Just Transition Platform Working Groups

Action 9: Technical note on granular mapping of employment consequences of just transition

December 2023

Regional and Urban Policy

Action 9: Develop a concept paper to advise public authorities on developing granular mapping of employment consequences

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Action contributors: European Federation of Building and Woodworkers, University of Bari, UNESID, Chemelot Circular Hub.

Category: Cement, Chemicals, Steel.

The **Just Transition Platform (JTP) Working Groups (WG)**, established in November 2021, bring together all stakeholders from across Europe with a common concern for the people and places affected by the transition to a climate-neutral economy. The WG for **Steel, Cement and Chemicals** each have a focus on a specific carbon-intensive sector that is heavily impacted by the transition, while a fourth Working Group focuses on **Horizontal Stakeholder Strategy**.

After finalising their Scoping Papers, outlining the focus areas and objectives of their WG, the WG members developed a common Implementation Plan, which sets out their 17 actions. This plan was finalised and published in April 2023. Throughout the rest of the year, the action leaders, together other WG members contributing to the action, have been implementing their respective action.

This document presents the final output of Action 9.

Introduction

Challenges addressed by Action 9

The shift toward climate neutrality will bring about significant transformations in the labour market, impacting not only the quantity of jobs but also the nature of job profiles and the corresponding skills required. The transition of employment in energy-intensive sectors such as cement, steel, and chemicals hinges on factors like access to competitively priced renewable energy sources, essential infrastructure, and the potential for industrial symbiosis. Decisive factors in this context include companies' strategies and investment decisions. Given the diverse strategies and perspectives across regions and sectors, the employment transition will vary accordingly. The transition's implications for the workforce in affected sectors raise uncertainties: can jobs be preserved, or will there be a reduction? What will the new job profiles be in Just Transition Fund (JTF) regions, and how do they align with existing skill sets? To facilitate a just transition that focuses on organising job-to-job transitions for the affected workforce, a detailed analysis of the current workforce and skills base, as well as an understanding of potential labour and skills requirements, is indispensable. JTF managing authorities currently face a deficiency in technical capacity to conduct forward-looking labour market analyses. While there is a substantial demand for granular regional data and analysis, existing European official statistics fall short of providing sufficient information to develop advanced regional models. In anticipation of future needs, it becomes crucial to offer robust and practical guidance on meticulously mapping employment consequences in regions supported by the JTF.

Objectives of Action 9

The goals of this action are to establish essential criteria for a detailed analysis of how a just transition affects employment, providing support for workers throughout the process. This includes determining the impact on companies and workers, addressing the needs of subcontractors, and adopting a comprehensive perspective on the entire value chain while ensuring training, reskilling, and upskilling measures are in place. The technical note presents a ready-to-use, standard methodology on how to granularly map employment consequences of a just transition in carbon-intensive sectors.

Stakeholders targeted by Action 9

JTF managing authorities (particularly their economic analysis, labour market, and statistical units) for their own analysis or to draft terms of reference for external contractors, as well as employers' representatives and trade unions, companies, statistical offices, research institutes and consultancies.

How this action was implemented

This technical note was developed by the JTP Secretariat in cooperation with members of the JTP Working Groups on Steel, Cement, Chemicals and Horizontal Stakeholder Strategy.

Technical note on granular mapping of employment consequences of just transition

December 1, 2023

Table of contents

List of boxes

List of figures

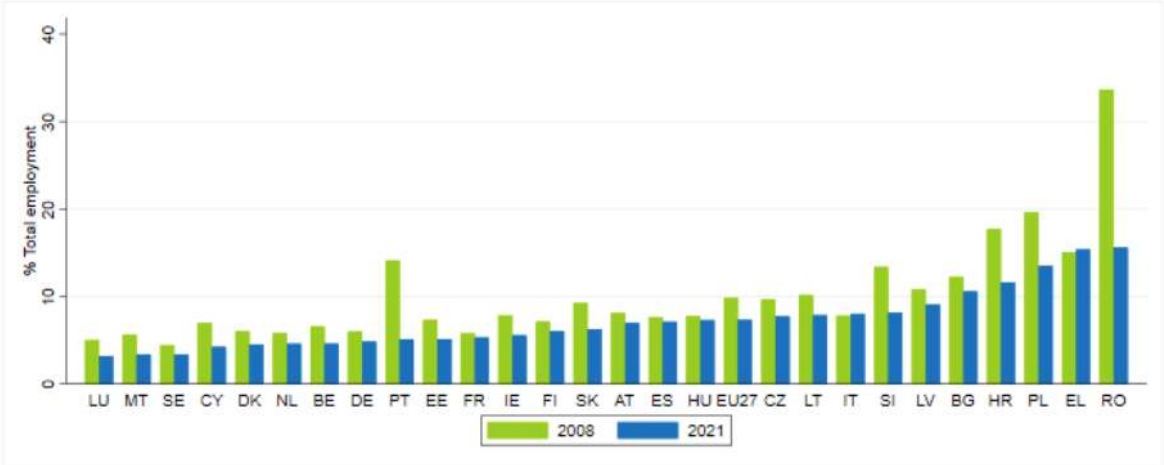
List of tables

1. Introduction

As part of the analytical work package of the project "Support to the management of the Just Transition Platform" (REGIO/2021/OP/0008) and as requested by the four Just Transition Platform (JTP) Working Groups on Steel, Cement, Chemicals and Horizontal Stakeholder Strategy, the JTP Secretariat and Working Group (WG) members elaborated this technical note to map employment consequences of carbon-intensive sectors in JTF regions. The technical note implements Action 9 - Develop a concept paper to advise public authorities on developing granular mapping of employment consequences of the JTP WGs' Implementation Plan led by IndustriAll European Trade Union and the European Chemical Employers Group (ECEG) and the contributors European Federation of Building and Woodworkers (EFBWW), University of Bari, Unión de Empresas Siderúrgicas (UNESID) and Chemelot Circular Hub (European Commission 2023: 40-41). In this regard, the Council recommendation of 16 June 2022 on ensuring a fair transition towards climate neutrality (2022/C 243/04) also invites Member States to **"develop and mainstream the use of robust and transparent employment, social and distributional (ex-ante) impact assessments as part of national climate, energy and environmental reforms and measures"** and to involve social partners and other stakeholders in the identification of evaluation questions and, as relevant, in the design and implementation of evaluation and consultation strategies (OJEU 2022).

Transition poses complex and interconnected challenges for carbon-intensive and coal regions respectively, stretching from massive needs for new infrastructure, alternative jobs, and investments in re-/upskilling, to governance and stakeholder engagement challenges. In addition, high energy prices put unprecedented pressures on the competitiveness of Europe's energy-intensive industries, posing high risk of (temporary) plant closures and potential relocation of jobs to countries with lower energy costs. Figure 1 indicates the overall decline from 2008 to 2021 in **"brown jobs"**, defined as jobs in economic activities with a high pollution intensity in sectors like coal mining, oil and gas exploration, as well as in carbon-intensive industries like steel, cement and chemicals. Many of these jobs are in central and eastern Europe, often in lower-income Member States, underlining the challenge if such jobs are not transformed through the adoption of new production processes necessitating different skill sets. In addition, an analysis by the European Commission's Joint Research Centre found that over 200 000 people work directly in industries linked to making energy from coal, peat, and oil shale in the EU. It also suggests that about 140 000 more jobs are connected to these industries in an indirect way (Mandras & Salotti 2021). This is important for policymakers who are thinking about moving away from using fossil fuels for energy and industry.

Figure 1: Employment in brown activities by Member State, 2008 and 2021



Source: Vandeplas, Vanyolos, Vigani & Vogel 2022. The authors' calculations are based on EU labour force survey and Air Emission Accounts data from Eurostat.

On a positive note, the transition is poised to stimulate growth in emerging sectors. **"Green jobs"**, that is jobs in (sub)sectors that directly relate to green technologies and processes, already account for many positions within the EU. According to Eurostat's data regarding employment in the environmental goods and services sector, this field currently constitutes roughly two per cent of the overall employment within the EU (Eurostat 2023). Most of these jobs are primarily concentrated in water supply, manufacturing, and construction. Currently, the proportion of green jobs varies, with figures ranging from approximately one per cent in Belgium to nearly eight per cent in Luxembourg (Vandeplas et al. 2022). Over the past five years, there has been a general upward trend in the prevalence of these environmentally focused positions. Additional investments in industrial modernisation, energy transformation, the circular economy, clean transportation, green and blue infrastructure, and the bioeconomy are set to generate new, local, and high-quality employment opportunities.

While jobs are increasing in construction, agriculture, forestry, and the renewable energy sectors, some industries may face challenges during this transition. Particularly vulnerable are regions whose economies rely on "brown jobs" that are either anticipated to diminish or require transformation. Moreover, existing jobs will need to adapt and evolve to align with the new economy. Managing this change must consider a possibly shrinking and aging labour force in the EU and the growing substitution of labour due to technological advancements such as digitalisation and automation. Rural areas, for example, must maintain a skilled workforce capable of meeting evolving demands in the agriculture and forestry sectors, even as they face declining rural populations. Small- and medium-sized enterprises, while presented with an opportunity through this transition, also confront specific challenges, including access to necessary skills and financial resources. These challenges need to be thoughtfully addressed to ensure a smooth transition.

