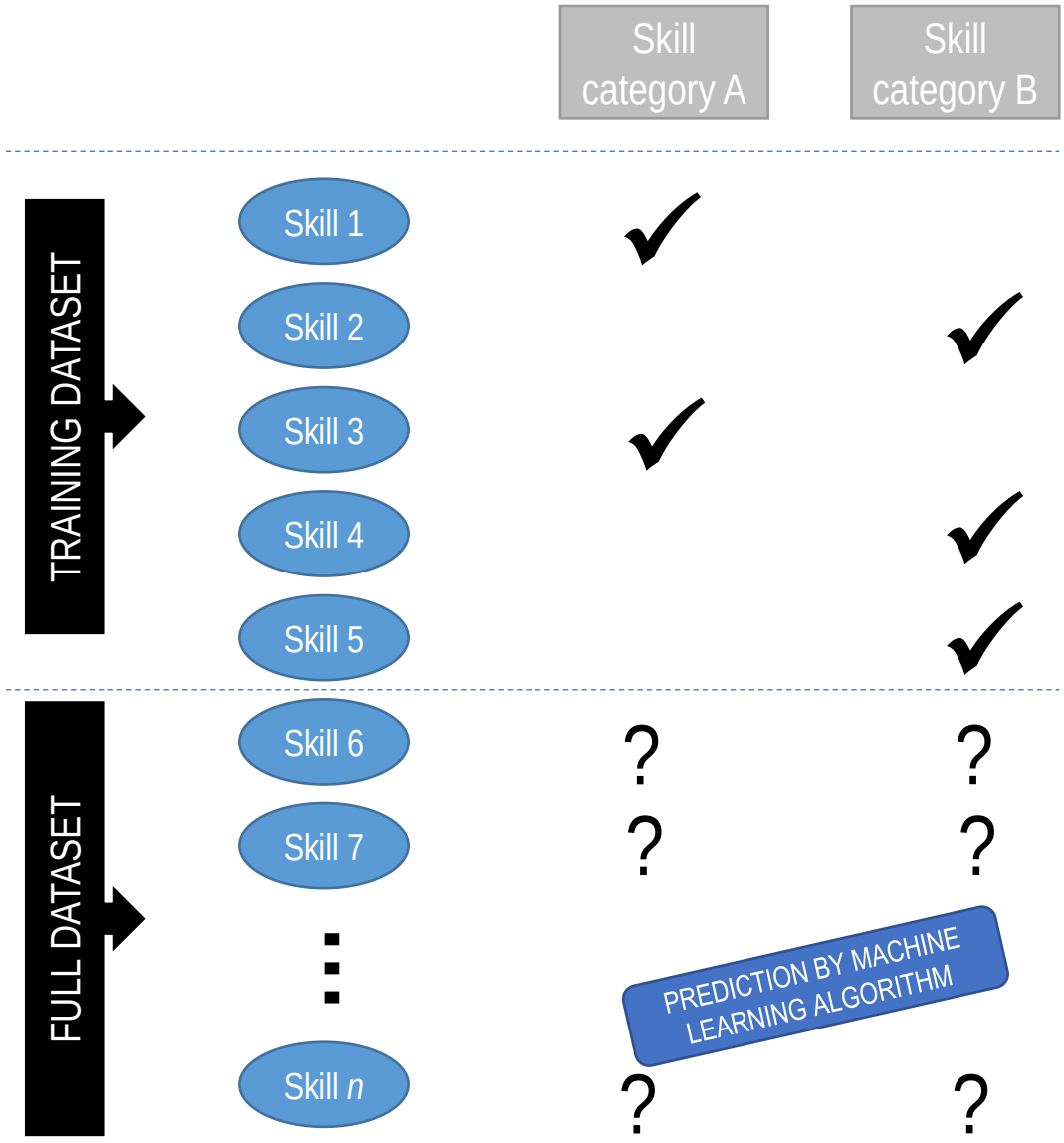
Big data has the potential of providing real-time, granular information compared to existing surveys and statistics sources. Since vast amounts of data are collected, however, selecting the correct methodology for proper data processing is imperative (ILO, 2020[6]). This is the case, for example, when identifying skills in big data, since information on skills typically appears as strings of text rather than pre-codified labels, and therefore require specific techniques to ensure that ambivalent text is mapped into meaningful skills categories.

Most studies attempting to classify skills based on OJVs use text classification, i.e. "the transformation of unstructured textual data (documents, books, reports, etc.) in a structured format" (Lassébie et al., 2021[11]). In recent years, a number of language models have been developed by researchers to correctly process textual data. These so-called Natural Language Processing (or NLP) models rely on machine learning, which is a type of artificial intelligence where a programme is able to learn rules from existing datasets without being explicitly programmed by humans (OECD, 2021[12]). In particular, the machine learning algorithms of NLP models often use the sematic context in which the text appears to transform strings into data (OECD, 2022[13]).

To simplify a very complex approach, many big data studies aimed at inferring skills from unstructured text (such as job postings or LinkedIn user profiles, as in the case studies below) follow a three-step methodology:

- First, the researchers create a training dataset to help the machine learning algorithm derive the logical rules to interpret text. The training dataset is composed of examples of skills and can take multiple forms – e.g. it can be a list of keywords or a collection of skills definitions.
- Second, learning from the training dataset, the NLP algorithms classify the text of, for example, the job postings or LinkedIn's profiles into the relevant skill category (see an illustrative example in Figure 5.1).
- Finally, researchers often validate the machine learning output through manual checks, experts' consultations, etc.

Figure 5.1. Example of skills analysis using machine learning algorithms



Source: Authors' elaboration.

The intricacies of using big data

All in all, two main features of big data analysis should be kept in mind to evaluate their usefulness for countries aiming to measure the skills needs stemming from the green transition. First, a key advantage of big data is their high frequency. These often-daily observations can clearly provide timely insights to understand better labour market trends. However, it is also important to note that these daily data cannot always be processed enough quickly by analysts, who therefore tend to publish their big data analysis results with a much lower frequency (e.g. quarterly or every six months). In a similar vein, users of these results – such as policy makers and journalists – risk having an information overload and cannot always digest highly-frequent updates on employment and skills trends.

Another key advantage of big data is their granularity. Data such as online job vacancies, in fact, provide very detailed information on individuals' employment characteristics and skills, most of which are not available in standard labour market datasets. Yet, it needs to be reminded that this information only captures flows: i.e. it focuses on what are the new job postings and what are the skills required in today's openings. This is useful to nowcast current and short-term trends – i.e. to get a sense of what are the emerging occupations or competencies in the economy. By contrast, big data such as OJVs do not provide insights on what are the skills currently held by the overall population (i.e. the stocks), thereby making it difficult to use these sources of current skills assessments.

Case study 1: Using big data to assess in-demand skills in Australia

In Australia, Jobs and Skills Australia (JSA), following on from work initiated by the National Skills Commission (NSC), is exploring data from Lightcast (formerly Burning Glass Technologies) to analyse real-time trends on job advertisements with the goal of identifying the skills that have grown in demand over the past five years. More specifically, the analysis matches skills information taken from the Lightcast job postings to the over 1 100 profiles outlining the required skills for each occupation contained in the Australian Skills Classification (ASC).

Each ASC skills profile for an individual occupation comprises three main elements – core competencies, specialist tasks, and technology tools (National Skills Commission, 2021[14]). *Core competencies* are universal skills that are required in all jobs although at different proficiency levels across sectors and professions – e.g. numeracy and literacy. *Specialist tasks* are the activities that workers undertake on a day-to-day basis within each occupation. Specialist tasks are only transferable to other occupations in the same *skill cluster*, i.e. jobs that have similar sets of specialist tasks.[2] Since specialist tasks are broadly transferable, it is likely that if a worker can perform one of the tasks in the cluster, (s)he can perform the other ones too. Finally, *technology tools* are the technologies required in each occupation. These can either be common technology tools that can be found across multiple jobs (such as email and search engines) or highly specialised, occupation-specific tools (like carbon monoxide analysing equipment).

Definitions and methods

To assess which skills are most in demand, JSA distinguishes between emerging and trending skills:

- *Trending skills* are defined as already existing skills within an occupation that have grown in demand over the past five years. For example, the need for *social media skills* has grown more than ten times for hotel managers in the past five years (National Skills Commission, 2021[14]).
- *Emerging skills*, on the other hand, are trending skills which are also new to a certain occupation. For example, *infection control skills* are now required by 38 new occupations compared with five years ago.

Through a network analysis, JSA also identifies those trending and emerging skills that can be considered *gateway skills*, i.e. skills that are trending in multiple occupations and have many connections to other skills. Gateway skills provide a point of transferability between different occupations and uncover job transition pathways (National Skills Commission, 2021[14]).

In practice, skills reported in the Lightcast database have been matched with those in the Australian Skills Classification (either specialist tasks or technology tools). Qualitative analysis and desktop research was used to remove duplicate skills where two or more Lightcast skills mapped to one ASC skill within an occupation (for example, Lightcast's "Facebook" and "Twitter" skills were both mapped to one Australian Skills Classification skill, i.e. "Social media and web publishing software").

After the matching, a skill is considered trending for a given occupation if it has been mentioned in job advertisements for that specific occupation more frequently over the past five years. This is calculated by measuring the number of job ads that require a particular skill as a proportion of all jobs advertised for that occupation each year over five years. By contrast, a skill is considered emerging for an occupation if has only emerged in job advertisements for that particular occupation in the last five years.

Application

At the time of writing, JSA big data analysis based on Lightcast data and the Australian Skill Classification does not focus on assessing specifically green skills needs. This is partly because, albeit a useful source of timely information, Lightcast data also comes with a number of drawbacks. These include: (i) the sub-optimal representativeness of the data, as job advertisements are over-represented by professional jobs whereas many green jobs are in sectors such as forestry, agriculture and manufacturing; (ii) the lack of labelled data on what constitutes a green skill; (iii) the need to validate machine learning estimates through experts' work. Nevertheless, JSA uses Lightcast data to identify trending and emerging skills for occupations in the Australian Skills Classification. For example, Solar Installers are a specialisation of the occupation Electrician (General) which has a trending skill of Enterprise resource planning ERP software (used to provide a central data source for organisational information, and enable a variety of business functions including HR, other resource management, reporting, and financial management).

Case study 2: Identifying clean growth jobs in the United Kingdom

In the United Kingdom, the Department of Business, Energy and Industrial Strategy (BEIS) adopts a big data approach as one way to monitor the development of green jobs and skills. Exploiting data from Lightcast, they apply machine learning algorithms to produce granular, real-time insights about the increase of "clean growth jobs" in the United Kingdom. In practice, this approach consists of an analysis of web-scraped OJVs across all online job postings in the United Kingdom, based on a keyword filtering approach and a machine learning process. In this way, BEIS traces and monitors job growth in specific low-carbon or net-zero sectors, occupations, skills, job roles and geographic areas. This information is then fed back to the central government and used as an empirical basis to inform policy making.

The big data approach of BEIS is framed by the government's 'Ten Point Plan for a Green Industrial Revolution' (Government of the United Kingdom, 2020[15]). With the goal of putting the United Kingdom at the forefront of global markets for clean technology, this strategic document outlines the ten priority industries for the green transition, namely: (1) advancing offshore wind, (2) driving the growth of low carbon hydrogen, (3) delivering new and advanced nuclear power, (4) accelerating the shift to zero emission vehicles, (5) green public transport, cycling and walking, (6) jet zero and green ships, (7) greener buildings, (8) investing in carbon capture, usage and storage, (9) protecting our natural environment, and (10) green finance and innovation. The 'Ten Point Plan for a Green Industrial Revolution' expects that up to 250 000 jobs will be created and supported in these industries by 2030, and a big data analysis is undertaken to provide insights into the type and quantity of jobs in each of these industries.

Definitions and methods

This approach adopts a definition of "clean growth job" based on the definitions set out in the Low Carbon and Renewable Energy Economy survey (LCREE) by the Office for National Statistics (Office for National Statistics, 2022[16]). A job is considered a clean growth job if: (i) a part of the role is related to "clean growth activities" (e.g. a technician who knows how to install a heat pump), or (ii) the role is located within a "clean growth company" (i.e. a company that operates in one of the sectors identified in the Ten Point Plan) and plays an active part in the company's activity (e.g. an accountant for a wind farm). The following table

provides concrete examples of how different online vacancies would be classified according to a keyword filter and a labelling method (see sub-section on methods and data below).

Table 5.1. **Classification of job advertisements as "clean growth jobs"**

Vacancy text	Keyword filter	Label	Notes
'… you will use your accounting skills to support development of our wind energy business'	1	1	Counted based upon LCREE approach – in a clean growth sector business
'Wind turbine engineer required'	1	1	Obvious clean growth sector job
'As a Blue Wind engineer you will support our advanced telecoms customers'	1	0	These companies could supply furniture or telecommunication services to wind sector or other green companies, however, they are outside of the LCREE definition and not detectable as "clean growth jobs" from the vacancy text.
'you will work for this major supplier of office furniture'	0	N/A	

Source: Information provided by the UK Department of Business, Energy and Industrial Strategy (BEIS).

As a result, the primary classification of "clean growth jobs" is done on an industry level, based on the prioritisation of the UK Ten Point Plan. BEIS also provides estimates according to occupations, skills, job roles or geographic areas, although this is not at the core of its analysis. Growth in demand for clean growth skills, for example, is extracted based on the skills taxonomy by Lightcast. This taxonomy currently consists of 17 000 individual labels which are organised into skill clusters (groupings of similar skills) and into skill types – specialised, software, and baseline skills (Burning Glass Technologies, 2019[17]).

