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A review of "Transition Management" strategies

LESSONS FOR ADVANCING THE GREEN LOW-CARBON TRANSITION

April 2019

OECD GREEN GROWTH PAPERS

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1. Introduction: The need for a just transition

The Paris agreement set the ambitious objective of preventing dangerous levels of climate change. Coming to a consensus among nearly 200 countries, the signatories agreed to hold the global average temperature increase to "well below 2°C" and to pursue efforts to limit it to 1.5°C above pre-industrial levels (UNFCCC, 2015a).

With the right policies in place – notably strong fiscal and structural reforms combined with coherent climate policy – governments can significantly reduce the risks of climate change, while also providing near-term economic benefits (OECD, 2017a). This requires combining climate-consistent, growth-enhancing policies with well-aligned policy packages for mobilising investment in low-emission infrastructure and technologies.

Climate policies are likely to have a modest impact on aggregate employment (CBO, 2010; Château et al., 2011). The literature on the employment consequences of climate policies is somewhat limited and studies are often not directly comparable given the different assumptions they build on (e.g. the type of policies analysed, mitigation scenario considered or the supply elasticity of labour). However, notwithstanding this heterogeneity, they tend to identify relatively limited labour market outcomes. For the instance, the US Congressional Budget Office (or CBO) (2010) develops three macroeconomic models for the USA and finds that climate change policies are likely to have only a very small effect on overall employment (and the sign of the effect differs across models). An evaluation conducted by the European Commission on the efforts required to meet the EU 2020 climate objectives suggests that the employment growth could limitedly decelerate (Commission of the European Comm., 2008) while Boeters and van Leeuwen (2010) find that a 20% reduction in energy use could marginally decrease employment. Hafstead et al. (2018) develop a general-equilibrium two-sectors search model, roughly calibrated to correspond to the effects of imposing a carbon policy in the United States, and finds that the employment effects on the polluting sector of the economy are generally offset by opposite effects (of roughly similar magnitude) on the non-polluting sector. A more positive scenario is depicted by a recent ILO report that concludes that the process of job creation triggered by the low-carbon economy (24 million jobs by 2030) would more than offsets the number of lost jobs (6 million jobs) (ILO, 2018). A larger positive impact is suggested by the recent New Climate Economy Report that finds that ambitious global climate action could to lead to a net employment gain of 37 million jobs globally by 2030 (NEC, 2018).

Nevertheless, the limited effect on aggregate employment should not hide that far-reaching mitigation policies can profoundly affect the lives of specific communities. The progressive phasing-out of carbon-intensive and extractive industry will present particular challenges to regions characterized by limited economic diversification and where firms operating in these sectors count for a large share of employment. While the relocation of workers to other regions may help to smooth the impact, this can lead to destabilizing effects on family and community lives. In addition, post-displacement jobs

tend "... to be 'worse' […] along a number of dimensions, including average earnings, [than previous employment]" (OECD, 2013).

The international community has acknowledged the importance of promoting a just transition. The preamble of the Paris Agreement states "the imperatives of a just transition of the workforce […] in accordance with nationally defined development priorities". The COP21 has agreed that the effects of climate mitigation policies on the workforce should be a key focus of the "forum on the impact of the implementation of response measures" . The need to combine climate action and a just transition has been recognised by trade unions (ITUC, 2010) while the EU has recently launched a Transition Initiative to assist regions with the structural changes of their economies (EC, 2017a, 2017b). In addition, New Zealand has recently concluded the consultation on the proposed "Zero carbon Bill" that recognises the need to ensure a "just and inclusive society" (MFE, 2018; MoCC, 2018). The Guidelines for a Just Transition, adopted by ILO delegates representing governments, employers and trade unions, underline the increasing consensus on what a just transition entails (Box 1.1).

Box 1.1. ILO Guidelines for a just transition towards environmentally sustainable economies and societies for all

The ILO constituents, including governments and both workers' and employers' organizations, unanimously adopted the 'Guidelines for a just transition towards environmentally sustainable economies and societies for all' in November 2015. These were adopted by the Tripartite Meeting of Experts on Sustainable Development, Decent Work and Green Jobs and highlight the following principles:

a Strong social consensus on the goal and pathways to sustainability.

b Policies that respect rights at work.

c The recognition of the strong gender dimension of environmental challenges and opportunities, and the consideration of policies to promote equitable outcomes.

d Policy coherence across economic, environmental, social, education, training and labour portfolios to generate an enabling environment for the transition.

e The anticipation of impacts on employment, social protection for job losses and displacement, skills development and social dialogue – including the right to organise and bargain collectively.

f The need to take into account the specific conditions of countries, including their level of development, economic sectors and sizes of enterprises – no "one size fits all" solutions.

g The importance of fostering international co-operation among countries.

Source: (ILO, 2015)

Importantly, programs need to be carefully designed in order to avoid crystalizing an unproven link between climate policies and economic hardship in the public debate (Lalonde, 2007). In fact, intense labour reallocation is a feature of modern economies and the contribution of climate policies to this process is expected to be limited. Recent OECD analysis suggests that total job reallocation (i.e. the sum of job creations and job destructions) due to the introduction of global carbon tax of USD 50t/CO2 would only be 0.3% for OECD and 0.8% for Non-OECD countries (Chateau et al., 2018). In comparison, over the period 1995-2005, total job reallocation accounted for 20% of total employment on average in the OECD area (OECD, 2012a). Instead, job displacement - i.e. involuntary job loss due to economic factors such as economic downturns or structural change – affects around 2-7% of employees every year in the countries for which data are available (OECD, 2013).

This issue paper aims to contribute to the debate by discussing the expected structural changes brought by the low-carbon transition and the relevant lessons-learnt from the wide experiences of countries in dealing with structural adjustment process. To this end, the paper is organised into three sections. The first section collects the available evidence on how a low-carbon transition may unfold paying particular attention to its impacts on workers. The second section presents examples of past and recent structural adjustment processes in both OECD and Non-OECD countries with a focus on implemented labour transition strategies. Finally, the third section discusses which policy frameworks could facilitate the low-carbon transition.

The low-carbon transition is one of the several transformations that societies need to undergo in order to move towards a more sustainable future. Sustainable ocean management, protecting biodiversity and improving resource efficiency are among the many, and often interrelated, challenges that lay ahead. As for climate change, meeting these societal objectives will require new technologies, innovations and, therefore, the reallocation of production inputs from certain polluting industries towards more environmental friendly alternatives. However, the economic and social consequences of these transformations are more limitedly analysed in the literature. Box 1.2 provides a brief review of the literature on the employment impacts of a shift to a circular economy while Box 1.3 briefly discusses some of the other mega-trends likely to affect the labour market in the years to come.

Box 1.2. The circular economy transition

Available studies on policies to promote a circular economy tend to conclude that their impact on aggregate economic growth is likely to be either positive or insignificant . In their literature review, McCarthy et al (2018) underline that only two studies suggest that an increased circularity of economic activities will decrease economic output (Hu et al., 2015; Schandl et al., 2016). Similar conclusions are reached by Best et al. (2018) that find that "although some of the scenarios do find that the analysed targets or policies can have a negative economic effect, it appears that a careful policy design could prevent these impacts". Importantly, however, McCarthy et al (2018) highlight that the possibility to significantly reduce the consumption of natural resources without large adverse economic impacts suggests that there are significant inefficiency in the current production (and consumption) processes. Nevertheless, these inefficiencies are not always discussed by the authors.

A similarity with the studies on the low-carbon transition is that also several models highlight the potential sectoral labour and capital reallocation effects. For instance, Cambridge Econometric et al. (2018) analyse the impacts of increased circularity in five sectors (food, construction, waste management, electronics and motor vehicles) and distinguish between a "moderate" and an "ambitious" scenario. This modelling exercise predicts that scaling up circular activities should yield overall positive impact on GDP across all scenarios but the gains are not equally distributed. For instance, the waste management sector is likely to see an increase in employment and investments while the lower materials demand induces negative employment impacts in the non-energy extraction, the non-metallic mineral processing and the construction sector. Similarly, the recent OECD study concludes that a "...consistent finding in existing modelling is a decreased activity in upstream extractive sectors – mining, oil and gas, agriculture, fishing, and forestry – and material transformation sectors – metal smelting and fuel refining" (McCarthy et al., 2018). At the same, the authors highlight how several sectors, including "secondary material production" or "repair and remanufacture" can become significant drivers of re-industrialisation. Furthermore, Rizos et al. (2017) underline that there is limited analysis in the literature on the indirect impacts (e.g. value chain).

Several governments have already started to set recycling or resource efficiency objectives either on a sectoral or aggregate level. For example, the EU Waste Framework Directive establishes a target of 70 % of construction and demolition waste to be recovered by 2020 (EC, 2017c) while the Netherlands is aiming for a 50% reduction in the use of virgin resource inputs by 2030 (MIE, 2016). In the United States, the Sustainable Materials Management Program Strategic Plan includes a national target of a 50% reduction in food waste by 2030 (US EPA, 2015).

Box 1.3. The mega-trends affecting the labour market

Besides the low-carbon transition, other mega-trends are likely to affect the labour market in the years to come. For instance, globalisation is making national economies increasingly integrated (e.g. the value of exports expanded from 19.5% to 28.2% of GDP in OECD countries between 1995 and 2016). On the one hand, as underlined by the evidence that export-driven sectors tend to pay higher wages, this may lead to higher job quality. On the other hand, greater openness to trade may decrease job quality by increasing the risk of job displacement due to offshoring or outsourcing. Technological progress is also likely to affect jobs. On the one hand, new technologies generate novel job opportunities. On the other hand, they lead to the automation of certain tasks, causing some jobs to disappear and radically transforming many more (Frey and Osborne, 2017; Nedelkoska and Quintini, 2018). Finally, the global population is quickly ageing, and the ratio between the number of working age people and those of retirement age is projected to halve by 2050 in OECD countries.

In light of these considerations, policies to promote a fairer low-carbon transition should not be designed in a vacuum but need to take into account all the different megatrends. Importantly, the interaction among these forces also needs to be carefully evaluated. In countries with ageing populations, for instance, demand is likely to shift from durable goods (such as cars) towards services (such as health care), potentially reinforcing the expansion of the service sector driven by the transition to a low-carbon economy. At the same time, changes in the composition of the demographic pyramid may have implications for skills shortages, with potential ramifications for the pace of technology adoption and automation.

Source: OECD, 2019. Employment outlook, OECD Publishing, Paris. forthcoming.

2. The low-carbon transition: expected structural changes

2.1. Aggregate impact on employment and structural changes at the sectoral level

Carbon pricing, considered as a cornerstone policy for an effective low-carbon transition, is expected to affect industries through higher energy prices. "Brown" sectors, broadly defined as carbon-intensive industries and sectors related to extraction and processing of fossil fuels, are expected to experience the largest job destruction. In fact, the pricing of carbon emission would increase the relative price of carbon-intensive goods, thus decreasing both demand and employment in these industries. Importantly, these changes in demand patterns can trickle down throughout the economy by decreasing the consumption of products that are used jointly with the high-carbon goods. Additional propagation channels of the impacts of carbon pricing include international trade (e.g. lower exports of energy-intensive commodities such as iron and steel) and macroeconomic conditions (e.g. households income).

However, a successful transition can also create - if well-managed – new opportunities for workers. Low-carbon sectors, defined as those industries that are characterised by a low-carbon intensity, will see the demand for their products increase as consumers look for substitutes to high-carbon goods.

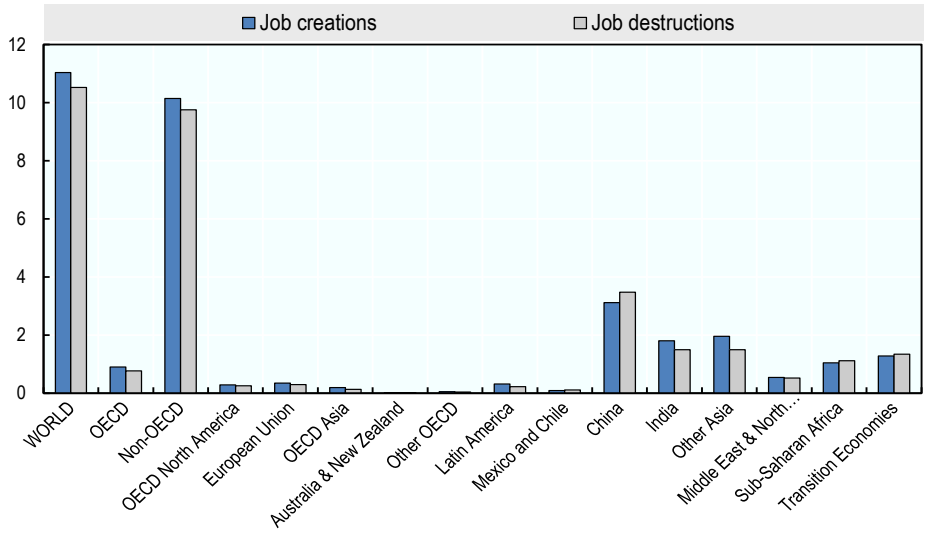
The aggregate impact of these changes on employment is expected to be limited. Simulations by a recent OECD study (Chateau et al., 2018) suggest that the overall reallocation of jobs (sum of created and lost jobs) triggered by a global carbon tax of USD 50t/CO2 would be around 0.3% for OECD countries and 0.8% for Non-OECD countries (Figure 2.1). These rates are relatively small compared to job reallocations observed during the past decades (e.g. job reallocation rates averaged at 20% over period 1995-2005 in the OECD area). One of the main explanations for the limited consequences in terms of job reallocations is that the heavily impacted sectors (mostly energy sectors) represent only a small share of total employment.

The employment contraction is expected to be concentrated in few sectors, mainly primary industries (Figure 2.2). There is limited analysis of the potential sectoral adjustments and Chateau et al. (2018) provides an important contribution in this regard. The authors analyse labour market structural changes induced by decarbonisation policies and find that variations in output and employment can be substantial for certain sectors (see Box 2.1). First of all, employment in 'mining and fossil fuel supply' and "fossil-fuel electricity generation" - in a scenario in line with the 450 ppm in 2035 objective – is likely to decrease by around 8% in OECD countries compared to baseline estimations. At the same time, the electricity generation sector is expected to experience a considerable shift of workers away from declining fossil-based generation towards low-carbon technologies. Furthermore, and as underlined above, not only sectors traditionally associated with the low-carbon transition will be affected. In fact, as the price of energy inputs increases, energy intensive industries will be likely to see a modest contraction of output and employment. ILO (2018) projections are similar in terms of the negatively

affected sectors but more dramatic in the impact. The ILO report compares two energy pathways analysed by the International Energy Agency, namely a 2°C scenario and the 6°C scenario (business-as-usual). The conclusions highlight strong negative impacts of the transition on "brown sectors" that are assumed to decrease their workforce between 11% (extraction of gas and petroleum) and 19% (coal-powered electricity generation) compared to a business-as-usual scenario by 2030 (ILO, 2018).

Figure 2.1. Job reallocations by region, global carbon tax of USD 50t/CO2

Absolute numbers (million jobs), 2011

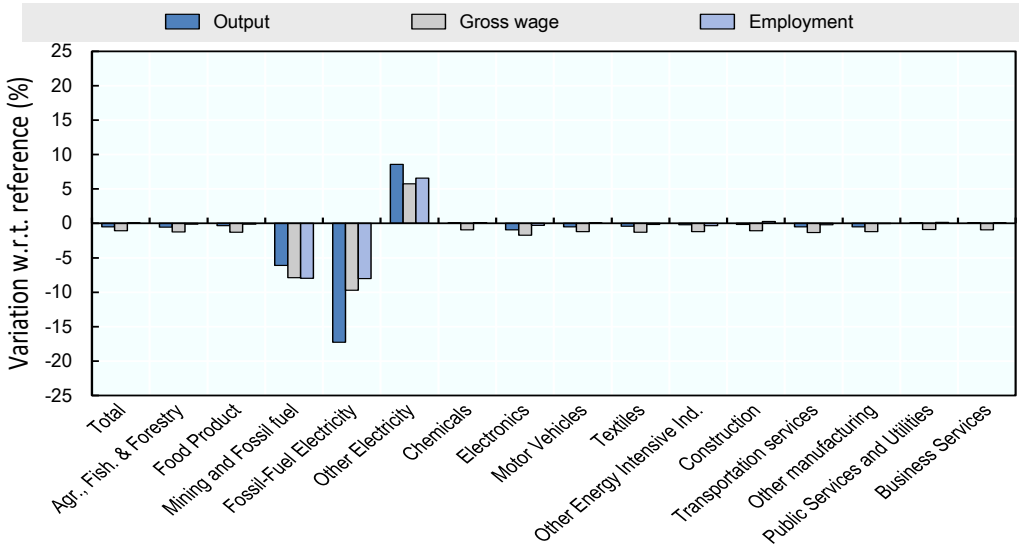


Source: (Chateau et al., 2018)..