The risks and worries related to a **"silent deindustrialisation"** and negative employment consequences of transition processes were repeatedly voiced by IndustriAll European Trade Union, the ECEG and other stakeholders like EFBWW in the JTP conferences and in the four JTP Working Groups. EFBWW for instance highlighted that the European cement industry was exposed to carbon leakage both at the EU's land borders and ports. Cement clinker produced in countries outside the EU Emissions Trading System (ETS) would become increasingly competitive if these countries did not incur the same level of CO2 costs. In turn, producing locally in the EU (and paying the CO2-related cost) would be less competitive than importing from non-ETS offshore locations (with the additional cost of transporting the product to the EU). The impact would be felt across Europe. It would be particularly strong in regions which were more exposed to clinker and cement trade due to their location at the EU's land borders. An exacerbation of these trends could result in a significant increase in CO2 emissions globally, in addition to the closure of factories in Europe, which is already happening today. The challenges of the decarbonisation transition therefore had to be sufficiently addressed, otherwise there was a risk of increasing inequalities resulting in massive restructuring, unemployment and deindustrialisation of territories and countries.

Some other stakeholders also indicated the lack of technical capacity at the end of regional and local authorities to perform the corresponding forward-looking labour market analysis. Despite high demand for detailed regional data and analysis, European official statistics do not yet provide adequate amounts of information for the construction of advanced regional models.[1] Looking ahead, it is therefore very interesting and important to place robust, pragmatic guidance on how to granularly map employment consequences in JTF regions at the disposal of authorities (specifically their economic analysis, labour market and statistical units) for their own analysis or to draft terms of reference for external contractors. Insights about the baseline and evolution of "brown jobs" as a share of total

[1] An exception is the is the dataset "Regional Input-Output Data for Europe" by European Commission / Joint Research Centre (2020).

employment in JTF regions will inform decision-makers' plans for different transition and industrial modernisation scenarios in their territory, ranging from "worst-case" to "best-case" scenarios, and ultimately enable them to take more effective action, considering a region's economic, social, and cultural realities.

Considering the above, the specific objective of this technical note is to present a **ready-to-use, standard methodology on how to granularly map employment consequences of a just transition** in carbon-intensive sectors such as the cement, chemical and steel industries in JTF regions. The proposed methodology builds on input-output calculation and calculation via regionally specific income multipliers to consider direct, indirect and induced employment effects that can result from the activity of a given carbon-intensive industry (section 2). For the sake of illustration, the methodology is applied to the case of the economic importance of hard coal mining in a fictitious JTF region, specifically of a mining company (sections 3 to 5). Section 6 concludes with some remarks on the application of the methodology to the cement, chemical and steel industries in JTF regions.

2. Methods and calculation for determination of the regional employment effects

2.1 Determination of direct, indirect and induced effects

This section lays out the theoretical foundations of direct, indirect and induced employment effects. In a status quo analysis of the regional economic effects emanating from the coal industry, the direct employment effect is of interest first. An analysis at the level of the administrative districts or independent cities allows the regional structure within the fictitious JTF region to be recorded in a differentiated manner. This requires close cooperation with the industry to be able to evaluate personnel data according to place of residence and to investigate the question of which intermediate goods and capital goods are procured by carbon-intensive firms from the fictitious JTF region.

Because of the division of labour in production, it is not sufficient for the present technical note to consider only direct production and the workers employed there. Rather, those employees must also be considered indirectly - for example, to produce capital goods and intermediate products - for the carbon-intensive industry. In addition to operating and capital expenditures, the carbon-intensive industry also generates demand for products and services in the region, which induces value-creating and job-creating effects in other sectors.

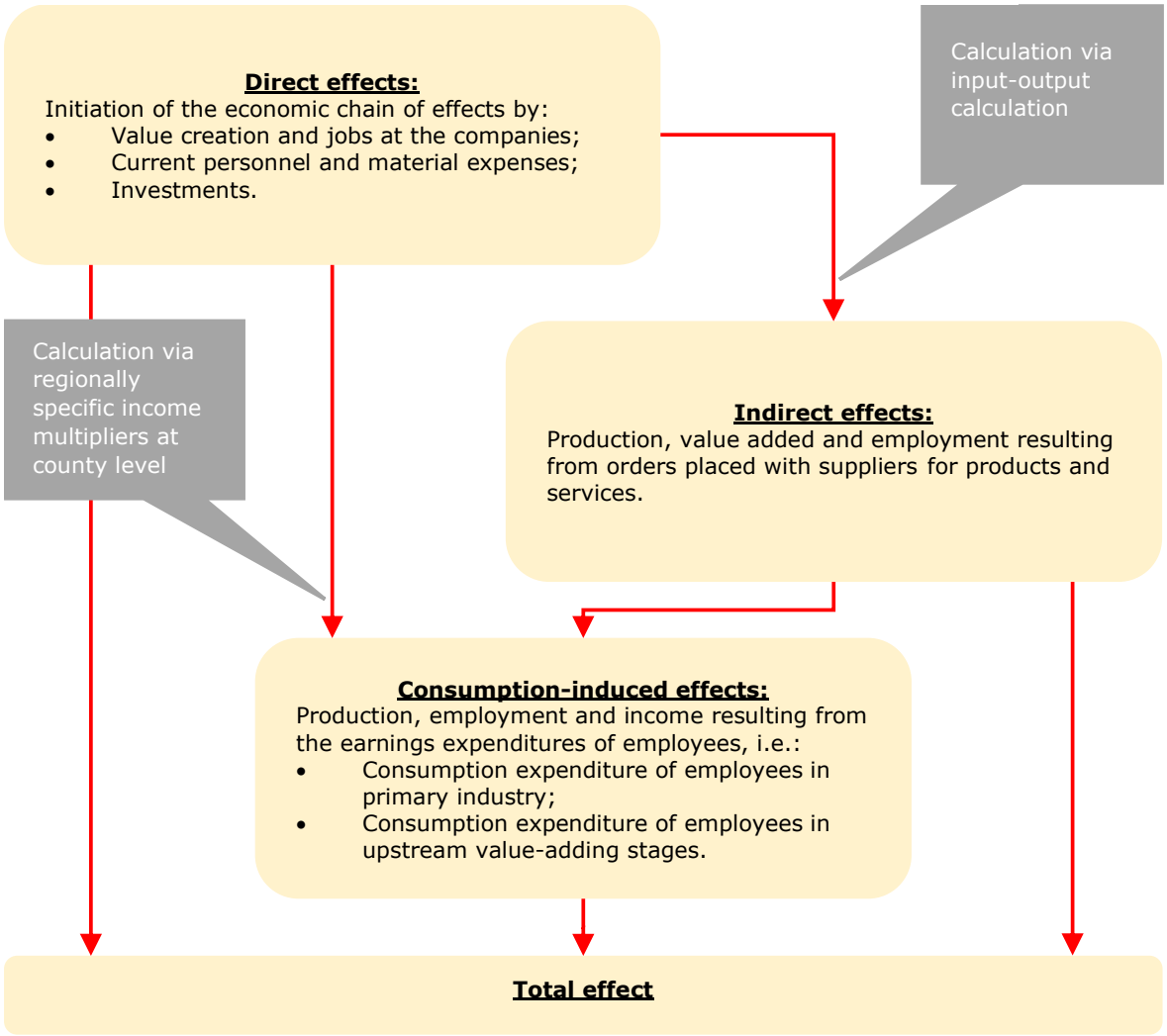
The effects resulting from the business activities of carbon-intensive industries in the region can be systematised into direct, indirect and induced effects:

- **Direct effects** refer to the primary production, employment and income effects that arise directly at the carbon-intensive industry in the fictitious JTF region. These include production, jobs and the income of employees.
- **Indirect effects** result from current expenditure and investments by the carbon-intensive industry in the fictitious JTF region. This demand for goods and services leads to increased value added and employment in the supplier industries. The upstream sectors in turn purchase intermediate inputs from other sectors (interdependence of intermediate inputs). This results in indirect effects of the first, second, ... and n^{th} order, and the magnitude of the effects from stage to stage becomes smaller and smaller.
- **Income-induced effects** in the fictitious JTF region are caused by the earnings expenditures of the employed. Employees in the carbon-intensive industry and in

supplying industries use part of their income for consumer spending. This additional demand results in induced effects, which consist of increased overall economic production, employment, and income.

Figure 2 depicts the strands of impact through which further economic activity is set in motion.

Figure 2: System of economic effects based on an input-output relationship



Source: JTP Secretariat 2023, based on Prognos AG (2007).

Figure 2 also shows how the effects are quantified:

- With the help of the so-called **input-output analysis**, an input-output table is used to calculate the indirect production and employment effects emanating from the carbon-intensive industry in the fictitious JTF region.
- By means of the **multiplier analysis** and a **regionally specific income multiplier**, it is possible to calculate the magnitude of consumption-induced effects resulting from the consumption expenditures of the employees.

By applying this model, it is possible to calculate the direct and indirect employment effects of the carbon-intensive industry. Strictly speaking, both indirect effects are calculated, which arise via intermediate consumption, and income-induced effects (induced effects) resulting from the consumption expenditures of carbon-intensive industry employees. The **multiplier analysis** is particularly suitable for investigating the effects on jobs in a situation of underemployment. In a situation of full employment, on the other hand, a spending stimulus from one industry cannot necessarily be credited with an employment

effect with falling unemployment, since when the industry ceases to exist, workers can easily fill a new job. The **input-output analysis** is used to calculate the direct and indirect employment effects of the carbon-intensive industry. Input-output analysis is still the state of the art when it comes to examining the economic linkages between different sectors of the economy (Miernyk 2020; OECD n. y.; U.S. Department of Commerce / Bureau of Economic Analysis 2012). Important for the construction of the model are regional economic indicators from the statistical offices. With the help of official data for example, sales or production effects can be converted into employment figures, value added and income effects. For each of the 12 economic sectors considered, statistical indicators from the official social product accounting are known or can be calculated. With the help of sectoral labour productivity and the inclusion of the value added, demand impulses can be transformed into employment figures. Table 1 provides an illustrative overview of key sectoral key figures for a **fictitious JTF study area** analysed in section 3 more in detail.