Data on OJVs in the United Kingdom is available since 2013 and the database contains over 65 million job vacancies, covering the near universe of all OJVs. BEIS analyses the data in two main ways: (1) applying a keyword filter and (2) using a machine learning process. To identify potential "clean growth jobs", BEIS produces a list of keywords associated with each priority industry covered by the UK Ten Point Plan. These keywords are selected by labour market experts. The text in Burning Glass job postings is then searched for mentions of these keywords and a data sample is obtained and mapped to the corresponding industry. It is worth stressing two aspects directly stemming from this approach. First, the same job posting may be assigned to more than one industry if the text contains multiple keywords. Second, some "clean growth jobs" can remain undetected as the filter may not fully cover all the relevant keywords for each industry.

In addition, Machine Learning techniques are used to analyse four industries that are identified as priority industries in the Ten Point Plan by the UK Government (Table 5.2).

Table 5.2. Methodology applied by industry

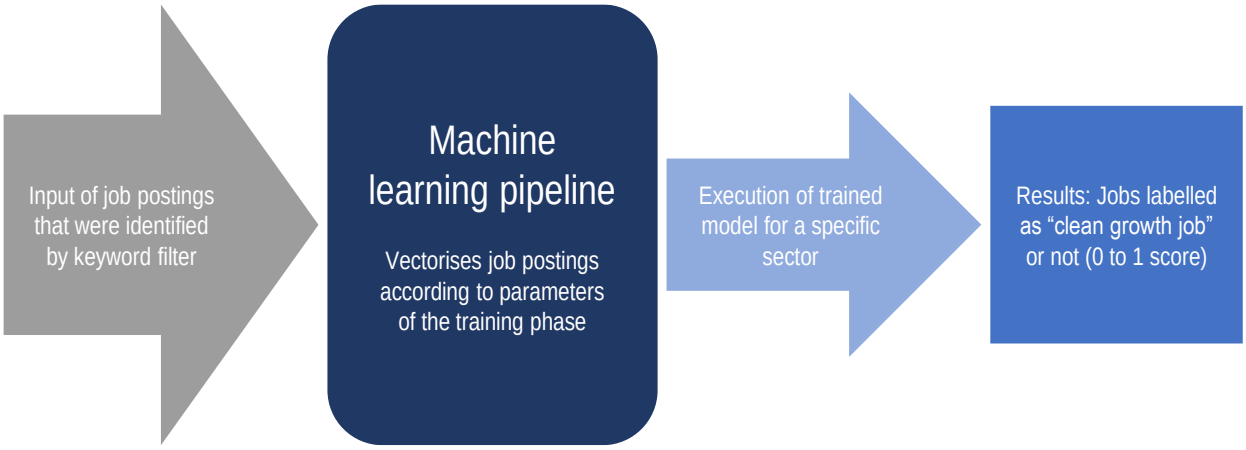
Industry	Keyword search	Machine learning
Wind	✓	✓
Hydrogen	✓	
New and Advanced Nuclear Power	✓	✓
Electric Vehicles	✓	✓
Green public transport and cycling	✓	
Jet zero and green ships	✓	
Heat and Buildings	✓	✓
Carbon Capture, Storage and Usage	✓	
Protecting the Environment	✓	
Green Finance	✓	

Source: Information obtained from the UK Department of Business, Energy and Industrial Strategy (BEIS).

The Machine Learning process is time-consuming and requires the development of a training dataset where a large sample of jobs from each industry are manually labelled to "train" and refine a machine-learning model. Experts provide labels for their sector, which encompasses a selection of relevant, "clean growth jobs". A portion of these labels are then fed into a machine learning pipeline, to "train" an algorithm that produces a model which predicts whether the job is a clean growth job for that sector or not. This means that new text from job postings is vectorised by the algorithm (a process that allows the algorithm to operate on a large set of values at the same time), assigned a 0 to 1 score, and designated as a relevant "clean growth job" or not based on the parameters provided by experts. The remaining portion of jobs labelled by experts is then used to test each model's performance and determine a threshold to increase accuracy.

The model (and corresponding threshold) is then applied to the full population of "clean growth jobs" to obtain a smaller but better-defined sample of relevant job postings. After this training phase, a similar process is followed to execute the trained machine learning algorithm (Figure 5.2).

Figure 5.2. Machine learning process applied by BEIS



Note: Authors' elaboration.

Application

This big data approach by BEIS to identify green jobs is used to regularly provide evidence and insights to the central government. Findings on the geographical distribution of emerging "clean growth jobs", for example, have high political relevance and may feed into policy making. Findings can also be shared with the Green Jobs Delivery Group, a forum between government and industry leaders (Government of the United Kingdom, 2022[18]).

The big data analysis by BEIS is currently not used to forecast the trajectory of "clean growth jobs" in the future. In addition, the approach focuses specifically on growth in "clean growth" occupations rather than green skills. Although the keyword filter is applied to tasks, activities and skills, these keywords are then used to label "clean growth jobs". A skills summary is currently provided for each priority industry as one of a number of elements of the reporting.

Case study 3: Defining green skills and knowledge concepts in ESCO

To support job mobility across Europe and a more integrated and efficient labour market, the European Classification of Occupations, Skills ad Competences (ESCO) provides a dictionary of the skills and

occupations relevant to the European labour market and adult learning landscape that can be used by stakeholders to share a "common language".[3] This taxonomy is very detailed, providing descriptions of 3 008 occupations and 13 890 skills linked to these occupations, and have therefore played a key role in shaping European-level policies on skills anticipation, job mobility and adult learning (European Commission, 2022[19]).

In 2021, the ESCO Secretariat conducted novel research to build a taxonomy of skills for the green transition, as part of the action plan of the European Skills Agenda, a five-year plan published by the Directorate-General for Employment, Social Affairs and Inclusion of the European Commission to strengthen sustainable competitiveness, ensure social fairness and build resilience. In particular, to support progress on the 2019 European Green Deal, the ESCO team set out to identify what skills and knowledge concepts are closely related to green activities, i.e. activities that reduce environmental degradation. To achieve this ambitious goal, big data analysis through machine learning (ML) techniques was conducted (European Commssion, 2021[20]).

Definitions and methods

The ESCO team created a dataset to train the machine learning algorithm to identify and classify skills as green, brown, and white. This training dataset was composed of about 4 800 strings of text (sentences and short definitions) extracted from over 30 European and international sources, describing activities as either environmentally sustainable, polluting, or none of the two. Text strings had been selected based on source reliability and their similarity to the structure and description of ESCO skills. The sources from which the text was collected include: 1) standard jobs and skills classifications, such as the EU taxonomy for sustainable activities, the O*NET skills taxonomy and the classification by the French *Observatoire national des emplois et des métiers de l'économie verte* (ONEMEV); 2) online job vacancies, such as Indeed; 3) European or national legislation; and 4) related reports from international organisations, such as the OECD, ILO and UNIDO.

Strings of text are then distinguished as brown (400 elements), white (2 100 elements), and green (2 300 elements). For example, 'production of electricity by coal' was classified as a brown element, while 'cogeneration of heat/cool and power from geothermal energy' as a green element (Table 5.3). The 'white skills' label is added to account for skills that are difficult to clearly classify as green or brown.

Table 5.3. The classification of text strings in the ESCO training dataset

	ESCO definition	Example of string for training data (source)
Brown	knowledge and skills which increase the negative impact of human activity on the environment	Production of electricity by coal (ILO "Skills for a Greener Future")
White	knowledge and skills which do not increase nor reduce the negative impact of human activity on the environment	Test computer or software performance (Australian Skills Classification)
Green	knowledge and skills which reduce the negative impact of human activity on the environment.	Cogeneration of heat/cool and power from geothermal energy (EU Taxonomy for Sustainable Activities)

Source: European Commission (2021[20]).

The labelling process used in ESCO follows a 3-step methodology, which combines human labelling and validation, and the use of machine learning algorithms. Firstly, skills and knowledge concepts are manually labelled by ESCO experts based on the definition of green skills suggested by Cedefop.[4] This manual labelling was conducted by comparing green skills definitions and the description of each skill from ESCO v1.1.

In the second step, a machine learning classifier was applied to classify green, brown and white skills among all the ESCO skills. Using the training dataset, the classifier was built using a pre-trained ML

technique for natural language processing developed by Google called the Bidirectional Encoder Representations from Transformers (BERT) model, based on the Python programming language. The results of the classifier analysis yielded the likelihood of each skill and knowledge concept being green (European Commssion, 2021[20]).

Lastly, the classification of skilled developed through the ML classifier was reviewed and validated through a comparison with manually labelled results. This verification focused on minimising the possibility of 'false positive' and 'false negative'. The final round of validation follows the following rules:

- If a concept is labelled as green by the two methods (manual and ML classification), it is automatically accepted as green;
- If a concept is labelled as non-green by the two methods, it is automatically accepted as non-green;
- If a concept is labelled as green by only one of the two methods, it is revised.

As a result, a total of 571 ESCO skills and knowledge concepts were labelled as green, including 381 skills, 185 knowledge concepts, and 5 transversal skills. ESCO also provides additional information such as the essential and optional relationship between each skill and occupation.

Application

ESCO's research on green skills is not technically an approach to SAA, as it focuses on identifying and categorising those ESCO skills and knowledge concepts that are relevant for the green transition, without undertaking a fully-fledged assessment of current skills needs or a forecasting of future skills for the green transition. Yet, ESCO's research identifies the skills that are currently the most prominent (therefore, expected to increase in demand) in relation to the green economy and green growth, and does so through the analysis of vast amount of data sources.

Policy makers in European countries could therefore build on the ESCO green skills taxonomy to construct their skills assessment and anticipation exercises and ensure the sufficient provision of training opportunities for these skills (ILO, 2015[21]). In this respective, ESCO encourages the public dissemination of their results and provides detailed information to guide those interested in using the ESCO green skills classification. Potential users include not only researchers, but also public employment services and education and training providers – as it offers a rich source of information to design training curricula around green skills (European Commssion, 2021[20]).

Global insights

Identifying the links between green jobs and training using a linguistic approach by O*NET

In 2022, O*NET, which provides a comprehensive taxonomy for occupations and skills in the American labour market, produced a novel big data analysis extracting green occupations and related training programmes using a linguistic approach algorithm similar to the efforts undertaken by ESCO. In particular, O*NET extracted 72 keywords on green topics from previous green-related research (National Center for O*NET Development, 2009[22]), and used these keywords as input in a machine learning algorithm to identify a range of 5 to 36 green-related occupations for each topic. Subsequently, a similar algorithm is used to identify which training courses included in the 2020 Classification of Instructional Programs produced by the Department of Education are related to each green topic. On average, 16 training programmes are connected to each topic. The full results are released on the O*NET webpage so that they can inform individuals who wish to search for careers and training related to green jobs and skills (National Center for O*NET Development, 2022[23]).

Case study 4: Using LinkedIn's Economic Graph to assess green skills

The popular social network LinkedIn houses one of the world's largest database of professional profiles and vacancies. The platform has more than 850 million members worldwide that input their professional profiles in the database, including data on skill demand through vacancies and skill supply through member profiles. The LinkedIn Economic Graph team has been tasked with using the company's data to carry out skills assessment in labour market areas that are particularly relevant to the new world of work.

In 2022, the team published the Global Green Skills Report 2022, a report that outlines the important role of human capital in greening the economy (LinkedIn, 2022[24]). The study features analysis on green jobs and green skills, how people's skills profiles are changing, how demand for green skills is evolving, and assessments on whether the green transition is just and inclusive. The report provides analysis at the country and sector level and measures gaps in green skills for specific socio-economic groups.

Definitions and methods

LinkedIn's approach to classify green skills is based on two initial qualitative definitions: the definition of green projects and a preliminary definition of green skills.

- First, green projects are defined as those that involve a focus on one or more of 12 Green Activities.[5] The list is based both on internal analysis – such as the 2019 Green Economy analysis produced in-house by the LinkedIn Economic Graph research and Insights team – and external taxonomies – namely, the definitions of green jobs and green goods and services produced by the Bureau of Labour Statistics of the United States through their O*NET Resource Center. Essentially, a green projects can be understood as a set of (economic) activities that are at least partially green.
- The second qualitative definition that feeds into the analysis is a preliminary list of green skills. This list is compiled using four sources of information: LinkedIn top skills (most cited skills by members in their profiles), inputs from the Economic Graph Team, interviews with industry experts, and ESCO.

This preliminary list on green skills is fed into a machine learning algorithm to identify which skills in the LinkedIn database can be labelled 'green'. The database draws mainly on information about skills found in the individual profiles of users, located under the 'Skills' section of a member profile and in the free text areas of the profile. Through the process of identifying green skills in the data, the Economic Graph team adds additional filters to capture relevant skills. The new list of green skills is then classified into four categories outlined in Table 5.4.

Table 5.4. Green skills classification

Green Skill Classification	Description
Green Skills	Clearly associated with "green" occupations
Ambivalent Skills	Utilised in both the Green Economy and elsewhere
Adjacent Skills	Tangentially associated with the Green Economy
Not Green Skills	Unassociated with Green Economy clearly, partially, or tangentially

Source: LinkedIn Economic Graph (2022[25]), https://economicgraph.linkedin.com/data-for-impact.

