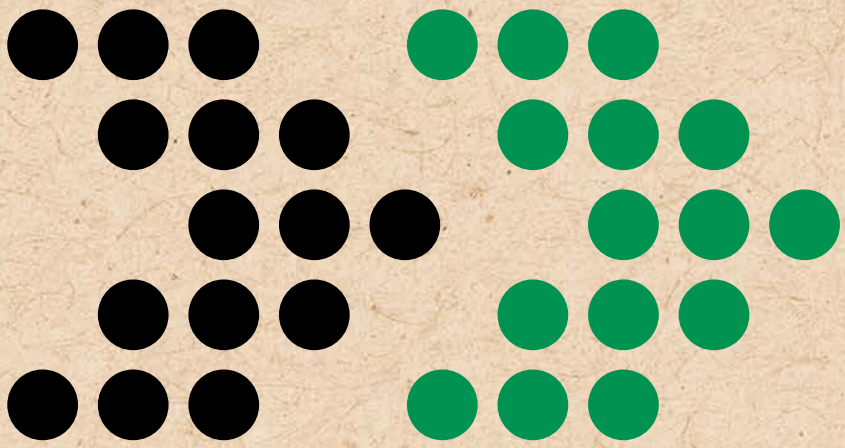
JUST TRANSITION COSTS AND COST FACTORS

A Decomposition Study



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Author: Chandra Bhushan

Researcher: Preet Kumar

Cover design: Raj Kumar Singh
Design and layout: Raj Kumar Singh

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Abbreviations

CBT	Community-Based Targeting
COP26	26th United Nations Climate Change conference at Glasgow
CSR	Corporate Social Responsibility
D&O	Derelict and Ownerless
DMF	District Mineral Foundation
GH2	Green Hydrogen
GW	Giga-Watt
JET IP	Just Energy Transition Investment Plan
JET-P	Just Energy Transition Partnerships
JTF	Just Transition Fund
JTM	Just Transition Mechanism
MER	Market Exchange Rate
MT	Million Tonnes
MTPA	Million Tonnes Per Annum
MW	Megawatt
NDC	Nationally Determined Contribution
NEV	New Energy Vehicle
PPP	Purchasing Power Parity
T	Tonne
TJTP	Territorial Just Transition Plan
TPP	Thermal Power Plant

Executive summary

A just transition in a fossil fuel-dependent region requires investments in several areas to rebuild a resilient and equitable economy while addressing energy security concerns. An analysis of the just transition plans and financial needs of several coal regions reveals that these financial requirements can be classified into the following eight cost components, each with its own set of specific outcomes:

1. Mine reclamation and repurposing;
2. Decommissioning of thermal power plants;
3. Labour support and transition;
4. Economic diversification;
5. Community resilience;
6. Green energy investments;
7. Revenue substitution and energy price support; and,
8. Planning and governance.

This study attempts to identify cost factors for each component based on a suitable denominator — the capacity of decommissioned thermal power plant (TPP), reduced coal production, affected worker or affected population. These factors have been derived based on the just transition investment plans of three coal regions. These are:

1. South Africa's Just Energy Transition Investment Plan (JET IP) for 2023-27, which aims to retire about 30% of the coal-based TPP capacity and reduce the coal use in electricity generation by about 30%. This plan focuses on the Mpumalanga province, which has the highest coal dependence.
2. Territorial Just Transition Plan (TJTP), for 2021-2027, of the Lusatian lignite mining area in Brandenburg, Germany, which aims to retire about half of the TPP capacity and 37% of the lignite production.
3. TJTP (2021-27) of Silesia voivodeship (province), Poland, covering the Upper Silesia coal basin in Poland, which aims to retire about 75% of the coal-fired power capacity and reduce coal production by about 23%.

A comparative analysis of the investment plans of the three regions reveals that just transition investments are highly influenced by local conditions. However, there are similarities in the cost factors for specific components.

- The decommissioning cost of TPPs per megawatt (MW) capacity is estimated at $55,000 in South Africa and $160,000 in Germany. The differential cost is primarily accounted for by the compensation paid to private power plant owners for foregone profits in Germany.
- The cost of reclamation and repurposing of coal/ lignite mines is $28.9 million per million tonnes per annum (MTPA) of coal capacity for Mpumalanga and $17.2 million per MTPA for Silesia. The difference is mainly because of the types of mines and the liabilities that companies have to bear.
- The cost factors for green energy investment demonstrate wide variation, from $5.1 million per MW of decommissioned TPP for South Africa to $0.1 million per MW in the case of Silesia and Lusatia. The difference is primarily due to nationwide green energy investment plan of South Africa versus the regional green energy investments in Silesia and Lusatia.
- The cost for economic diversification per MW of decommissioned TPP is very similar in Mpumalanga, Silesia and Lusatia, at around $0.16 million to $0.19 million.
- The community resilience costs are also similar across the three regions at about $ (PPP) 366 to $ (PPP) 471 per affected person. Community resilience is also about 20% of the total just transition investments.

- The labour support costs show wide variations ranging from about $22,100 per worker in the case of South Africa to $14,285 in Silesia and $6,315 per worker in Lusatia. The difference is due to pre-existing and alternate labour support structures in the European countries.
- The costs for planning and governance range from 2% to 4% of the total just transition investments.

Building an understanding of the cost components and factors is crucial to estimate the funding support that coal-dependent economies will need in the coming decades. While the investment requirements vary across regions depending on the existing state of social infrastructure, fossil-fuel dependence and economic diversification needs, this study identifies the main cost components and factors that can be considered for just transition planning and investments.

1. Introduction

A just transition from coal dependence encompasses technological transition with social, economic and institutional transformation. Financing it, therefore, entails more than just funding the closure of coal mining or coal-based power generation activities. It includes a broad set of costs, including the funding required for labour and community transition, economic diversification, green energy infrastructure development, capacity building, and planning and implementation.[1]

The importance of just transition finance is well-recognized globally, which has resulted in Just Energy Transition Partnerships (JET-P) between developed and developing countries. So far, three such deals have been signed – the $8.5 billion deal with South Africa in 2021[2], $20 billion with Indonesia[3], and $15.5 billion deal Vietnam[4] in 2022. These deals have accelerated the discourse on transition financing, with a nuanced focus on the overall transition budget, type of funding instruments, sectoral allocation of funds, overall implementation and management of the transition.