Table 1: Illustrative example - Total number of people in employment and labour productivity in a fictitious JTF region

No.	Summarised economic sectors in the accounting of the social product	Employed persons in the fictitious JTF region	Employed persons subject to social security contributions in the fictitious JTF region	Value added per employed person in the fictitious JTF region [EUR]	Compensation per employee in the fictitious JTF region [EUR]
1	Agriculture and forestry	122 600	40 163	20 310	19 899
2	Mining, quarrying, energy, water	122 900	101 895	82 563	60 515
3	Mineral oil, chemicals, processed stones / earths	272 995	241 161	96 628	50 332
4	Metal	387 990	342 746	35 418	40 494
5	Machines, vehicles, data processing equipment, electronics	541 924	478 730	22 433	52 352
6	Textiles, leather, wood, paper, secondary raw materials	252 439	223 002	86 795	34 043
7	Food, beverages, tobacco	137 652	121 600	224 011	26 443
8	Construction	393 800	283 444	36 755	31 057
9	Commerce, transport, news, restaurants	2 207 300	1 340 722	36 533	27 287
10	Banking, housing, corporate services	1 436 989	941 400	89 170	32 739
11	Health and social care	1 521 331	879 499	35 063	22 974
12	Public administration, services of private households	1 010 669	584 279	49 729	42 728
	Total	**8 408 600**	**5 578 641**	**52 516**	**33 589**

Source: JTP Secretariat 2023.

2.2 Determination of an input-output table for the fictitious JTF region

Indirect effects are defined as value added and job effects that arise in the carbon-industry's **intermediate input sectors** and its own intermediate input suppliers. First-order intermediate input effects can still be calculated using the intermediate input structure of the industry in question. If one wants to calculate the indirect effects over many stages in a single gear, the effects can be quantified in a model using **input-output calculation**. Input-output tables directly show the direct economic linkages between and within manufacturing sectors and the final use of goods for a specific elapsed period.

The calculation of indirect effects with input-output analysis requires the existence of a specific input-output table for the fictitious JTF region. Usually, no official input-output table exists for any JTF region. For this reason, specific input-output tables for JTF regions can be best configured based on experience. The **estimation** requires care and experience, ideally from a consultant. The starting point can be the input-output table of the country of a fictitious JTF region, which is based on official statistics with a breakdown into 12 economic sectors. From this table, with the help of a few assumptions, a specific table for the fictitious JTF region can be estimated, which reflects the interdependence of intermediate inputs. Thus, one can assume that for each economic sector in the fictitious JTF region the ratio of value added to production value, the structure, and the share of imports from abroad correspond to the country average for the sector of the fictitious JTF region. To assume that an industry in the fictitious JTF region has completely different structures (for instance, share of value added in production value or input structure) than the national average for the sector is not plausible in the absence of better available data. Furthermore, the percentage of intermediate inputs that are sourced from the fictitious JTF region is estimated. Important reference points for this are primarily data from national and regional statistical offices and existing studies. With information on the value-added structure of the fictitious JTF region considering for instance mining, quarrying, energy, water, trade, transport, and manufacturing, it is possible to generate conservative estimates of the regional intermediate input ratios by sector. Table 2 presents the result of the estimate for a fictitious JTF region in comparison to reference values for the country of the fictitious JTF region, ideally one which produces input-output tables at the national and sub-national levels. The values indicate what proportion of the intermediate consumption originates from the region under consideration.

Table 2: Sectoral regional ratios of intermediate input purchases for the country of the fictitious JTF region and the fictitious JTF region

No.	Economic sector	Country of fictitious JTF region (input-output table)	Estimates for the fictitious JTF region under analysis
1	Agriculture and forestry	0.755	0.65
2	Mining, quarrying, energy, water	0.573	0.5
3	Mineral oil, chemicals, processed stones / earths	0.596	0.45
4	Metal	0.694	0.4
5	Machines, vehicles, data processing equipment, electronics	0.621	0.5
6	Textiles, leather, wood, paper, secondary raw materials	0.709	0.6
7	Food, beverages, tobacco	0.753	0.6
8	Construction	0.941	0.9
9	Commerce, transport, news, restaurants	0.913	0.8
10	Banking, housing, corporate services	0.945	0.85
11	Health and social care	0.854	0.8
12	Public administration, services of private households	0.91	0.85

Source: JTP Secretariat 2023.

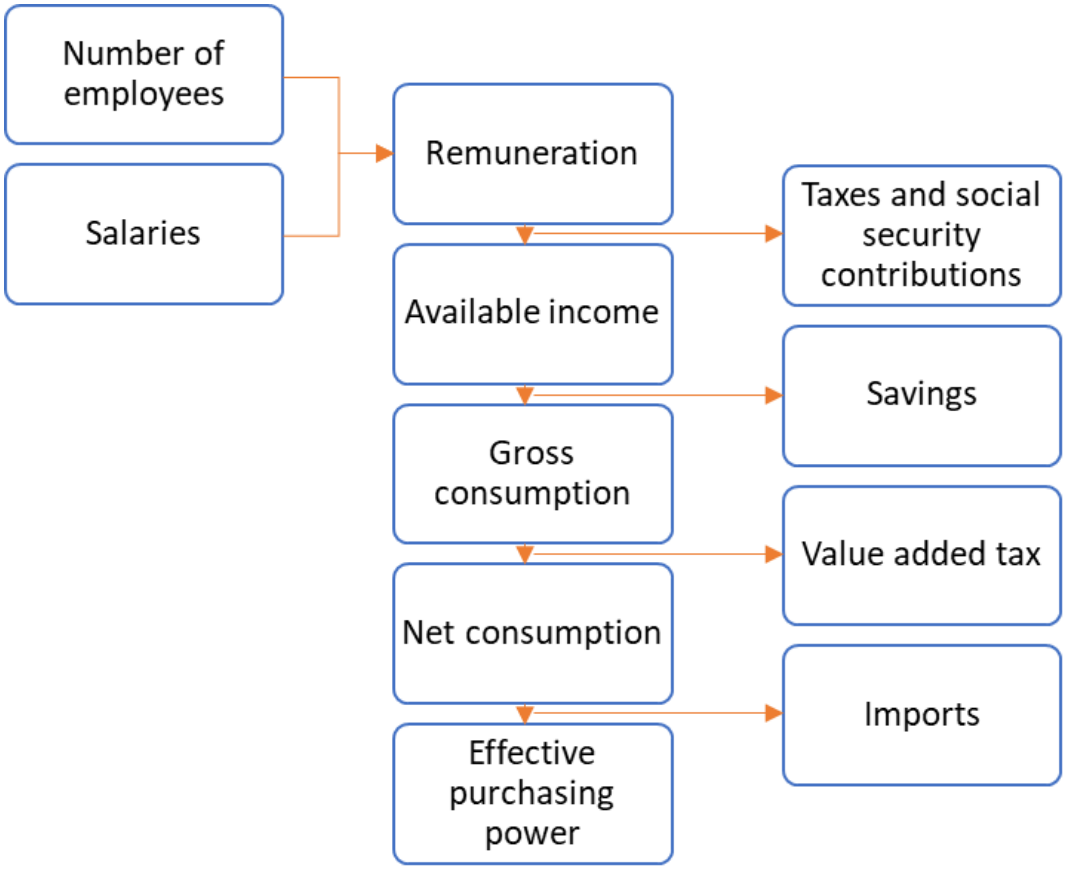
The table indicates that, according to estimates, 50 per cent of the engineering products (sector in the fifth row of the table) procured by companies of the JTF region originate on average from the fictitious JTF region. These estimates have been made for each branch

of industry. With this information, it is possible to adjust the input-output table for each region. The estimated input-output table for the fictitious JTF region can be found in the appendix to the report (section 7.3). For the exact methodological procedure for carrying out the input-output accounting, please refer to the individual calculation steps in the appendix too (sections 7.1 and 7.2). In simple terms, a matrix calculation is used to determine the quantity that must be produced in all sectors of the economy, including all intermediate input stages, to meet the coal industry's demand for intermediate input goods. To be able to calculate with the input-output model, the intermediate input purchases and capital expenditures of the coal industry must be quantified at the level of the 12 economic sectors of the input-output table. These figures were collected in cooperation with the fictitious mining company.

2.3 Determination of a regional income multiplier for the fictitious JTF region

This section deals with the determination of a regional income multiplier for the hypothetical JTF region. The so-called **"income multiplier process"** consists of the fact that employees spend part of the wages paid to them for consumption purposes. This consumer demand leads to a stimulation of production and the generation of additional value added and additional income in the consumer goods industry. Their employees also spend part of their income on consumption. A continuous multiplicative process is created, which, however, becomes smaller and smaller in size due to leakages such as taxes, social security contributions, savings and imports from other regions. Figure 3 illustrates the "leakage losses".