The employment in sectors characterised by low-emission intensity, including low-carbon electricity generation, is expected to grow compared to the baseline. However, their relative impact on total employment depends on the sectoral labour intensity and the extent to which labour can substitute the progressively more expensive energy inputs. OECD simulations suggest that employment is most likely to expand in the 'Service' and 'Construction' sectors in OECD countries while industries like 'Electronics', 'Food products', or 'Motor vehicles' sectors will play an important role for Non-OECD countries (Chateau et al., 2018). Similarly, ILO (2018) discusses how action taken to limit global warming to 2°C will lead to higher employment in the entire value chain associated with renewable energy, electric vehicles and construction. Furthermore, the ILO report also underlines how the growing demand for inputs for electric vehicles and electrical machinery could lead to higher demand for certain mining activities (e.g. copper, nickel, iron and other non-ferrous and metal ores) (ILO, 2018). Importantly, however, the two studies remarkably differ on the magnitude of expected job creation effects as ILO depicts a scenario with a strong positive overall impact on employment.

Figure 2.2. Change in output, employment and gross wage by sector, global carbon tax of USD 50t/CO2

Percentage change w.r.t. reference equilibrium, 2011.



Source: (Chateau et al., 2018).

Box 2.1. ENV - Linkages model

Chateau et al. (2018) exploit the OECD ENV-Linkages model to analyse the impacts of climate policies on labour market and income distribution. The ENV-Linkages is a global Computable General Equilibrium (CGE) model that links economic activities to energy and environmental issues. It covers 35 economic sectors and 25 regions.

The model used for this analysis assumes the labour market to be segmented into 5 job categories: (i) professionals, defined as highly qualified workers in different sectors; (ii) managers and officials; (iii) service and sales workers; (iv) clerical workers that includes less qualified workers in different sectors (e.g. general office clerks, secretaries, customer services clerks, etc.) and 'blue collar and farm workers'. Importantly, workers cannot move from one category to another but can switch between sectors.

This enhanced version of ENV-Linkages is used to assess the impact of selected climate policies on labour markets and wage income distribution. In this issue note, only the labour market consequences of the central scenario, namely the introduction of a carbon tax of USD 50t/CO2 uniformly across all world regions, are presented. Notably, simulation results depend on key modelling assumptions. For instance, job reallocation rates would be higher if countries were assumed to introduce non-homogenous carbon prices. Chateau et al. (2018) offer a comprehensive analysis of the impact of different scenarios, assumptions and sensitivity of the results to the key modelling assumptions.

Sources: (Chateau et al., 2018)

2.2. A geographic dimension: Will new jobs be located in the same geographic areas where carbon-intensive industries will be phased-out?

The impact of the low-carbon transition is likely to be geographically concentrated. While coal-mining activities are necessarily clustered, there is some evidence that also "brown" industries exhibit – to various degrees - some tendency towards geographic concentration. For instance, a recent OECD study of 14 European countries shows that certain carbon-intensive sectors, like "coke and fuel production" or "manufacturing of basic metals", are highly localised, especially in several former socialist countries (e.g. Czech Republic, Poland, Slovakia). Instead, 'electricity generation and supply' and 'manufacturing of chemical products' are reported to be among the least concentrated in the considered sample (OECD, 2012a). The findings by Cragg and Kahn (2013), who report a strong variation in per-capita carbon emission across US counties, seem to further corroborate the hypothesis of a clustered geographic impact beyond the mining sector. In this regard, it should be noted the nature of the production processes of certain heavy industries (e.g. steel), which may not allow for smooth output adjustments, may lead to mass lay-off. Notably, while mass lay-offs typically account only for a small share of total dismissals, their geographically localised nature poses particular restructuring challenges (Silva et al., 2018).

This geographical concentration can present specific challenges if new jobs are not located in the same areas as the industries being phased out. If new jobs created - which in principle should (help to) offset the job losses - are located in distant regions, then workers will have to leave their communities in order to be employed, with potentially destabilising effects on family and community lives. Some workers - especially older ones - may refuse to move and transition into unemployment. Importantly, the literature highlights how also longer commuting distance, and not only relocation, may discourage job search (Marinescu and Rathelot, 2016).

The few available studies suggest the presence of such spatial divergence. Haerer and Pratson (2015) focus on the variation in employment associated with the coal, natural gas, wind, and solar industries between 2008 and 2012 in the USA. The authors' estimations suggest that increase in gas, solar and wind employment generally did not occur in the same regions where there were significant job losses in the coal industry. This geographical divergence can be further compounded by the nature of renewable energy technologies that, unlike fossil-fuel power plants, need to be situated close to the natural resource they exploit (OECD, 2017a).

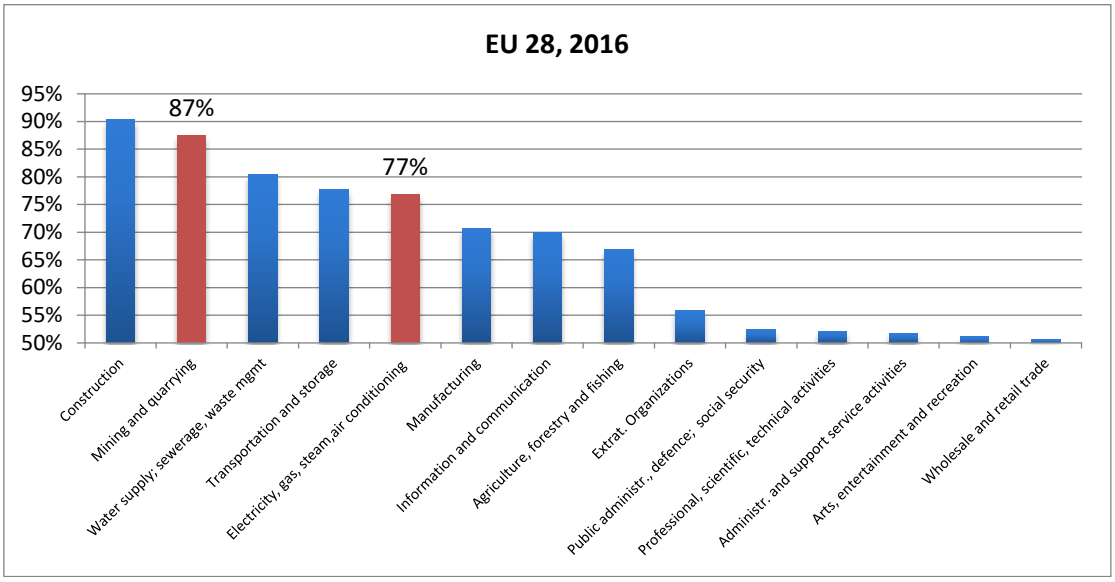
The likely concentration of job losses may represent a particularly difficult challenge for small or not diversified regional economies. If local governments extensively rely on tax revenues collected from the industries being phasing-out, their ability to provide education and other public services may be affected further complicating the transition management.

2.3. Two Gender aspects? A predominately male work force in primary sectors and women's under-representation in STEM education

The role of the energy sector in the low-carbon transition seems to suggest the possible presence of two gender dimensions. First, the work force of extractive industries and energy utilities in Europe is largely composed of men (Figure 2.3), and

likely so in other part of the world. While this aspect is scarcely debated in the literature, it may be important to evaluate heterogeneous effects by gender when assessing the first and second round effects of the energy transition on local labour markets. For instance, Aragon et al. (2017) study the restructuring of the UK coal mining sector and find that the closures of mines increased the number of male workers but decreased female employment in manufacturing, in both relative and absolute terms.

Figure 2.3. Share of male employment, selected sectors



Note: the category "Water supply; sewerage, waste management" includes also remediation activities.
Source: Eurostat dataset, accessed on February 2018.the source here. If you do not need a source, please delete this line.

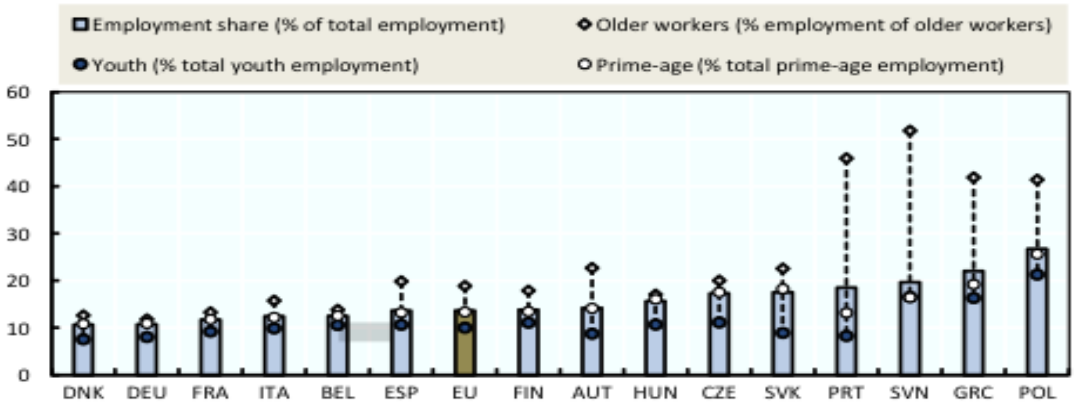
Secondly, the expansion of the renewable energy sector creates both opportunities and challenges for female employment. The sector is rapidly expanding (IRENA, 2018) and therefore may become an important segment of the growing "green" labour market. In this context, its more gender-balanced workforce suggests that women may start to play a larger role in the traditionally maledominated energy industry. For instance, a survey carried out by IRENA shows that women compose on average 35% of the workforce in renewables as opposed to 20 - 25% in the "traditional" energy sector (IRENA, 2016). Similar findings are reported for Spain (26% and 20%) and USA (30% and 17%) while a substantially equal representation is found in Germany (24% and 23.7%) (BloombergNEF et al., 2017). However, the few available data suggest that women - on average – count for almost half of the administrative positions but only for the 28% and 32% of technical and management roles (IRENA, 2016). Numerous hypotheses can be put forward to explain this lower representation in the technical roles, including a tendency for the "science, technology, engineering and mathematics (or STEM)" tertiary education to attract fewer women than men. As noted in the literature, this under-representation in STEM education is a likely barrier to higher female participation in several growing segments of the "green" labour market (OECD/Cedefop, 2014) and may confirm a gender bias in roles. Importantly, renewables are increasingly adopted to provide electricity to off-grid households (e.g. off-grid solar markets are

growing at about 60% per year since 2010) (IFC, 2018). The barriers traditionally hindering female labour market participation, such as limited access to education or to credit, are likely to constrain women's participation also in this growing segment of green labour market (IRENA, 2013).

Furthermore, some evidence suggests an over-representation of older workers in "brown" industries in certain OECD countries (OECD, 2012a). As shown in Figure 2.4 and Figure 2.5, this is often the case for some of the former centrally planned economies. As a large body of empirical research suggests, this disproportionate share of older workers can increase the adjustment costs. In fact, older workers are often found to face above-average displacement challenges that result in longer durations of unemployment spells and lager wage losses once re-employed (OECD, 2005a, 2005b). In addition, cultural bias towards learning in old age and the shorter remaining professional life to recoup investment in skills upgrading may limit the participation of older workers in education and training programs (OECD, 2017b).

Figure 2.4. Age distribution in polluting industries

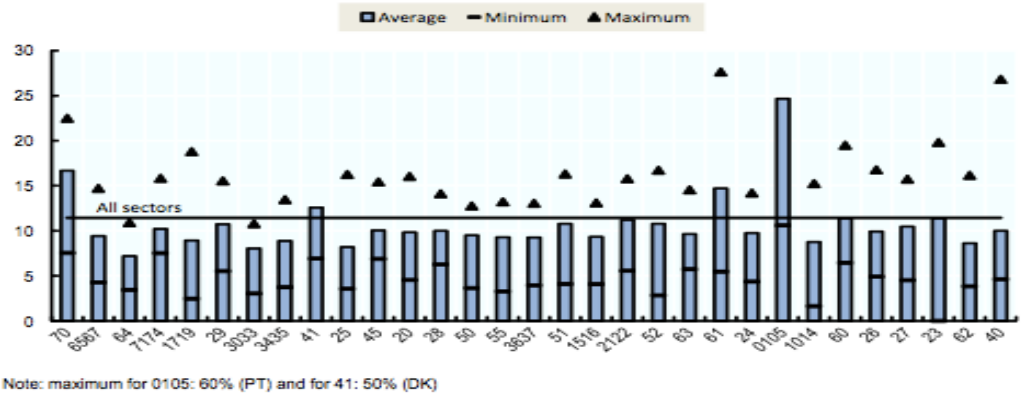
Share of workers for age cohort in polluting industries.



Source: (OECD, 2012a)

Figure 2.5. The age profile of workers in industries ranked by CO2 intensity, 2000-07

Share of older workers (55+) in total employment - Average, minimum and maximum values across 15 EU countries



Legend: Agriculture, hunting, forestry, fishing (0115). Mining and quarrying (1014). Coke, refined petroleum products and nuclear fuels (23). Chemical and chemical products (24); Other non-metallic mineral (26); Basic metals (27); Electricity gas (40); Inland transport (60); Water transport (61); Air transport (62); Other supporting and auxiliary transport activities, activities of travel agencies (63). Please see appendix for complete legend.
Source: (OECD, 2012a).

2.4. Skills transferability: to what extent will new jobs require the same skills as those being phased-out?

The Paris Agreement raises the important skills-related question about whether workers have the necessary "green skills" that low-carbon jobs will require. However, the term "green skills" (and even more "low-carbon skills") is still debated in the literature despite its large diffusion in the political discourse (Jagger et al., 2014). Following the definition in OECD (2011), skills can be defined as "the bundle of knowledge, attributes and capacities that […] enable an individual to perform an activity or task and that can be built [..] through learning". Instead, green skills can be understood as those "skills needed to adapt product, services and process to climate change and the related environmental requirements regulations" (OECD/Cedefop, 2014). Importantly, the term green jobs and green skills should not be conflated.

Existing evidence suggests that most green jobs will simply require a "topping-up" of existing skill sets (Jagger et al., 2014). A Cedefop's study on the skills needed to develop a low-carbon economy in six EU countries (Denmark, Germany, Estonia, Spain, France and the UK) highlights how many of the skills required for low-carbon jobs can be found in existing occupations. In most cases, a low-carbon skill set is likely to be a balance of "traditional" generic skills (for example autonomy and communication) and generic green skills (e.g. reducing waste).

Notably, the literature identifies numerous cases where the skill sets of jobs in "brown" industries are transferable and adaptable to low-carbon sectors. The similarity of skills between several jobs in the oil and gas industry and off-shore wind is

highlighted by numerous studies (e.g. CBI (2012), HM government (2016)). Louie and Pearce (2016) argue that a relatively minor investment in retraining would allow the vast majority of coal workers to switch to PV-related positions. The geothermal sector can benefit from the expertise of professionals in petroleum drilling technologies (IRENA, 2017) while the operation of renewable energy plants requires the skills of electrical engineers and technicians at fossil-fuel power stations. Moreover, the EC and ILO (2011) discuss how the skills of workers displaced from the traditional construction sector may successfully be leveraged in 'green building', provided that appropriate retraining programmes are established (Table 2.1).