The Territorial Just Transition Plans (TJTP) of the European Union (EU) has further added to the understanding of the financial needs of just transition. These territorial plans for coal regions are being supported with a grant funding of €17.5 billion ($19.6 billion) under Just Transition Fund (JTF) available for the 2021-2027 period. JTF is part of the larger Just Transition Mechanism (JTM) introduced by the EU in 2020 to mobilize around €55 billion ($61.6 billion) funding between 2021-2027 to support regions most affected by energy transition, to alleviate their socio-economic impact.[5] So far, through the JTF mechanism, funds have been mobilized by various EU member states to implement the TJTPs. For example, Germany has mobilized €2.5 billion ($2.8 billion) for four coal regions, while Poland has mobilized €3.85 billion ($4.3 billion), and Spain has mobilized €869 million ($973.3 million).[6]

This study attempts to identify and delineate the cost components of just transition that have been considered in the transition plans of different countries and coal regions. It then aims to determine and analyze cost factors for each component. For this, the transition and investment plans of three specific coal regions are studied and analyzed in detail, including the planned investments in the Mpumalanga province of South Africa, the Lusatia district in the Brandenburg province of Germany and, the Silesia region of Poland.

The study aims to develop an overview of the just transition costs involved in transitioning fossil fuel regions into a green economy that leaves no one behind. Developing this understanding is vital to provide clarity on the funding support that coal-dependent economies in the global South will need in the coming decades.

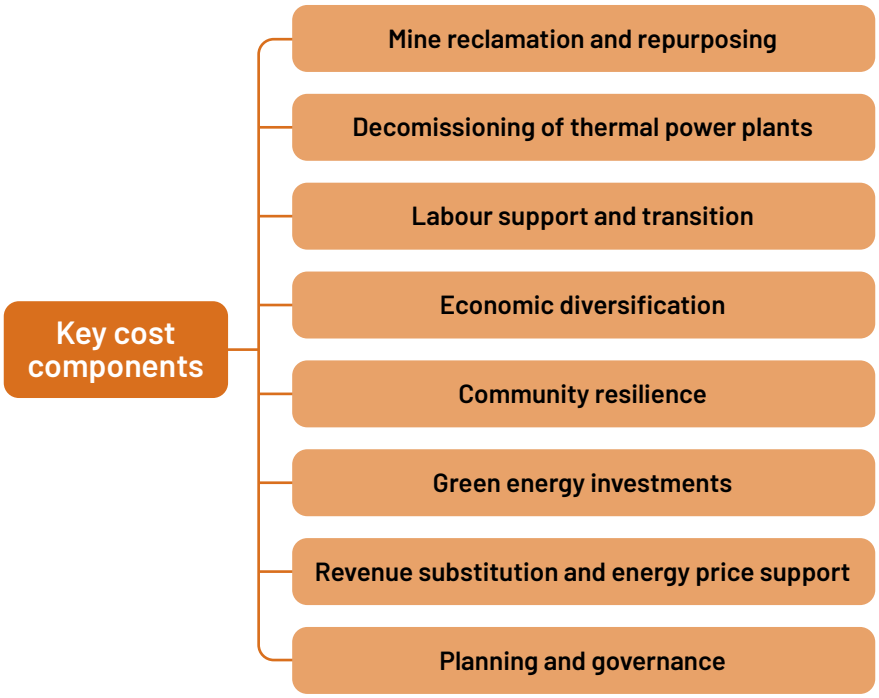
2. Cost components of just transition

Just transition of a coal-dependent economy/region entails complex set of activities and tasks. These can be broadly grouped into certain cost components based on specific outcomes being targeted/delivered. The present study identifies eight key cost components for estimating the financial requirements for just transition. These include the costs for mine reclamation and repurposing, decommissioning of TPPs, labour support and transition, economic diversification, community resilience, green energy investments, revenue substitution and energy price support, and, planning and governance.

This cost delineation is based on a detailed review of the just transition plans being rolled out in the coal-dependent regions of the EU and South Africa. Coal regions in the EU are being provided financing support for operationalizing their TJTP through grants under the JTF. These plans identify the interventions required for just transition, along with the investments needed for each of them. Such details are also available in South Africa's JET IP.

The understanding of cost components developed through these global examples is further supplemented by just transition requirements studied and identified through field assessments undertaken by iFOREST in some of the coal-dependent districts of India, particularly Ramgarh in Jharkhand[7], Korba in Chattisgarh[8], and Angul in Odisha[9].

Figure 2.1: Key cost components for just transition



Source: iFOREST Assessment

Cost component 1: Mine reclamation and repurposing

Mine reclamation is a complex and multi-step process of improving the state of the mined land to an environmentally and economically usable form. It includes the cost of closing the coal mines and repurposing the mining land for subsequent economic use. This cost component accounts for the following set of interventions:

a. **Technical closure of mine:** This refers to the scientific closure of a coal mine site through the following set of activities:
   - Reclamation of mined land;
   - Topsoil management;
   - Waste/overburden management;
   - Coal rejects management;
   - Environmental remediation; and,
   - Disposal of infrastructure and machinery, etc.

b. **Biological reclamation:** This is a type of land reclamation under which the degraded coal mine land is modified to an ecologically functional state and entails plantation of suitable species on the designated reclaimed area, creation of an aquatic ecosystem .

c. **Post-closure monitoring:** This accounts for monitoring and managing environmental parameters of air, water and, noise for a specific period identified by relevant laws/ regulations. In India, the period for post-closure monitoring is three years.

d. **Land repurposing:** This refers to interventions over and above technical mine closure to prepare the land for the next beneficial use, such as the development of infrastructure (roads, electricity line, water supply etc.), industrial park, horticulture, pisciculture, etc. However, it excludes the cost of setting up the new business on the land (such as investments in renewable energy projects).

e. **Compensation for present value:** The closure of a coal mine before its useful life entails financial payouts to owner companies to cover the present value of the return on equity, interest on the capital loan and, depreciation costs over the remaining period of useful life.

f. **Labour and community transition:** Detail set of efforts are required for labour and community transition, which have been considered separately as dedicated cost factors of labour support, economic diversification, and community resilience.