Figure 3: "Leakage losses" from remuneration to effective purchasing power



Source: JTP Secretariat 2023 based on Prognos AG (2007).

The "induced effects" described above (income effects including the consequential effects) are modelled by the multiplier analysis. The multiplier effect is estimated using regionally specific income multipliers. The income multiplier is calculated based on the macroeconomic income utilisation equation:

$$Y = C + I + (X - M)$$

Gross value added Y is equal to the sum of the total goods produced and sold in a year in total goods and services produced and sold in the last use. These are, on the one hand, consumer goods C, on the other hand, capital goods I as well as net exports, that is exports minus imports $(X - M)$. On the right-hand side of the equation, only consumption C is dependent on income Y. If we combine I and $(X - M)$ into the autonomous expenditures A and plot the dependence of consumption C on Y, we get:

$$C = f(Y) = c(1 - t)(1 - q)Y$$

$$Y = c(1 - t)(1 - q)Y + A$$

The level of consumption depends on income Y, on the tax ratio t, on the marginal consumption ratio c, and on the import ratio q. Solving this equation for Y yields:

$$Y = \frac{1}{1 - c(1 - t)(1 - q)} A = mA$$

The multiplier m is directly readable in this formula and indicates the change in Y as a function of a change in autonomous expenditure A. The multiplier is:

$$m = \frac{1}{1 - c(1 - t)(1 - q)}$$

The formula makes it clear that the lower the regional import ratio, the higher the regional income multiplier, the higher the consumption ratio and the lower the tax ratio. To determine a regionally specific income multiplier m using the above formula, values for the tax and contribution burden t, the consumption ratio c and the import ratio q must be determined. In the following, we will describe which values for the tax ratio, savings rate and import ratio are used to arrive at regional income multipliers.

2.3.1 Tax ratio

Recipients of labour income must pay taxes. The tax ratio can be calculated from the average ratio of disposable income to compensation for work. In official statistics, compensation for work is understood to mean the personnel costs, that is the gross salary plus ancillary personnel costs (employer's share of social security contributions). For example, the **tax wedge (income tax plus employee and employer social security contributions, minus cash benefits)** for the average single worker in OECD countries varied greatly across OECD countries in 2022, amounting up to 47.8 percent in Germany and 53 percent in Belgium (OECD 2023). For example, in a study to assess the regional economic impact of structural change in the coal industry in North Rhine-Westphalia, the ratio of disposable income to wages was 54.7 per cent in 2006/7 (Prognos AG 2007: 18). This means that the tax ratio is 45.3 percent, values that are roughly comparable with previous and following years.

2.3.2 Savings rate

The savings rate is defined as the **share of savings in the disposable income of private households**. The average savings rate of private households, which had been decreasing in the 1990s, has been rising steadily again since 2000. The savings rate varies greatly from country to country and region to region. The household saving rate in the

euro area stood at 14.1 percent in the first quarter of 2023 (Eurostat 2023). This results in turn in a consumption ratio of 85.9 percent. It is assumed that the regional savings rate in the analysed fictitious JTF region amounts to 10.1 percent. This results in a consumption rate of 89.9 percent.

2.3.3 Regional import ratio

When considering regional effects, it must be considered that not all consumer spending takes place in the region, but that **part of the demand is met by imports from other regions**, so that this expenditure does not benefit the region. The import ratio is significantly influenced by the size and economic structure of the respective study region. Accurate determination of a regional import ratio requires precise knowledge of interregional consumption and trade linkages, but this is not available at either the national or regional level. Since often no data on regional import ratios are available at the state or regional level, it is necessary to refer to comparative studies. In case timely and relevant data on regional import ratios are not available from comparative studies, analysts can also revert to the data on inter-regional trade flows for Europe at the NUTS2 level and NACE2 sectoral disaggregation prepared by the European Commission / Joint Research Centre (2020). These regional data, which include specific details about different sectors, are meant to be used in models that analyse how economic activities and social factors interact in different areas. They help answer various policy-related questions.

2.3.4 Regional income multiplier

In summary and as an example, we can assume the following estimates for the tax ratio, savings ratio and import ratio for the fictitious JTF region:

- Consumption rate $c = 0.899$;
- Tax ratio $t = 0.453$;
- Import ratio of the fictitious JTF region $q = 0.25$;
- Import ratio of area specific territory in the fictitious JTF region $q = 0.35$.

These values can be inserted in the abovementioned formula which yields a regional income multiplier of 1.58 for the fictitious JTF region:

$$m = \frac{1}{1 - 0.899(1 - 0.453)(1 - 0.25)} = 1.58$$

Based on the different estimate of the regional import ratio for the specific territory in the fictitious JTF region of $q = 0.35$, the regional income multiplier for that area was $m = 1.47$. In the literature, values between 1.05 and 1.9 can be found for regional multipliers, with most studies finding 1.2 and 1.5.[2] These literature values confirm the calculation above. The average income multiplier of 1.58 means that EUR 1 of the compensation paid to employees through the multiplier process will ultimately trigger another 58 cents of indirect production and income in other economic sectors of the fictitious JTF region.

3. Employment effects of a fictitious JTF region – the example of hard-coal mining

The following chapters provide guidance on the quantification of the effects on sales, employment and income that emanate from a fictitious carbon-intensive industry in a JTF region and have an impact on the surrounding area, namely the hard coal mining industry

[2] For an overview of reference studies, see Prognos AG 2007: 20.

in the fictitious JTF region. First, the direct effects on the regional economy (in particular production, sales, employees and incomes), which are generated directly by the fictitious hard coal mining industry, are assessed. Subsequently, the expenditure structure and the intermediate consumption of the fictitious hard coal mining industry and the consumption expenditures of employees are included in the regional economic analysis and indirect effects are determined based on models.

3.1 Direct employment effect

From 1998 to 2019, the fictitious mining company pooled all the activities of the country's hard coal mining industry. In this function the company was an important economic factor, especially for the specific territory of the fictitious JTF region, where most of the company's sites were located. With a total of eight mines and one coking plant, the company's sites were in two regions of the country.

By producing hard coal, the fictitious mining company contributed to the security of energy supply in the country. It supplied the country's power plants with domestic hard coal, going some way to ensuring independence of the country from imported energy sources. According to the company, its **total sales** amounted to over 25 million tonnes of hard coal, of which 24 million tonnes came from production, while the remaining coal was procured from inventories, which decreased to around four million tonnes. The company's **main customers** were power plants in the country: more than three quarters of the production volume flowed into the power industry. Over six million tonnes were purchased by the steel industry, the remainder was sold to other customers in the heating market and industry as well as to small-scale consumers. In addition, the mining company awarded contracts worth around EUR 2 billion a year.

The fictitious mining company was one of the most important employers in the region, as well as beyond the specific territory of the fictitious JTF region. Despite a rapid decline over the years, **27 157 people** were employed by the mining company. Of these, 25 498 worked in production. The remaining 1 659 employees belonged to the so-called "inactive workforce", that is they were, for example, retrainees and employees undergoing qualification measures. The mining company also employed 1 821 apprentices and thus had a training rate of around 7.1 percent.

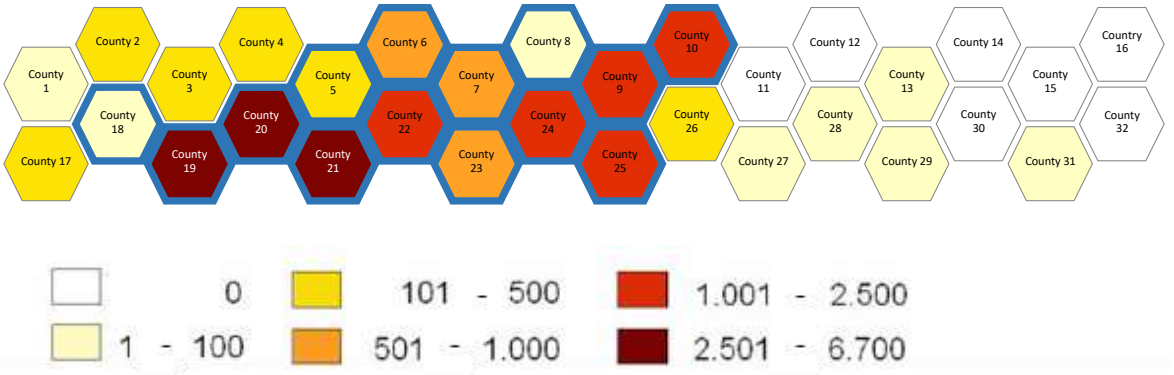
The total **annual net compensation** of employees was around EUR 597 million, which corresponded to a gross remuneration (including employer contributions) of EUR 1.192 million per year. The employees paid a total of social security contributions amounting to EUR 176 million per year. In addition, the entire mining company paid taxes and social security contributions amounting to EUR 900 million. These figures illustrate the economic importance of hard coal for the specific territory of the fictitious JTF region.

3.2 Regional employment structure

An evaluation of the fictitious mining company's personnel statistics according to the **places of residence** of employees revealed the following: of the 27 157 employees working at the various sites, nearly 94 percent (25 506) resided in the specific territory of the JTF region, 1 480 employees (5.4 percent) lived in the neighboring counties of the fictitious JTF region and only 0.6 percent lived in other regions of the country. This means that over 99 percent of the company's employees resided in the fictitious JTF region.