The green projects (i.e. projects that comprise of one or more of the 12 Green Activities) and green skills classification serve as inputs into the classification of what LinkedIn calls "green occupational titles" (Table 5.5). This terminology is used to identify which jobs are considered green, greening, or potential greening. LinkedIn essentially first identifies green skills and green projects, and then defines green occupational titles as those that contain green skills or green projects. This classification of green occupations can be used to assess the increase in green jobs in labour markets, but also shows how fast are green jobs growing compared to non-green jobs on a country and sector level.

Table 5.5. Green Occupational Classification

Green Titles	Occupations that usually work with Green Projects	or	Require Green Skills
Greening Titles	Occupations that sometimes work with Green Projects	and	Typically require some level of Green Skills
Greening Potential Titles	Occupations that occasionally work with Green Projects	and/or	May require some level of Green Skills

Source: LinkedIn Economic Graph (2022[25]), https://economicgraph.linkedin.com/data-for-impact.

The green skills classification is also used to quantify skill intensity – the extent to which different entities (e.g. countries, industries, and occupations) use these skills. This analysis relies on entities' "most characteristic skills", called a skills genome. The skills genome is an ordered list of the ~50 skills reported with most disproportionate frequency by members in any given entity. An algorithm called TF-IDF ranks each skill on the basis of i) how frequently it is reported by a member in the entity (TF), and ii) the logarithmic inverse entity frequency of the skill across a set of entities (IDF), which indicates how common or rare a skill is in the entire entity set. The more unique a skill is to a given entity, the more likely it is to be in the skills genome. Green skill intensity is then measured by assessing what share of the skills genome is comprised of green skills. Green skill intensity was used to help differentiate greening and green potential titles, and also track the flow of labour from greening, green potential and non-green jobs into green jobs.

Application

The project was initiated prior to the 2021 United National Climate Change Conference, as the company saw a need by policy makers to have more information and analysis on the labour market changes due to the green transition. The report provides a global overview of skills trends along with some sector and country-specific analyses, and includes action plans for policy makers, business leaders, and the global workforce. Selected green data are available for multilateral institutions – such as the World Bank, the International Monetary Fund, Inter-American Development Bank and OECD – through LinkedIn's "Data for Impact" programme (LinkedIn, 2022[26]). Currently, data-sharing with national governments is limited and takes place on request.

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Notes

[1] OJVs are not only useful for SAA exercises. For example, in 2022, Sweden's Public Employment Service and JobTech Development released the *JobSearch Trends* dataset, which analyses job postings to understand what jobseekers look for when using the PES online platform (JobTech, 2022[28]).

[2] The motivation behind creating skill clusters is to deconstruct the traditional notion of occupational classifications and qualifications to get a more nuanced understanding of skill needs and their transferability (National Skills Commission, 2021[14]).

[3] ESCO is a European Commission project, run by the Directorate General for Employment, Social Affairs and Inclusion (DG EMPL).

[4] Cedefop (2012[27]) defines green skills as "the knowledge, abilities, values and attitudes needed to live in, develop and support a society which reduces the impact of human activity on the environment".

[5] The Green Activity Categories (and sub-categories) are as follows: pollution prevention, waste prevention, renewable energy generation, energy management, environmental remediation (including waste management, water quality management, environmental restoration), ecosystem management (including natural resource management, erosion control, biodiversity conservation, water resource management, climate change mitigation and climate change adaptation), sustainable education, sustainability research, environmental auditing (including environmental impact assessment and carbon accounting), environmental policy (including energy law and environmental law), sustainable procurement and environmental finance.

6 Using the results of skills assessment and anticipation for evidence-based policy making

Even if there is available evidence on skill shortages linked to the greening of the economy, it is often unclear whether and how this information is used in policy making. This chapter reviews ways in which general insights from skills assessments and anticipation exercises have been applied directly or indirectly to steer policies in a range of areas such as adult training, formal education, career guidance, employment policies, industrial policies, and migration policies.

Introduction

For the output of SAA exercises to support the green transition, it is crucial that the results feed into actual policies and actions to improve the country's responsiveness and resilience. Unfortunately, the use of SAA results to support the green transition is currently limited to very few examples. This could be because policy makers have only recently devoted attention to SAA as a tool to plan for the green transition. Another potential explanation is that the green transition is cross-disciplinary and requires collaboration between many stakeholders, which can slow down the negotiations on how to use the final outputs. Nevertheless, the potential value of SAA exercises in green policy making remains largely untapped.

Before investigating why there are limited policies that are founded on green SAA exercises – which will be the focus of the next Chapter – it is important to understand what the relationship between SAA and policies is. To provide examples of good practice for adoption and adapting policies based on green SAA results, this chapter presents an overview of how general SAA exercises are being used by different actors in a broad range of policy areas. The goal is to showcase as many policy uses as possible, in order to underscore the potential of SAA exercises to support evidence-based policy making. In a first instance, six policy areas with direct and straightforward uses of SAA results are identified – namely adult training, formal education, career guidance, employment policies, industrial policies and migration policies. Second, for each of these, examples of existing case studies are presented to show how systems can be set in place to translate results into action. This will provide the basis for understanding how SAA exercises can influence policies, which will launch the discussion in Chapter 6 on how green SAA exercises are and should be utilised.

The policy taxonomy

The policy taxonomy presented in Figure 6.1 provides a conceptual overview of potential uses of SAA results in different policy areas. In the area of adult learning, the results of skills assessment and anticipation exercises may be used to update the content of training courses for adults, guide public funding decisions about training, guide the design of financial incentives for employers and individuals, and plan the professional development of trainers. These adjustments may help to reduce skills mismatches in the labour market, facilitate the job placement of unemployed adults, and build capacity for training on skills that are in-demand in the labour market.

In formal education, SAA exercises provide valuable information that is used to update qualifications and curricula, to determine student numbers, and to develop apprenticeship programmes. Robust evidence on emerging occupations and skills can help education systems to revise their offer to better prepare students and apprentices for future labour market and skills demands. Determining study places based on information from SAA is particularly important to prevent large field-of-study mismatches in the labour market, while at the same time supporting the labour supply for occupations in high demand. In the field of apprenticeships, policy makers have an interest in relying on SAA exercises to design high-quality vocational programmes that meet the changing requirements of occupations.

In many countries, the results of SAA exercises are also used to update career guidance services and provide labour market information to individuals needing career orientation or training opportunities. Public employment services, for instance, often use the insights of SAA to support job counsellors with updated labour market and skill needs information. Combining this information with a personalised mapping of skills is particularly useful to identify suitable career pathways or training opportunities for individuals. Labour market information systems, which make the results of SAA exercises accessible through brochures, websites or online tools also support individuals in making well-informed choices about their careers.

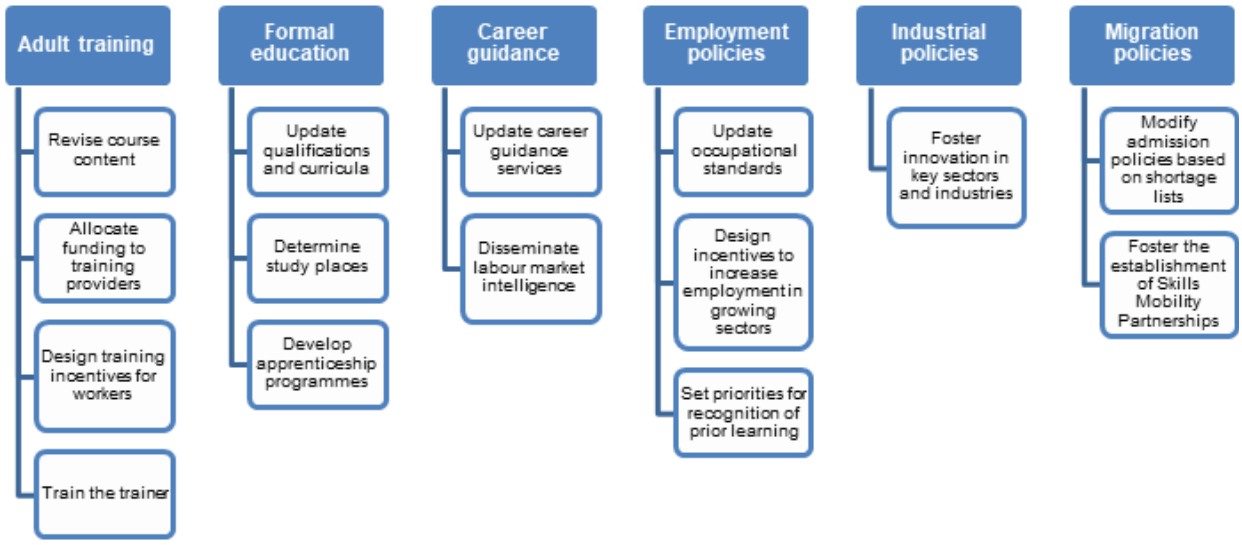
In the domain of employment policies, skills assessment and anticipation exercises are particularly useful for governments to update occupational standards, inform structural adjustment policies about skills needs

in growing and declining sectors, and guide adjustments in programmes for recognition of prior learning. The update of occupational standards is often connected to changes in qualification frameworks and education or training curricula, taking emerging occupations and changing skills requirements into consideration. SAA results can also inform the design of financial incentives to foster employment in growing sectors. For instance, information on the demand for and supply of skills in different sectors can aid policy makers in designing support systems in of the context of industrial restructuring or mass layoffs where re-training to transition to growing sectors and occupations may be needed. Finally, findings from approaches to assess and anticipate skills can be used in the context of the recognition of prior learning, to set priorities for skills validation and update existing programmes.

SAA exercises can also be a useful reference in industrial policies aiming to support firms' innovation and productivity growth through tax and financial incentive for businesses. Information on changes in the demand and supply of skills and occupations, can help policy makers and firms to effectively select areas that require intensive R&D investment. Given that recent industrial policy emphasises the importance of training to foster innovation and technology development, SAA is expected to play an increasingly important role in industrial policy.

Finally, skills intelligence also plays an important role in the design of migration policies. In some OECD countries, SAA exercises are the basis of occupational shortage lists which determine the entry requirements for migrant workers. This way, countries facilitate the inflow of workers with the skills to work in occupations in shortage. Some countries have established Skills Mobility Partnerships – typically bilateral or multilateral agreements concluded between states that foster skills development and workforce mobility – and can be informed by SAA to target priority skills and sectors in the destination country.

Figure 6.1. The use of SAA in different policy areas



Source: Authors' elaboration.

Adult training

In many countries, the results of SAA exercises are used to update the content of training courses for adults, to guide funding decisions about adult training, to update the professional development of trainers, and to design financial incentives for training. In some cases, the findings of SAA exercises are used directly to identify training areas for skills in shortage and then adjust the existing training offer, or to target subsidies available for training providers. Such a targeting of training could concern publicly adult training offered public employment services or public training institutions, but also employer-sponsored learning in firms. If SAA exercises identify a particular area of skills shortages, such as IT skills, targeted government support programmes may be put in place to support skills development in this area. Policy makers can also choose to target financial incentives such as subsidies for training that are available to individuals, employers or training providers to skills in demand and shortage occupations. Other mechanisms are more indirect, for instance, when SAA exercises feed into established governance bodies in the area of labour market and adult learning, to inform the formulation of priority areas for training and the funding schemes linked to it. Overall, these mechanisms may help to reduce skill mismatch in the labour market, facilitate the job placement of unemployed adults, and build the capacity of the adult learning system to provide training in high-demand skills.

Revise course content

Skills assessment and anticipation can produce valuable information on labour demand and supply and help forecast areas where skills shortages are likely to emerge in the future. Many countries exploit these key insights of SAA exercises to guide the content of training programmes for jobseekers and workers. For instance, the results of SAA exercise can be used by training providers to adjust their course offer and target skills where shortages are emerging, thereby helping workers or jobseekers to improve their labour market prospects in the future or transition to a different occupation. Evidence generated through SAA exercises may also inform policies on the up- and re-skilling of workers in employment.

Belgium has a tradition of using the results of SAA exercises to adapt the training offer to labour market needs. Both in Flanders and Wallonia, SAA exercises are used by public employment services to actively guide the training of the unemployed towards occupations in shortage. In Wallonia, the public employment service (Forem) run SAA exercises on skills shortages and mismatches to inform the provision of specific training programmes and sessions. This adaptation of training areas happens through several channels, notably through changing the eligibility and use of financing instruments (e.g. "*cheques formation*"), or by issuing call for tenders in emerging training fields. In Flanders, the mechanism through which training areas are adjusted according to the findings of SAA exercises is not direct but based on established channels of social dialogue and collaboration between labour market analysis and policy making for evidence-based training policies (OECD, 2017[1]).

In France, the *Réseau Emplois Compétences* (Network Employment Skills) brings together different stakeholders to produce analyses on skills trends, regional employment, and training in enterprises. Led by France Stratégie, it brings together sectoral and regional observatories, stakeholders in the field of employment, training and vocational guidance, and other experts. The studies and forecasts produced by the *Réseau Emplois Compétences* are useful tools for employment services, guidance and training providers, and aim to ultimately support companies and workers in adapting to changing skill demand. Its workshops and events provide fora for exchange among experts and practitioners to put insight into action and develop tailor-made, co-ordinated solutions to training. Summary reports produced by working groups within the Network are intended to contribute to the rethinking of practices in the area of employment, training and career guidance and may be used by intermediary bodies in these policy fields to provide information to individuals and the public (France Stratégie, 2022[2]).