Cost component 2: Decommissioning of TPPs

Decommissioning a coal-based TPP entails several technical, environmental, social and, economic interventions to ensure that the closed power plant site is fully remediated, the economic loss of dependent workforce and communities are compensated, and, new economic opportunities and environmental outcomes are created for communities to benefit from. This cost component accounts for the following set of interventions:

a. **Closure, demolition and remediation:** This refers to interventions pertaining to the demolition of structures, removal of equipment and salvage, and remediation of the site, including remediation of contaminated areas, particularly the ash handling area.

b. **Land repurposing:** This pertains to preparing the land for other economic purposes and could include the development of infrastructure for repowering, industrial parks, plantation etc. These do not include the costs of repowering and repurposing.

c. **Compensation for present value:** The closure of power plants before the end of life entails financial payouts to the owner companies to cover the present value of the return on equity, interest on the capital loan, and depreciation costs over the remaining period of useful life.

d. **Labour and community transition:** These have been considered separately as dedicated cost factors under labour support, economic diversification, and community resilience.

Cost component 3: Labour support and transition

Labour-focused interventions are needed at the time of coal mine and power plant closure to provide transition and re-employment support to all types of affected labour force. This includes funds required for the following set of interventions:

a. **Skilling and reskilling:** Labour force directly impacted by the fossil fuel phase out requires to be reskilled and re-employed in new sectors, especially green industries, which can be achieved through workforce training programmes, pre-apprenticeship programmes, etc. Similarly, investments in higher education and new skilling programmes are required to develop a new generation of workforce for the green economy.

b. **Compensation:** Retrenched employees are entitled to compensation payments, the quantum of which varies from country to country depending on local labour laws.

c. **Pension support:** The liability of providing pension support to retiring and retired workers is on the companies or private pension funds. But in certain cases, pension support might be required if the plant/mines are closed before the end-of-life.

d. **Voluntary retirement scheme/ Severance package:** Such provisions are often considered part of the transition plan to enable certain workers to negotiate a one-time settlement.

e. **Transition support:** This is a one-time payoff provided to transitioning workforce to cover re-employment and relocation support.

f. **Career support:** This entails extending infrastructure support for career enhancement of the transition workforce by developing career counselling facilities, contract job hubs etc.

These cost components for labour support remain similar for coal mines, TPPs and all other fossil fuel-dependent industries and include the costs for both formal, informal and induced workers.

Cost component 4: Economic diversification

Economic diversification entails transitioning a fossil fuel-dependent economy to non-fossil fuel-dependent sectors. This cost component includes green investment and business support for new industries and entrepreneurship in the fossil fuel-dependent region and setting up new businesses on coal mine and power plant land (including the cost of repowering through green energy), and research and innovation costs. However, it excludes the overall green energy investments required to compensate for the reduction in fossil fuel energy at the grid level. This is dealt with separately as a dedicated cost head – green energy investments.

Overall, business support is a key part of economic diversification, which is the financial assistance given to public and private enterprises to develop new green businesses and to the existing businesses to phase out fossil fuel dependence. This includes the following set of interventions:

a. Development of green industrial zones;
b. Support to existing businesses to move to green energy and improve environmental practices, including resource efficiency improvements, circular economy, retrofitting and technological upgradation etc.; and,
c. Innovation and entrepreneurship support to upcoming businesses/start-ups to create new green jobs.

Cost component 5: Community resilience

Community resilience needs investments to improve social and physical infrastructure in fossil fuel-dependent regions and secure basic amenities and services for communities affected by phase down and closures. The costs components include the following:

a. **Maintaining and enhancing social infrastructure:** Coal and power companies often provide social infrastructure facilities such as healthcare, education, drinking water and electricity to the dependent workers and communities. These have to be compensated in the event of the closure of the coal facilities.

b. **Infrastructure investment:** Depending on the existing gap, investments are needed to build physical infrastructure (transport, electricity, communication etc.) in affected regions. Climate

change adaptation measures are also required to bolster the resilience of communities during the transition phase, and to build resilience to the impacts of climate-linked disasters.

c. **Investments in livelihood:** The transition away from fossil fuels disproportionately impacts the population indirectly dependent on fossil fuel industries and employed in a range of induced jobs. Strengthening economic opportunities for the indirectly dependent population necessitates investments to build safety nets through community-based targeting (CBT) that cater to the socio-economic requirements of the community during transition. This may include investments in sectors such as land, water, agriculture, forestry and, animal husbandry. Overall, investments in economic diversification and community resilience are important to address the requirements of induced workers and the affected community.

Cost Component 6: Green energy investments

These include investments in renewable energy (RE), storage, hydrogen, grid infrastructure, energy efficiency, energy access etc., to compensate for the phase-out of fossil fuel-based electricity generation. A green energy equivalency factor can be used to estimate this cost. The green energy equivalency factor is the amount of RE and storage required to replace the electricity services provided by the existing TPPs. The objective is to ensure that green energy investments are made in fossil-fuel dependent areas and aid economic diversification.

Cost component 7: Revenue substitution and energy price support

Financial support is needed to prevent any undue economic burden that the local governments might face due to revenue loss from the closure of fossil fuel industries. Likewise, support is also needed to cover the increase in energy prices, if any, for the communities and industries as they transition to using clean energy sources. These costs entail:

a. **Revenue substitution:** This includes provisions to compensate for the financial loss of the state and district governments due to forgone earnings from royalty, cess and taxes on the fossil fuel industry. This also includes foregone investments in the communities from Corporate Social Responsibility (CSR) and other corporate or government funds. For example, in the case of India, this will also include the loss of District Mineral Foundation (DMF) funds.

b. **Energy price support:** This includes provisions to cover the increase in energy prices for domestic and industrial consumers. This support is necessary to protect the competitiveness of the region and to maintain the cost of living of the residents.