In three southern counties of the specific territory of the fictitious JTF region, there were very high employment levels of between 2 500 and 6 700 mining employees, as the map in Figure 4 shows. Outside the specific territory of the fictitious JTF region, 1 480 employees of the mining company were residents in the JTF region, and 171 employees were based in other regions.

Figure 4: Stylised map of the fictitious JTF region with the number of employees of the mining company by place of residence in the JTF region



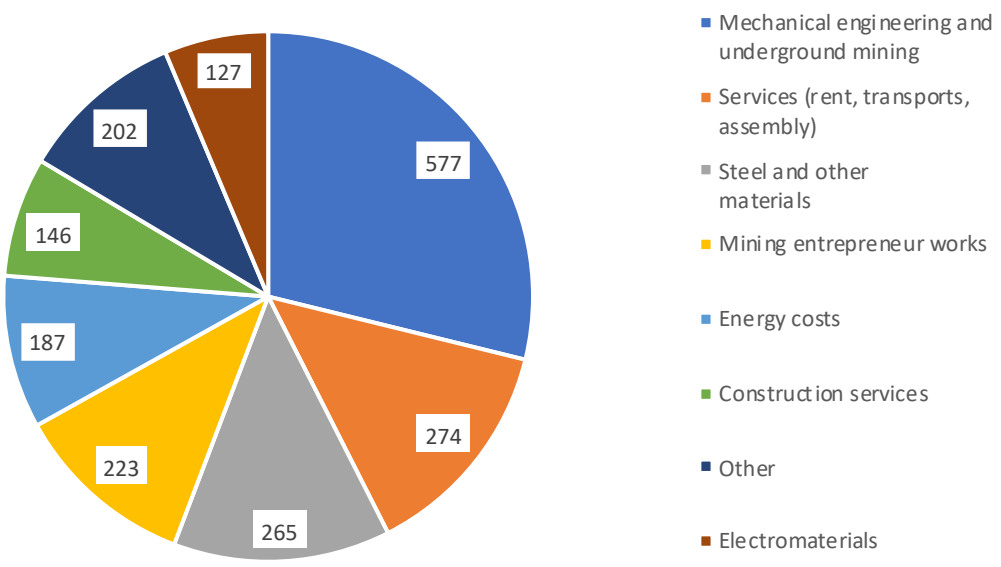
Source: JTP Secretariat 2023. The counties with blue borders designate the specific territory of the fictitious JTF region.

3.3 Indirect employment effect

The advance purchases of the fictitious mining company, that is the **expenditure on current orders and current investments**, trigger so-called indirect effects in the intermediate input sectors. These expenditures, for instance on mining machinery, but also for repairs and services, lead to value creation and employment in the direct and indirect intermediate input sectors. The determination of indirect effects in the intermediate input sectors requires precise knowledge of the type, volume and regional origin of the goods and services procured.

The evaluation of company-related data gathered from the fictitious mining company revealed that the country's coal mining industry had a purchasing volume of EUR 2.119 billion per year, including a subsidiary (outside of the specific territory of the JTF region), energy, and compensation for mining damage. In the context of this hypothetical study, however, only the intermediate inputs emanating from the mining industry of the specific territory of the fictitious JTF region were relevant. In addition to the invoiced order volume of the mining company (EUR 1.612 billion), energy costs, expenditures for remediation of mining damage, transport, and insurance, etc., had to be considered. **In total, the procurement volume of the mining industry in the specific territory of the fictitious JTF region was EUR 2 billion from a total of more than 4 000 suppliers** (Figure 5).

Figure 5: Procurement volume of a fictitious mining company (in EUR million)



Source: JTP Secretariat 2023 according to data collected from the fictitious mining company in the JTF region. Invoiced order volume includes energy purchases, coal transport and compensation for remediation of mining damage.

Mechanical engineering accounted for a large share of the goods and services procured. The fictitious mining company procured underground machinery (for example hoisting equipment, mining equipment) and surface equipment, but also repair material and equipment, and steel for underground support (mine support, arches, ventilation systems). The mining-specific order volume of EUR 567 million includes not only underground machinery but also mining-related company work. The heading "Other" includes expenses for coal transport by a logistics provider, remediation of mining damage, insurance, contributions and other services.

After a **regional analysis of the mining company's order volume according to suppliers' postcodes,** the following picture emerges: of the purchasing volume of EUR 2 billion, 86 percent was sourced from the JTF region (EUR 1.7 billion) and of that, 79 percent (EUR 1.58 billion) was sourced from the specific territory in the fictitious JTF region. These figures demonstrate the company's very strong integration in the fictitious JTF region. One of the reasons for this is the fact that many intermediate goods such as hydraulic shield support were produced within the country only in the fictitious JTF region.

In the first two columns Table 3 translates the average annual expenditures (including current investments) of the country's hard coal industry into the classification of the 12 economic sectors of the official input-output table. Column one shows the purchases from the fictitious JTF region. Column two shows the purchases from the coalfield of the specific territory of the fictitious JTF region. From the level of demand for goods and services of EUR 1.663 million in the JTF region, it is possible to calculate the value-added (third column) and employment effects (fourth column) in the intermediate goods and services sectors (and the input industries of the input industries, etc.) in the JTF region. The determination of these indirect effects in all intermediate industries was carried out with the help of the regional input-output model presented above, which considers the interconnectedness of all economic sectors.

Table 3: The mining company's intermediate consumption from the fictitious JTF region and the specific territory in the fictitious JTF region (in EUR million excluding VAT per year) and calculation of the indirect employment effect (in number of persons)

No.	Summarised economic sectors in the accounting of the social product	Current expenditure in the fictitious JTF region (adjusted for merchandise)	Production value of all intermediate input levels in the fictitious JTF region	Value creation in the fictitious JTF region	Indirect labour force in the fictitious JTF region
1	Agriculture and forestry	0	2	1	52
2	Mining, quarrying, energy, water	161	198	94	1 140
3	Mineral oil, chemicals, processed stones / earths	99	176	53	550
4	Metal	117	180	63	1 771
5	Machines, vehicles, data processing equipment, electronics	575	717	228	10 175
6	Textiles, leather, wood, paper, secondary raw materials	0	33	12	138
7	Food, beverages, tobacco	0	6	2	7
8	Construction	335	360	157	4 238
9	Commerce, transport, news, restaurants	133	265	144	3 932
10	Banking, housing, corporate services	243	584	354	3 971
11	Health and social care	0	8	6	160
12	Public administration, services of private households	0	30	21	424
	Total	**1 663**	**2 559**	**1 135**	**26 603**

Source: JTP Secretariat 2023 according to data from the fictitious mining company. Deviations in the totals due to rounding possible.

The production values in column three indicate which production (sales) in the upstream industries and their respective suppliers was stimulated in total. The production that was stimulated in the entire economy was thus higher than the demand emanating from the mining company. Production in the amount of almost EUR 2.6 billion was stimulated in the fictitious JTF region (total value in column three). This production value corresponded to a value added of EUR 1.1 billion in the JTF region (column four). It arose mainly from the demand generated by the mining company. The remaining production concerned goods needed as intermediate inputs in the production of the goods demanded by the mining company. Column five of the table shows that the **orders placed by the mining company created or secured 26 603 jobs in the upstream economic sectors**. This represented a share of 0.3 percent of all jobs in the fictitious JTF region at the time.

These jobs were mainly in mechanical engineering, for example in manufacturers of mining machinery, but also in construction firms, transport, maintenance and assembly companies, business-related services and in the steel production sector. In the mining technology sector alone, there were 16 000 jobs in the fictitious JTF region. With an export quota of approximately 50 percent, around 8 000 jobs can be described as dependent on mining in the specific territory of the fictitious JTF region. The question as to the **regional distribution of indirect employment** could not be answered, as there were no statistics available on the districts in which the employees of the intermediate input companies had their place of residence. The chain of induced effects is summarised in Figure 6.

Figure 6: Chain of indirect effects

Source: JTP Secretariat 2023.

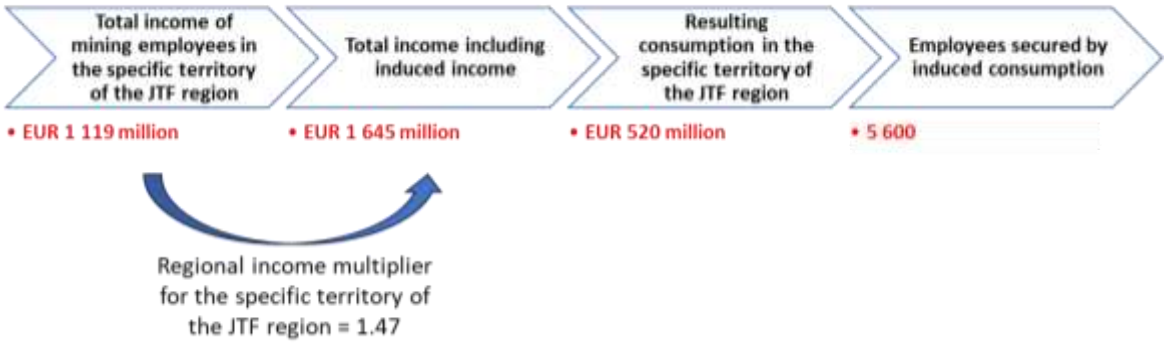
3.4 Induced employment effect

Mining employees spend part of their income on consumer spending, thereby triggering value creation in the consumption sectors and securing employment and income there (induced effects). The fictitious mining company employed a total of 27 157 people with a total income of EUR 1.192 billion per year, including employer's contributions. Of these, 25 506 employees resided in the specific territory of the fictitious JTF region and they accounted for wages of EUR 1.119 billion. A part of their income is used by the mining employees for consumer spending. After social contributions, taxes and household savings, around EUR 350 million was spent in the specific territory of the JTF region. This expenditure generated additional income for the employees in the consumer goods sectors, thus leading to renewed consumer spending, which in turn led to the generation of further income.