The public employment service in Estonia runs the programme 'Work and Study' for adults in employment. The programme targets adults that are at risk of unemployment due to a low level of qualifications, a lack

of Estonian language skills, or with low income. Employers can apply for a training grant to upskill their employees in certain identified shortage occupations. The design of training programmes is limited to fields that are growing and experiencing skills shortages, as determined by sectoral analyses conducted by the Estonian Qualifications Authority (European Commission; Directorate-General for Employment, Social Affairs and Inclusion; Sienkiewicz, Ł, 2022[3]; Eesti Töötukassa, 2023[4]).

In Austria, the Standing Committee on New Skills by the Public Employment Service (PES) was established in 2009 to identify changes in skills and qualification needs. Based on SAA exercises produced by working groups that consist of experts from the public and private sector, the Committee suggests and develops continuing education and training programmes that make it easier for jobseekers to re-enter the world of work. Each working group formulates a list of current and future sector-specific requirements for employees and jobseekers in their respective sector. The output by the Committee is then used by the Austrian PES to develop call for tenders for certain active labour market programmes and also serves as a guide to continuing training in companies and specific occupations. In this way, the results of SAA exercises effectively influence the content of adult training and decisions on the allocation of PES funding (Cedefop, 2022[5]).

Allocate funding to training providers

The results of SAA exercises may guide funding decisions about adult training, particularly when it is publicly financed. In principle, governments can adjust training policies according to skills shortages and mismatches by changing eligibility criteria for subsidised training (e.g. for adults working in a particular sector, or training provided in a particular field), setting requirements for certain funding instruments (e.g. training grants for certain in-demand skills), or the designing of tenders for private training providers. Decision makers may also decide to dedicate funding to finance targeted training programmes in sectors or occupations with strong skill shortages.

The provision of public vocational training in Japan is built on a strong system of skills assessment and anticipation to ensure that the training provided is relevant (OECD, 2021[6]). The exercises generally involve a range of stakeholders and influence both the content of publicly funded vocational education and training, as well as the allocation of training funding. At the national level, the Ministry of Health, Labour and Welfare leads the work of a Central Training Council, which assesses priority areas and the scale of the public vocational training offer on an annual basis in order to contribute to its effective development based on the skills needs of industries. The Council undertakes a number of skills assessments relying on an analysis of the employment rate by field of vocational training and additional data from the Public Employment Service on job openings and job seekers by industry and occupation. Moreover, on an ad hoc basis, more specific SAA exercises are carried out to better understand the skill needs in certain industries or occupations. In 2016, for instance, a special council was convened for the promotion of skills development for the fourth industrial revolution, with a particular focus on IT skills. This ultimately contributed to the Growth Strategy 2017 in the form of an Intensified Emergency Plan on Enhancement of IT Capacity. Overall, the results of the SAA exercises conducted by the Central Training Council and its local branches converge in training plans, which are used by all providers of publicly funded vocational training as a guideline to determine their public vocational training offer (OECD, 2021[6]).

The Federal Government of the United States launched the TechHire programme in 2015 as a dedicated training programme to respond to the acute skills shortage in the IT sector identified through SAA. In essence, the programme consists of grants provided by the Department of Labor to support public-private partnerships across the United States, which provide training through universities, community colleges and “coding camps”. Its goal is to offer alternative training pathways that allow workers without a college degree to upskill and reskill (Opportunity@Work, 2023[7]).

Design training incentives for workers

Subsidies for adults to participate in training compliment subsidies for training providers, and act in a more direct way to incentivise training participation. Notably, these subsidies are crucial when training options are available but not used. In this context, subsidies that either promote the participation in training courses or employer-provided and on-the-job training can help address skill gaps in particular areas by addressing financial barriers to participation and provision more directly. SAA exercises can help design targeted vouchers and stipends for individuals, and financial and administrative support for employers. SAA helps identify which sectors and occupations face large skills mismatches and compare those to data on training, to identify skills and occupations that face a high labour-market demand but low participation or provision of training courses. If an SAA exercise intends to target such initiatives it often has to rely on data from a wide range of sources, as well as collaboration between different ministries, government bodies and key stakeholders, including employers themselves.

In Canada, information from skills assessment and anticipation exercises are used to generate economic incentives for employers to upskill or reskill workers or new hires through the Canada Job Grant (OECD, 2016[8]). The Canada Job Grant provides direct financial support to individual employers or employer consortia who wish to purchase short-term training to existing and new employees in sectors and industries facing important skill shortages. Employers can get up to CAD 10 000 support per person for training costs. Employers with 100 or more employees need to contribute half of the training cost, while small employers with less than 100 employees need to contribute to 1/6 of training costs. For small employers (less than 100 employees) who are training and hiring unemployed individuals may be eligible for 100% funding and up to CAD 15 000 per trainee. Employer groups can also apply for support through the Consortium Stream, which allows two or more employers to pool their resources to support common training objectives. The programme is delivered on a provincial level and is available in five out of ten Canadian provinces.

In Estonia, the Ministry of Education and Research manages the Labour Market Monitoring and Future Skills Forecasting OSKA exercise, which is used to analyse skills needs and identify training courses that adults can access through training vouchers. Training vouchers are offered through the Estonian Unemployment Insurance Fund managed by the Ministry of Social Affairs. The aim of the voucher scheme is to provide free upskilling and reskilling opportunities for people whose skills and qualifications do not meet the demand of the labour market, because either their skills are becoming obsolete due to technological changes or they initially trained in a sector facing decline. Initially only available for unemployed adults, since 2017 the scheme has been extended to employed adults as a measure for preventing unemployment through job-related training (OECD, 2020[9]). To be eligible for training vouchers, those in employment must meet certain criteria, such as the inability to continue their current position due to health issues; being above 50 years of age; low income; lacking professional or vocational education and/or having insufficient language skills for further occupational development. The vouchers can cover training up to EUR 2 500, for training that lasts up to 2 years for unemployed adults and 3 years for employed adults.

Train the trainer

Where the results of SAA exercises are used to adjust the course content and financing of adult training, or even to update qualification frameworks, curricula and apprenticeship programmes (see section on formal education), they may also influence the professional development of teachers or trainers. This is one aspect that helps keeping education and training programmes up-to-date and responsive to skills needs.

In England, for instance, the results of skills analyses are used to identify training gaps and professional development needs of teachers in vocational education and training institutions. Based on the results of SAA, teachers involved in delivering training for young people or adults are given a tailored plan for training

and professional development, including subject-specific training that focuses on practical skills development (OECD, 2021[10]; Education and Training Foundation, 2018[11]).

Formal education

Robust evidence produced by skills assessment and anticipation exercises can enhance the effectiveness of education policy by helping to make the content of school, vocational education and higher education more responsive to labour market demand. Strengthening skills anticipation capacity can also help education systems to better navigate the high degree of uncertainty surrounding changes to future labour markets and skills demands. In most countries, information from SAA exercises is used to design new qualifications, reform curricula, decide which courses to fund, or set targets for higher education including universities, polytechnics and adult learning provided by education institutions.

Update qualifications and curricula

The curricula of primary and higher education programmes, as well as their qualification standards, need to be continuously updated to ensure that they keep focusing on those skills most requested in the current and future labour markets. In this perspective, the systematic assessment and anticipation of skills needs is particularly important to design and plan the necessary courses sufficiently in advance, since it takes several years to implement them (ILO, 2015[12]). SAA results could also influence the design of new types of modular qualifications, such as micro-credentials, that provide a more flexible and learner-centred approach.

In Finland, the National Forum of Skill Anticipation – composed of employer and employee representatives, VET providers, higher education institutions, and teaching staff – conducts quantitative and qualitative SAA exercises to inform education and training design. Results feed in the drawing up of national qualification requirements and planning of educational curricula by the Finnish National Agency for Education (Ministry of Education and Culture, 2022[13]). The Ministry of Education and Culture also used the results of the National Project on Anticipation of Competences and Skills Needs that provided anticipation of the occupational structures changes in different industries for the establishment of the Development Plan for Education and Research for 2011-16. The Plan decided on the targets for provision of education and drew an overview of the types and amounts of provision that would be required in the future in initial and adult education (Hanhijoki et al., 2012[14]).

In Estonia, OSKA focuses on the skills assessment and anticipation for five or six sectors, thereby managing to cover all key professions over a five-year period. The Estonian Qualification Authority (EQA) uses OSKA to update the Estonian Qualifications Framework and to ensure consistency and quality in the process of referencing Estonian qualifications to the European Qualification Framework levels (Kutsekoda, 2022[15]).

In the Netherlands, the Education and Labour Market Project initiated by the Research Centre for Education and the Labour Market produces a general labour market forecast mainly including warning indicators of possible imbalances between supply and demand in the labour market every other year. The information is especially influential in shaping educational policy, where many programmes and curricula are adapted or created with the intent of satisfying future skills needs (Cedefop, 2017[16]) (Fouarge, 2015[17]). The Higher Education Efficiency Committee, which is responsible for the accreditation of new study programmes in higher education, uses the forecasts of the Education and Labour Market Project in their evaluations to avoid that fields that are in excess supply open new education programmes (Higher Education Efficiency Committee (CDHO), 2022[18]).

Determine study places available

In order to minimise mismatches in the labour market, supplying enough graduates for those sectors and occupations most in need is crucial, especially in fields where labour shortages are intensified due to the digital and green transitions. Currently, study places often remain low in high-demand fields. For example, across the OECD, only 6% and 14% of new entrants to tertiary education in 2020 were enrolled in information communications technology (ICT)-related programmes and in health and welfare, respectively, despite these being high-demand sectors (OECD, 2022[19]). Exploiting SAA results could prove key to adjust the places available for students by field of study and support education institutions in mitigating skills mismatches.

The Swedish National Agency for Higher Vocational Education uses long- and medium-term skills anticipation results produced by Statistics Sweden to plan the number of places available in their higher vocational education programmes (OECD, 2016[8]). Local education providers have also routinely utilised these SAA results to decide which education programmes to offer and the extent of scale. For example, three regions (Skåne, Västra Götalandsregionen and Östergötland) conducted an in-depth analysis of the local labour situation of engineers and nurses for educational programme planning and funding based on the skills anticipation (Cedefop, 2017[20]). Similarly, in Austria, Universities of Applied Sciences (*Fachhochschulen*) need to motivate the modification of available study places with the results of skills forecasting exercises.

Assessing and anticipating skills can provide a particularly suitable sources of information to determine the number of students that are accepted for enrolment in health education programmes. The Advisory Committee on Medical Manpower Planning (ACMMP) in the Netherlands provides health education institutions with a recommended intake size for each programme based on their quantitative forecast scenarios. The “Allocation Decree” of the Dutch Ministry of Health, Welfare and Sport also refer to ACMMP’s recommendations to set the student quota for health education programmes each year (OECD/ILO, 2022[21]).

Develop apprenticeship programmes

Depending on the design of their labour market and education systems, in many countries apprenticeships can play an important role in addressing growing skills shortages by fostering high-quality programmes that meet employers’ skill needs. However, to make sure that they focus on those sectors, occupations and skills most in demand, apprenticeship programmes could make better use of the results of skills assessment and anticipation exercises (Department of Education, 2017[22]).

In Portugal, the Qualification Needs Anticipation System (SANQ) has been established by the National Agency for Qualification and Vocational Education and Training to evaluate which qualifications are needed in the labour market to plan the supply of professional and apprenticeship courses. SANQ ranks qualifications from one to ten according to priority levels, using a variety of data sources and indicators, such as statistical data on recent employment dynamics, a survey to identify skills needs of employers, and job vacancies at regional and occupational level. The Institute for Employment and Vocational Training combines the SANQ results with their own labour market anticipation system to determine which fields should be prioritised when developing apprenticeship courses and, more widely, compulsory formal education programmes (OECD, 2019[23]; Cedefop, 2021[24]).

The Expert Group on Future Skills Needs (EGFSN) in Ireland carries out analyses and research on future skills requirements at thematic and sectoral levels. Its skills anticipation exercise is used to create apprenticeship programmes and assess their effectiveness. For example, consortia of labour market actors submit their proposal on new sectors/occupations for which a new apprenticeship programme may be developed and offered referring to the EGFSN’s skill assessment report (EGFSN, 2021[25]).

Career guidance

Some career guidance services provide a mapping of skills that an individual has (OECD, 2021[26]). Combining such a skills mapping with insights from SAA exercises about the labour market prospects in different sectors is particularly useful in determining suitable upskilling and reskilling pathways for adults who are seeking a change in their career. The results of skills assessment and anticipation exercises may be used in career guidance policy in two main ways: informing career guidance professionals of developments in skill needs; and updating online platforms that provide information on the labour market prospects of certain occupations and upskilling opportunities for in-demand skills. Career guidance services and information that is regularly updated with the findings of SAA exercises supports adults and young people in making well-informed choices about potential career pathways and upskilling or reskilling opportunities.

Update career guidance services

The use of up-to-date information generated through SAA is crucial to provide tailored career guidance and employment counselling services with a strong evidence basis. In many OECD countries, the insights of SAA exercises are actively used by public employment services to support career guidance professionals with updated labour market information (European Commission; Directorate-General for Employment, Social Affairs and Inclusion; Sienkiewicz, Ł, 2022[3]). SAA may also influence a change in career guidance policy itself.