Cost component 8: Planning and Governance

Managing the transition process entails planning, administrative and managerial costs that broadly include the following:

a. **Technical and administrative capacity:** Implementation of just transition action plans requires investments in offices, councils and advisory bodies dedicated to the purpose, as well as strengthening the technical and administrative capacity of the local (state and district) administration in terms of knowledge, skills and human resources.

b. **Communication and outreach:** Just transition requires broadening engagement with relevant stakeholders to build stakeholder support for the transition plans.

c. **Capacity building:** This includes costs for developing the plans and building the capacity of stakeholders to engage with the just transition process. This will also include capacity building of the government, non-government organizations (NGOs), local community and industry.

3. Cost factors of just transition

A cost factor is defined as the unit cost of each cost component. It can be determined by dividing the investment under a particular cost component by a suitable denominator. For example, the denominator could be the number of workers affected, the population affected, the scale of power capacity or coal mining closed etc.

A comparison between the financial allocations for different cost components of just transition between various countries/regions can be made through a relevant cost factor. For inter-country comparison, these factors must be derived for a suitable currency. For the current analysis, both US dollars ($) at the market exchange rate (MER)[10] and purchasing power parity (PPP)[11] have been considered.

The list of cost factors, suitable denominators and, the justification for choosing the denominator is listed in Table 3.1.

Table 3.1 : Cost factors for just transition

Cost component	Denominator for the cost factor	Units	Justification for the denominator
Mine reclamation and repurposing	Coal mine capacity that will be decommissioned during the just transition plan period	Million tonnes per annum (MTPA)	The investments in closure, reclamation and repurposing typically depend on the size of the mining operation, which is linked to the mining lease area.
	Lease area of the coal mining operations that will close during the just transition plan period	Hectares (ha)	The investments in closure, reclamation and repurposing will be done on the land occupied by the coal mining operations and will depend on its land footprint.
Decommissioning of TPPs	Installed power generation capacity that will be decommissioned during the just transition plan period	MW	The investments in decommissioning will largely depend on the capacity of the TPP, though other factors, such as the size of units and plant area, could also have an impact.
Economic diversification	Coal mine capacity that will be decommissioned during the just transition plan period	MTPA	The size of coal mining and power generation operations reflects the extent of economic dependence on these assets. Thus, the reduction in the quantum of coal production and installed capacity of TPPs impacts the extent of investments required for economic diversification.
	Installed power generation capacity that will be decommissioned during the just transition plan period	MW	
	Number of people affected by the transition	Affected population	All just transition plans are developed for a specific region and the affected population of the area. Therefore, the affected population's size is crucial in deciding the investment needs for economic diversification.

Table 3.1 continued

Cost component	Denominator for the cost factor	Units	Justification for the denominator
Community resilience	Number of people affected by the transition	Affected population	The closure of coal mines and decommissioning of TPPs will remove the support provided by these economic activities to the local populace. The size of the affected population is, therefore, a suitable indicator for estimating community resilience needs.
Labour support	Affected worker population due to the closure of coal mines and decommissioning of TPPs during the just transition plan period	Number of workers affected during the plan period	The labour support investments are targeted towards the workforce directly or indirectly employed at the coal mine and/or the TPP, who will be directly affected due to the mine closures or plant decommissioning.
Green energy investments	Installed power generation capacity that will be decommissioned during the just transition plan period	MW	Green energy investments are being made primarily to compensate for the reduction in fossil fuel-based electricity.
Planning and governance	Percentage of the total just transition investments	Total just transition investments	Planning and governance costs are typically a proportion of the total costs.
Revenue substitution and energy price support	These will have to be calculated for the specific regions as taxes and cess, and energy prices are highly specific to local laws and regulations.		

Source: iFOREST Assessment

4. Just transitions investments and cost factors

To develop the cost factors for each of the identified cost components, the present study reviews the just energy transition plans and investment proposals of three coal regions. The regions are the Mpumalanga province of South Africa, the Lusatia lignite district in the Brandenburg province of Germany and, the Silesia province of Poland. While Mpumalanga's costs are included in the investment plan for the just energy transition of South Africa (South Africa's JET IP), Lusatia and Silesia costs are from their respective Territorial Just Transition Plans, which the EU is funding as a grant under the JTF. Thus, the costs for Mpumalanga are mentioned in terms of total investments, while that of Silesia and Lusatia are given as grant amounts. Therefore, in Silesia and Lusatia, the national governments and private sector may have made additional investments to supplement the grant funding. So, the present analysis might not reflect the total JT investments for Silesia and Lusatia. Likewise, in the case of Mpumalanga, the grant component of the total investment is not available. Nevertheless, despite these shortcomings, the investment plans of all three regions are sufficient to provide a clear understanding of the cost components, their objectives and the quantum of investments required to meet the objectives.

Further, it is important to note that all three plans are for a specific duration (five to six years) and do not account for the total just transition investments that may be required to close all fossil fuel-dependent industries and for the region to transition to a green economy completely.

4.1 Mpumalanga, South Africa

Map 1: Mpumalanga

At the COP26, in November 2021, South Africa entered a JET-P deal with the United States (US), the United Kingdom (UK), France, Germany and the EU to mobilize an initial amount of $8.5 billion between 2023 and 2027 to support the national energy transition and climate goals. The funds have been mobilized through a combination of financing instruments, with concessional loans comprising a 62% share, and grants, commercial loans and guarantees accounting for the rest. The initial amount is pledged for a five-year period. Additional funds may be raised at a later stage as the partnership of countries aims to help South Africa move away from coal over the next two decades and to accelerate its transition to a low-emission, climate-resilient economy.[12]

The JET-P provided the impetus for developing South Africa's JET IP for 2023-27, which was released in November 2022.[13] The plan aims to retire about 30% of the coal-based TPP capacity and reduce the coal use in electricity generation by about 30% during the five-year plan period. It focuses on the Mpumalanga province, which has the highest coal dependence. Specific targets included in the plan are as follows:

a. Retire about 12 GW of coal-based generation capacity by 2030, which is 30% of the current capacity.[14]
b. Reduce coal demand for electricity generation by 55 MT – from 113 MT in 2021 to 55-60 MT in 2030.[15] The projected decline in Eskom's coal is by 37 MT between 2021 to 2027, the JET IP period, which is 32% of the current consumption.[16]
c. Repurpose coal mining areas with 15 MTPA capacity in Mpumalanga, which is about 8% of the total capacity.[17] The mining land to be repurposed during the JET IP period is estimated to be 4,800 ha.[18]
d. Support 18,102 coal mine and TPP workers estimated to be affected during the plan period.[19]
e. Support Mpumalanga's estimated population of 4,743,584, which is likely to be affected by the transition, given the massive dependence on the coal economy.[20]

The JET IP has put forth an aggregate funding requirement of $98.7 billion to achieve the climate and just transition goals.[21] The JET-P deal accounts for only 8.5% of the assessed requirement for the five-year period.