Table 2.1. Examples of transferable and new skills

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	Occupations	Core training	Up-skilling	New occupation
Denmark	Industry electrician / energy technologist	VET qualifications / tertiary engineering qualifications	Knowledge of energy sources, ability to integrate energy systems, project management	Manager in renewable energy
	Industrial operator / industry electrician	VET qualifications / upper secondary qualifications	Assembly, installation of parts, use of tools	Wind turbine operator
Estonia	Construction worker	No professional standard	Knowledge of energy systems, data analysis, project management	Energy auditor
France	Recycling sector worker	General certificate of vocational qualification	Sorting and reception techniques, knowledge of conditioning and storage	Waste recycling operator
	Product design and services	22 initial training courses with varying specialisation	Integrating environmental	Eco-designer
United Kingdom	Commodity trader / broker	Tertiary qualification	Practical skills on functioning of carbon market, understanding of trading tools	Carbon trader / broker

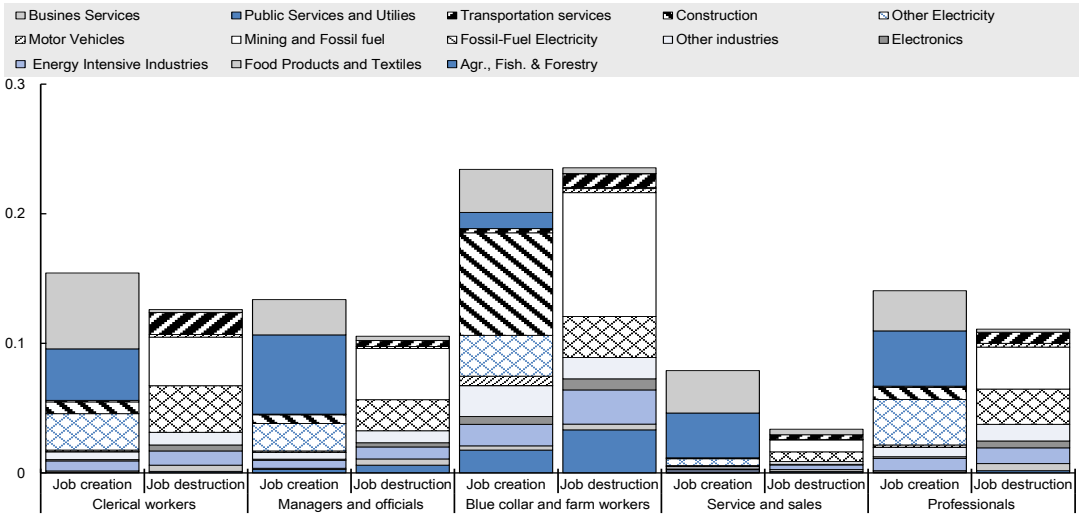
Source: : (Cedefop, 2010).

The extent to which workers will need to adjust their skills set will also depend on how job opportunities are distributed in the low-carbon economy. As certain sectors will progressively become less (or more) competitive, their relative demand for employment will decrease (or increase). However, given the segmentation of the labour market, not all "types" of workers will be affected in a similar manner by the contraction (or expansion) of a given industry. For instance, if the low-carbon transition would lead to the growth of sectors employing highly skilled workers while driving a contraction of industries characterised by a low-skilled workforce, then the different skills requirement

between the two sectors would limit the opportunities for the reemployment of displaced workers. Unfortunately, few studies provide evidence of how the skills demand and supply would evolve by adding this layer of analysis to the assessment of the sectoral impacts of the low-carbon transition. An important exception is provided by Chateau et al. (2018) that analyse sectoral reallocations considering a labour market segmented along five job-families (see Box 2.1).

Their finding shows that progressively higher carbon prices would lead to a strong process of job destruction for blue-collar workers, especially in sectors such as mining or fossil-fuel power generation (Figure 2.6). At the same time, the largest increase in employment opportunities for this job family would be in sectors such as construction, low-carbon power generation and services. Importantly, their simulations underscore how the transition would also affect medium- and high-skilled workers, especially in OECD countries. Also for these two job-families, the restructuring of mining and carbon-intensive power generation would be responsible for the largest job destruction. However, the service sector (both business and public services and utilities) and other (alternative) power generation are expected to provide the highest number of new jobs for these two higher skilled job families. The stronger impact on low-skilled workers is also identified by Yip (2018) who uses individual-level data to estimate the labour market consequences of the introduction of a revenue-neutral carbon tax in British Columbia (Canada).

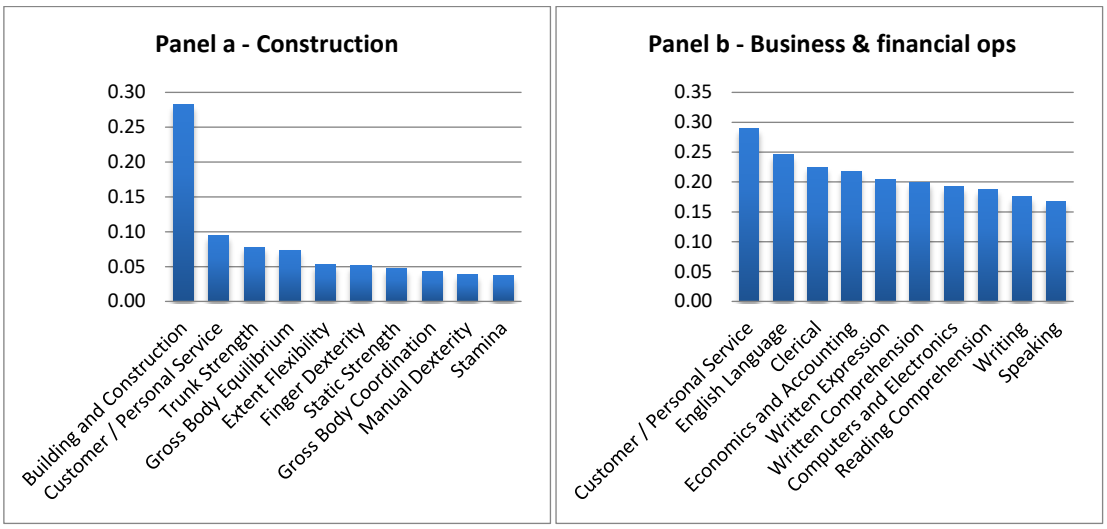
Figure 2.6. Sectoral composition of job creations and job destructions, by job category. Global carbon tax of USD 50t/CO2



Note: Percentage change in employment relative to total employment of the category in the reference equilibrium, 2011.
Source: Chateau et al. (2018).

Importantly, training needs can vary significantly according to the previous experience of workers and the sector where they are seeking employment next. This difference points to the need of carefully identifying potential "destination" sectors when training programs are designed. For instance, a worker in the mining sector may need to develop very different types of skills according to whether he is expected to find new employment in the construction or service sector (Figure 2.7).

Figure 2.7. Training needs for switching industry



Note: The graph shows the "skill difference" (e.g. training needs) to switch from the "mining" sector to an occupation in "construction sector" (panel a) and in the "Business and Financial operations" sector (panel b). Ten most relevant "skill differences" showed only.
Source: OECD Skills for Jobs database, 2017.

2.5. Quality of jobs: higher or lower?

In addition to the quantity of jobs created or transformed, their quality is an important dimension for a just transition. The literature suggests that often post-displacement jobs are of lower quality along a number of dimensions since benefits, including job security, are frequently linked to tenure. Several studies focus on the US job market and find that workers have a high probability of losing their health insurance coverage after displacement (Couch, 1998; Olsen, 1992; Podgursky and Swaim, 1987). Brand (2006), who leverages data on the US labour market as well, finds that post-displacement jobs tend to be characterised by lower status, lower job authority/autonomy and reduction in both employer-sponsored pension and health insurance plans. The OECD analyses the variation in a range of benefits of after-displacement jobs in three countries (Australia, France and Korea), and finds a preliminary evidence of decreased job quality regarding the working conditions that are closely linked to tenure (OECD, 2013).

While jobs in declining 'brown' industries differ in numerous dimensions, they share some common characteristics. Employees in most polluting industry are more likely – probably because of the large share of older workers, as discussed in section 2.3 - to hold permanent contracts than the national average in some OECD countries (OECD, 2012a). As such, the presence or absence of such long-term contracts may represent an important dimension for dismissed employees' perception of the quality of future jobs. In addition, data collected on the US coal miners' salaries point to the challenges of re-employment with equivalent compensation. In fact, according to the National Mining Association, less than 3 per cent of coal miners have a bachelor's degree while their average weekly earnings amount to USD 1 492. By contrast, the U.S. median weekly earnings of workers with no college degree are USD 678 per week (Morris, 2016).

Occupational hazards associated with "green jobs" are often found to be similar to those in other industries. The shift to low-carbon energy sources will directly lower the demand of work in dangerous occupations associated to fossil fuels extraction. Furthermore, it may indirectly improve the quality of the work environment in other mining activities. For example, converting heavy-duty vehicles for mining from fossil-fuel combustion engines to electric models may lead to better air quality at underground mining sites. The WHO (2011) also notes how the manufacture and use of chemicals that are safer for human health and the environment, often described as "green chemistry", may provide many opportunities to improve health and safety at work. At the same time, however, some reports point to possible risks associated to several green occupations (Table 2.2). For instance, the toxic substances contained in solar panels may pose risks during their manufacturing and installation (EASHW, 2013; SVTC, 2014, 2009) while the sorting or removal of toxic material highlights the risks connected to home retrofitting (ILO, 2012). Also recycling - an important sector for a green transition - may entail dangerous and unhealthy work, especially where it is performed in informal sector with lax implementation of occupational safety measures. In developing countries, such waste picking and sorting tasks are often performed by members of marginalised groups.

Table 2.2. Potential risks associated with low-carbon jobs

Green Job	Examples of possible occupational risks
Transportation	Battery workers may be exposed to high-voltage
Waste collection and segregation	Handling and exposure to hazardous materials and chemicals
Construction	Handling and exposure to hazardous materials
Wind energy	Working at heights

Source: Authors' elaboration based on WHO (2011), ILO (2012).

2.6. Main takeaways

The literature suggests that the net aggregate employment impact of moving towards a low-carbon future is limited. In fact, most of the literature points to a modest total job reallocation caused by low-carbon policies, compared to the process of job creation and destruction normally observed in economies. Authors often underline the limited share of the most negatively affected sectors in total employment as the main reason for this modest impact. However, some of the most recent reports suggest that larger gains in employment are possible.

Nevertheless, intense jobs reallocation is expected in certain sectors. "Extraction of fossil fuels" and "Fossil fuel based electricity generation" are among the economic activities expected to experience the largest contraction due to climate policies while "renewables', "manufacturing of electric vehicles" and "construction" are often singled out as the sectors where employment is likely to expand the most.

The available data on the demographics of the workforce of sectors affected highlight both a gender and age dimension of the low-carbon transition. On the one hand, the workforce of most negatively affected sectors is largely composed of men. Remarkably, the literature is very limited on second round effect of such gender-skewed impact. On the other hand, the transition offers also some opportunities to increase female representation in the traditionally male-dominated fossil energy sectors since the renewable energy industry tends to have a more balanced workforce than the traditional

fossil-fuel power generation. Energy intensive sectors, which are likely to be negative affected by the transition, are often characterised by an older workforce. This may increase adjustment costs since older workers often face above average displacement costs.

The limited available evidence suggests that locations where "brown" jobs are lost may not coincide with where "green" ones are created, thus increasing adjustment costs. Employment in fossil-fuel mining and in several carbon-intensive sectors appears to be geographically concentrated. If the new "green" jobs are not located in the same regions, then laid-off workers would have to leave their communities for such new jobs with potentially destabilising effects on family and community lives.

Jobs in a low-carbon economy are likely to require a balance of "traditional" skills and generic green skills. The literature highlights how many of the skills needed for low-carbon jobs are found in existing occupations, and workers may only need to "top up" their skills to shift from "brown" to "green" sectors. However, the retraining needs for displaced workers will vary according to the expertise of the individual worker and his (expected) new occupation. For instance, a worker in the mining sector may need to develop very different types of skills according to whether he is expected to find new employment in the construction or service sector.

3. Lessons from previous industrial restructuring experiences

3.1. Key insights

This section examines a number of examples of past and recent industrial restructuring experiences. The measures introduced to address their impacts on workers offer valuable lessons as we consider inclusive solutions for the low-carbon transition. The examples have been selected for their relevance to the low-carbon transition in terms of affected sectors, geographically clustered socioeconomic impact or labour and skills policies implemented. A brief summary of each case is provided in this section, while a more detailed discussion is included in Annex I.

The Ruhr Valley: a multi-stakeholders approach (Germany).

In the mid-1950s, the coal sector employed almost half millions persons and, jointly with the steel industry, accounted for around 70% of jobs in the Ruhr Valley. As these core industries began to sharply contract in the 1960s, the region underwent a dramatic restructuring from its original coal and steel-based specialisation to a more diversified service economy. Today, the two sectors employ just under 95 000 people (2015).

The transition experience, which is considered to be among the most successful, highlights the role that multi-layered policy packages play in ensuring a smoother impact on workers and local communities. An important aspect of the German restructuring experience is the development of long-term strategies with key stakeholders, such as the federal government, the lander and firms. This is evident in the landmark 2007 agreement on the final phase-out of subsidies to underground hard coal mining by 2018. Other measures included social protection, vocational training and early retirement. Initiatives for physical regeneration, which aimed at preserving and converting industrial sites to showcase the Ruhr Valley's 'industrial culture' to tourists, have also attracted a large international interest given their results. For instance, the Zollverein (one of Europe's largest industrial coal facility) has become a UNESCO World Heritage Site.

The UK coal mines: a gender dimension in the transition? (UK)

At its peak of production in 1952, the UK coal mines employed more than 700 000 miners. However, the diffusion of cheaper substitute fuels and a progressive tertiarisation of the UK economy led to the progressive demise of this sector. By 1985, the UK coal industry had a total workforce (including white-collar staff, workshops, opencast mines, etc.) of 221 000. In the following few decades, nearly 95% of coal mines were closed leading to the loss of 193 000 jobs.

This example is particularly interesting since it highlights a gender dimension of the transition. In fact, over 90% of displaced coal workers were men according to reports. In this regard, the limited literature focusing on the gender aspect of this mass lay-off discusses some evidence of a crowding-out of female employment as a second-round consequence of the mass layoff. Furthermore, the UK experience underlines that rebuilding former mining communities takes time and, as in the case of the Ruhr Valley, it requires a well-rounded suite of policies (e.g. physical regeneration, active labour market policies and promotion of new enterprises). The evaluations of implemented programs have underlined the complexity of estimating cost and duration of restoration activities for highly contaminated sites due to limited data availability on the environmental damages. In addition, the need of closer coordination among implemented initiatives has also been highlighted.

New labour policies in response to industrial restructuring in China.

The rapid growth of the Chinese economy has been accompanied by several rounds of large-scale industrial restructuring. For instance, the progressive privatisation of state-owned enterprises (SOEs) is estimated to have caused lay-off of around 28 million workers between 1998 and 2003. More recently, the current overcapacity in numerous heavy industries seems to underline an important role of transition management policies for workers in the near future.

Initiatives to support affected workers, such as the Re-employment Service Centres (RSCs) that were typically located within firms undergoing restructuring and provided both job search services and vocational training programmes to displaced workers, evolved over time. A study on the effectiveness of worker retraining programmes in China notes that a mix of diversified training providers (e.g. public, commercial providers) can be beneficial since each type of provider has specific competencies with different categories of training. Also, the involvement of employers in designing training programmes may help to ensure that programmes are well aligned to local labour needs. Furthermore, job search, counselling and labour market information are highlighted as effective tools to increase the return on the investment in worker retraining.

The oil and gas industry: web-based tools to support the workers' transition (UK).

The UK oil and gas industry is considered as a global centre of excellence. However, the sector has been going through a contraction due to the decline in global oil prices in recent years. As a result, the workforce has been reduced (available estimates suggest that around 120 000 jobs were lost between 2014 and 2017) while development projects have been mothballed. Furthermore, the prospects for workers are also darkened by a projected 5% annual decline in domestic oil and gas production after 2022.