The German public employment service is continuously updating the information provided to jobseekers and adults looking for advice by incorporating newly emerging skills and occupations in green and digital sectors into career guidance services. Moreover, updated information from SAA exercises is also used to further develop IT procedures, for instance, self-exploration tools, occupational orientation and online career guidance (European Commission; Directorate-General for Employment, Social Affairs and Inclusion; Sienkiewicz, Ł, 2022[3]). Another, more indirect impact of SAA exercises in Germany concerns the extension of eligibility for public career guidance services. As a consequence of the shortage in skilled labour and low participation rates in adult learning, since 2019 public employment services in Germany are obliged to offer career guidance to all adults regardless of their age and work situation. This means an expansion of their mandate, and a widening of eligibility to career guidance services in response to demographic and structural changes in the economy (National Guidance Forum in Education, Career and Employment, 2022[27]).

The Canadian Future Skills Centre provides analysis on career transitions in Canada, relying on a skill-based assessment of viable and attractive career pathways workers could choose. A section of this analysis focuses on workers in tourism and hospitality in Ontario, for instance, where employment has been shrinking since the outbreak of the COVID-19 pandemic. The analyses by the Future Skills Centre are freely available online and disseminated in workshops and events, to inform the work of career guidance practitioners (Future Skills Centre, 2021[28]).

Disseminate labour market intelligence

The results of SAA exercises may feed into online platforms that provide orientation and guidance on the labour market prospects of different occupations as well as linking labour demand to upskilling and reskilling opportunities. In many countries, public employment services or adult learning institutions run informative websites, or offer online tools, that rely on evidence from SAA exercises. If sufficiently accessible, these types of information platforms help individuals find targeted orientation about career choices and adult learning opportunities, based on up-to-date future skills needs.

The dissemination of SAA results to a wider public is perhaps most exemplary in Finland, where the public employment service runs a web-based system called ForeAmmatti. It provides comprehensive and

up-to-date labour market information that can be used to better understand regional labour markets, available training, competences required for different jobs, and labour market forecasts.[1] Individuals can register to unlock services, map their competences and receive suggestions for jobs or upskilling and reskilling opportunities The system provides the average number of job openings for a specific occupation in a particular region (e.g. pharmacists in Pohjois-Karjala), based on both historical and projected data. It also shows the regions where the specific occupation is in greatest demand and the degree to which competition for jobs in these occupations is likely to change in the coming years. This information is based on data from public employment services, analyses of job postings and different forecasts (OECD, 2016[8]). ForeAmmatti also targets experts in employment services, coaching, vocational rehabilitation, and educational institutions, who can access skills forecasting for the purposes of planning and designing their services. Based on the ForeAmmatti portal, career guidance professionals can share information with clients, provide online tools and resources (e.g. a competence mapping), and suggest individualised steps towards employment, education, or training. Different modules on ForeAmmatti provide support for coaching, labour market information, and solutions to improve skill mismatch (ForeAmmatti, 2022[29]).

The Austrian Public Employment Service (PES) also runs an online information system on labour market prospects, called the Skills Barometer, which is fed with the data of a comprehensive skills anticipation and assessment exercise. Conducted twice a year, the Skills Barometer provides information on general labour market trends, and skills supply and demand. It compiles information from quantitative analysis, job advertisements, studies on skills demand, and expert surveys. In essence, the barometer compiles and organises information on skills trends and makes it publicly available through an online tool, which is openly available. The main target groups are young people or jobseekers, but also career guidance professionals, employment counsellors, educational institutions, or policy makers (Eurofound, 2022[30]). In practice, the Skills Barometer is used by counsellors in the Austrian PES' career information centres and by those in charge of planning training programmes in the provincial PES offices (Cedefop, 2023[31])

Employment policies

Assessment and anticipation exercises can be particularly informative, as they provide timely insights into how labour markets function and what policies can better promote high-quality jobs. Through a focus on skills (rather than jobs), policy makers can zoom in on more detailed units of labour-market measurements and shape employment policies that are highly targeted towards labour-market mismatches. Indeed, performing SAA enables policies to be designed based on: (1) the skills and competences that workers possess, and (2) the skills and competences that the labour market requires.

Update occupational standards

Occupational standards are documents that describe the knowledge, skills and abilities an individual needs to be competent for a job, and they are often used as a common lexicon of occupations and skills in the economy. They are typically managed centrally through a ministry or governmental body and are connected to qualification frameworks – where a clear link is established between formal education and occupational competence. Not only do occupational standards ensure professional competence at work, they also provide a reference point for policy makers to measure developments in the labour market. Indeed, these standards interact with the labour market and wider economy in numerous ways. For example, educational institutions and training providers can use them to create qualifications and training programmes for specific jobs and industries. Definitions of occupational standards and the corresponding qualifications can then in turn feed into apprenticeship programmes for students in formal education. Through defining occupational standards, countries can identify shortages in skills and competences that can feed into migration policies. Occupational standards can also be used by private actors such as employers and industry bodies to create job descriptions to recruit new staff or training plans to develop skills in their own workforce.

Given the potential wide reach of occupational standards in the labour market, it is crucial that these are updated regularly using timely, precise, and relevant data. Skills assessment and anticipation exercises can feed into occupational standards by proving more up-to-date information about the skills required in an occupation. SAA exercises are at the forefront of identifying these new skill or qualification needs triggered by advances in technology or extensive changes in how tasks are carried out.

In Australia, the skills assessment and forecasting activities of Jobs and Skills Australia influences the updates to the Australian and New Zealand Standard Classification of Occupations (ANZSCO) maintained by the Australian Bureau of Statistics (ABS) (Australian Bureau of Statistics, 2022[32]). ANZSCO is a skills-based classification that was first published in 2006 using the (then) contemporary overview of skills. Recently the ABS has received feedback that the recognition of skills needed to change to reflect the contemporary Australian labour market. The ABS has throughout 2022 conducted a review of skills in ANZSCO and drafted six proposals to address the main concerns, due to be implemented by 2024. In its revision of occupational standards, the ABS completed a targeted review of four areas, one of which are occupations identified by Jobs and Skills Australia in their SAA exercise 'Emerging Occupations'.

Design incentives to foster employment in growing sectors

SAA information could be used to smooth transitions in the context of structural change. SAA exercises generally allow comparing skill needs between sectors and this information can be exploited design transition and training programmes.

Some countries are already using SAA results to provide services for workers in declining sectors (OECD, 2019[33]). In Australia, Structural Adjustment Programmes (SAPs) can be developed in exceptional circumstances to respond to changes in the economy that involve large-scale retrenchments. SAPs are sector-specific programmes that provide assistance to employees in areas with declining industries or where large-scale plant closures are planned. Targeted employment assistance under SAPs can involve skills and training components for adult learners, including pre-retrenchment measures for those who have not yet lost their job but need assistance with (among other things) comprehensive skills assessments, training, industry experience and digital literacy.

Such mechanisms can be used not only in declining industries, but also in cases where there are sudden and unexpected labour shocks, like in the event of a natural disaster. Following the 2010 Canterbury earthquake in New Zealand, demand for workers increased exponentially as part of the initiatives to rebuild the region. The now dismissed Canterbury Skills and Employment Hub had well-established practices in using information from SAA exercises to enable labour market matching for semi-skilled and unskilled occupations prior to the earthquake. These mechanisms were leveraged to implement initiatives such as relocation assistance for the unemployed to relocate to Canterbury to participate in the rebuilding initiatives. Candidates could receive NZD 3 000 when they took up full-time positions (OECD, 2016[34]).

Financial incentives could also be geared towards increasing employment by providing employers with financial incentives to hire workers. Financial tools for employment can come in the form of tax incentives for employers that hire workers with certain characteristics, within certain sectors, or geographic locations. In spite of limited adoption of such practices, SAA exercises could feed into such policy practices by identifying sectors or skills that are growing and in-demand and fostering employment.

Set priorities for recognition of prior learning

Through recognition of prior learning (RPL), skills and competences that are acquired through labour market or personal experience are validated and certified. Adults can use this certification on the labour market to gain higher-quality employment or enter new industries and sectors, and, as such, the recognition of prior learning is a key instrument to improve the employability of adults. Recruiting employers stand to

gain from this process as well, as RPL leads to more concrete information on the skills and abilities of the hiring candidate, allowing for more transparency and better matching of skills to jobs.

To be responsive to labour market developments, RPL requires regular updates on the skill needs of each occupation. Indeed, with technological progress, the tasks associated with certain occupations are changing. For example, digitalisation is pushing workers to acquire digital skills in occupations that have not previously required such skills. In order to ensure the labour market accepts certifications issued through validation programmes, it is crucial that these validation programmes keep up to date with the changing skills needs within occupations. While this is often done directly through updating occupational standards, in those contexts where such standards have not been developed, SAA can take the shape of a "refreshment" exercise to take stock of how skills composition in occupations have changed. This can provide vital information for updating the validation programmes to maintain their relevance to the labour market, particularly as qualification standards are updated less frequently.

For countries that do not yet have an extensive system for the recognition of prior learning, SAA exercises can pinpoint priorities for development of validation programmes. Through analysis of occupational and skills-level data, they can inform policy makers of which sectors, industries or occupations could benefit from validation programmes the most, and which skills are in-demand in these occupations. This allows for more efficient and tailored design of validation programmes, including more targeted and modular upskilling opportunities. In Wallonia (Belgium), the public employment service has recently adapted their validation programmes according to analysis on skills shortages (OECD, 2016[34]).

Industrial policies

Foster innovation in key sectors and industries

Industrial policy aims to structurally improve the performance of the private business sector. Although traditional objectives of industrial strategies cover innovation, productivity, and economic growth, more and more they tend to extend their priorities to social inclusiveness and quality jobs, and recently, to the green transition and resilience against external shock such as the COVID-19 crisis (OECD, 2022[35]). In particular, the failure of industrial policy to translate economic development into inclusive growth over the past decades has emphasised the importance of creating high-quality jobs (ILO, 2014[36]), and therefore, the role of SAA, which can predict changes in job and skill demand, is also expanding.

Industrial policy instruments can be categorised according to their scope. While horizontal industrial policies are available to all firms, irrespective of their activity, technology, or location, targeted (or "vertical") industrial policies are applied only to limited areas, such as specific sectors, regions, and missions where economies of scale and knowledge externality can occur, or where learning-by-doing is important (OECD, 2022[35]). Insights from SAA exercises can be a useful reference when selecting target areas that require intensive investment support for innovation and productivity improvement. Indeed, firms can use information from SAA exercises to strategically determine technology and skill areas that require investment.

For example, in 2017 the Italian Ministry of Economic Development launched the *Industria 4.0* national plan, which aims at supporting industrial change through a series of combined measures, including strong tax incentives and financial access support for firms that invest in their technological and digital transformation processes, as well as support for skills development through institutions such as 'Digital Innovation Hubs' and 'Competence Centres'. SAA exercises – such as the Excelsior survey conducted by the Italian Chambers of Commerce every year to identify the skills required to respond to technological advances – have been used to understand which sectors and skill area needed more investment (European Commission, 2017[37]).

SAA exercises are expected to create synergies when combined with R&D investment incentives such as tax expenditures and grants. In fact, R&D investment incentives rarely lead to substantial productivity improvement within firms without being accompanied by upskilling policies that support workers in acquiring new innovative skills. As a result, when facing a lack of training opportunities, industries keep declaring skills shortages and skill mismatches despite of expanding R&D investment (Foy, 2013[38]).

Migration policies

Skills assessments and anticipation exercises can also play an important role in countries with selected migration policies. In particular, approaches to SAA can be the foundation for the lists of occupations in shortages used to allow easier entry to migrant workers. The establishment of Skills Mobility Partnerships should also be informed by SAA results for the skills and fields considered high priority by the destination country.

Modify admission policies based on shortage lists

Labour migration management aims to address the skills needs of a country by attracting and selecting foreign workers capable of making a positive contribution to the receiving economy (OECD, 2019[39]). A number of labour migration policies exist across OECD countries, each with its own set of admission requirements and conditions. In particular, a few countries – including some of the so-called settlement countries, i.e. those countries, such as Australia, Canada and New Zealand, established through migration from other continents over the past few centuries – have temporary labour migration regimes to satisfy immediate labour needs based on special lists of in-demand occupations. The results from skills assessment and anticipation exercises clearly play a key role in informing policy makers about the sectors facing the most serious skills shortages and the occupations that are in high demand to be at the centre of admission policies. Skills intelligence can also be an important tool to anticipate future labour market trends and make sure that migration policies are proactive (OECD, 2022[40]).

For example, the Skilled Occupation List (SOL), which is one of the eligibility criteria for Australia's skill migration programmes (including the Temporary Skill Shortage and Employer Nomination Scheme visas), are informed by the results of SAA exercises. Future updates to the SOL or targeting of migration to skilled workforce needs will be informed by SAA results and stakeholder engagements by Jobs and Skills Australia.[2] In addition, during the COVID-19 crisis between 2020 and 2022, the former National Skills Commission was responsible for the labour market analysis which informed the composition of the Priority Migration Skilled Occupations List (PMSOL), now discontinued. Created in the aftermath of the COVID-19 pandemic, this list allowed employer-sponsored skilled workers to enter Australia to work in occupations in sectors critical to Australia's economic recovery from the pandemic. More recently, the Australian Government has also committed to invest AUD 19.7 million in skills assessments until 2023-24 to support migrants into priority jobs. In particular, the Department of Employment and Workplace Relations (DEWR) is currently running three Skills Assessment Pilots, offering free and fast-tracked skills assessments, free employability assessments and subsidised training to onshore migrants in order to supplement Australia's domestic workforce in key occupations, including nurses, childcarers, engineers and electricians.[3] The Faster Migrant Skills Assessments pilot concluded in June 2022, with the Skills Assessment Opportunities for Migrants, and Employability Assessments pilots currently scheduled to finish in June 2023.