Of the total identified investment requirement, 48% is for the electricity sector, 22% for municipal capacity building, 21% for the green hydrogen (GH2) sector, 9% for the new energy vehicle (NEV) sector, and the remaining 1% on skills development *(Table 4.1)*. The electricity sector investments are targeted at meeting the investment needs of national electricity infrastructure, including electricity distribution in municipalities. *(Refer to Annexure 1 for a detailed component-wise investment plan under JET IP)*

Table 4.1: Financing needs of South Africa JET IP for the period 2023–2027 ($ billions)

Categories	Electricity	New energy vehicles	Green hydrogen	Total
Infrastructure	65.2 (6.9)	5.5 (0.2)	20.9 (0.5)	91.6
Planning and implementation capacity	0.1 (0.7)	0.1	0.4 (0.2)	0.7
Economic diversification and innovation	2.7 (0.02)	2.9	0.0	5.6
Social investment and inclusion	0.6 (0.02)			0.6
Skills development	(0.012)			0.2
Total	**68.7 (7.65)**	**9.0 (0.2)**	**21.0 (0.7)**	**98.7 (8.55)**

Note: Figures in parentheses is JET-P contribution.
Source: South Africa's Just Energy Transition Investment Plan 2023-2027.

Mpumalanga is the most coal-dependent province in South Africa, accounting for 83% of the country's total coal production and 12 out of the 15 operational TPPs. It is estimated to account for nearly 85% of the total coal mining jobs. The JET IP identifies an investment requirement of $4.0 billion for meeting the just transition needs of the province *(Table 4.2)*. Nearly 40% of these funds are allocated for diversifying the local economy, 22% for repurposing coal mining land, 20% for infrastructure improvements, 9% for workforce-related interventions, 6% for repurposing coal mines, and the remaining 3% on planning and capacity building activities.

Table 4.2: Mpumalanga's just transition investment needs for 2023–2027

Category	Investments ($ million)
Repurposing coal plants	226.7
Repurposing coal mining land	867.0
Improving infrastructure for development	820.3
Diversifying local economies	1,600.5
Caring for the coal workforce	373.5
Investing in youth and preparing future generations for the transition	50.0
Planning for success	20.0
Instituting policies for post-mining redevelopment	3.3
Building capacity for success	66.7
Total	**4,028.0**

Source: South Africa's Just Energy Transition Investment Plan 2023-2027.

4.1.1 Cost components and factors

(a) Decommissioning of coal-based TPPs

For coal power plant decommissioning, JET IP has allocated an investment of ZAR 19.3 billion for decommissioning 22 GW of capacity during 2023-35 *(Table 4.3)*. This reflects the estimated costs as planned by Eskom for the indicated time frame and is additional to the costs of repowering and repurposing projects and other infrastructure investments.[22] In this case, the per MW decommissioning cost is about $55,000 per MW. The same adjusted for PPP is $122,500 per MW.

Table 43: Decommissioning cost for coal power plants in South Africa

Particulars	Investment Amount (ZAR)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Coal plant decommissioning cost (millions)	19,300	1,215.9	2,695.5
Per unit cost of decommissioning (per MW)	*877,273*	*55,268*	*122,524*

Source: South Africa's Just Energy Transition Investment Plan 2023-2027.

(b) Mine reclamation and repurposing

JET IP 2023-27 plans to invest ZAR 13 billion for the reclamation and repurposing of coal mines for new public and private use *(Table: 4.4)*.[23] This amount is for both derelict and ownerless (D&O) mine and operating mine sites. The plan does not provide detailed information on mine types, investments for different types of mines (opencast and underground), and mine lease areas for reclamation and repurposing, which have been estimated by iFOREST.

- The total cost for rehabilitation of 5976 D&O mines in South Africa is estimated to be ZAR 47 billion.[24] As Mpumalanga has 13% of the country's total D&O mines[25], considering the same proportion for costs, ZAR 6.11 billion is estimated to be allocated for D&O mines closure under the JET IP. Therefore, the remaining ZAR 6.89 billion is considered for reclamation and repurposing of the operating mine sites.
- Coal production in Mpumalanga is estimated to be about 200 MT, and the total coal mining land is about 64,400 ha.[26] As JET IP plans to repurpose 15 MTPA capacity of coal mines, assuming the same proportion of land, it is estimated that 4,800 ha of lease land will be repurposed.

From the above estimates, the per hectare reclamation and repurposing cost in South Africa is estimated at $90,000. In PPP terms, it is about $200,000.

Table 4.4: Reclamation and repurposing costs for coal mines in South Africa

Particulars	Investment Amount (ZAR)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Coal mines reclamation and repurposing investments (millions)	6,890	434	962
Per unit cost (per ha)	*1,435,417*	*90,431*	*200,477*

Source: South Africa's Just Energy Transition Investment Plan 2023-2027.

(c) Just transition investments

The just transition investment in Mpumalanga can be categorized under economic diversification, community resilience, labour support and planning and governance. Given the investments indicated in the JET IP, economic diversification and community resilience investments are respectively estimated to cost $411 and $165 per capita of the affected population. On the other hand, the labour support and transition investments are estimated to amount to $22,100 per worker *(Table 4.5, 4.6 and 4.7)*. The planning and governance costs amount to about 2.4% of the total investments envisaged for the just transition of the province *(Table 4.8)*.