The case of the UK oil and gas industry is particularly interesting given its focus on a key sector for the low-carbon transition (i.e. oil and gas extraction), and because it provides valuable insights on innovative web-based tools to support displaced workers to find new jobs. More precisely, the Oil & Gas Workforce Plan, which was prepared by the Government with the aim of supporting displaced workers and of retaining sectoral expertise, underlines how the skills of Oil and Gas workers can be applied in numerous other industries. For example, systems engineers or signal designers can be employed in the railway sectors while the growing oil and gas decommissioning industry can offer

opportunities to workers with expertise in mechanics. “Skills connect” is among the various web-based tools that the Government is planning to deploy. This platform should help displaced workers to identify occupations in other sectors that require similar set of competencies and relevant technical trainings. Furthermore, an additional dedicated online platform will allow companies interested in recruiting former oil and gas industry employees to have direct access to individual profiles.

Creating skills for greening existing industries in Flanders (BE).

The Flanders government is pursuing a strategy of decoupling economic growth from environmental impact in a number of industries. This case complements others above since it focuses on efforts to green - instead of phasing-out - an existing sector, another important aspect of the transition.

Several initiatives, both at the sectoral and regional level, have been implemented to support this process. Examples of regional (or horizontal) actions include the development of green experience certificates and the inclusion of green skills in the regional database on qualifications and job profiles. These are coupled with numerous vertical initiatives that target sectors that are strategic to a green low-carbon transition. For instance, the Flemish chemical and construction sector federations have set-up a wide range of activities to address a skills shortage, including green skills. These include increased collaboration with universities, “improved branding” for these sectors, websites to provide information regarding career perspectives and collaborations with universities for the development of curricula.

A “modern transition” strategy: the case of Alberta (CA).

In November 2015, the Government of Alberta launched the Climate Leadership Plan that includes an accelerated phasing-out of coal fired power generators and the introduction of a carbon price. The phase-out is particularly ambitious since coal-fired utilities account for almost 55% of total provincial electricity generation with more than 3 000 people employed in the sector, including coal mining and coal-power generation.

The case of Alberta is particularly interesting since it represents one of the first “low-carbon just transition” strategies in place. The Government has implemented several initiatives to accompany this structural adjustment. The revenues of the carbon levies represent the bulk of a fund to promote innovation and economic diversification. In addition, a dedicated Advisory Panel on Coal Communities has been established in order ensure that the concerns of local communities and workers are considered. Building also on the recommendations elaborated by the Panel, numerous initiatives have been designed to support workers during the transition. These include top-ups to the employment insurance benefit, relocation grants to support geographic mobility and on-site career counselling.

Overcapacity and labour policies in the fishing industry (Peru).

Significant overinvestment in vessels, coupled with changes in ocean currents due to climatic events like El Nino, created significant pressures on the Peruvian fish stock. As a result of the reform introduced to improve fisheries management, a quarter of the fleet

was decommissioned and a large number of workers were displaced both in the fishing industry and in related sub-sectors.

The program put in place to facilitate labour adjustment to the restructuring process built on a three-pronged approach: financial and training support for workers transitioning to other sectors, entrepreneurial training and early retirement. Workers choosing the first or second option were offered a compensation package for voluntary redundancy and a subsidy for the duration of the retraining period. Workers close to retirement age could opt for a temporary subsidy to "bridge them" to the pension insurance benefits. The schemes are financed by the private sector through fees imposed on vessel operators and fish-processing plants. The program, which was introduced within the framework for a larger loan from the World Bank, has been considered successful in decreasing overcapacity and mitigating the associated social impacts. At the same time, Murillo (2014) notes that one of the program deficiencies was that it targeted only fishers and therefore workers in related industries, which also experienced large lay-off, did not have access to the transition support mechanisms.

3.2. Main takeaways

The main takeaways from the selected cases are summarised below:

- **A suite of policies is usually introduced in order to smooth impacts of sectoral restructuring on workers**. Furthermore, the development of long-term strategies with the participation of key stakeholders seems to underpin most successful cases.
- **Physical regeneration activities may be necessary, especially for those regions whose environment has been damaged by extractive industries**. The program implemented in the Ruhr Region, where some former coal mining facilities have entered the UNESCO World Heritage list, represents an important example in this regard.
- **The case of UK coal mines highlights the gender dimension of the transition**. The literature underlines that not only over 90% of displaced coal workers were men but also that coal jobs accounted for a large proportion (typically 20% - 35%) of all the jobs held by male workers in the affected regions. Furthermore, the literature discusses some evidence of a crowding-out of female employment as a second-round consequence of the mass layoff.
- **Web-based information tools can be used to help workers to identify job opportunities in other sectors and possibly related skill gaps**. Such tools, which can either target workers and help them to identify industries that require similar skills-set or allow firms to directly contact workers with specific competencies, can complement vocational retraining initiatives to enhance return on investment in the latter.
- The impact of sectoral restructuring on workers employed in closely related sectors in the value chain should also be considered when designing transition support measures.

4. Policies for a just transition

The structural transformations described in Section 2 highlight the wide-range and cross-sectoral changes that a shift towards low-carbon growth requires. Within the power generation sector, deep-decarbonisation will result in the stranding of production assets. The decline in the coal (and, down the line, of oil and gas) will imply that numerous workers will have to retrain to find jobs in other sectors and that communities that rely heavily on their extraction will have to diversify their economies. Beyond fossil fuels, other GHG-intensive sectors, which we have defined as "brown industries", such as steel, paper and pulp or cement are likely to undergo profound technological transformation, with possible consequences for the relative value chains.

To ensure a just transition, the policy challenge is to achieve deep emission reductions while minimising the impact on workers. To this end, previous industrial restructuring experiences and the current understanding on the unfolding of the low-carbon transition highlights the role to be played by a mix of policy instruments. These include well-designed carbon pricing mechanisms, structural reforms, active labour market and skills policies. Regions whose environment has been severely damaged by mining can also benefit from physical regeneration programs.

4.1. Carbon pricing

During previous industrial restructuring processes, both OECD and Non-OECD countries devoted considerable resources to facilitate sectoral adjustment. During the 1980-85 steel crisis, for example, European companies received around ECU 38 billion of state aid (23 to support continued operations, 12 to improve operations, 2 for closure and one to support R&D) (Davignon, 2016). In the case of UK coal mines, the three major national programs involved a commitment of almost GBP 1.1 billion of public expenditure (NAO, 2009).

Pricing emissions, through taxes or tradable permits, is an essential climate mitigation policy. These policies, sometime referred also as "explicit" carbon pricing, are cost-effective tools to reduce emissions for three reasons. First, polluters face an incentive to abate emissions as long this is less costly than paying the carbon prices. Secondly, the explicit carbon pricing solves the issue of information asymmetry that would arise if the regulators specify process and technologies should be leveraged to deliver emission reduction. Finally, they provide an incentive for firms to continuously look for cheaper abatement options, thus stimulating innovation (OECD, 2016a).

At the same time, carbon pricing increases public revenue. This additional budget can be substantial and, for instance, it has been estimated that a carbon price set at EUR 30 per tonne would generate revenues - on average across G20 countries and considering current emission levels – amounting to almost 1% of GDP (OECD, 2017a). Importantly

almost 88% of all emissions from energy use are still priced considerably less than EUR 30 per tonne, which represents a conservative minimum estimate of the damage that results from emitting one tonne of carbon (Box 4.1).

Box 4.1. Carbon pricing is slowly gaining momentum

The OECD has recently analysed the extent of carbon pricing across 42 countries, including both OECD and G20 countries, that together account for 80% of global CO2 emissions. Significantly, the report adopts a comprehensive definition of carbon pricing by considering taxes on energy use, carbon taxes and emissions trading systems in place.

The study finds that the carbon pricing gap – which measures the difference between actual carbon prices and the benchmark rate of 30 EUR per tonne – remains high with some small improvement. In fact, the carbon pricing gap dropped from 83% in 2012 to 79.5% in 2015 and is estimated to reach 76.5% by the end of 2018. The decrease is due to the initiatives undertaken by several countries, including France, India, Korea, Mexico and the United Kingdom (OECD, 2018).

However, several countries still subsidise fossil fuel production and consumption. These subsidies can be broadly considered as a form of negative carbon pricing and take different forms across countries, including subsidised fuel for consumers, and concessional credit or loan guarantees for producers. The reform of such subsidies can create important additional fiscal space. Before Morocco and Indonesia embarked on their reforms, energy subsidies reached respectively 5.5% and 4.1 of their GDP, while the Mexican gasoline and diesel price subsidies were equal to 1.4% of its domestic GDP. The dimension of these saving can be more easily understood if compared to other public expenditures items. For instance, Indonesian fossil-fuel consumption subsidies were four times total government expenditure on health (AsDB, 2015; OECD, 2017a; World Bank, 2012).

How these revenues are used is an important piece of the just transition puzzle. These could be leveraged to compensate firms for potential loss in competitiveness, to support low-carbon innovation or to ease the impact of the transition on workers. Importantly, higher energy prices are likely to be regressive and therefore several analysts underline the need to leverage the expected tax revenues to compensate low-income households. However, studies note that only a limited portion of the total revenues from higher energy taxes is often needed to mitigate energy affordability risks for households, thus multiple objectives can be pursued (Flues and Van Dender, 2017; OECD, 2017a). Nevertheless, which form of recycling is most desirable depends in a complex way on specific national circumstances. Furthermore**,** since these options entail trade-offs between economic efficiency, social benefits and political economy considerations, a careful analysis on the allocation of the "carbon revenues" should underpin this decision.

Currently, countries have adopted various approaches to recycle carbon-pricing revenues. In the UK, which has introduced a carbon floor in addition to the EU ETS, these contribute to the general budget. French carbon tax revenues are used to finance a tax credit to improve firms' competitiveness. In the EU, half of revenues from the ETS auction should be used for "climate and energy-related purposes" (OECD, 2017a). In Alberta, as discussed above, these have been partially directed towards funding training

programs (and other measures) for displaced workers and to support firms investing in low-carbon technologies. Importantly, a share of the revenues is also reinvested to provide tax rebates to low- and middle-income households.

In deciding the destination of such revenues, policy makers should be aware that the extent to which these should be earmarked is debated. Broadly speaking, allocation of all the revenue to a stated purpose – often defined as a "strong earmarking" – is often considered as inefficient since it does not allow policymakers the flexibility to redirect spending when needed. "Soft earmarking", or statements of policy intent, can help gather social support for implementation without the disadvantages of strong earmarking.

The literature also notes that carbon pricing can sometimes generate a double dividend. The weak form of the so-called "double dividend hypothesis" asserts that the efficiency costs of a revenue-neutral environmental tax reform are lower if the additional revenues generated from carbon pricing are recycled through a reduction of distortive taxes (e.g. taxes on labour or capital income). In its strong form, the hypothesis states that an environmental tax reform can enhance both environmental and economic outcomes, such as employment. However, the initial labour tax distortions should be relatively strong for an employment dividend to materialise (Château et al., 2011).

4.2. Framework conditions: well-designed market regulations and the importance of coordination among transition support initiatives

The transition involves a reallocation of productive inputs (e.g. labour and capital) across sectors. For this reason, well-functioning markets are necessary to ensure that firms and workers can quickly adjust to new economic opportunities.

Therefore, several "structural policies" can play a key role in ensuring a fairer transition for workers. Easier and less time-consuming procedures to start a business would reinforce the effects of programs aiming at promoting both entrepreneurship among displaced workers and the creation of (low-carbon) start-ups that would help local economies to diversify. Furthermore, reforms that strengthen competition and market entry are likely to lead to higher investment, innovation and productivity, thus potentially improving the response of firms to the higher energy prices generated by carbon pricing instruments. Improved insolvency regime would further facilitate this process by easing the reallocation of resources towards innovative activities (McGowan et al., 2017).

Reforming housing policies can facilitate geographic mobility, thus increasing the quality (and availability) of post-displacement jobs. Permanent shocks, such as a low-carbon transition, could lead to unbalances in regional labour supply and demand (Janiak and Wasmer, 2008; Mcgowan and Andrews, 2017). Therefore, higher mobility would allow workers to broaden the geographical area of their job search, potentially increasing the probability of finding jobs that better match their skills (Mcgowan and Andrews, 2017). Improving access to low-cost housing, streamlining administrative procedures for building permits and decreasing transaction costs connected to the buying and selling of real estate (e.g. stamp duties, acquisition taxes) are all instrumental in this regard. Finally, workers on temporary contracts or still in their "probationary period" - as recently reemployed displaced workers are likely to be - may struggle to provide the guarantees required by landlords in particularly tight housing markets. The establishment of guarantee schemes may be a way to alleviate this problem (OECD, 2006a).

A well-coordinated approach is necessary to improve the effectiveness of transition programs. The experiences also show that numerous programs (e.g. skills training, job-search, etc.) are usually put in place in order to smooth the impact on workers. Coordination among them is necessary in order to improve their effectiveness and create the necessary synergies. For instance, as underlined by the NAO evaluation of the UK transition programs for coal regions, appropriate reporting and coordination mechanisms should be established to build in incentives to cooperate among independent initiatives. Also the creation of working groups across programs and/or along the vertical and horizontal levels of government can be conducive in providing coherence and improving overall performance.

Importantly, the reviewed cases of industrial restructuring underline the importance of involving all stakeholders in the transition planning. Campbell and Coenen (2017) note that the transition strategies that historically tend to show greater political resilience and a more coherent and comprehensive approach were those where a relative consensus was reached on the need to phase out certain industries. Caldecott et al (2017) reach a similar conclusions through a review of coal transitions in six different OECD countries. Germany is a particularly good example of this. The decision to progressively close the coal mines has been taken through a dialogue that involved different levels of government, employers and trade unions. In Alberta, a dedicated task force has been established in order ensure that the concerns of local communities were considered in the development of the transition strategy.

4.3. Active labour market policies: good old tools?

Overall, as underlined in (OECD, 2012a), some form of flexicurity[1] is likely to be instrumental to ensure an efficient flow of workers from contracting "brown" industries towards modern low-carbon sectors. However, the correct balance between its dimensions (i.e. security, flexibility) is likely to be context dependent. Job security regulations typically combine two key elements: the obligation of employers to pay redundant workers a severance payment (often computed considering workers' tenure and monthly salary) and the obligation to provide an early notice of dismissal. Both elements are a recurrent feature in the most successful cases of transition discussed above. In the Ruhr region, for instance, "redundancy payments" were granted to miners who lost their job as a consequence of closures or rationalisation. Each worker who qualified received redundancy payments between DM 2 000 and DM 5 000, depending on age and seniority between 1966 and 1979. The funding for this payment was provided by the Federal government, and amounted to EUR 223 million. (Storchmann, 2005). In Alberta, a "relief grant" has been introduced to provide displaced workers with up to 75% of their previous weekly earnings when combined with Employment Insurance benefit (Gov. of Alberta, 2018a, 2018b). Importantly, available resources should be carefully managed and, for instance, a key principle adopted by Charbonnages de France[2] during its closure

[1] There are multiple definition of flexicurity that can be broadly defined as the deliberate combination of flexible labour contractual arrangements and modern social protection system

[2] Charbonnages de France was a company established in 1946 in France when coal production was nationalised. The company was also a key actor in the management of the long-term decline of this sector.

programmes was that is better to allocate funding to trainings for new jobs rather than on lump-sump redundancy payment (IEA, 2009). Furthermore, the IEA (2009) notes that large lump sum payments could be ineffective especially in case of limited financial education of the receivers.

All the cases examined highlight the importance of active labour market policies. These can be broadly defined as those policies aiming at improving the probability of the unemployed to find a job by developing his skill-set and by facilitating the matching between skills and job vacancies.

Job-search training, here defined as those programs designed to help workers to find jobs by improving their job-search skills, can be an important tool to facilitate matching between vacancies and displaced workers. In fact, as underlined in Section 2, workers currently employed in "brown" industries may possess valuable competences but may find it problematic to navigate the job markets or to identify suitable opportunities in other sectors. Moreover, there is evidence that guidance and counselling services increase the effects of financial incentives to invest in skills (OECD, 2017c, 2017d).