Foster the establishment of Skills Mobility Partnerships

In the past few years, an innovative tool has emerged – especially in the context of the discussions around the United Nation's Global Compact for Migration – with the potential to associate skills development and migration policies: the so-called Skills Mobility Partnerships (SMPs).[4] SMPs are multifaceted, structurally elaborate agreements through which governments and possibly other stakeholders from both origin and

destination countries co-ordinate to share the benefits and costs linked to talent migration. A number of different cost-sharing models exist (OECD, 2018[41]). A typical SMP may, for example, involve an agreement by which individuals take up training courses in their origin country, entirely funded by the destination country through Official Development Aid (ODA), with an option of employment in the destination country upon completion of the programme. This can be a triple-win process, since through the SMP origin countries increase their overall skilled workforce, the destination countries might receive talented migrants, and migrants themselves have the possibility to improve their labour market outcomes. Numerous other forms of SMPs exist, including those where training is financed directly by employers or the migrants themselves, and those where skills development takes place in the destination country.

Only a few countries in Europe have active SMPs (European Commission, 2022[42]). Among these, Austria has implemented six SMPs within its framework for International Higher Education Co-operation, mostly focusing on allowing temporary stay in Austria and subsistence allowances to researchers and university students from Africa (Africa-UniNet),[5] Asia (ASEA-UniNet)[6] and Eastern Europe (CEEPUS Programme).[7] In Belgium, the Belgian Development Agency (ENABEL) in collaboration with IOM and ILO established the THAMM programme, whose goal is to provide training to 350 young people in Morocco and Tunisia during 2021-23 with the possibility for one fourth of them to get a job in Belgium.[8] Since 2013, the German Agency for International Co-operation (GIZ) directs the "Triple Win" initiative, where nurses from Bosnia and Herzegovina, Philippines, Tunisia, Indonesia, Jordan, and Kerala (India) receive supports to be hired by German employers. In particular, migrants receive free training in German language, professional preparation for the placement, and help with the recognition process for the qualifications acquired abroad.[9]

SPM initiatives are rare even outside Europe, although some well-established examples exist. For instance, since 2006 the Australian Government has supported the Australia Pacific Training Coalition (APTC).[10] The goal of APTC is to promote economic growth across the Pacific region through skills training and employment. In practice, it provides Australian qualifications in various vocational fields to graduates from ten countries: Fiji, Kiribati, Nauru, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu and Vanuatu. While not initially designed to facilitate emigration, APTC now includes a 'Labour Mobility Track', which prepares participants for working overseas – including additional training in financial management, health, well-being and international expectations – despite not guaranteeing employment in Australia upon completion of the programme.

Although increasingly recognised as a policy tool to promote a sustainable approach to skilled migration and mobility, most empirical examples of SMPs have never moved beyond the piloting phase (Sauer and Volarević, 2021[43]). A number of challenges exist, including large costs and scarce involvement of employers (see OECD (2018[41]) and EMN/OECD (2022[42]) for a thorough discussion of the challenges and opportunities for SMPs). One of the key design elements that is likely to influence the success of a SMP is also the type of skills that are at the centre of the agreement. For instance, Clemens (2015[44]) argues that "a Global Skill Partnership cannot function as intended unless it creates skills that employers proactively demand". This aspect is crucial since SMP participants need to train on those precise skills that are sought after in the destination labour market in order to have the chance to be hired abroad. In this perspective, skills assessment and anticipation exercises, such as the ones under study in this report, have the great potential to inform the design of SMPs and improve the matching of the training provided with the labour market needs across countries.

Fostering talent in the workplace: The role of employers and social partners

While it is true that many implications of the results of skills assessment and anticipation exercises pertain to governments and public bodies, the private sector also has a key, active role to play. Job-related training is a key component in ensuring that people have the skills that are needed in the labour market. Employee

training is also essential to the success of businesses worldwide thanks to enhanced labour productivity and improved company culture. To make sure that employees keep their skills and knowledge up to date with the global megatrends, employers and social partners can make use of SAA estimates to understand which new skills should be at the centre of their training programmes. For example, since 2011 the Chilean Mining Council – a sectoral organisation gathering a group of large employers in the mining sector in Chile – conducts ten-year skills forecasts to identify training content, as well as to update curricula in upper secondary schools in collaboration with VET providers in the region (OECD, 2016[8]). Similarly, in the United Kingdom, Sector Skills Councils, jointly managed by both employers and workers' representatives, make long-term projections for their industry to anticipate future skill needs and adapt consequently their training, occupational standards and apprenticeship programmes (OECD, 2019[45]).

In Finland there is a long tradition of using skill forecasting exercises as discussion points in skills councils. Two key forecasting tools – VATTAGE and MITENNA – are used to steer education in accordance with sectoral developments and vocational education needs, and results are used for educational design (ILO, 2017[46]). The results are discussed by councils to make adjustments to training provision according to stakeholder views, comprising of sector-specific education and training committees and tripartite bodies in occupation fields. The outcomes of the discussions are training and education proposals for occupations. The main trade unions contribute to the dialogue process, and different regions are obliged to take into account SAA forecasts in their future strategies and activities.

In France, the French Occupation and Skills Observatories (*Observatoires Prospectifs des Métiers et des Qualifications*, OPMQ) are privately led skill councils organised by sectors, and are funded by employers' organisations and trade unions. The OPMQ councils conduct mappings of occupations, surveys and analysis on skills management, training and recruitment needs, and create certification schemes. The OPMQ skill councils create recommendations and develop actions and tools for use by firms and workers to address current and future skills needs (Center for Studies and Research on Qualifications (Céreq), 2012[47]). In a similar vein, in Australia Jobs and Skills Councils (JSC) are being established to provide industry with a stronger, more strategic voice in ensuring Australia's VET sector delivers better outcomes for learners and employers. The Energy, Gas and Renewables JSC is one of ten JSCs that were announced in December 2022. It will support industry to effectively address workforce challenges and prepare for emerging skills needs. In addition, it will have responsibility for working with industry to ensure that qualifications for energy sector jobs are up to date and provide relevant, contemporary training.

Collective bargaining is also a tool that can be used by workers' representatives and trade unions to fund skills assessments and provide training for workers. In the Netherlands, the Training and Development Fund (*Opleidings- en Ontwikkelingsfonds*) is financed through a compulsory payroll levy fixed by collective agreement. The Fund, through constant exchange with social partners, is able to anticipate skills needs and provide lifelong learning to workers to keep them "up-to-date" and ready to find new jobs (OECD, 2019[45]).

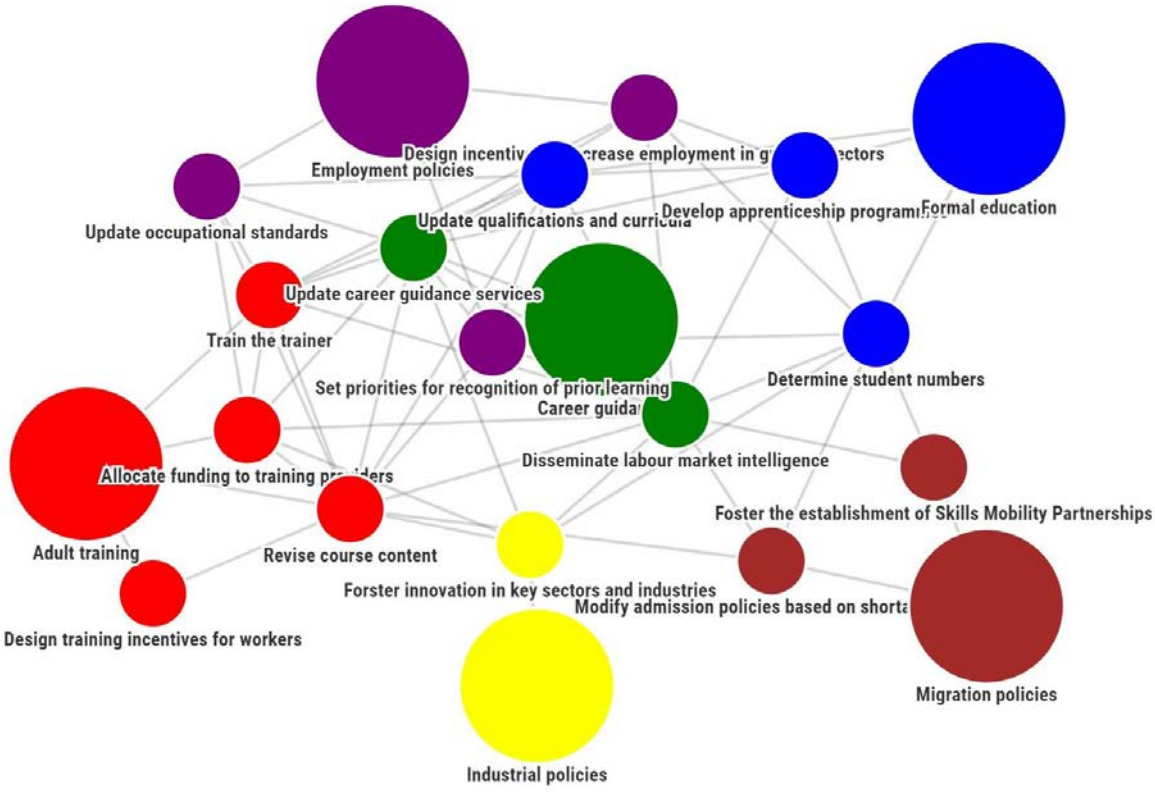
The interconnectedness of SAA-based policies

As outlined in this chapter, the potential use of SAA as a tool in evidence-based policy making is vast and oftentimes untapped. The policy implications of skill intelligence are not confined to just adult training and formal education, but can help strengthen areas such as career guidance, migration, employment, and industrial policies. Skills permeate almost every aspect of society; therefore, it is not surprising that SAA results can be used in a multitude of ways and for different policy issues. As policy makers and stakeholders alike move away from the idea that only formal qualifications matter, skills are increasingly becoming the primary unit of measurement and area of policy execution. Therefore, it is not surprising that the policy areas outlined in this chapter are fundamentally interconnected (Figure 6.2).

For instance, if curricula in formal education are changed following SAA findings, course content in non-formal training will adjust to either cover the gap between formal education and labour market realities or provide upskilling opportunities to adults in employment, so that their skills and knowledge match new graduates. In the case of industrial policies, if the government fosters innovation in key sectors and industries, it is likely that the occupational standards within those sectors will need to be updated. Further, increased innovation might lead to a greater demand of workers within those sectors, leading to a modification of admission policies for migration. The establishment of accessible labour market information systems (often used in the context of career guidance) can have ripple effects throughout several policy areas, as it is able to provide timely and up-to-date information about skills composition in the economy, and may be used to develop apprenticeship programmes, assist workers in declining sectors, determine student numbers and allocate training funding.

It is of utmost necessity for governments and key stakeholders to map out how specific SAA results can be used in policy planning, in order to reap the full benefits of such extensive analysis' and create harmonisation across policy fields for the creation of more resilient labour markets.

Figure 6.2. Policy areas are connected across policy streams



Note: Colours denote different policy streams. Lines illustrate interconnectedness across policy areas in different policy streams.
Source: Author's elaboration.

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[3] More information about the Skills Assessment Pilots is available here: https://www.dewr.gov.au/skills-assessment-pilots (accessed on 25 April 2023).

[4] The concept of Skills Mobility Partnerships is linked to other similar and often interchangeable concepts, such as Global Skills Partnerships, Talent Partnerships and Transnational Skills and Mobility Partnerships. In this report, only the use of the term SMPs is adopted for simplicity.

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7 Turning results into policy action for the green transition

Some approaches to assessing and anticipating skills related to the greening of the economy are more successful than others in leading to policy action. By means of best practice examples, this chapter identifies common challenges and success factors for evidence-based policy practices on skills for the green transition. While both skills analyses and policy initiatives in this area are still relatively novel, there are some common characteristics of successful approaches that are illustrated.

Introduction

Using evidence from skills assessment and anticipation to design policies that support the green transition is not an easy endeavour and comes with several challenges. First of all, most skills policies for the green transition are still relatively recent and require resources and innovation to be developed. Secondly, setting up a skills assessment and anticipation exercise comes with important choices about its methodological approach and sources of data. Third, the translation of the results of SAA exercises into policy practice relies on good co-ordination and communication among institutions and public bodies. Fourth, this translation also requires policies for the green transition to be prioritised at a political level, particularly given their inter-connectedness with other policy issues. Lastly, using SAA results for decision-making of green transition policies is demanding because SAA exercises and the policy implications derived from them are often national, while the implementation of green transition policies typically takes place at a local level. Decision-makers need to keep these challenges in mind in order to identify innovative solutions and use SAA in a more strategic and effective way for real policy change.