Table 4.5: Economic diversification investments in Mpumalanga

Particulars	Investment Amount (ZAR)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Social investments in TPP communities (millions)	3,400	214	475
Diversifying local economies (millions)	24,000	1,512	3,352
Manufacturing and localizing the clean energy value chain (millions)	1,600	101	223
Piloting social ownership models (millions)	1,650	104	230
Total (millions)	**30,650**	**1,931**	**4,281**
Per unit cost (million per MW coal TPP to be decommissioned)	*2.58*	*0.16*	*0.36*
Per unit cost (per TPA of coal mines to be decommissioned)	*828*	*52*	*116*
Per unit cost (per capita affected population)	*6,521*	*411*	*911*

Source: South Africa's Just Energy Transition Investment Plan 2023-2027.

Table 4.6: Community resilience investments in Mpumalanga

Particulars	Investment Amount (ZAR)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Improving infrastructure for development (millions)	12,300	775	1,718
Per unit cost (per capita affected population)	*2,617*	*165*	*366*

Source: South Africa's Just Energy Transition Investment Plan 2023-2027.

Table 4.7: Labour support and transition investments in Mpumalanga

Particulars	Investment Amount (ZAR)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Caring for coal workforce (millions)	5,600	353	782
Investment in youth (millions)	750	47	105
Total (millions)	**6,350**	**400**	**887**
Per worker cost	*350,794*	*22,100*	*48,994*

Source: South Africa's Just Energy Transition Investment Plan (JET IP) 2023-2027.

Table 4.8: Planning and governance costs in Mpumalanga

Particulars	Investment Amount (ZAR)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Planning for success (millions)	300	19	42
Instituting policies for post-mining redevelopment (millions)	50	3	7
Building capacity for success (millions)	1,000	63	140
Total (millions)	**1,350**	**85**	**189**
As percentage of Mpumalanga JT investments (%)		*2.4*	

Source: South Africa's Just Energy Transition Investment Plan 2023-2027.

(d) Green energy investments

The largest share of JET IP has been earmarked for investments in electricity, NEV and GH2 sectors. For the decomposition of cost factors, only the electricity sector has been considered, as NEV and GH2 investments are largely outside Mpumalanga and are not directly related to the closing of coal power plants and mines. The JET-P support is also mainly for the electricity sector – transmission and distribution, solar, wind and battery, with the total investments aggregating to 70% of the total JET IP amount *(Table 49).*

Table 4.9: Green electricity investments in JET IP

Particulars	Investment Amount (ZAR)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Solar PV (millions)	233,200	14,692	32,570
Wind (millions)	241,700	15,227	33,757
Battery (millions)	23,000	1,449	3,212
T&D (millions)	145,600	9,173	20,335
Municipal-scale electricity service delivery (millions)	319,060	20,101	44,561
Total (millions)	**962,560**	**60,641**	**134,436**
Per unit cost (million per MW coal TPP to be decommissioned)	*81.1*	*5.1*	*11.3*

Source: South Africa's Just Energy Transition Investment Plan 2023-2027.

Overall, the JET IP of South Africa identifies the total investment needs of the country over the next five years, as well as the support being provided by JET-P. However, it doesn't mention the total grant (other than JET-P contributions) and public money required for a just transition. Notably, the South African JET IP is heavily focused on electricity infrastructure because the country is currently facing an electricity crisis. Therefore, it is likely that a significant portion of investments needed in the community has been postponed for a later period. Nonetheless, JET IP is important in guiding energy transition financing through international partnerships.

4.2 Lusatia region, Brandenburg, Germany

Map 2: Lusatia region, Brandenburg

Brandenburg is among the most fossil fuel-dependent states in Germany. The state currently produces about 25 MT of lignite from two active mines and houses two TPPs aggregating a capacity of 3.4 GW that collectively employ about 8,600 people. To manage the energy transition, the state has formulated a TJTP for 2021-2027, identifying key challenges as well as an action plan to meet specific developmental and just transition objectives.[27] From a just transition perspective, the plan focuses primarily on two regions - Lausitzer Revier or Lusatia, where the lignite mines and power plants are located and Uckermark, where the oil refinery is located.

The TJTP outlines key investment areas and funds necessary to support various activities, including transition support to the impacted workers, investments for supporting economic diversification and innovation, RE and non-conventional energy development, increasing resource efficiency in industrial material use and production processes, supporting the circular economy, and, building social infrastructure and community resilience. In October 2022, Brandenburg received €785 million ($879 million) from JTF.[28] Of this, €645.5 million ($879 million) has been allocated for the Lusatian lignite mining area.

For the Lusatian lignite mining area, Brandenburg's TJTP 2021-2027 aims to retire about half of the TPP capacity and 37% of the lignite production. The specific goals are as follows:

a. Retire about 1,860 MW of lignite-based generation capacity by 2028, about 55% of the current capacity.[29]
b. Reduce lignite production capacity by 13 MTPA due to the closure of Jänschwalde opencast mine.[30] This will reduce the lignite production capacity by about 37%.
c. Support 9536 workers likely to be affected due to the closure of lignite power plants and mines.[31]
d. Support the 0.71 million population likely to be affected by the closures.[32]

4.2.1 Cost components and factors

(a) Decommissioning of TPPs

For lignite power plant decommissioning, Germany is paying a compensation of €1.75 billion to the coal company LEAG for the closure of TPPs in Lusatia.[33] This includes the additional mine rehabilitation costs that LEAG might incur due to the early closure of lignite mines, which is estimated to be €15-150 million.[34]

The per MW decommissioning cost for 2,790 MW of capacity by 2030 is estimated to be about €150,000 or $164,000 per MW.

Table 4.10: Decommissioning cost for lignite power plants in Lusatia

Particulars	Investment Amount (€)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Coal plant decommissioning cost (millions)	1,667[35]	1,833	2,384
Per unit cost of decommissioning (per MW)	*149,328*	*164,261*	*213,631*

Source: Act on the reduction and termination of coal-fired power generation and on the amendment of other laws, Germany.

(b) Just Transition investments

In Lusatia, the lignite industry is one of the most important structural sectors and is among the largest employers. The TJTP 2021-2027 has allocated €645.5 million for supporting the structural change in the lignite mining area. These investments have been categorized under economic diversification, community resilience, labour support and green energy investments.