Job-search training may include - among other activities - consultations to review CVs, discussions on future career progress, advices on both job-search strategies and interview techniques. Similar schemes have been implemented in most of the cases considered above (e.g. the Ruhr Valley, Alberta, UK) and can be provided by external actors or by the (former) employer. Arguably the provision of job-search services, as also noted by the Alberta task force on the just transition, should beginning as soon as the workers receive notice or even before in order to improve the effectiveness of such measures (OECD, 2015a) (see also Box 4.2). The UK case also underlines how web 2.0 tools can be useful to allow workers to independently identify new career paths and relevant skill training needs.

The effectiveness of these services may be increased through a reduction of the client-staff ratios. A recent experiment in Germany showed that decreasing the staff/client ratios resulted in shorter benefit durations in the participating Public Employment Services (or PES) offices. Furthermore, the costs of hiring additional caseworkers were offset by decreased benefit expenditure after a period of about ten months (OECD, 2015b).

Often, job-search training is coupled with job brokerage services. Information is crucial if labour market supply-demand matching is to work efficiently. Jobseekers need to be well informed about available jobs and job requirements while employers need information about jobseekers' skills and interest in their openings (OECD, 2015b). In a number of OECD countries, online vacancy databases have been established and proved relatively successful in improving matching skills demand and supply. An interesting application of these online tools has been leveraged for the UK oil and gas displaced workers, where a dedicated online platform has been established and targeted to firms particularly interested in the competencies of workers leaving this sector. Nevertheless, the opportunity to replicate this approach in other contexts needs to be carefully considered since not all workers have the necessary capabilities to use IT tools. In some countries, an even more active job-brokerage technique is taken, namely 'reverse marketing'. This approach entails actively marketing a job seeker to a targeted employer who has not yet created a formal vacancy (OECD, 2015b).

Box 4.2. Shrinking (carbon) sectors and the risks for employer-sponsored retirement plans

In several countries, workers generally finance their retirement through a combination of personal savings, social security schemes and employers' pension funds. As carbon-intensive or extractive firms go out of the market, such workers may face the risk of seeing their employer's contributions to their pensions decline or drastically reduced. Importantly, also multi-employer funds, which are generally considered low-risk given their diversification of financing sources, can be threatened as entire sectors are expected to shrink.

Similar concerns are currently emerging in the US where the 'United Mine Workers of America Health and Retirement Funds' (or UMWA) is facing various challenges following the recent bankruptcies and layoffs. The UMWA is the main pension program in the US coal industry and relies on contributions from multiple employers for about 20% of its income (ITUC, 2017). The fund currently provides pensions to almost 90 000 retirees but the shrinking number of active workers (currently the ratio is one for every twelve retirees) means that contributions coming in to the pension plan are quickly decreasing. The plan is already underfunded and could become insolvent in the mid-2020s (UMWA, 2018).

Overall, given that the industries connected to fossil fuel extractions are expected to contract during the next 20-30 years, it is important to ensure that the impact on employer-sponsored retirement plans is correctly monitored.

Source: (Pollin and Callaci, 2017; UMWA, 2018)

Policies to support redundant workers may also include entrepreneurial training. However, it should be noted that only a limited share (2-5%) of displaced workers typically return to work by starting a business (OECD, 2017e). Furthermore, there is some evidence that the likelihood of starting a business increases with the duration of unemployment, thus suggesting that this may be a makeshift for some workers. Finally, it should be underlined that encouraging uninterested or unqualified workers towards self-employment may lead to severe financial and psychological consequences.

Nevertheless, a relatively high rate of entrepreneurial success may be observed among displaced workers under certain conditions. The OECD (2017e) notes that entrepreneurial ventures are most likely to succeed when redundant workers master market-competitive and tacit knowledge. For instance, case of the Ruhr region underlines how the stringent environmental policies regulating the steel and coal sectors created a solid knowledge base that underpinned the development of a cluster of firms specialising in environmental management services. Effective policy packages should include a suite of tools such as entrepreneurship training, mentoring, leasing of intellectual and material resources on preferential terms, administrative and networking services, access to finance that match the context and needs of the displaced workers (ILO, 2009; OECD, 2017e) (Box 4.4).

Box 4.3. Swedish Job Security Councils

The Swedish Job Security Councils (or JSCs) are often considered as some of the most successful examples of re-employment assistance for laid-off workers (OECD, 2017f). *They were first developed in the 1970s as existing Public Employment Services were considered to provide insufficient support to displaced white-collar workers* (Diedrich and Bergström, 2006). *JSCs are based on collective agreements between the social partners within the different economic sectors and most of Swedish employees are currently covered by this mechanism in case of displacement.*

JSCs are actively involved in the restructuring process since its early stage and are allowed to intervene as soon as workers receive redundancy notice. Support activities for displaced workers include counselling and coaching, activity plans and competence development activities. Intensive counselling makes up the core of re-employment assistance and each dismissed worker is assigned to a personal adviser. (OECD, 2017e, 2015c).

Job Security Councils are a complement to public unemployment support and firms finance their activities by a contribution fixed as a percentage of the company total payroll. As such, the JSCs operate as a form of insurance, distributing the risk and costs of restructuring among its members (European Commission, 2010).

Source: (Diedrich and Bergström, 2006; OECD, 2017e, 2015c)

Box 4.4. 'Entrepreneurial training for displaced workers'

The Swedish "Support for starting a business" (Stöd till start av Näringsverksamhet) programme supports adults over 25 years old who are unemployed or are facing dismissal to start their own business. The program also supports adults aged 18 if they are considered to be particularly distant from the labour market.

The program offers an integrated package over six months. Future entrepreneurs are selected through a review of their business plan that must be expected to have a satisfactory level of profitability and to provide a long-term job. The Public Employment Service offers counselling and advises in addition to the possibility to participate at workshops, webinars and networking opportunities. 'Start-uppers' receive also a grant that is based on the individual's unemployment insurance entitlements.

A total of 5 300 participants accessed the 'Support for starting a business programme' in 2015. Around 77% of those who left the program were back in work within 180 days, either in self-employment or as an employee. This is often considered one of the most successful active labour market programmes in Sweden even if the earnings of those who continue to be self-employed tend to be low.

Source: (Eurofond, 2012; OECD, 2017e)

4.4. Skills policies

The low-carbon transition creates specific roles for skills policies through two main processes. On the one hand, workers that leave a declining sector will probably need to expand their skill-set with new competencies. On the other hand, the progressive greening of existing industries will probably require also workers that do not transition to a new sector to update their competencies in order to master new more environmental friendly production methods. Within this context, certain skills policies will directly target the displaced workers while others will focus on employed workers who may need additional – not necessarily green - skills. Importantly, such policies should also take into consideration other mega-trends affecting labour demand and supply (e.g. ageing, automation) to identify the most relevant training needs.

Trainings can be provided by public or private entities. The case studies show that often workers are given access to grants that allow the individual to freely choose the most relevant training (e.g. the 'Canadian Coal and Electricity Transition Tuition Voucher' funds post-secondary education fees up to a maximum of CAD 12 000 while the 'Scottish TTF' offers grants up to GDP 4 000 for training). If grants can be used only with certified providers, then a review of available training options should be carried in order to ensure that included courses cover the specific needs of workers displaced by the low-carbon transition. To this end, for instance, the UK government is planning to review the current courses offering with the aim of identifying possible gaps particularly relevant to oil and gas workers (HM Goverment, 2016). For some sectors, licenses are also important and grants may cover the cost of maintaining them as well, as in the case of the Scottish TTF.

Box 4.5. Assessing skill needs for displaced workers: 'TransverS'AL'

Between 2003 and 2011, the shrinking of the automobile, chemical, food processing and machine construction/electronics industries in the Alsace region in France resulted in almost 8 000 lost jobs. In response to these changes, the local the employment and training centre (Maison de l'Emploi et de la Formation or MEF Mulhouse)) has started a dialogue with regional stakeholders with the aim of improving the support offered to workers in the transition towards more stable careers in emerging sectors. As the project progressed, its focus was extended to new and emerging occupations such as those created by the emerging "low-carbon" sustainable construction cluster.

For instance, the TEXBAT project (acronym for textile to building sectors) was prepared in collaboration with the federation of training in the textile sector (FORTHAC). The program started in 2008, following a large loss of jobs in a local textile firm. The trade union asked the MEF to create a platform for skills and employment in the textile industry with a particular focus on transferable skills.

Overall, a number of related studies have been undertaken by the MEF Mulhouse in collaboration various stakeholders (e.g. trade unions, sector federations). Importantly, the program also involved providers of vocational education and training in order to ensure that the training programs were aligned to the skill demands of expanding sectors.

Source : (Miranda et al., 2011; OECD, 2014) (OECD, 2012b).

Training programmes yield the most successful outcomes when they are closely tied to the needs of the labour market. In most OECD countries, there are several systems in place for assessing and anticipating skills needs. In France, the National Observatory for Green Economy Jobs and Skills (Observatoire national des emplois et métiers de l'économie verte) has been established in line with the National Transition Strategy Towards a Green Economy. The Observatory is tasked with monitoring the sectoral and macroeconomic impact of the green transition, with special attention to its implications for jobs and skills (OECD, 2016b). A sophisticated system has been put in place in Alsace (Box 4.5) with the aim of identifying opportunities for workers to move from shrinking industries towards emerging or expanding sectors, including those linked to the low-carbon growth (OECD, 2012b). In Italy, the provision of VET programmes follows an analysis of local needs in the context of both environmental and social sustainability policies. Building on this process, the training programmes include skills such as "the ability to evaluate the environmental impact of energy systems" or the ability to apply methodologies for environmental and strategic impact assessments (OECD, 2017c).

Alternatively, governments can provide subsidies to employers to hire and train the unemployed. While this mechanism is very effective in aligning training with employers' needs, it has been scarcely mentioned in the literature on the selected cases. Such programs are implemented in the UK and France and are found to generate strong employment outcomes. In the UK, the process is articulated in two steps. First, employers contact public employment service (Jobcentre Plus) and detail their needs. Then, Jobcentre Plus provides employers with potential candidates and covers the costs of short-term training, which generally lasts three or four weeks. A similar programme exists in France (the '*Préparation Opérationnelle à l'Emploi')* where firms receive a subsidy to cover up to 400 hours of training when they hire someone who lacks some of the skills required for the job (OECD, 2017c).

Recognising informal green training is an important way to up-skill the labour force and to rapidly respond to an emerging demand. A flexible approach towards validating skills acquired through on-the-job or informal training should be adopted to facilitate the transition towards new or greener occupations (OECD, 2012b). Importantly, this process of recognition of prior learning can ease mobility of workers in the labour market since it provides them with a tool to more effectively signal the skills they master (OECD, 2017c). The Flemish 'green experience certificate', which can be awarded to workers after having successfully completed a test, goes some way in this direction.

Strengthening incentives to invest in training can help workers who currently do not face redundancy threats to adapt to changing technologies. Most OECD countries offer incentives for employed workers to continue learning, including training leave, training accounts and loans. For their effectiveness, it is important that little administrative burden is placed on firms and that guidance is offered to workers regarding in high-demand skills. Some countries have also reinforced the incentives to take part in these programs through subsidies. For example, Scotland's Low Carbon Skills Fund gives businesses with under 100 employees the opportunity to apply for training funds covering up to 50% of employee training costs, with a ceiling of GBP 1 000 per employee, in areas such as low-carbon technologies, energy efficiency, waste management and reuse, and reducing carbon in supply and energy management.

Stronger links between education institutions and firms are needed to ensure that curricula include relevant green skills. In the Flemish region, several companies are pursuing direct collaborations with universities and colleges. Joint development of

specialised curricula is an important aspect of strategies to ensure that education is well aligned to business needs. Other important tools include project-based course work and in-class activities such as guest lectures. Targeted apprenticeships can contribute to provide people with the right skills to (re-) enter the labour force, especially where there is strong employer and trade union involvement (OECD, 2017c). At the local level, apprenticeship programmes can provide local employers with a targeted skilled workforce (see section 4.5).

4.5. Distribution of impacts: a role for gender, age or geographically targeted policies?

The uneven geographical distribution of impacts of the transition highlights the role of regional actors. This role is likely to be stronger in countries characterised by higher decentralisation and autonomy of local authorities. For instance, the reviewed cases highlight how several "transition" policies were simultaneously implemented at different levels of government (e.g. the Scottish transition funds or the New Anglia Local Enterprise Partnership). This multiplicity of actors adds an additional layer to the coordination challenge discussed in section 4.1. As such, adequate mechanism (e.g. a mapping of all activities undertaken by different levels of government) should be in place to ensure both horizontal (among the different policy areas) and vertical (among the various levels of government) coordination.

Improvement to intermediary wage-bargaining systems may facilitate adjustment of local labour markets. In several countries such wage-bargaining systems are mainly influenced by the economic conditions prevailing in the leading sectors and regions, thus creating a gap between wages and productivity in lagging regions (OECD, 2006a). A decentralised wage-setting mechanism that, for instance, allows for an oscillation band may help to smooth transition impact by stimulating job creation.

Policies to enhance regional productivity and employment levels may also be needed. Special industrial zones (SEZs) have been created in many OECD countries but the available evidence cast some doubt about the efficiency of such schemes. For example, an analysis carried-out on the UK Enterprise Zones found that deadweight effects (i.e. jobs that would have been created anyway) and regional displacement (i.e. firms simply relocating from neighbouring areas) were sufficiently large to imply an extremely small net employment effect (OECD, 2006a). Nevertheless, several countries are considering the creation of low-carbon special economic zones (LSEZs) or greening existing SEZs, including China, India, Korea and the United Arab Emirates. For instance, the Republic of Korea started a pilot project for the greening of 915 industrial parks with a focus on improving resource efficiency and abating industrial pollution (UNCTAD, 2013). A low-carbon zone project was launched in the Chittagong Export Processing Zone in Bangladesh in 2011 leading to identifying, for instance, "low-hanging" mitigation opportunities through waste-heat recovery (World Bank, 2014).

Decentralisation of active labour market policies can allow for tailored responses of training programmes to local demand. Local labour markets exhibit considerable diversity in terms of industrial structure and employment opportunities in several countries. As such, training programs based on nationally aggregated occupational needs may be ill-suited to respond to the regional labour demand (OECD, 2016c). For this reason, national schemes should allow some autonomy to regional and local governments. Following the devolution of national powers in England, for examples, cities can independently develop apprenticeships schemes. However, simply creating space for

local decision-making is often not sufficient to ensure alignment to regional needs. A precondition is the development of mechanisms that encourage the engagement of stakeholders at the local level. In Norway, for instance schools, politicians and employers gather to discuss the following year's course structure for the county each autumn (OECD, 2016c). Local links between firms and schools can also be fostered by allowing practitioners to teach part-time in schools (OECD, 2015d).

In addition to the regional clustering, age may represent a further challenge of the low-carbon transition in certain OECD countries. Since older workers might experience particular difficulties in finding new employment, specifically targeted active labour market policies might also be appropriate (OECD, 2017g, 2012a). A key priority in this regard is providing adequate retraining for older workers since this is often mainly targeted to the youth. Information campaigns can help to remove the negative perceptions of age and ageing workers, such as of the polish "The Benefits of Maturity project" (OECD, 2014). In addition, certain economic factors increase the costs of hiring older workers, including seniority-based wage systems and costly employer- provided health insurance. Efforts to reduce labour costs of older workers have been made in certain countries by for instance introducing age-specific wage subsidies or labour tax reductions. However, targeting these measures on age alone should be avoided (OECD, 2006a). Actions undertaken at the local level can also encourage the labour market participation of older workers (Box 4.6). Finally, it should be noted that incentives to bridge older workers into retirement are often introduced in case of restructuring industries. In this regard, it is important to underline that the solidity of employer-sponsored retirement plans needs to be assessed given that some "brown" industries are expected to contract during the next 20-30 years, thus potentially undermining the possibility of former employers to honour the pension contributions (Box 4.2).

Box 4.6. Perspective 50plus: a labour market participation program targeted to older workers

The German 'Perspective 50plus' program was introduced in 2005 to complement pensions and benefits reforms aimed at reducing the rate of early retirement in Germany. The programme was designed to target workers that may exhibit several demographic features in common with (some of) the workers expected to be displaced by the low-carbon transition. For instance, participants had an average age of 54 years and the majority had only completed the lowest levels of education. Additionally, poor health was common among participants, as it may be case for ex miners. Importantly, there were also notable differences. For instance, they had been unemployed on average for more than two years.