This so-called **income multiplier effect** increased the total income of the economy (direct, indirect and induced effect). The calculated income multiplier for the specific territory of the fictitious JTF region of $m = 1.47$ indicates the strength of the multiplier effect. The total income in the specific territory of the fictitious JTF region of EUR 1.119 billion increased by the induced income of EUR 526 billion to EUR 1.645 billion per year. Of this income – in accordance with the values applied for the import, consumption and tax ratio – 32 percent was spent on consumption. This corresponded to a total consumer demand in the specific territory of the fictitious JTF region of EUR 520 million per year. To better explain: this value means that the consumption expenditure of the mining workforce amounting to EUR 350 million ultimately resulted in the situation where employees in consumer goods sectors and other intermediate goods industries could spend a further EUR 170 million in the specific territory of the fictitious JTF region.

Consumer spending generated sales at the companies and triggered value creation (50 percent) as well as the purchase of inputs (50 percent). With an average value added per person in employment of EUR 52 516 in the JTF region, the ratio was 9.5 employees per EUR 1 million in turnover (excluding value-added tax). The induced consumer demand of EUR 520 million thus **secured the employment of 5 600 workers** in the specific territory of the fictitious JTF region. There was no statistical information available on the municipalities or places of residence of the induced employees. The chain of induced effects is summarised in Figure 7.

Figure 7: Chain of induced effects



Source: JTP Secretariat 2023.

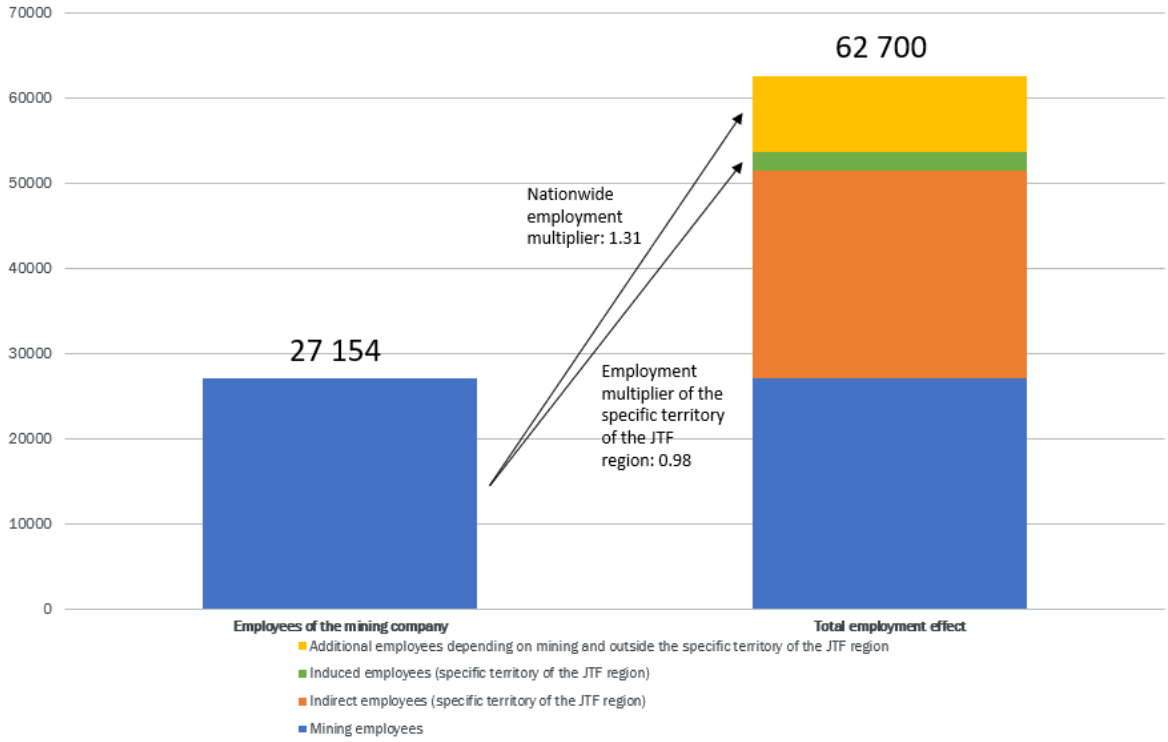
The calculated employment effect indicates how many jobs have been created or secured by the expenditure of the mining employees. If one assumed a scenario without the jobs provided by the fictitious mining company, the induced jobs would not be eliminated, since **unemployment benefits and social transfers** would maintain part of the purchasing power of the mining employees. If one assumed that 60 percent of income was generated by wages and salaries in the form of unemployment benefits, 2 264 jobs in the specific territory of the fictitious JTF region would have been lost by the reduced consumer spending of the coal miners alone if mining had ceased in the fictitious JTF region.

4. Total effect and regional multiplier

The proposed regional economic model shows that the mining industry of the specific territory of the fictitious JTF region, with 27 154 employees of the mining company, of which 25 506 reside in the specific territory of the fictitious JTF region, had considerable indirect and induced employment effects in the specific territory of the fictitious JTF region. In total, in addition to the company's employees, a further 26 600 jobs depended on the coal industry of the specific territory of the fictitious JTF region. Of these, 24 340 were gainfully employed or in jobs at supplier companies in the company's intermediate sectors and 2 264 were safeguarded by the consumer spending of the consumption expenditure of the mining employees. In total, 53 760 people were directly and indirectly dependent on the coal mining in the coalfield of the specific territory of the fictitious JTF region. In relation to total employment in the specific territory of the fictitious JTF region at the time, this corresponded to a share of about 3.5 percent. This results in an **employment multiplier for the specific territory of the fictitious JTF region of 0.98** (Figure 8). This means that for one mining employee, there were statistically a further 0.98 indirectly employed.

In addition, the mining industry of the specific territory of the fictitious JTF region also influenced employment outside the specific territory of the JTF region. If one considered the additional 8 900 employees at the country level who are dependent on mining, there would be 35 500 employees who were dependent on mining in the specific territory of the fictitious JTF region in addition to those directly employed in the mining industry. This corresponded to a **nationwide employment multiplier of 1.31**, which means that for every person employed in the mining industry 1.31 additional employees depend on that industry. This of course benefited the JTF region, but also the whole country from the economic factor of hard coal.

Figure 8: Employment effects of the coal industry in the country of the fictitious JTF region



Source: JTP Secretariat 2023.

Indirect employees were mainly found in the mechanical and vehicle construction, the building industry and certain service sectors. Statistically, for every person employed in the mining industry there were:

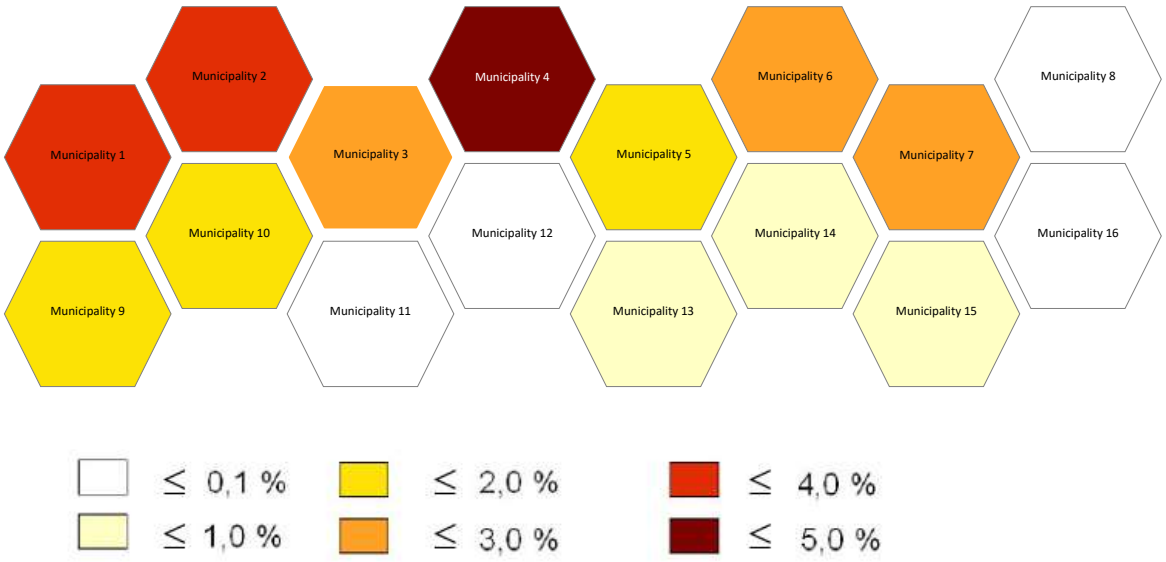
- **0.35 indirect employees** in the sector "mechanical engineering and vehicle construction and vehicle construction, data processing equipment, e-technical equipment";
- **0.17 indirect employees** in trade, transport, communications and catering;
- **0.15 indirect employees** in business-related services; and
- **0.14 indirect employees** in construction.