Overall, the economic diversification and community resilience investments are estimated to cost $299.6 and $339 per capita affected population, respectively *(Table 4.11 and 4.12).* The labour support and transition investments amount to $6,315 per worker *(Table 4.13).*

Table 4.11: Economic diversification investments Lusatian lignite mining area

Particulars	Investment Amount (€)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Research and innovation (millions)	119.7	131.6	171.2
Support to SMEs & start-ups (millions)	134.7	148.2	192.7
Support to large companies (millions)	18.0	19.8	25.8
Total (millions)	**272.3**	**299.6**	**389.6**
Per unit cost (million per MW TPP to be decommissioned)	*0.15*	*0.16*	*0.21*
Per unit cost (per TPA of coal mines to be decommissioned)	*20.9*	*23.0*	*30.0*
Per unit cost (per capita affected population)	*382*	*420*	*546*

Source: Territorial Just Transition Plan: 2021-2027, Lusatian lignite mining area, Brandenburg.

Table 4.12: Community resilience investments in Lusatian lignite mining area

Particulars	Investment Amount (€)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Information and Communication Technologies: Broadband networks (millions)	172.1	189.3	246.2
Water management and protection of water resources (millions)	3.5	3.9	5.0
Protection the biological Diversity, natural heritage and natural Resources (millions)	5.5	6.1	7.9
Eco-friendly public transport infrastructure (millions)	10.0	11.0	14.3
Environmentally friendly rolling stock in local transport (millions)	9.0	9.9	12.9
Combined heat and power, district heating and cooling (millions)	15.2	16.7	21.7
Other social organizations contributing to local social inclusion (millions)	3.5	3.9	5.0
Support the Primary and secondary education (millions)	1.3	1.4	1.8
Total (millions)	**220.1**	**242.1**	**314.8**
Per unit cost (per capita affected population)	*308*	*339*	*441*

Source: Territorial Just Transition Plan: 2021-2027, Lusatian lignite mining area, Brandenburg.

Table 4.13: Labour transition investments in Lusatian lignite mining area

Particulars	Investment Amount (€)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Vocational training and adult education (millions)	43.3	47.6	61.9
Support for the adjustment from workers, companies and entrepreneurs (millions)	11.5	12.7	16.5
Total (millions)	**54.8**	**60.2**	**78.3**
Per worker cost	*5,741*	*6,315*	*8,213*

Source: Territorial Just Transition Plan: 2021-2027, Lusatian lignite mining area, Brandenburg.

(c) Green energy investments

Aggregate investments of €98.3 million are planned for energy efficiency, RE and alternate fuels development in the Lusatian lignite mining area. This amounts to an average investment of $58,146 per MW of decommissioned TPP capacity *(Table 4.14)*.

Table 4.14: Green energy investments in Lusatian lignite mining area

Particulars	Investment Amount (€)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Energy Efficiency (millions)	58.5	64.4	83.7
Renewable energy (millions)	3.8	4.2	5.4
Alternate fuels (millions)	36.0	39.6	51.5
Total (millions)	**98.3**	**108.2**	**140.7**
Per unit cost (per MW TPP to be decommissioned)	*52,860*	*58,146*	*75,623*

Source: Territorial Just Transition Plan: 2021-2027, Lusatian lignite mining area, Brandenburg.

Overall, the TJTP 2021-2027 for the Lusatian lignite mining area largely focuses on economic diversification and community resilience investments. In comparison, the investments in green energy are relatively limited for the Lusatian region as Brandenburg has historically invested heavily in RE development and met its targets. Similarly, the per unit labour costs seem low due to large-scale support provided to the formal labour through the Coal Phase-Out Act (2020), which has earmarked about €5 billion for labour transition in Germany.[36]

4.3 Silesia, Poland

Map 3: Silesia, Poland

Poland has developed TJTPs for six coal regions, of which the European Commission has so far approved five plans. For implementing these plans, a total of €3.85 billion ($4.3 billion) has been allocated through the JTF mechanism.[37] Of the total allocation, the combined plan for Silesia and Western Małopolska account for 62% share, while Wielkopolska, Lower Silesia and Łódzkie account for 11%, 15% and 9% share, respectively.

Most investments are focused on the Silesia region (covering Upper Silesia coal basin in Poland), primarily because it is one of Europe's largest coal mining areas *(Refer to annexure 2 for component-wise details of the investments planned under Silesia TJTP).*[38] The region houses 19 operational coal mines producing about 29.5 MT of coal per year and four TPPs aggregating a capacity of 6.3 GW. Silesia has developed a comprehensive TJTP that outlines a strategy to support a planned transition till 2030. However, the plan has been developed considering a coal mine and power plant closure scenario beyond 2030 as the last mine in Silesia is planned to be closed in 2049.[39]

Overall, the TJTP for Silesia aims to retire about 75% of the coal-fired power capacity and reduce coal production by about 23% during the 2021-30 time period. Specific goals include:

a. Decommission 4,935 MW coal-based generation capacity by retiring five plants – Jaworzno II (200 MW), Jaworzno III (2,255 MW), Laziska (1,155 MW), and Rybnik (1,325 MW).[40] This will reduce the current generation capacity by 75%.
b. Reduce coal production by 23% - from 29.5 MTPA (2022) to 22.8 MTPA (2030).[41]
c. Repurpose 9,517.1 ha of post-mining and industrial land.[42]
d. Support 36,500 workers estimated to be affected by the transition.
e. Support a population of 1.27 million estimated to be affected due to the transition. This is the population of mining subregions identified in the TJTP.

4.3.1 Cost components and factors

(a) Reclamation and repurposing of post-mining and industrial land

TJTP has allocated a significant amount for the development of the post-industrial region, mitigating the effects of mining and industries, including remediation, reclamation, decontamination and regeneration, and damages caused by the operation of coal mining and coal-based TPPs *(Table 4.15)*. The per unit cost of reclamation and repurposing is estimated at $12,000 per ha.