Regional pacts were in charge of delivering the programs and were given ample discretionary power. The programme funding could be used to purchase services from external providers, provide services internally or even to provide employment subsidies. The result was the adoption of a wide range of different interventions, including: profiling, special training measures, information campaign, promotion of internships, placement wage subsidies for employers and also unorthodox approaches to address transportation problems. For instance, funding was used to provide support to the obtaining of driver's license or interest free loans for buying a car.

An evaluation found that the programme outcomes were better than standard operations and that costs per head were lower. The analysis suggested that the positive results could

be attributed to a number of factors, including strong interactions between jobseekers and jobcentre staff, a focus on training and personalized services.

Sources: (Knuth, 2014; OECD, 2014, 2006b)

The role and status of women in the green economy offers the opportunity to improve gender equality but some challenges need to be addressed. The renewable energy sector, where women have a larger representation than the traditional energy sector but still lower than the economy-wide average, is a vivid example of this imbalance. Several countries (e.g. Canada, Chile, Finland, India, Italy, Japan, Mexico, South Africa, Sweden, the United Arab Emirates and the United States) are participating in a Clean Energy Education and Empowerment initiative to encourage women to seek careers in clean energy (CEM, 2018; IRENA, 2013). Initiatives to increase female participation in traditionally male dominated (green) fields should build on multiple levers, including attracting women towards STEM education, connecting women with role models and mentors, providing opportunities for scholarships for both academic and industry research (IRENA, 2013). Equally important is the provision of adequate training or vocational apprenticeship programmes. Measures such as targeted information campaigns in schools and universities can be instrumental to this end. Gender certifications of firms, such as the Gender Equity Model developed in Mexico with the World Bank, could accelerate the rate at which the renewable energy sector can develop a more gender-balanced workforce (IRENA, 2013). The initiative *Les Elles du BTP* (Women of the Construction Sector) in the Alsace region (France) provides an example of a scheme that builds on multiple approaches to increase female participation in a low-carbon sector, namely green building (Box 4.7).

When displaced workers are women, programs to promote entrepreneurship face additional challenges. Female entrepreneurs, regardless if former employees or not, face higher barrier to access finance. While there are often a number of reasons behind this gender disparity, including social constructs and limited ability to place collateral due to ownership structures, this has far-reaching consequences for any type of program aiming at promoting entrepreneurship and should be carefully considered (IRENA, 2013).

There is limited literature on the first- and second-round impacts of the displacement of male workers. The male-dominated workforce of extractive industries suggests a potential role for gender sensitive transition policies in certain regions. However, the literature is particularly limited in this regard and further research is clearly needed. In the case of the UK, the available evidence on the consequences of the "gender-skewed" coal mine restructuring suggests the presence of second round negative effects (i.e. crowding-out) on female employment that emerged within a generation or so. This time lag is justified by the authors considering the evolving social norms and perception of "men's" and "women's" jobs. More precisely, the authors underline that ex-miners may have shunned certain employment they saw as `women's work' while the following generation was probably more open to fill different types of vacancies. However, as such stereotypes may be less resilient nowadays, a shorter timeframe for this crowding-out may be possible.

Box 4.7. Les Elles du BTP

In the Haut-Rhin region, the on-going efforts to green the construction sector generated a need for new skills such as those required to comply with new regulations (e.g. energy efficiency standards). This was perceived as a good opportunity to increase the participation of women in the construction sector also because certain green skills-set are likely to require a balance of physical and technical skills

In this context, Les Elles du BTP is an initiative that seeks to communicate the working opportunities in the construction sector to women. The initiative leverages actions such as customised trainings and meetings with a network of women already working in the sector who share their experience. The program is supported by numerous actors, including the French Federation of the Construction Sector, the Regional Government of Alsace, the Chamber of Crafts Industry and Women Group of the Construction sector in the Haut-Rhin region.

Source : (OECD, 2012b)

Finally, the past experience suggests that old industrial sites can become important touristic attractions, thus providing opportunities for local employment. Former mines, power stations and steelmaking factories are currently leveraged to exhibit the 'industrial culture' to tourists in the Ruhr Valley where the Zollverein (one of Europe's largest industrial coal facilities) has become a UNESCO World Heritage Site. Importantly, the reconversion can also begin when these industrial sites are still in operation, as for instance in Lusatia, where tourists can tour the still operational open-cut mines (Campbell and Coenen, 2017). Local leadership and tightly knit network of local governments, institutions and companies are instrumental to the successful implementation of these policies (Egberts, 2016; Trettin et al., 2011).

4.6. Main takeaways

The numerous measures usually introduced by governments to facilitate sectoral adjustment could be (partially) financed by the revenues generated through carbon pricing. Currently, countries have adopted various approaches to recycle carbon-pricing revenues, including measures to address competitiveness concerns, to support low-carbon innovation or to ease the impact of the transition on workers. Importantly, the most desirable form of recycling depends in a complex way on specific national circumstances.

Several "structural policies" can play a key role in ensuring a just transition since the transition involves a reallocation of productive inputs (e.g. labour and capital) across sectors. For instance, reforms to housing policies can facilitate geographic mobility of workers, thus increasing the quality (and availability) of post-displacement jobs while reforms that strengthen competition are likely to spur innovation, thus potentially improving the response of firms to the higher energy prices.

Strong coordination among different stakeholders is an important enabler of a just transition. The cases show that numerous programs (e.g. skills training, job-search, etc.) are usually implemented in order to smooth the impact on workers. Coordination among

them is necessary in order to improve their effectiveness and create the necessary synergies. Furthermore, transition strategies where a relative consensus on the need to phase out activities was achieved tend to historically show a greater political resilience.

Some form of flexicurity is likely to be instrumental to ensure an efficient flow of workers from contracting industries towards modern low-carbon sectors. Severance payments and early notice of dismissal characterise the most cases of industrial restructuring. In addition, active labour market policies, such as job-search training or entrepreneurial training, are likely to play an important role in facilitating workers' reallocation in new (low-carbon) sectors. OECD countries have already developed some experience on designing labour market participation programs targeted at older workers.

The low-carbon transition creates specific roles for skills policies through two main processes. On the one hand, the gradual phase-out of certain sectors will require displaced workers to expand their skill-set with new competencies and move on to jobs in different sectors. On the other hand, the progressive greening of existing industries will probably require also workers that do not transition to new sectors to update their competencies in order to master new more environmental friendly production methods. Importantly, specific mechanisms (e.g. stronger links between education institutions and firms) need to be in place in order to ensure that training programmes are tightly coupled with labour market needs.

5. Conclusions

5.1. Main findings and conclusions

A sector-specific approach is necessary in order to correctly understand the impact of the low-carbon transition since, as often is the case, aggregate data hide specific hotspots. In fact, while economy-wide jobs impact of the low-carbon transition is likely to be modest, several industries are expected to experience a severe contraction in output and employment. This is the case of sectors traditionally associated to the low-carbon transition, such as extractive industries and fossil-fuels based electricity generation, as well as energy intensive industries due to higher energy prices resulting from the low-carbon policies. At the same time, several sectors (e.g. renewable energy, construction industry) are expected to see considerable increases in employment.

As previous restructuring experiences highlight, a suite of policy instruments is necessary to facilitate workers relocation across sectors. These include well-designed structural reforms, active labour market and skills policies. Moreover, regions whose environment has been severely damaged by mining can also benefit from physical regeneration programs. Finally, the involvement of key stakeholders in the development of long-term strategies with the aim of building a shared vision for the future of the regions/sectors is an important feature of most successful transition management experiences.

However, the low-carbon transition differentiates itself from previous restructuring experiences for two main reasons:

- **The restructuring process is policy-driven**: In other transitions, the decline of certain sectors was mainly driven by changes in market conditions, which may have made it easier to reach a social consensus for the need for industrial structuring. In contrast, under the low-carbon (and green) transition, policies aiming at internalising the environmental externalities of certain production (and consumption) choices are the main driver of the restructuring process. This policy-driven process may face resistance from the segments of the society that are, or perceive to be, negatively affected by such policies.
- **In previous restructuring experiences, governments often leveraged considerable financial resources to facilitate structural adjustments**. **The revenues from pricing emissions, which is an essential climate mitigation policy, could play an important role to this end.** The OECD estimates that a carbon price set at EUR 30 per tonne would generate revenues amounting to almost 1% of GDP in G20 countries. These funds could be leveraged to compensate firms for potential loss in competitiveness, to support low-carbon innovation or to ease the impact of the transition on workers. Importantly, the most desirable form of recycling depends in a complex way on specific national and local circumstances.

The analysis of the most affected sectors highlights a number of challenges and opportunities:

1. **The transition may be characterised by two interrelated gender dimensions**. The workforce of both extractive industries and energy utilities – two of most negatively impacted sectors - is mostly composed by men. At the same time, the renewable energy industry - which is expected to sensibly grow under most low-carbon scenarios - is characterised by a relatively more gender-balanced workforce, thus suggesting that female employment may increase in the traditionally male-dominated energy sector.
2. **Some evidence points to an over-representation of older workers in "carbon intensive" industries in certain OECD countries**. This age distribution is likely to increase the adjustment costs since older workers often face above-average displacement costs. In addition, cultural bias towards learning in old age can limit the participation of this segment of the workforce to education and (re)training programs.
3. **The impact of the transition is likely to be geographically concentrated**. In fact, while fossil fuel extraction sectors are naturally geographically clustered there is some evidence that also certain "energy intensive" industries are – to various degrees – concentrated in specific regions. This geographic concentration can present specific challenges if new jobs created - which in principle should (help to) offset the job losses - are located in distant regions.
4. **Available evidence suggests that most green jobs will simply require a "topping-up" of existing skillsets.** Furthermore, the literature identifies numerous cases where the skillsets of jobs in "brown" industries are transferable and adaptable to low-carbon sectors (e.g. offshore oil and gas and offshore wind power). However, training needs can vary significantly according to the previous experience of workers and to the sector where they are seeking employment next.

5.2. Areas of future work

The review of literature highlights that the future research could usefully be directed at investigating specific areas in the context of the green transition, including:

- **Social dialogue:** The reviewed cases of industrial restructuring underline the importance of involving all stakeholders in the transition planning. However, there is limited evidence on how to promote a broad acceptance and support for (environmentally motivated) restructuring processes.
- **Beyond the low-carbon transition:** further research is needed on the economic impact of other environmental-related transitions (e.g. policies promoting a shift towards a more circular economy). In this regard, considerations for their sectoral dimension seems to be an interesting area for further research since the available evidence suggests the presence, also in this case, of sectoral reallocation effects.

- **Gender dimension:** The evidence highlights that a large share of the workforce affected by the low-carbon transition are men. The possible implications of this gender-specific impact, including possible second round consequences on female employment, seem to be an interesting avenue for further research.
- **Spatial divergence of the declining and growing industries:** There is limited literature on the extent to which the industries that are likely to be phased-out and those that are likely to grow will be located in the same geographic areas. Further analysis of this spatial dimension, considering also workers' job-search costs, may lead to important additional insights on the employment implications of the low-carbon transition.

Annex A. Reviewed cases of industrial restructuring

The Ruhr Valley: a multi-stakeholders approach (Germany)

Over the last five decades, the economy of the Ruhr area in Germany has undergone a dramatic restructuring and shifted from its original coal and steel-based specialisation to a more diversified service economy. In the mid-1950s, the coal sector offered nearly half a million jobs and, jointly with the steel industry, employed around 70% of the regional labour force (Taylor, 2015). As these core industries began to sharply contract in the 1960s, the entire region faced a dire economic crisis. Nowadays, the two sectors employ just a little below 95 000 people (2015) (Euracoal, 2018; Stahl, 2018).

The objectives of the policies implemented to follow through the restructuring process have evolved over the decades. From the early 1960s to mid-1980s, the main focus was on preserving the existing industrial structure revolving around coal and steel (Hospers, 2004). During this phase, even if several compensation measures were introduced to facilitate the exit of some workers from these industries (e.g. early retirement at age of 49), new generations of young miners and steel workers were educated with subsidies from the local government (Galgóczi, 2014). It is only from the mid-1980s that the structural policies in the Ruhr area took on a more dynamic perspective, often referred in the literature as "neo-industrialisation".

The IBA initiative (International Building Exposition for the Emscher River), which operated between 1989 and 1999, is a vivid example of the decentralised but well-coordinated approach that characterised several of these actions. This Agency was set up with the explicit mission to co-ordinate the socio-economic and environmental revitalization of a densely populated and highly degraded area of 800 square kilometres. Following its slogan "revitalization from within" (Hospers 2004), the initiative promoted projects that were based on ideas competitively developed by various local stakeholders (e.g. municipalities, architects, associations). Among the large number of projects, those focused on the restoration and adaption of old sites to new uses, including industrial tourism, have gained worldwide attention for their success. For instance, the industrial complex "Zeche Zollverein", which was restored with the aim of promoting and conserving the industrial culture of the areas, become an important historical monument and entered the UNESCO World Cultural Heritage list (Open IBA, 2018). Overall, the Agency is considered to have played a key role as broker and coordination mechanism between several stakeholders according to several authors but it was not the only mechanism with this objective. For instance, the Aktionsprogramm Ruhr (APR) focused on the largest interest groups and the State authorities, increasing coordination through interministerial working groups (Galgóczi, 2014).

As in other case studies, the history of this transition underlines how several levels of government played a role in regeneration activities. For instance, the state of North Rhine-Westphalia (NRW) adopted a new technology policy targeting "sunrise technologies" in 1984. This industrial diversification strategy was based on the

establishment of several local technology transfer centres that provided advice and services to new firms. Within a decade, the region that formerly focused on heavy industries could sport 29 of such centres. However, the results of these initiatives have been mixed, with some regions decisively more successful than others. An experience often regarded as positive is the Technology Centre established at the University of Dortmund. The centre was designed to work both as an incubator for young enterprises and a possible location for the R&D departments of established companies (Taylor, 2015). This technology park, which was created in 1988 in one of the largest municipalities in the Ruhr, generated – according to some estimates – up to 3,700 jobs over ten years. The ability to develop strong ties with the industry has been considered as a key factor behind the higher effectiveness of this initiative compared to other R&D centres.

Interestingly, the region developed an active environmental management cluster. This sector was built on the knowledge accumulated by the local coal and steel industry. In fact, a deep expertise in techniques and procedures to comply with environmental regulations was developed within these sectors (Galgóczi, 2014). Examples of relevant know-how include waste management (especially scrap collection for recycling), construction of ventilation systems (for mining), and experience in transportation of hazardous waste (Taylor, 2015). The latest available data report that the cluster features employed around 100 000 people among universities, research institutes and several firms in the mid-2000s (UNFCCC, 2016).

Also, measures taken to facilitate labour reallocation highlight a strong cooperation among the various stakeholders. The Ruhr Coal Vocational Training Society (or RKB), which was a fully owned subsidiary of Ruhr Coal AG (RAG)[3], was in charge of addressing the structural change in the Ruhr area by managing labour market transitions in the mining industry. In the absence of clear expectations on the evolution of the labour market, the RKB worked together with the regional government, companies and other institutions in order to determine objectives for skills development programs. The re-training courses were offered by a variety of providers - under the coordination of the RKB - while workers were still employed by RAG (Davies, 1995; Galgóczi, 2014). The developed models proved to be relatively successful and were also replicated during the transformation of the East German economy after reunification.

More recently, the IBA experience has inspired numerous other projects aimed at addressing the progressive deindustrialisation of the region. For instance, the city of Dortmund, which was among the most important German coal and steel centres, set-up the "E-city Dortmund" initiative in response to the closure of the local Thyssen-Krupp steelworks in the early 2000s. Following the IBA approach, the project aims at "strengthen[ing] what is strong, invest[ing] rather than subsidis[ing]" (Hospers, 2004). Given the knowledge base – partially connected to steel processing - in manufacturing, information technology and logistics, the local parties have launched "incubation centres" and start-up promotion schemes targeting sectors such as e-logistics and robotics. Furthermore, the former Thyssen-Krupp plant site has been adapted to new uses (Taylor, 2015).