The input-output analysis, considering the interrelationship of sectors in the fictitious JTF region, substantiated and quantified the effects of a shrinking process in other sectors triggered by a declining mining industry.

5. Impact on the mining sites

The **evaluation of the employee statistics** of the fictitious mining company by place of residence shows that the importance of mining within the specific territory of the fictitious JTF region varies greatly. While some districts outside or on the outskirts of the mining locations benefited only slightly from the employment effects, mining continued to play a major role in the counties of the specific territory of the fictitious JTF region. In some municipalities, mining played a dominant role.

Figure 9: Stylised map of the fictitious JTF region with share of mining employees in total employment in percent



Source: JTP Secretariat 2023.

The map in Figure 9 shows the share of direct mining employees of all employees subject to social security contributions. The indirect and induced employment effects due to the wages and the intermediate consumption of hard coal could not be considered in this small-scale representation, as extensive special studies would have been necessary. This means, only about 50 percent of the actual effects are shown in the map and the employment shares at district and municipality level were therefore below the actual values and represent a kind of **conservatively estimated lower limit**.

In the specific territory of the fictitious JTF region overall, the share of employees directly and indirectly dependent on coal mining was 3.5 percent of all employees subject to social security contributions. If one considered only those employees who are directly in mining, it would have been 1.7 percent of all employees subject to social security contributions.

While in some districts, there were almost no mining employees, their share in other districts was over 3 percent or even just under 5 percent in one district. In general, there was a north-south divide in the importance of coal workers in the labour market.

- In seven districts, mining had virtually no direct effect on employment. Here, the share of employees was less than 1 percent.
- In six other districts, the share of employment was between 1 and 3 percent.
- Between 3 and 5 percent of all employees were in three other districts.

If one analysed the **effects on unemployment** that would have been associated with the loss of coal mining, it would have been the place of residence of the employees that was important and not the place of work, since jobseekers were registered at their place of residence. According to the employment agency, the unemployment rate in the districts and towns of the specific territory of the fictitious JTF region was between 8.8 and 18.1 percent. This resulted in an unemployment rate for the specific territory of the JTF region of 13.1 percent. If 52 106 people at the time employed directly or indirectly in the coal industry were unemployed, the unemployment rate in the specific territory of the fictitious JTF region would be two percentage points higher, namely at 15.1 percent. Even when analysing the unemployment rate at district and municipality level, it was only possible to make statements for the direct mining employees, as it was not known where the employees indirectly dependent on mining had their place of residence. If all employees of the fictitious mining company had been unemployed, the unemployment rates in some

counties would not have changed or would have hardly changed, while in other districts it would have increased considerably. In three districts, it would have risen by between 2.2 and 3 percentage points and 1.5 to 2 percentage points in two districts, whereby only mining employees had been considered. The actual increase in unemployment rates would have been significantly higher if the jobs of those indirectly dependent on mining had been considered. At the level of individual municipalities, the labour market would have been even more dramatic if the coal industry had been to cease immediately: six municipalities would have seen an increase in their absolute unemployment figures between 25 and 38 percent. In the two other municipalities, the number of unemployed would have risen by as much as 50 percent.

6. Concluding remarks

This technical note has sought to introduce input-output calculation and calculation via regionally specific income multipliers in the discussion about the employment effects of a just transition. It proposed a concrete analytical framework to granularly map direct, indirect, and induced employment effects that can result from the activity of a given carbon-intensive industry in JTF regions. The analytical framework was illustrated using the case of hard coal mining in a fictitious JTF region. The framework can inspire JTF managing authorities to conduct similar analyses on employment and skills in the different regions and sectors, including on subcontractors and downstream value chains, ideally together with social partners, that is employers' representatives and trade unions, companies, statistical offices, research institutes and consultancies. This is important since availability of timely and quality data at the regional level can pose challenges for research designs.

To draw a complete and multifaceted picture, such analyses could also consider new jobs that might be created by just transition ("green jobs") and could consider more qualitative information by asking carbon-intensive industry stakeholders relevant and forward-looking evaluation questions, for example on areas where re-/upskilling is needed. Box 1 describes for instance a hypothetical case for the chemical industry in which "green jobs" are added. One study from the chemical sector states that such a transformation requires highly specialised profiles that have so far not been represented in the chemical industry – it recommends developing and attracting talent through modern working time legislation, more teaching of digital and science, technology, engineering and mathematics (STEM) skills at school, more qualified immigration, better childcare options and latest leadership culture (Bundesarbeitgeberverband Chemie e.V. (BAVC) & The Boston Consulting Group (BCG) 2023). Forward-thinking is needed to set up a responsive skills agenda encompassing initial education, up- and reskilling as well as lifelong learning for professionals.

Box 1: Use of employment multipliers: The effect of a green chemistry plant opening in Scotland

Multipliers can be used to look at the impact of a specific event on the economy - for example a company opening or closing. To illustrate this, a hypothetical opening of a company in the "Other chemicals" industry, specifically the green chemistry sector, employing 100 people on a full-time basis in Scotland is considered.

In assessing the impact of this new company one estimates:

- Effects on suppliers of the company; and
- Effects on the economy due to an increase in the spending of employees.

This is achieved by employing the appropriate multipliers for the type of industry concerned. For the illustrative example, the multipliers used will be for the "20.5 – Other chemicals" Input-Output group. Data on multipliers come from the Scottish Government which has a strong and easy-to-use collection of multipliers across sectors and years.

Effects on Suppliers (indirect employment effect):

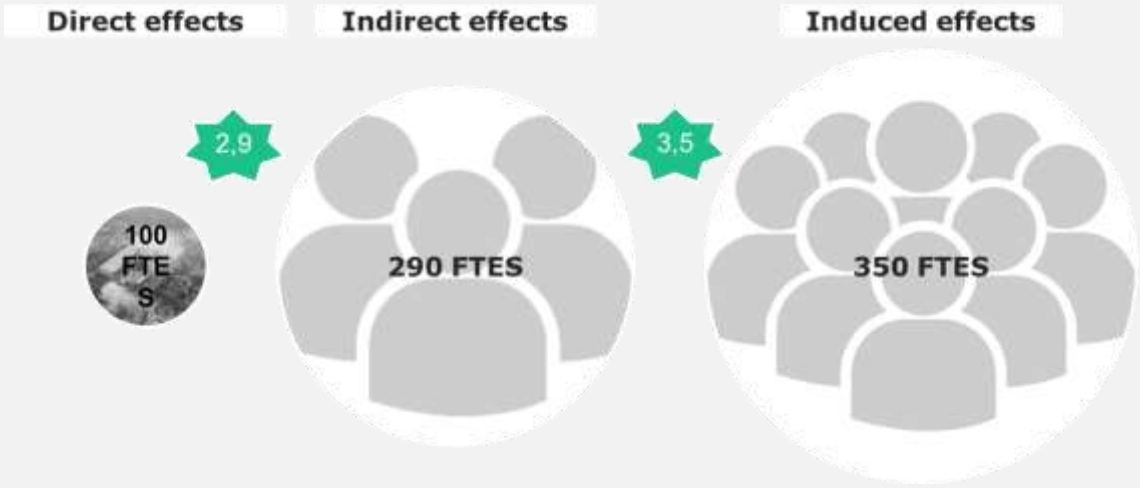
Multiplying the direct increase in jobs by the "Other chemicals" Type I employment multiplier for 2019 gives: 100 x 2.9 = 290 direct and indirect full-time equivalent jobs. Subtracting the initial direct job increase gives

the additional indirect number of jobs supported throughout the Scottish economy as 190 (full-time equivalent (FTE)) (Scottish Government / Chief Economist Directorate 2022: 749).

Effect of increased Household Expenditure (induced employment effect):

In addition to the effect of increased employment, one can expect to see an increase in household expenditure among the people who have gained employment through both the direct and indirect employment effects. This is the induced effect and is estimated using the Type II multipliers.

Multiplying the direct increase in jobs by the "Other chemicals" Type II employment multiplier for 2019 gives: 100 x 3.5 = 350 direct, indirect, and induced jobs (Scottish Government / Chief Economist Directorate 2022: 947). As a direct and indirect increase in employment of 190 (FTE) has already been calculated, it is estimated that 160 further jobs would be supported because of this induced demand.



Source: Scottish Government / Chief Economist Directorate 2022.

It is crucial that the discussed approach is also applied in the context of sector-specific transitions, like those in the steel industry and energy utilities. To enhance the approach, the potential for new value creation arising from transition plans in terms of investments in renewable infrastructure, technology shifts, and decarbonisation projects in carbon-intensive sectors should be factored in too. Not only the immediate impacts of technological shifts and retraining needs should be considered but also long-term consequences. For instance, there is a difference between temporary and structural job creation that is sustainable. The construction of new pipelines results in temporary high labour demand, their maintenance is limited to fewer structural jobs.

Moreover, analyses should extend beyond evaluating the qualitative effects on existing jobs and should include a quantitative assessment linked to employment forecasts resulting from the Territorial Just Transition Plans (TJTPs). This entails developing a strategy to mitigate the impacts of job losses by leveraging opportunities for new value creation within the affected regions through actions like site recultivation, the expansion of electricity grids, or investments in electric arc furnaces in steel facilities, among others.