After providing more details on each of these challenges, a number of innovative policies and programmes are reviewed that make effective use of the results of green SAA exercises for their design. Five key insights into using SAA for the green transition are drawn from the review: (1) most examples of SAA exercises that translated into policies underscore that trust and collaboration across stakeholders is essential; (2) those SAA exercises designed specifically to target skills needs for the green transition are more likely to lead to sustainable policy than pre-existing general SAA exercises featuring a smaller green dimension; (3) focusing the analysis on skills – rather than on occupations or industries – allows for more targeted policies for the green transition; (4) green SAA exercises with a more narrow scope – in terms of geographical or sectoral coverage – have been more easily put into practice; and (5) SAA exercises mixing both qualitative and quantitative analysis seem to ensure better tailored green policies.

Challenges of using skills intelligence for green policy making

Challenge #1: Initiatives on skills for the green transition are novel

The urgency and complexity of the green transition require innovative policy solutions, and, as for any policy innovation, this means that new evidence needs to be generated. In fact, with state-of-the-art data and information on the changes in skills that are needed for a greening of the economy, new policies can be developed or existing policies adjusted. Yet, such policy reform takes resources to be formulated, implemented, and deliver impact. Evidence on what skills are needed to support the green transition is still comparatively scarce. At the same time, few green policies are currently applied to the area of skills. While this chapter identifies and discusses a number of innovative initiatives that have successfully taken new approaches to skills policy for the green transition, these are, in many cases, still under development in the context of pilot projects or institutional reform.

For instance, in lower Austria, the first training centre focused on green jobs – called the Climate Protection Training Centre (*Klimaschutz-Ausbildungszentrum*) – was opened in 2023. It is financed by the regional public employment service in co-operation with the Vocational Training Institute (BFI) in Austria. It offers vocational education for occupations that are in high demand and supports the green transition in areas such as electromobility or building technology. In the context of the investments linked to France's Recovery Plan, the Network grouping the *Centres d'animation, de ressources et d'information sur la formation* (CARIF) and the *Observatoires régionaux de l'emploi et de la formation* (OREF) started to identify training related to the green transition. CARIF-OREF are publicly financed bodies which provide guidance and research on adult learning issues at local level. The Network of CARIF-OREF have developed an online platform (CertifInfo) with an inventory of almost 7 000 certifications available in France, based on an underlying thesaurus (Formacode) which classifies training into different domains.

The Formacode of each training was manually labelled to identify those who are connected with the green transition, resulting in 333 certifications that are green-related. Such rethinking of existing policies, or entirely new approaches are the start of a new policy agenda on green skills.

Two additional promising programmes that are currently under development are the New Energy Apprenticeship and New Energy Skills Program, launched by the Australian federal government in 2023. Both programmes, managed by the Department of Employment and Workplace Relations, have been influenced by internal assessments on skills needs for the green transition as well as the quantitative findings of Jobs and Skills Australia. The programmes aim at tackling skills needs of students and workers in green industries, through career guidance, apprenticeship incentive payments, and supporting the delivery of VET qualifications for clean energy jobs.

Challenge #2: SAA exercises use diverse definitions and methods

The lack of common definitions on what green sectors, jobs and skills are (see previous chapters) is an important challenge for skills assessment and forecasting. There is not yet a universally accepted definition of these concepts, neither at international nor national level. This means that SAA exercises, even if they are undertaken, may not be interoperable, as they apply different concepts without complementing each other. While further work is necessary for an internationally accepted definition of green sectors, jobs and skills, countries can aim to take a consistent conceptual approach when they conduct or commission SAA exercises.

Another barrier is a scarcity of analyses and information that focuses specifically on skills rather than employment and occupational projections more generally. It is currently still difficult to reliably measure and forecast the demand and supply of skills for the green transition in a quantifiable way. Most SAA exercises that are dedicated to skills for the green transition rely on qualitative expert consultations. An example is the explorative study undertaken by the Network Association Carif-Oref (*Centre animation ressources d'information sur la formation / Observatoire régional emploi formation*) in France, which compares the extent to which skills and training needs are changing due to the green transition across three regions (Réseau des Carif-Oref, 2023[1]). While qualitative approaches can deliver robust and detailed information, they are limited in their potential to be repeated and scaled. They typically rely on stakeholder consultations and are more focused on a specific sector or region. As such, they are less suited to provide whole-of-economy insights and are difficult to update regularly, which means that it may be more difficult for qualitative insights to translate into policy action. Innovations in this area could involve big data analysis on skills requirements, as well as incorporating skills components in existing labour market datasets.

Challenge #3 The governance of policies on skills for the green transition is complex

The co-ordination among different public and private institutions that are involved in the governance of skills policies, including those supporting the green transition, is relatively complex. Indeed, policies for the development of skills are at the intersection of education, labour and industrial policy, and, therefore, their responsibility is often shared across different ministries and public agencies at the central level of government. In addition, skills development for the green transition has an important regional component, which brings into play local and regional actors, both private and public. Without good co-ordination both horizontally and across levels of government, the policy agenda on skills for the green transition risks being fragmented, inconsistent and overall, less effective than it could be. An interesting approach to ensure co-ordination is the newly formed General Secretariat for Ecological Planning (*Sécrétariat général de la planification écologique*, SGPE) in France, which co-ordinates policy planning related to the green transition across government ministries. As it is placed directly under the authority of the Prime Minister, the Secretariat manages to consistently drive the green policy agenda, engage a multitude of stakeholders, and measure the impact of a wide range of policy actions (Gouvernement Français, 2023[2]).

Another important aspect where governance is crucial is the governance approaches to SAA itself. Whether SAA exercises rely on a central model, a collaborative model, or an external model (Figure 3.1 in Chapter 3) might influence how their results are shared with policy-making authorities. Across all three governance approaches of SAA exercises, however, the dissemination and communication of SAA results is typically not (yet) streamlined and standardised. One of very few exceptions is Jobs and Skills Australia, which performs skills assessment and anticipation exercises and makes their results publicly available. As a central government agency, the information generated by them is distributed across different government institutions and guides policy making in a range of areas.

Challenge #4 There are competing and interconnected political challenges

As other important megatrends impact labour markets at the same time as the green transition, policy makers face the tough challenge of integrating environmental sustainability with policies to reduce the digital divide, fight inequalities or curb long-term unemployment. This means that policy action on skills for the green transition needs to be linked to a range of other policy objectives, which might be competing on the political agenda. Partially, this challenge needs to be addressed through political leadership; however, institutions and mechanisms can support the prioritisation of green policies, such as skills policies for the green transition, and facilitate the alignment with other policy objectives. Institutions that are located at the highest, central level of government, such as the French General Secretariat for Ecological Planning, might be particularly suitable to overcome this challenge. Such institutions are able to oversee policy action on the green transition, and drive reform across different ministries and public agencies, while avoiding a duplication and inconsistencies with respect to other policy objectives.

In Austria, the Ministry for Climate Action, the Ministry of Labour and Economy, and the social partners co-operated to create the Environment Foundation (*Umweltstiftung*). Implemented in 2022 together with the Austrian public employment service, the programme aims to support training and upskilling in occupations that have been identified as in shortage yet critical for the green transition. The target groups are jobseekers or persons with low employability, who receive income support and coaching during their training period. The inter-ministerial collaboration underlines a successful consolidation of two priorities within the programme: to strengthen the supply of skills for the green transition, on the one hand, and to better integrate vulnerable groups in the labour market, on the other hand (Aufleb Association, 2023[3]).

Challenge #5 Implementation takes place locally

While policy decisions related to skills for the green transition might be taken at the central level of government, the implementation of these policies typically takes place at a local or regional level, through the work of different community actors, including companies, training centres, public employment services, VET providers, adult learning institutions, etc. Depending on the country context, regional and local public authorities may also have significant responsibilities to shape policies on adult learning or vocational education and training. As a result, they themselves are key stakeholders to (re-)design skills policies that support the green transition.

The local dimension of skills policies for the green transition has several consequences. First, the results of SAA exercises need to take into account local economic structures and skills needs in order to be useful for regional policy makers. Second, these results need to be communicated to community actors on the ground, so that they can use them in their own decision-making. The frequent lack of expertise of local actors also means that the results need to be made accessible for a broader public. The Carif-Oref Network Association in France is translating and communicating information from skills analyses and forecasts for local and regional actors. Their role is to inform regional actors about developments related to employment, training, and career guidance.

Key elements for effectively translating green skills analysis into policies

Despite the challenges governments face when relying on SAA to help design evidence-based skill policies for the green transition, a few noticeable cases have recently emerged. Policy making in the area of skills for the green transition is still relatively new, so a common element of the cases identified is that they have been introduced recently or are still in the early phases of implementation. There are many innovative policies in the pipeline for the five countries reviewed, however, there is not yet sufficient information available to assess the role played by skills intelligence in their design and implementation. Reviewing both implemented and planned policies points at five key insights into using SAA exercises for the green transition. This section highlights the policies identified where an SAA has had a direct impact on policy making for the green transition, and untangles what makes these SAA exercises and policies successful.

Key insight #1: Policy dialogue across a wide range of stakeholders is essential for translating skills intelligence into action

To tackle the issue of co-ordination, some countries have created forums for different stakeholders to come together and share insights and challenges, and tackle issues arising from the green transition. Many non-governmental stakeholders (such as non-profit organisations, research institutes, think tanks and advocacy groups) have established themselves as important actors in the green transition. These stakeholders have built a wealth of knowledge on sustainability and manage extensive networks of key players in the green transition. As they often possess expertise related to the green transition, many stakeholders also carry out SAA exercises. This is the case, for instance, for Race 2030 in Australia, the Shift Project in France, Vinnova in Sweden, NHO in Norway and GWS in Austria. When governments are tasked with creating skill policies, SAA exercises can be of a great value as they can supplement policy makers' own knowledge and analysis.

In France, the National Observatory of Jobs and Occupations in the Green Economy is a government-led initiative that brings together a range of stakeholders including governmental units across different ministries and cabinet, the national institute for statistics, the public employment services, research institutions, employers' associations, local authorities, educational bodies, and think tanks. The Observatory maintains an overview of a large number of SAA exercises and policy initiatives thanks to its extensive network and uses this overview to inform its own skills assessments and anticipation. In addition to this, the Observatory is tasked with managing a central SAA produced by the government. The Observatory is one of the leading advisors for policy making for the green transition in France and facilitates the use of SAA results by other non-governmental bodies, thereby operating as a bridge between public and private research and initiatives. Similarly, in Norway, the Committee on Skills Needs brings together representatives from academia, employer/workers' organisations and regional representatives to create a knowledge base of existing SAA exercises for the green transition and carry out an independent SAA exercise. It is also planned that the Committee will act as an advisor to policy making on the green transition once the skills assessment is completed. Co-operation between different stakeholders is key to gaining a full perspective over existing initiatives and exploit synergies to create holistic policies for the green transition. However, it also requires the co-ordinating body to have a clear mandate to implement actions based on findings, or have a key role in the policy-making process.

Key insight #2: Skills intelligence focusing specifically on the green transition is more often exploited for policy making

This chapter's review of green SAA exercises that directly impact policy initiatives has not identified any cases where the green dimension has been added to a pre-existing general SAA exercise. By contrast, good practices suggest that the most impactful exercises are designed specifically to focus on green transition from the start. When looking across the board of the SAA exercises reviewed, those that have

focused primarily on the green transition are the ones that have resulted in the most extensive policy actions. For example, the public employment services in Sweden conducts assessments of skills needs brought about by the rapid expansion and greening of the battery and steel industries in Västerbotten and Norrbotten (the northern part of the country). The analysis identified skills needs for the industry itself (which includes analysis on the changing skills needs due to the fossil-free production and electrification of these industries), skill needs needed to support the industries (including manufacturing and transportation), and skills needs of the region following an expansion of the cities in the north (such as healthcare workers and teachers). As such, the policies that are being implemented by the newly established PES office in Skellefteå are targeting both green (technical) skills and skills that will support the greening of the economy and are being informed by ongoing SAA exercises (Box 7.1).

By contrast, the SAA exercises that feature a smaller analysis of skills needs for the green transition as part of a broader skills analysis are used less in policy making. Such exercises shed an important light on the skill needs and help bring the issue to light, and their results are being used to raise awareness of the skill need related to the green transition, rather than directly impacting policy making by the government or the organisations themselves. Yet, there are exceptions. For example, the Workforce Specialist Initiative in Australia uses SAA exercises to identify key industries and occupations and inform delivery of projects. The SAA exercises used as inputs include skills for the green transition as part of a broader assessment of skill needs, and policies on the green transition are a part of a larger framework to guide and inform the Workforce Specialist panel. This larger framework highlights potential opportunities related to green industries, particularly in construction and manufacturing industries, and identifies green jobs as an emerging priority (Department of Employment and Workplace Relations, 2020[4]). Even though the green dimension features as part of a larger skills analysis, the SAA exercises used for the Workforce Specialist Initiative are new and have been developed to yield useful information for the programme design and delivery.

Box 7.1. Providing holistic support for the green transition through the public employment service in Skellefteå

In June 2022, the Swedish PES published a skills assessment and anticipation study on competences needed for the expansion of large companies in Västerbotten and Norrbotten (northern Sweden). The large investments being made in northern Sweden revolve around both new establishments such as Northvolt (battery manufacturing) and H2 Green Steel (fossil free steel) as well as greening of existing companies within mining industry and other traditional industries. Among other findings, the SAA exercise highlighted the need to strengthen the use of skills intelligence in policy planning, to co-ordinate efforts to provide the skills needed in the industries and the region, to improve the policies for labour market mobility, and to foster co-operation with the companies to tackle employment and skills shortages.