[3] The coal mining company owning and operating all of the Ruhr's coal mines since 1969.

The consensual approach to industry restructuring is also evident in the landmark agreement taken in 2007 on the final phasing-out of subsidies to underground hard coal mining by 2018. In fact, this decision was taken involving numerous stakeholders, including the German federal government, the NRW, the Saarland State government (where hard coal mining still took place) and RAG. The agreement foresaw that the RAG Group would be split into two organisations: the RAG Corporation, which continues its coal mining and processing operations, and Evonik Industries AG, a corporation focusing on chemicals. In addition, a foundation (RAG-Stiftung) was established and charged with the responsibilities to meet RAG's agreed social obligations and to oversee the management of the legacy mine sites (e.g. perpetual pumping of water from the underground mines).

Numerous aspects of the phase-out plan aim at avoiding major economic and social disruption. The phase-out date (2018) was chosen considering that a large part of the workforce will reach retirement age by that time. In this context, early retirement provisions, which entail a monthly payment available for a period up to five years until workers qualify for pension schemes, were introduced.

The transition plan includes also specific provisions for around 1,200 workers who will not reach the legal age for pension entitlement by the date of plant closures. Around 500 jobs are estimated as necessary to enable the industry to meet its long-term operational commitments after 2018, therefore an equivalent numbers of workers are likely to be redeployed within these occupations. Nevertheless, around 700 will have to exit the industry by end of 2018. For this reason, the German Coal Association and the 'Trade Union for Mining, Chemical and Energy Industries' negotiated an agreement whereby remaining workers are guaranteed a job either at their current facility or a subsidiary until end of 2018. However, in case their position ceases to exist, workers agreed to move to any post that they might be able to fill after a maximum nine-month training period either in the coal industry or at any RAG subsidiary. To facilitate this process, the agreement foresaw the opening of in-house 'Personnel Development Centres' to train workers for jobs outside of the coal mining industry (Galgóczi, 2014; Sheldon et al., 2018).

As a general conclusion, the Ruhr experience underlines the importance of comprehensive policy frameworks (e.g. physical regeneration, structural and active labour market policies). Strong coordination and concerted efforts among the various levels of government and stakeholders played a key role in developing a consensus on the restructuring process. The experience also highlights how several derelict industrial sites can be successfully adapted to new usages.

The UK coal mines: a gender dimension in the transition? (UK)

Coal played a key role in UK's industrial revolution and remained an important source of jobs for unskilled workers well into the 20th century. According to estimates, at its peak of production in 1952, UK coal mines accounted for 90% of UK's primary energy consumption (Surrey, 1992) and employed more than 700 000 miners (Beatty et al., 2007). However, during the last forty years, the sector underwent a dramatic contraction due to numerous factors, including the diffusion of cheaper substitute fuels and a progressive tertiarisation of the English economy. Between 2001 and 2009, nearly 95% of English coal mines have closed, resulting in 193 000 job losses from an industry of 200 000.

According to studies, the employment impact showed several specific characteristics. First of all, the loss has been geographically concentrated – as natural to an industry that depends on the extraction of natural resources - in around a dozen areas across Britain. Secondly, male employment was most heavily affected. In fact, not only over 90% of displaced coal workers were men but also coal jobs accounted for a large proportion (typically 20% - 35%) of all the jobs held by male workers in the affected regions. A few exceptions were the more urbanised regions (North Staffordshire and Lancashire) where male employment was more diversified. (Beatty et al., 2007).

Figure A.1. Loss of coal jobs in UK, 1981 - 2004

Coalfield	Male job loss 1981 - 2004	Male coal job loss as a percentage of male coal jobs in 1981	Male coal job loss as a percentage of male jobs in the area in 1981
Yorkshire	67 000	95	27
Nottinghamshire	40 300	96	35
South Wales	27 200	97	21
Durham	22 800	100	26
Derbyshire	13 700	99	20
Northumberland	10 100	94	32
S Derbyshire/NW Leicestershire	9 600	99	31
North Staffordshire	8 600	100	13
Lancashire	7 100	100	9
South Staffordshire	5 700	100	27
North Warwickshire	5 500	92	23
Kent	3 200	100	48
North Wales	1 200	100	39
England and Wales coalfields	222 000	97	24

Source: (Beatty et al., 2007).

Despite numerous programs implemented in the former coal mining regions, in the late 1990s the regions was still characterised by a substantial job deficit and by relatively higher incidence of several diseases. For this reason, the 1997 special Coalfields Task Force recommended an increased focus on broad regional regeneration programmes. In response, the Government developed three major initiatives.

A major programme for coalfield-site reclamation and redevelopment (National Coalfield Programme or 'NCP'), led by the government agency 'English Partnerships' and initiated in 1996, was further expanded following the Task Force's recommendations. The program, which was expected to spend GBP 876 million but also to generate receipts of GBP 334 million, focused on physical regeneration of former mine sites. Its ambitious targets included bringing 4 000 hectares of land back into use, developing 2 million square meters of commercial floor space and 8 000 quality new homes. The programme aimed at achieving these objectives by attracting private capital (over GBP 1 billion) and creating 42 000 new jobs.

The NCP faced numerous challenges from its start. First, it proved particularly time consuming (on average 4.5 years) to establish and transfer ownership of the sites, introduce site security and acquire all the required permits. Programme evaluations have also underlined the complexity of estimating cost and duration of restoration activities for highly contaminated sites. This was made more difficult by the often limited data availability on the real contamination of sites or by the need to avoid further

environmental damage (e.g. the need to remove protected wildlife). In addition, the compulsory purchase of land or buildings delayed development projects for 3-18 months.

The Programme reports to have helped create almost 19 000 jobs between December 1996 to July 2009. However, successive evaluations have noted how the Programme considered - in accordance with Government guidance - all coalfield site developments as outcomes of its activities irrespectively of the scale of public sector support or expenditure (e.g. the Programme has taken credit for 228 houses, 44 000 square metres of employment space and nearly 1,400 jobs created on seven sites where the private sector has paid for the entire redevelopment). As such, the "additionality impact" of performed activities is particularly complex to gauge. The National Audit Office (NAO) evaluation also underlines the scale and long-time horizon that such interventions require. For instance, the same report estimated that the floor-space targets would only be met in 2017, 21 years after the start of the program.

A second initiative was the creation of a Coalfields Regeneration Trust (CRT). The Trust focuses on both social and economic regeneration and allocated its initial GBP 190 million budget on four themes: access to opportunities; education and skills; health and enterprise development. One of its flagship programs was the Family Employment Initiative (FEI). The FEI targeted "the *worklessness among those most distant from the labour market"* and its functioning was based on two fundamental principles. First, it adopted a 'whole family' approach building on an understanding that barriers to employment can take many forms. As such, the initiative aimed at engaging the family and friends of displaced workers in order to ensure that the support provided to one individual was shared within the household. Secondly, the FEI helped to access a wide range of services, including preventative health care, housing, debt advice and other specialist services. To provide such varied forms of support, numerous partnership arrangements were established (e.g. County Councils, Job Centre Plus and debt advice services) (CRT, n.d.; Eko Gen, 2011).

In addition to the FEI, the CRT has introduced numerous other programs. An example is the 'Community Future' that helps communities to develop a community action plan. Alongside the support to the planning process, the program offers each community a GBP 20 000 grant that can be used to kick-start projects identified as high-priority (CRT, 2015). The 'Young Upstarts' program provides support (e.g. training) to develop business plans to 16-18 year olds while the Coalfields Community Investment Programme (CCIP) provides up to GBP 10 000 to projects that address skill gap, employment or that deliver improvement to health/wellbeing in the top 30% most deprived coalfield communities. Meanwhile, programs like "Game On" aim at improving health, skills and self-esteem by promoting participation in local sport activities (CRT, 2017; Game on, 2018).

The report by Coalfields Task Force also pointed out that business start-up rate was lower than national average in these regions "*probably because of the traditional dependence on one large employer"* and recommended the establishment of the Enterprise Fund to support smaller businesses. The 2004 launch of this dedicated fund took longer than expected due to both the need of approval from the European Commission regarding the compliance with State Aid Rules and the lack of the necessary financial services accreditation of the initially appointed mangers. Through its initial endowment of GBP 10 million, the "Enterprise Fund" invested between GBP 40 000 and GBP 500 000 in new or expanding businesses in the coalfields, upon the conditions that funding was matched by another public or private entity. Businesses needed to be based in - or willing to relocate to - a coalfield area; to draw employees from coalfield areas or to bring other

benefits to these regions. The fund was a commercial operation that aimed to demonstrate that investment in the region could be profitable, as such it did not have regeneration targets but specific financial and investment criteria were included in its governing documents. The Fund is now fully invested and it has recently announced four exits: Barber of Sheffield, Woodall Nicholson, ChargePoint and Finch (NAO, 2009; Technologies, 2018).

The UK experience highlights how rebuilding former mining communities takes time and, as in the case of the Ruhr Valley, it requires a well-rounded suite of policies (e.g. physical regeneration, active labour market policies and enterprise promotion). Closer coordination among the three national coalfields initiatives was identified as a possible area for improvement. The establishment of program-specific targets, in addition to separate reporting and accountability arrangements, have been highlighted as barriers to closer cooperation among these programs (NAO, 2009).

Notwithstanding the resources poured in the regions, the legacy of the jobs loss continues to be substantial unemployment. Some analysts suggest that there is still a diversion of working-age men into 'economic inactivity', often on incapacity benefits (Foden et al., 2014). Environmental improvements through land remediation have helped to transform coalfield areas blighted by mining into more attractive places to live and work.

There have been limited studies in the literature on the gender aspects of the impact of the coal mine closures. An exception is provided by Beatty et al. (2007) that find that the share of newly created jobs in the coalfield areas going to men increased over time. More precisely, the authors report how the share of new jobs taken by men increased from 40% between 1981 and 1991 to 72% between 2001 and 2004. The authors argue that this positive trend may be due to a specific dynamic. More precisely, while ex-miners may have shunned certain employment they saw as 'women's work', the following generation was probably more open to fill different types of vacancies. As such, one of the long-term effects of coal industry job losses seemed to be a crowding-out of women from the job market. However, this negative second round effect took almost a generation or so to emerge. An empirical study by Aragon et al. (2017) confirms the qualitative finding of Beatty et al (2007) by estimating that the closures of mines increased the number of male workers in manufacturing but decreased female employment, in both relative and absolute terms.

China – New labour policies in response to industrial restructuring

During the last decades China has undergone several rounds of large-scale industrial adjustments that were accompanied by mass layoffs. One of the most important restructuring processes towards the end of last century was triggered by a progressive privatisation of state owned enterprises (SOEs) (Cai, 2009; Garnaut and Song, 2005). According to some statistics, around 28 million SOEs workers were laid-off only between 1998 and 2003 (ILO, 2013). More recently, the restructuring – which is still an on-going process – of heavy industries, such as steel or electrolytic aluminium manufacturing, is accompanied by strong labour reallocation.

The Public Employment Services (PES) have been introduced relatively recently, partly as a response to the first wave of industrial adjustments at SOEs. When large scale retrenchment began in 1998, the State Council issued an eight-points document to provide protection to the retrenched workers (Garnaut and Song, 2005; ILO, 2013). In addition,

around CNY 73.1 billion was allocated to programs aiming at providing both subsistence payments and re-employment to former SOEs workers between 1998 and 2003.

One of the policies adopted was the establishment of Re-employment Service Centres (or RSCs). These were typically located within the firms from which workers had been laid-off and performed numerous tasks including the distribution of subsistence allowances, job brokerage and vocational training. Other policies implemented in those years include the provision of financial incentives to companies willing to take on redundant workers and skills training programs. Several measures were also introduced to promote self-employment and creation of start-ups, including a three-year tax break and loans below market rates for laid-off workers wishing to take up self- employment.

The PES have been consolidated through the years and currently operate on a large scale, providing support to 20 million people on average per year through a network of both private and public agencies (ILO, 2013). The RSCs, which were typically located within the firm undergoing restructuring, have been closed in 2003 and currently the PES provide a "one-stop" registration service to laid-off and unemployed people looking for jobs. Services provided include information distribution, employment brokerage, vocational training, entrepreneurship service, and both labour and social security services (ILO, n.d.). Training for re-employment is organised at various levels tailored to match workers' skills with the needs of regional economies in order to enhance employability (ILO, 2013). In some cases, the PES can also set up a specialised "coordinated process" that covers industrial and commercial registration and offers both advice on taxation and labour protection matters for laid-off workers who want to set up their own businesses.

Importantly, the government has often addressed economic downturns and resulting unemployment by adopting ambitious investment plans and expansionary fiscal policies. A remarkable example in this regard is the two-year stimulus plan announced in November 2008 to sustain growth during the global financial and economic crisis. The programme budget, equal to 16 per cent of 2007 Chinese GDP (or CNY 4 trillion), mostly focused on government-subsidised housing projects, post-earthquake reconstruction for the Sichuan region and infrastructural projects including the power and railway sector (Wong, 2011). It was estimated that the Plan would have created 6 million jobs and required the production of 20 million tonnes of steel, thus creating knock-on labour demand in other sectors (ILO, 2013).

More recently, economic expansion, industrial policies and generous subsidies have contributed to the substantial overcapacity in numerous heavy industries, thus leading to the introduction of policies to rationalise production (Shi et al., 2018). This structural adjustment process is expected to lead to the lay-off of some 1.8 million workers in the coal and steel industries, or about 15% of the workforce (the guardian, 2016). The central government has allocated USD 15 billion to a fund for the retraining, reallocation and early retirement of affected workers (Reuters, 2017).

There is limited independent evaluation of the efficacy of the implemented measures to support laid-off workers. An exception is provided by Bidani et al. (2009) who analyse the effects of training programmes offered to over 2 000 displaced and unemployed workers in Shenyangand and Wuhan (respectively the capital of the Liaoning and Hubei region).

The two training programmes differed in a number of dimensions. In Shenyang, the large majority of courses lasted one month and often focused on theoretical education. Instead, one-month courses were not eligible for funding in Wuhan where courses lasted on

average two-three months. Other than duration, another key difference was the diversity of training providers. In Wuhan, these included a variety of institutions such as colleges, universities, vocational education and training schools whereas in Shenyang most training was provided by the PES itself. Furthermore, 21 % of trainees in Wuhan covered at least part of the training costs (i.e. they were exempt from fees but were expected to purchase textbooks and practice materials) while in Shenyang only 3% of trainers provided some financial contributions towards the training costs. Finally, the authors underline that the program in Wuhan seemed to exhibit a stronger connection to the local demand for the skills, especially when providers were private actors. Building on the results of various econometric estimations, the study concludes that only the participation in the trainings provided in the city of Wuhan is likely to have improved placement rates.

The study also notes how the analysis of the two cases suggests some lessons to design better workers retraining policies. First of all, the diversification of training providers (e.g. public, non-profit and commercial providers) can be beneficial since different providers may have specific competencies with different types of training. Secondly, training design should be well aligned to local labour demand, possibly by involving employers in designing the training programmes. Thirdly, job search, counselling and labour market information are mentioned as a very effective tool to increase the return on the investment in vocational training.

Oil and gas: web-based tools to support the workers' transition (UK)

The UK oil and gas industry is considered as a global centre of excellence. However, the sector has been going through a contraction due to the recent decline in global oil prices. As a result, the workforce has been reduced while development projects have mothballed (HM Goverment, 2016). In 2014, when investment levels were at their peak, it was estimated that industry supported between 375 000 and 463 900 jobs or one in every 80 UK jobs (HM Goverment, 2016; Oil and Gas UK, 2017a). In 2017, total employment was almost 120 000 units lower. The prospects for workers are also darkened by the projections for domestic oil and gas production to decline at 5% annually after 2022.

Table A A.1. Total employment in the UK oil and gas sector

	2013	2014	2015	2016	2017
Direct	6,600	41,300	37,300	29,500	28,300
Indirect	198,100	206,100	163,100	150,600	141,900
Induced	206,200	216,500	173,400	135,300	132,000
Total	440,900	463,900	373,800	315,400	302,200

Source: (Oil and Gas UK, 2017b).