To further refine the approach, a granular examination of the most prominent professions and skills profiles in JTF regions is necessary. This helps understand the existing skills potential and align it with the skill requirements dictated by investments associated with TJTPs. Undoubtedly, this is a complex undertaking, but it is of paramount importance to prevent an emigration of talent ("brain drain") from JTF regions and ensure that transition plans benefit the current workforce while creating opportunities for the regions' younger population. Important lessons for this can be learned from recent interventions by stakeholders at JTP events, for instance the Spanish mining regions where employment creation arrived too late, leading to population migration or the Swedish JTF region Västerbotten County where attracting vocational workers to relocate is a challenge. Incorporating this added layer of complexity is instrumental in anticipating and managing change effectively, including forecasting skill needs and providing the necessary educational opportunities. Ultimately, this comprehensive approach is pivotal in fostering

successful and sustainable transitions that support both existing workers and the aspirations of JTF regions' youth.

7. Appendix

7.1 Procedure for input-output accounting

The input-output calculation is used to calculate the quantitative effects of coal production. The calculations are based on the **open static Leontief model**. It is called open because the final demand areas are set exogenously. The model is static because it assumes constant technical input coefficients. That is to say, the inputs necessary for production are directly proportional to the outputs. With the so-called input-output calculation, the input matrix can be used to determine the indirect effects of final demand. In addition to the turnover directly triggered by final demand, it is also possible to quantify the effects that occur in the supplying sectors (and their suppliers) via intermediate inputs.

Matrix calculation makes it possible to calculate all intermediate inputs in one step and not to go through the turnover round by round. For this purpose, the respective expenditure vector Y, which differentiates intermediate consumption (e. g. current expenditure and investment) according to 12 economic sectors, is multiplied by the so-called **"inverse Leontief matrix"**. The result is a column vector X that indicates the sectoral gross production values. This is the total output of all sectors of the economy that are necessary for the production of intermediate inputs.

Expressed as a formula, the derivation of which is below, the relationship can be represented as:

$$X = (E - A)^{-1}Y = CY$$

with:

X = Vector of gross sectoral production values;

Y = Vector of expenditure;

E = Unit matrix;

A = Quadratic matrix of input coefficients (intersectoral input linkages);

$C = (E - A)^{-1}$ = Inverse Leontief matrix.

In this way, it is possible to determine how much is produced in all economic sectors, including all intermediate input stages to produce final products worth EUR 1 million.

7.2 Solution of the open static Leontief model

Under the **assumption of linear-homogeneous and limitational production functions**, we obtain the Leontief production function:

$$x_{ij} = a_{ij}x_j$$

Thereby are:

x_{ij} = Intermediate inputs of sector i to sector j;

x_j = Total output of sector j (gross production value);

y_i = Deliveries of sector i to final demand;

$a_{ij} = \frac{x_{ij}}{xj}$ = Input coefficient of the purchases of sector j from i.

The following balance equation can be drawn up for production area i:

$$x_i = \sum_{j=1}^{n} a_{ij}\, x_j + y_i$$

The formula expresses that the output of sector i is dependent on the final demand as well as the intermediate demand of all other sectors. The production function and the identity equation can be formed for each sector of the economy. Consequently, the structure of an economy can be described by a system of equations whose specific structural properties are given by the numerical values of the input coefficients, which can be calculated based on an input-output table.

This system is defined in matrix notation as:

$$X = AX + Y$$

with:

X = Column vector of the technologically dependent output (production); consists of the elements x_1 to x_n;

Y = Column vector of exogenous final demand;

E = Unit matrix;

A = Square matrix of input coefficients (intersectoral input linkage);

C = Inverse Leontief matrix;

The resolution of the matrix equation according to X results in the solution of the model, that is the determination of the sectoral direct and indirect gross production values with exogenously given final demand:

$$X = (E - A)^{-1} Y = CY$$

In the solution of the system of equations, E is the unit matrix, a matrix in which the main diagonal is 1 and all other elements are zero. $(E - A)^{-1}$ represents the inverse of the matrix of input coefficients and is called the Leontief matrix. With the help of the solution equation, it is now possible to easily **calculate from final demand the production values of all sectors incl. intermediate inputs**.

7.3 Estimated input coefficients of the input-output table for the fictitious JTF region (production and imports as percentage of production value)

	Input of production sectors													
No.		1	2	3	4	5	6	7	8	9	10	11	12	13
	Production sector	Agriculture and forestry	Mining, quarrying, energy, water	Mineral oil, chemicals, processed stones / earths	Metal	Machines, vehicles, data processing equipment, electronics	Textiles, leather, wood, paper, secondary raw materials	Food, beverages, tobacco	Construction	Commerce, transport, news, restaurants	Banking, housing, corporate services	Health and social care	Public administration, services of private households	Total of production sectors
Output according to goods groups														
1	Agriculture and forestry	2,0	0,0	0,1	-	0,0	0,8	16,9	0,0	0,1	0,1	0,1	0,1	0,7
2	Mining, quarrying, energy, water	1,5	6,0	6,8	2,6	0,4	1,0	1,0	0,6	0,6	0,1	0,5	0,5	1,1
3	Mineral oil, chemicals, processed stones / earths	4,2	1,1	12,5	2,4	2,6	3,1	1,2	7,0	0,9	0,1	0,8	0,4	2,2
4	Metal	0,3	1,0	0,8	12,9	3,9	0,6	0,5	2,2	0,2	0,0	0,2	0,1	1,4
5	Machines, vehicles, data processing equipment, electronics	1,1	3,0	0,9	1,8	16,3	0,6	0,4	2,9	1,1	0,2	1,5	0,6	3,2
6	Textiles, leather, wood, paper, secondary raw materials	0,4	0,4	1,2	1,0	1,1	17,1	1,6	2,3	1,1	0,5	0,8	0,9	1,7
7	Food, beverages, tobacco	5,1	0,0	0,7	0,0	0,0	0,0	9,0	0,0	1,3	0,0	0,8	0,2	0,7
8	Construction	0,7	2,7	0,6	0,6	0,3	0,4	0,4	-	0,7	2,3	1,5	1,0	1,2
9	Commerce, transport, news, restaurants	6,5	3,5	4,7	6,3	5,5	6,2	7,7	4,9	14,1	1,2	3,0	3,6	5,7
10	Banking, housing, corporate services	8,2	11,8	10,9	5,9	8,0	9,1	9,5	12,6	11,8	25,2	7,7	5,4	13,1
11	Health and social care	2,5	0,4	0,5	0,4	0,1	0,4	0,5	0,2	0,6	0,4	1,2	0,8	0,5
12	Public administration, services of private households	0,5	4,9	0,5	0,4	0,3	1,9	0,7	0,4	1,1	1,6	1,2	7,2	1,6
13	Inputs from the production sectors in the	33,1	34,9	40,3	34,4	38,4	41,3	49,3	33,1	33,6	31,8	19,4	20,8	33,2

	Input of production sectors												
No.		1	2	3	4	5	6	7	8	9	10	11	12	13
	Production sector	Agriculture and forestry	Mining, quarrying, energy, water	Mineral oil, chemicals, processed stones / earths	Metal	Machines, vehicles, data processing equipment, electronics	Textiles, leather, wood, paper, secondary raw materials	Food, beverages, tobacco	Construction	Commerce, transport, news, restaurants	Banking, housing, corporate services	Health and social care	Public administration, services of private households	Total of production sectors
	fictitious JTF region													
14	Inputs from other regions and from abroad	16,8	16,3	28,9	30,2	29,3	21,8	23,6	22,5	10,8	6,3	7,2	6,0	15,5
15	Taxes on products less subsidies on products	2,5	1,2	0,6	0,5	0,4	0,6	0,2	0,7	1,4	1,3	2,8	2,8	1,3
16	Intermediate inputs of the production domains at acquisition prices	52,4	52,4	69,8	65,2	68,2	63,7	73,2	56,3	45,8	39,4	29,4	29,6	50,0
17	Other taxes on production less other subsidies	-3,9	-4,6	0,7	0,6	0,3	0,8	0,5	0,3	1,2	1,0	-2,4	-0,3	0,3
18	Compensation of employees in the country	20,4	28,4	22,2	27,0	26,7	22,6	16,3	29,3	36,2	19,7	56,9	49,0	30,2
19	Write-offs	16,5	18,5	5,1	4,6	3,8	5,3	4,3	2,5	7,1	14,1	9,3	9,5	8,3
20	Net operating surplus	14,6	5,3	2,1	2,7	1,0	7,5	5,7	11,8	9,7	25,8	6,7	12,2	11,3
21	Gross value added	47,6	47,6	30,2	34,8	31,8	36,3	26,8	43,7	54,2	60,6	70,6	70,4	50,0
22	Production value	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: Estimates by JTP Secretariat 2023.

8. References

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9. Acknowledgements

This technical note has been developed by the Just Transition Platform (JTP) Secretariat in cooperation with members of the JTP Working Groups on Steel, Cement, Chemicals and Horizontal Stakeholder Strategy. It has been authored by Markus Zock (Prognos AG) with comments and inputs from Jan-Philipp Kramer (Prognos AG), Corinna Zierold (IndustriAll European Trade Union), Emma Argutyan (European Chemical Employers Group), María Ángeles Romero (European Federation of Building and Woodworkers) and Björn Koopmans (Chemelot Circular Hub). The JTP Secretariat thanks all those who have helped in carrying out the research. The technical note is also an output under sub-task 3.4 Collection of information and identification of gaps for carbon-intensive sectors under the service contract "Support to the management of the Just Transition Platform" (REGIO/2021/OP/0008) managed by the European Commission, Directorate-General Regional and Urban Policy (DG REGIO).