In September 2022 the public employment service opened a new office in Skellefteå in northern Sweden. The central government mandated the Skellefteå office to tackle employment-related challenges for the industrial changes in the region as identified in the SAA exercise. The office focuses not only on attracting talent with “green skills”, but also on providing upskilling and reskilling opportunities, and strengthening labour mobility to the region to support employment growth in the green industries. Still in the early phases of the project, the office is carrying out new, more tailored SAA exercises on the skill needs of the region to inform the design of new policies by the public employment services. Currently, the PES is piloting or evaluating the following policy tools:

- Co-operation with VET institutes in other regions, so that students can do practical placements in northern Sweden.
- Design of PES-administered vocational training based on the need of the labour market (already implemented).
- Subsidies for seasonal employment in the summer (offering subsidies for accommodation).
- Working with migrant construction workers that are building the new factories to incentivise them to stay in northern Sweden after their work is completed, also by offering job-seeking help to their spouses and families to relocate to northern Sweden.
- Dissemination of information on labour market needs, including co-operating with PES offices in locations with high unemployment.
- Working on expanding legislation that gives jobseekers financial support to travel for job interviews.

Key insight #3: Focusing SAA exercises on skills rather than on occupations or industries allows for more targeted policy making

Most of the SAA exercises covered in this report do not have a skills-based approach, but rather focus on sectors or jobs that are defined as crucial for the green transition. Choosing a skills-based approach often reveals that a broad range of skills are needed for the green transition and they are present in many occupations but at different levels, creating a green continuum with every job and sector having a certain extent of 'greenness' (OECD, 2023[5]). The benefit of such an approach is that it identifies which specific skills or tasks are needed to support the green transition, and changes in education or training can be adjusted across different policies and programmes to satisfy the demand, such as investing in skills related to recycling across different educational programmes and occupations.

Many of the other SAA exercises described in Chapter 1 define green sectors that need to be supported by the government for the transition to a cleaner economy. Under this definition, all jobs and skills that are part of a green sector are considered implicitly green and hence should be boosted. Such SAA exercises are useful in designing industry policies, however, these policies will likely also cover non-green jobs that are in a green industry, such as accountants and cleaners. Other studies focus instead on occupations, and attempt to define what constitutes a green job, regardless of the industry. This type of SAA can be used to target training for e.g. solar panel engineers, regardless of whether the engineers work in renewable industry production (green sector) or installation in the construction sector (non-green sector). Many SAA exercises have moved towards occupation-based analysis to gain more granular insight in how to boost the green transition, but there are challenges in translating findings into policy action as the occupations span across different sectors, stakeholders, and it can be challenging to pinpoint direct policy action. For example, the Global Talent Visa programme in Australia relies indirectly on SAA results at the occupation level, however, the government has decided to focus the visa scheme on green industries instead of occupations, to allow for more flexibility in attracting talent.

Some countries have initially carried out assessments at an occupation level and supplemented this with a skill-level analysis further into the policy-making process. For example, the initial analysis conducted by the Swedish PES focused on jobs for the green transition and identified which skills might be needed for these jobs through qualitative assessments. Since the establishment of the new office in Skellefteå the PES has carried out more skill-focused SAA exercises and are continuing to tailor services based on more detailed findings, including skills findings.

In France, the Skills Forecast: Occupations 2030 exercise is in the process of defining which specific skills are needed for the green transition and how prevalent they are across different occupations. In Australia, the Workforce Specialist programme will map the skill supply of their target group against the skill demand in green industries to support career transitions and career pathways towards green occupations. In Sweden, programme co-ordinators at University West map skills and competences covered in educational programmes against those in-demand in the labour market to update curriculum and implement industry training programmes (Box 7.2). Carrying out assessments at a skill level allows for more tailored policies, as it drills down on exactly what a worker needs to know, not just what job they have to do. Knowing that the green transition will bring about increased demand for engineers is a good start but needs to be supplemented with a skills analysis to unlock exactly what it is the engineers should know – e.g. sustainable manufacturing. Assessments at the skill level can also shape how policy makers view the green transition, as skills-focused SAA exercises often reveal that the green transition is closely tied to the digital transition. Or they can reveal that workers in green occupations need to be good communicators and have high problem-solving skills, as the road to sustainability is complex.

Box 7.2. Adapting formal education to skills needs through Work-Integrated Learning at West University

Since the 1990s, University West (*Högskolan Väst*) in Sweden has been collaborating closely with the regional industry and regional partners to design higher education courses and programmes tailored to the labour market and regional economy in relevant areas. In 2002, the University was asked by the Swedish Government to develop forms of work-integrated learning as part of an initiative aimed at renewing the pedagogy of higher education. Since 2018, this work has been further developed through the Work-Integrated Learning (WIL) evaluation model, which provides a methodology and framework for programme co-ordinators to ensure the labour-market readiness of their students (University West, 2022[6]).

Through the WIL programme evaluation, each educational course is asked to reflect on the theoretical and practical skills and competences students should gain throughout university courses. Sustainability is an evaluation criterion in the WIL-programme. Each education programme must evaluate how their programme fits within the ambition to create knowledge to ensure the development of social, economic and environmental sustainability. There are currently three education programmes at University West on sustainability. Examples are new technical education programmes shaped by the need for a green transition have been initiated. These programmes include courses on green technology, energy prices and how the demand for sustainable production will affect the training needs of students, and adjust the curriculum accordingly.

Labour market needs are identified through strategic partnerships with key employers within each sector, either through a branch organisation or other contacts established through alumni. The programme co-ordinators, in co-operation with key labour-market players, map out the gap between skills needs and skills acquired through the education programme, with (if relevant) inputs from labour-market representatives, and national assessments of industry growth/changes. Once the assessment is carried out, the programme co-ordinators use different pedagogics and tools to bridge the gap, including changing curriculum, introducing new practical learning exercises, or implementing work placements such as internships, apprenticeships and study visits. All University West programmes are evaluated based on a co-operation by the programme responsible with inspiration from other programmes responsible by the WIL committee, that then evaluate the education programmes and approves them. The whole process is based on WIL-guidelines and clear evaluation criteria, the process focusses on quality enhancement of the programmes and their work on integrating theory and practice. Currently, the University West has almost finalised the evaluation of all their programmes and, in partnership with the Sweden's innovation agency Vinnova, is working on transferring the WIL-methodology to other universities in Sweden.

Key insight #4: A narrower scope allows for an easier implementation of green skills analysis

As examined in Chapter 2, the scope of SAA exercises for the green transition varies widely in terms of coverage. Some studies look at regional impacts while most take on a national perspective; similarly, a number of green SAA exercises adopt a whole-of-economy approach, while some take an industry-level perspective. Although such heterogeneity in scope leads to rich information on the skill need from various angles, it can also limit the uptake of SAA exercises in policy making due to a lack of data disaggregation. Indeed, according to an OECD survey, policy makers identify the lack of information required to establish specific policies as the most challenging factor that makes it difficult to use SAA as a tool to plan policies (OECD, 2016[7]). SAA exercises with a wide coverage provide fewer details on challenges on the ground and the specificities of the sectors and regions undergoing changes due to the green transition. This

hinders the direct use of these SAA exercises in designing specific employment, training, and education policies, although they still contribute to drive the public discourse towards greater sustainability.

However, even when SAA exercises have a limited target, they also face challenges in providing segmented and tailored information of green skill needs required by a specific policy initiative. Therefore, it is important to consider the specific scope of the policy and its objectives when initiating, designing, and executing SAA related to the green transition. For example, in Australia, the Victorian Skills Authority conducted a small range of tailored SAA exercises that fed into policies on wind turbine training and support measures in the coal-mining sector. Similarly, the Swedish public employment service conducted a tailored SAA exercise focused on five of the largest companies in the region which are transitioning to more sustainable operations, so that the analysis can be applied directly to their specificities. In both cases, the SAA exercises were conducted ad hoc when a labour market need was identified, utilising qualitative methods such as consultations and workshops with experts and industries, with limited scope. These factors increased the likelihood of successful application to policy making, as detailed information needed for implementation was provided through the SAA exercise.

When planning a new policy, the policy maker might find that the most efficient option is to carry out a tailored SAA exercise themselves. On the other hand, designing and executing a tailored SAA exercise for every policy area, region, sector, and topic can be time consuming and costly. Some initiatives, such as the Global Talent Visa Programme of Australia leverage several existing SAA exercises and use the results indirectly in management of the visa scheme for green sectors.

Key insight #5: Mixed method approaches to SAA are most useful for tailored and targeted policies

The review of green SAA exercises and their policy applications in the five participating countries show that mixing quantitative and qualitative methods increases the likelihood of the SAA results influencing policy making. This is mainly due to two characteristics of the mixed method approach.

Firstly, quantitative data can be a good source for measuring the emergence of new skills needs for the green transition, as it compares skills use across different occupations and provides a comparative view of skill intensity. These results can help policy makers allocate resources for emerging green skills and the SAA exercises can be updated regularly to identify new trends and developments within green sectors. If disaggregated sufficiently (preferably at the skill level), the data can be used in policy planning for a wide range of policies. Public support for training, education and employment initiatives on the specific skills needed for the green transition is even easier to obtain when these policies are supported by a quantitative forecasting exercise (Department for Business, Innovation and Skills, 2011[8]). The Workforce Specialist Initiative in Australia uses data from the SAA exercises by JSA as well as their own data from their previous programme, Jobactive, to measure the skill level of participants and adjust services accordingly.

On the other hand, the process of gathering qualitative data fosters co-operation between stakeholders and gathers the support of key institutions and stakeholders, which is valuable during the implementation stage. Qualitative methods often involve stakeholder consultations, workshops, and expert interviews. Although these engagement activities are instrumental to gathering data they also serve as opportunities for awareness building. Further, as qualitative methods are more tuned to the on-the-ground challenges of the green transition, the information gathered is often better suited at tailoring the policy tools. For example, the public employment service in Sweden used qualitative methods that involved several key stakeholders which facilitate the subsequent policy response that requires co-ordination among a broad range of actors including the public employment services, industry representatives, formal education and adult training, local, regional, and national agencies. All these stakeholders are currently in the process of implementing programmes that together make up the wider policy intervention by the PES in northern Sweden. Co-ordination at the level of SAA increased the likelihood of policy co-ordination and strong delivery of service.

The way forward: Bridging direct and indirect uses of SAA results in green policy design

A direct use of SAA results in policy design implies that decision makers are presented information on skills demand and supply for the green transition and are able to make choices that are informed by that data. For example, SAA exercises can identify the rise of new skills and occupations related to the green transition, which then helps policy makers adjust existing qualifications or update occupational standards. Information on current and future skills gaps in green sectors can also inform priority areas for training. Yet, as outlined in the Chapter, the challenges of such a direct use of green skills intelligence in policy making are numerous. Decision makers face having to navigate, reconcile and co-ordinate a vast network of stakeholders and a multitude of definitions and targets, while at the same time working in a field that is relatively new and highly interconnected with other policy areas.

Given these difficulties, policy makers are not always able to make use of skills intelligence directly; yet, a considerable number of policies reviewed in this report still use the information indirectly. Indeed, in many circumstances the results of green SAA exercises are not explicitly used to tailor polices and implement new initiatives, but they can still inform the public debate and push the sustainability agenda forward.

While, in this way, SAA exercises can trigger policy changes even if these changes are not directly linked to the SAA findings, indirect use of SAA exercises is challenging to measure. It is hard to draw a direct link between SAA exercise and the policy initiative, as there are different factors that influence a policy initiative. For example, it can be hard to grasp if the SAA has influenced the policy initiative through bringing general knowledge of the green transition to the forefront, or if it has inspired one individual policy maker in the design of the policy, without necessary being a major source of data.

Through policy questionnaires, interviews, and desk research, it is apparent that in the case of the green transition, indirect use of SAA results far outweighs their direct use. The commonality among the policies that use skills intelligence indirectly is that the results are often not disaggregated enough to be used in policy making. Though there is a need for broad and large-scale policy actions to reach sustainability goals, the reality on the ground is that often the most efficient and effective policies are highly targeted. These initiatives require skills assessments that are customised to the practical challenges of fostering sustainability. Turning indirect use of green SAA results to direct use requires rethinking how the studies are framed, what type of data is used, and how a wide range of actors can be empowered to make evidence-based changes. For this purpose, skills assessment and anticipation can be the missing link between aspirations and change.

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Getting Skills Right

Assessing and Anticipating Skills for the Green Transition

UNLOCKING TALENT FOR A SUSTAINABLE FUTURE

Policies aimed at reducing the environmental impact of human activities have important consequences for labour markets, jobs, and skills. As employment is shifting towards more sustainable activities, workers are increasingly expected to have skills that support the transition to a greener economy. Assessing and anticipating emerging skill needs is crucial to avoid bottlenecks and sustain the green transition. This report sheds light on existing methods to measure changes in skill demand and supply related to the green transition through an in-depth review of practices in five OECD countries (Australia, Austria, France, Norway and Sweden). It also identifies best practice on how to feed information on changing skill needs into policies, notably in the areas of employment, career guidance, education and adult learning.

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