The jobs are distributed roughly equally across England (60%) and Scotland (38%). Detailed employment data by gender are available for offshore oil and gas, and highlight that women represent less than 10% of the total *offshore* workforce.

In order to support displaced workers and to retain important expertise, the UK government has released the Oil and Gas Workforce Plan in 2016. The strategy underlines how several skills of oil and gas workers can find application in numerous other industries. For instance, the plan estimates that the growing domestic railway sector could need the expertise of systems engineers, signal designers, project managers and

commercial managers while professionals with knowledge in mechanics, construction and installation are likely to be employed in the growing oil and gas decommissioning industry.

The numerous web-based tools that the Government is planning to deploy are a particularly interesting aspect of this transition strategy. Among these is "Skills connect", an online platform originally designed to help military personnel to transfer to the oil and gas sector. OPITO, the scheme operator, has been tasked with the redesign of the platform in order support oil and gas workers to identify occupations in other sectors by matching their skills and job requirements. In addition, the web-tool is also to help workers to identify technical trainings they may need to adapt their skill-set to employment in another industry (HM Goverment, 2016).

In addition, the Talent Retention Solution (TRS) will provide a central platform through which individuals can both seek new job opportunities and be contacted by companies interested in their skills and experience (TRS, 2017a). Once the platform is ready, it will allow *"companies interested in recruiting employees from the Oil and Gas sector to have direct access to individual profiles and CV's"* (TRS, 2017a). While the platform operates with the sponsorship of numerous large industrial groups (e.g. *Airbus, BAE Systems, Rolls-Royce, Siemens, EDF Energy),* it also allows *S*MEs to post vacancies and search for candidates on the platform free of charge (TRS, 2017b). This web-based tool was originally designed to support employment and redeployment from the aerospace and defence industry.

Workers will also have access to existing programs, such as the "Advanced Learner Loans" in England. These loans cover expenses of retraining provided by any organisations approved by the Skills Funding Agency and become repayable only once the training is complete and if the applicant is in work and earning at least GBP 21 000 a year. This initiative can reinforce the skills approach of the "Skills Connect" program since it can be used to cover the cost of most of the training needs identified through the web-tool. In order to ensure this synergy, the government is to review the accessible courses with the aim of identifying possible gaps particularly relevant to oil and gas workers (HM Goverment, 2016).

The Scottish Government also launched a GBP 12 million training fund to help displaced workers to transition into other energy sectors or manufacturing firms. The fund aims at preserving the highly skilled energy workforce in the North Sea region by offering grants up to GBP 4 000 to support training and to cover the costs associated to maintaining any licenses. The fund may also assist transitions into STEM-related teaching. Importantly, workers can apply for the fund not only after having lost their jobs but also when facing the threat of redundancy (Transition Training Fund, 2018). According to data reported, around 67% of the recipients are currently employed and almost half (56%) of these had transitioned into new sectors. Skilled trades, transport and "renewables and other engineering" are among the top three new occupations reported by fund recipients who participate in a survey (Skills Development Scotland, 2017).

Local communities and businesses are also developing programs to respond to the downturn. The New Anglia Local Enterprise Partnership (NALEP) has created the East of England Oil and Gas Taskforce that focuses on two main strands of support to both business and redundant oil and gas workers. First, funds have been set aside to sponsor specialist consulting services for firms with a focus on diversification, re-structuring and

alternative growth opportunities. Secondly, assistance will be offered via Jobcentre Plus to ensure that displaced workers can retrain, find alternative employment or maintain their industry certifications (EEER, 2016).

Creating skills for greening existing industries in Flanders (BE).

The Flanders has been pursuing a decoupling of economic growth and environmental impact in a number of sectors. Several initiatives, both at the sectoral and regional level, have been implemented to promote this objective. A key stepping stone was the 2009 New Industrial Policy (NIP) that was designed with the aim of promoting a greener, more social and creative industry. With this clear mandate from high-level strategic economic policy documents, both education and labour market policies are being redesigned in order to better align them with the green transition.

The 'Flemish Agency for Higher education, Adult education, Qualifications and Grants' (AHOVOKS) is currently updating the 'Flemish Qualification Database'. This stores information on skills, qualifications and tasks for numerous job profiles. The project aims at screening the existing profiles in order to identify potential additional "green skills" that need to be included. For example, the green skill 'integration of building elements in an airtight way' has been added to the job profile of 'roof workers' in the building sector. Attention has also been given to include green skills in the training provided to the long-term unemployed. To this end, the VDAB (the agency managing public employment services) has introduced green activities to the VDAB Work Experience Program (WEP+) that is dedicated to workers that have faced long-term unemployment (OECD, 2016d).

A 'green experience certificate' has also been developed by the Government as a tool to certify professional green skills. This is awarded to workers who have successfully completed a test and/or completed relevant portfolio. A call to sectoral social partners is issued yearly by the Social-economic council of Flanders (SERV) to suggest professions for which such an experience certificate might be useful.

These horizontal activities are coupled with numerous vertical actions that target sectors that are strategic to a green low-carbon transition. For instance, the construction sector is seeking partnerships with training providers to address the expected gap in green building skills. To this end, the construction employers' federation, jointly with VDAB and several education providers, has set up a Sustainable Building Task Force.

In addition, the sector is also collaborating with universities and colleges to the development of a professional Bachelor in Building. The curricula are expected to include specific trajectories that focus on low-carbon technologies. For instance, low-carbon technical skills such as 'installation of solar energy' or of 'heat-pumps' will be included in specific training programs.

The chemical sector, which is particularly important to the Flemish economy, has identified an increasing skills demand for numerous profiles only partially due - even if green skills are increasingly playing a larger role - to the green transition. To this end, the sectoral federations have launched numerous initiatives to promote skills development and attract qualified employees. For instance, a covenant on chemical industry and education has been set up by the 'Belgian Federation for Chemistry Industries' jointly with the trade unions, the Flemish government and the school systems. The initiative aims at enhancing the cooperation between the industry and the education system. The

sectoral federations have also launched numerous initiatives to increase the visibility and attractiveness of jobs in the sector. To this end, a web-tool has been designed to order to facilitate the teachings and to inform students about prospects in the sector (OECD, 2016d).

Several companies are also pursuing direct collaborations with universities and colleges. Activities include joint effort to develop specialised curricula, holding student competitions and in-class activities such as guest lectures. However, the OECD reports that, although this collaboration strategy effectively leads to the take-up of relevant expertise in the curricula, the industry seems to believe that specialised skills are best developed through on-the-job training.

Furthermore, VDAB is collaborating with Umicore, a global materials technology and recycling giant, to organise training on recycling and material reuse for future 'materials technology operators'" in Antwerp.

Overcapacity and labour policies in the fishing industry

Peru is home to one of the world's largest single stock fishery, the anchoveta (World Bank, 2017), and is among the largest fishing nations accounting for nearly 9% of the global marine production over 2003-2012 (FAO, 2016). Informality and the seasonal variability complicate computing its total workforce that, however, has been estimated to be equal to around 223 000 workers (including salaried jobs in industrial fishing vessels and processing plants) by the National Fisheries Society (Sociedad Nacional de Pesca – SNP). The International Labour Organization (ILO) put the total direct and indirect employment at 142,232 or just below 1 per cent of total employment in the country in 2008 (Murillo et al., 2014).

The overinvestment in vessels, coupled with recurring changes in ocean currents due to climatic events like El Nino, created a significant pressure on the Peruvian fish stock. As such, the government decided to overhaul the management of the industrial anchoveta fishery. A property rights-based system was introduced with quotas assigned to individual companies with the aim of reducing fishing and thus replenishing the natural reserve stock. However, as a result of the reform, a quarter of the fleet was decommissioned and a large number of workers displaced both in the fishing industry and in connected sub-sectors. For instance, almost 3 000 workers - or 40% of the workforce - lost their jobs in the processing industry.

The Government's transition plan introduced the Compensation Fund for Fisheries Management (FONCOPES) in order to support displaced workers. This has been conceived as an independent entity financed by the private sector. The holders of fishing permits pay a fixed amount per vessel with a license to operate, which is used to cover the fund's fixed costs. In addition, operators pay a variable amount that, based on the number of workers that adhere to the social programs, is used to cover FONCOPES's variable costs. The law further introduced a temporary contribution per ton of fish that is loaded into processing plants. The budget raised through this contribution is set aside to provide the main funds for the fishermen's pension system (World Bank, 2016).

FONCOPES finances three main programs to support displaced workers. The first initiative focuses on retraining fishermen for employment in other sectors. Under this scheme, workers are offered a compensation package for voluntary redundancy coupled

with a temporary economic subsidy during the training period. The bonus for voluntary resignation is set at 2.25 monthly remuneration for each year worked with the last employer, subject to a cap of 18 monthly remuneration, while the temporary subsidies is equivalent to 20% of monthly compensation and capped at 1.5 the minimum salary. The training focuses on technical skills. Furthermore, workers are also provided with advice on reintegration into the job market.

A program to facilitate self-employment has also been introduced. Interested workers can opt for a start-up package that includes both a training in business management focused on starting or developing a micro/small enterprise and counselling on either setting up or strengthening existing businesses. In addition, these workers still receive the compensation package for voluntary redundancy and the temporary economic subsidy.

Finally, an early retirement option is also offered. This is aimed at workers aged between 50 and 55. Workers, who can prove that they have sufficient contributions so that after a period of no more than five years are entitled to a retirement pension, can receive a subsidy to transition into the pension scheme. The temporary economic subsidy is equivalent to 50% of the remuneration. Grants greater than PEN 500.00 will be reduced annually until reaching the sum of PEN 500.00 (Foncopes, n.d.).

These reforms have been implemented within the framework of a larger loan from the World Bank aiming at improving the environmental performance of the country. In its evaluation report, the Bank notes that almost 2 078 workers benefitted from FONCOPES. However, as the program required the suspension of fishing permits (boarding passes) for a period of five years, a group of workers opted to leave the fishing sector through the regular compensation system established by the Peruvian labour legislation. This option allowed them to maintain their fishing permits and to join a crew rotation system. The report concludes that the Peruvian government has managed to decrease the fleet overcapacity for anchoveta fisheries while mitigating the associated social impacts (World Bank, 2016). Murillo (2014) notes that one of the program deficiencies was that it targeted only fishers. As such, workers in fishmeal processing industry, where also several jobs were lost, did not have access to the transition support mechanisms.

In addition to these initiatives, the Peruvian Government set up a Fisheries Training Centre in Paita (Centro de Entrenamiento Pesquero de Paita – CEP Paita), whose mission is to improve the knowledge on fishing and aquaculture activities. The centre operates through training and capacity building activities and provides technology transfer to improve competitiveness and labour welfare. CEP Paita has also developed certifications for fisheries and aquaculture workers.

A "modern transition" strategy: the case of Alberta (CA).

In November 2015, the Government of Alberta launched the Climate Leadership Plan that aims at "*lowering emissions, ensuring Alberta's resources are developed responsibly and creating new opportunities to diversify the economy into renewable energy*". The strategy has five main building-blocks: an accelerated phasing-out of coal-fire power generators, the introduction of a carbon price, a tripling of renewable energy by 2030, capping oil sands emissions to 100 megatonnes per year and reducing methane emissions by 45% by 2025 . The first objective is particularly ambitious for the State of Alberta since coal-fired generators account for almost 55% of total electricity generation, with more than 3 000

people employed in coal-fired power stations and their associated mines. At the same time, it should be noted that the Province enjoys a large electricity reserve margin[4], a factor that probably facilitated the decision of closing several power plants (Caldecott et al., 2017).

The Government has implemented several initiatives to accompanying this structural adjustment. Power generators that were originally slated to continue their operation beyond 2030 will receive a financial compensation linked to the reduced assets life. The criteria to compute these so-called "transition payments" have been developed through discussion with the plants owners and are based on the net book value of the assets. The payments are funded through the revenues generated by Alberta's carbon levy (Gov. of Alberta, 2018c).

Figure A A.2. Coal Units, owners and associated mines in Alberta

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Source: (Gov. of Alberta, 2018c).

The revenues of the carbon levies represent also the bulk of a fund to promote innovation and economic diversification. The fund is worth nearly CAD 1.4 billion and aims at reducing the carbon intensity of existing industries while supporting the growth of new sectors. The largest share of funding, about CAD 440 million, will be targeted at the oil sands industry. The remainder is split between measures that are aimed at driving low-carbon innovation across industries (CAD 225 million), large scale energy-efficiency projects (CAD 240 million), loan guarantees aimed at reducing risk for financial institutions and other corporations that invest in renewable energy and energy efficiency measures (CAD 400 million) and bioenergy projects (CAD 63 million) (CBC, 2017; Gov. of Alberta, 2017a).

An Advisory Panel on Coal Communities has been established in order ensure that the concerns of local communities and workers were considered. Importantly, the Panel did

[4] The reserve margin is generally defined as the amount of producible electricity in excess of the peak demand

not engage only the potentially affected workers but also municipal leaders, small business, local associations and First Nations. The outcome was a strategy document containing 35 recommendations focusing on workers, communities and First Nations. The 18 recommendations regarding workers relate to a number of issues, including both income and pension security, retraining and re-employment. Importantly, the Panel notes that "*Programs and training should be delivered, as much as possible, while workers are currently employed and should include accessible and flexible skills development models*".

Building also on the recommendations elaborated by the Advisory Panel, numerous initiatives have been designed to support workers during the transition. Relief grant have been introduced to provide displaced workers with up to 75% of their previous weekly earnings when combined with Employment Insurance benefit while they look for a new job. Furthermore, "soon to be retirees" will receive up to 75% of their previous weekly earnings until they're eligible for employer pension or up to 72 weeks (Gov. of Alberta, 2018a, 2018b).

The possibility that workers may have to relocate in order to find new jobs has also been considered. For this reason, a specific relocation grant has been established. More precisely, workers that have moved for a confirmed new full-time job or for self-employment will receive a grant up to CAD 5 000 to help pay for moving-related expenses (Gov. of Alberta, 2017b).

On-site career counselling and employment services have also been set-up. These will schedule individual or group meetings to help workers identify how existing skills can be transferred to new jobs and how to prepare for interviews. The cost to acquire new skills will be supported by the Coal and Electricity Transition Tuition Voucher that will fund post-secondary education fees up to a maximum of CAD 12 000 (Gov. of Alberta, 2017b).

In addition to measures targeted at individuals, a Transition Fund for Coal Community has been established. The funding is available to municipalities and First Nations affected by the phase-out of coal in Alberta's electricity system. The call for projects focused on initiatives to enable the transition away from economic reliance on coal-fired electricity generation.

This case is interesting since it represents one of the first low-carbon "just transition" strategies in place. Furthermore, it provides insights on how revenues from carbon pricing can be used to address both companies and workers concerns connected to the shift towards a low-carbon economy.

Annex B. List of industries and industry codes for figure 2.5

ISIC Code	Description
0105	Agriculture, hunting, forestry, fishing
1014	Mining and quarrying
1516	Food, beverage and tobacco
1719	Textiles, Wearing Apparel, Dressing And Dying Of Fur, Leather, leather and footwear
20	Wood and of wood and cork
2122	Pulp, paper and paper; Printing, publishing and reproduction
23	Coke, refined petroleum and nuclear fuel
24	Chemicals and chemical products
25	Rubber and plastics
26	Other non-metallic mineral
27	Basic metals
28	Fabricated metal
29	Machinery, nec
3033	Office, accounting and computing machinery; Electrical machinery and apparatus, nec; Radio, television and communication equipment; Medical, precision and optical instruments
3435	Motor vehicles, trailers and semi-trailers; Other transport equipment
3637	Manufacturing nec; Recycling
40	Electricity, gas
41	Water supply
45	Construction
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles
52	Retail trade, except of motor vehicles and motorcycles; repair of household goods
55	Hotels and restaurants
60	Inland transport
61	Water transport
62	Air transport
63	Other Supporting and auxiliary transport activities; activities of travel agencies
64	Post and telecommunications
6567	Financial intermediation, except insurance and pension funding; Insurance and pension funding, except compulsory social security; Activities related to financial intermediation
70	Real estate activities
7174	Renting of machinery and equipment; Computer and related activities; Research and development; Other business activities

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