Table 4.15: Reclamation and repurposing costs of post-mining and industrial land cost in Silesia

Particulars	Investment Amount (€)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Mitigation of the effects of industrial activity, including mining, on the environment, improvement of biodiversity indicators in areas used for social purposes (millions)	70	77	105
Improvement of water conditions in the mines impact area (millions)	15	17	22
Systemic land management of post-industrial areas (millions)	20	22	30
Total (millions)	**105**	**116**	**157**
Per unit cost of reclamation and repurposing (per ha)	*11,033*	*12,136*	*16,541*

Source: Territorial Just Transition Plan: 2021-2027, Silesia.

(b) Just transition investments

The Silesian TJTP has allocated €845 million for supporting businesses for economic diversification *(Table 4.16)*. The community resilience investments aggregate €399 million and include investments in the transport sector and level-up investments in the affected communities *(Table 4.17)*. Meanwhile, €474 million has been allocated for vocational education, higher education, and interventions in the labour market to support a smooth transition of the affected workforce *(Table 4.18)*. The per capita investment, based on the population of the affected community, for economic diversification and community resilience amounts to $731 and $345, respectively. The cost factor for labour support and transition investments is about $46,000 per affected worker.

Table 4.16: Economic diversification investments, Silesia

Particulars	Investment Amount (€)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Development of the potential of high technologies and institutions supporting innovation towards climate neutrality (millions)	35	39	52
Development of R&D potential and undertaking implementation works (millions)	100	110	150
Economic diversification of mining subregions (millions)	35	39	52
Diversification of enterprises in mining subregions, including activities for circular economy (millions)	296	325	443
Support for creating new companies and running businesses (millions)	150	164	224
Support for development of enterprises classified as regional technological specializations (millions)	140	154	210
Improvement of competitiveness of MSMEs undergoing transformation (millions)	90	99	135
Total (millions)	**845**	**930**	**1267**
Per unit cost (million per MW coal TPP to be decommissioned)	*0.17*	*0.19*	*0.26*
Per unit cost (per TPA of coal mines to be decommissioned)	*126*	*139*	*189*
Per unit cost (per capita affected population)	*665*	*731*	*997*

Source: Territorial Just Transition Plan: 2021-2027, Silesia.

Table 4.17: Community resilience investments in Silesia

Particulars	Investment Amount (€)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Improvement of mobility for the region's inhabitants and transport network of mining regions (millions)	30	33	45
Level up activities of communities participating in the just transition process (millions)	41	45	61
Use of post-industrial area for the development of the region (millions)	328	361	492
Total (millions)	**399**	**439**	**598**
Per unit cost (per capita affected population)	*314*	*345*	*471*

Source: Territorial Just Transition Plan: 2021-2027, Silesia.

Table 4.18: Labour transition investments in Silesia

Particulars	Investment Amount (€)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Creating conditions for professional development	100	110	150
Development of vocational education in cooperation with entrepreneurs, universities in particular for smart and technological specializations	238	262	357
Targeted development and support for higher education oriented to the needs of the green economy	37	41	55
Instruments related to intervention in the labour market to ensure continuation/change of professional path	95	105	142
Interinstitutional cooperation for labour market	4	4	6
Total (millions)	**474**	**521**	**711**
Per worker cost	*12,986*	*14,285*	*19,470*

Source: Territorial Just Transition Plan: 2021-2027, Silesia.

(c) Green energy investments

The TJTP has allocated €300 million for RE capacity development. The cost factor is about €61,000 or $67,000 per MW or of coal power plant decommissioned *(Table 4.19)*.

Table 4.19: Green energy investments in Silesia

Particulars	Investment Amount (€)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Energy development based on renewable energy sources (millions)	300	330	450
Per unit cost (per MW TPP to be decommissioned)	*60,790*	*66,869*	*91,140*

Source: Territorial Just Transition Plan: 2021-2027, Silesia.

(d) Planning and governance

Development of knowledge and skills, and strengthening of social and economic management for just transition is an important pillar in the TJTP. This amounts to about 4.2% of the total TJTP investments in the region *(Table 4.20)*.

Table 4.20: Planning and governance investments in Silesia

Particulars	Investment Amount (€)	Investment Amount ($, MER)	Investment Amount ($, PPP)
Developing knowledge and skills for a just transition (millions)	5	6	7
Strengthening the social and economic management capacity for a just transition in mining subregions (millions)	89	98	133
Total (millions)	**94**	**103**	**140**
As percentage of Silesia TJTP investments (%)	*4.2%*		

Source: Territorial Just Transition Plan: 2021-2027, Silesia.

5. Decomposition study

The analysis for the three regions mentioned in the previous section shows that the just transition investments are country-specific; regions have planned investments based on their needs. For example, while South Africa has allocated 70% of JET IP investments to green energy (no specific allocation for Mpumalanga), the same in Silesia is 13.5% and in Lusatian district, Brandenburg is 15%. The difference is because South Africa's JET IP addresses both the energy transition goals of the country (to meet the NDC targets) and the just transition needs of Mpumalanga. On the other hand, the TJTP's of Silesia and Lusatia lignite regions mainly focus on the transition needs of these two fossil fuel areas; the energy transition targets are being addressed through other EU and national programmes.

But are there any underlying similarities in the cost factors for various components of just transition? An attempt has been made below to derive cost factors based on the just transition investment plans of Mpumalanga, Silesia and Lusatian district (Brandenburg).

5.1 Decommissioning of Thermal Power Plants

While investments for the decommissioning of TPP have been provided in the plan of South Africa, the decommissioning cost for plants in the Lusatian district is provided in the closure law of Germany. Silesian TJTP does not specify any investment for decommissioning.

Table 5.1: Cost factor for decommissioning thermal power plants

Particulars	South Africa	Lusatia
Per unit cost of decommissioning ($ per MW)	55,268	164,261

Source: iFOREST Analysis

The decommissioning cost per MW capacity is estimated at $55,000 in South Africa and $160,000 in Germany. This difference can be explained by the fact that Germany is paying compensation to private power plants in lieu of foregone profits. In contrast, TPPs in South Africa are owned by the government.

5.2 Reclamation and repurposing of coal mines

Separate reclamation and repurposing costs have been provided in the just transition plans of Mpumalanga and Silesia, but not in the TJTP of the Lusatian district. The cost factors are $28.9 million per MTPA coal capacity for Mpumalanga and $17.2 million per MTPA coal capacity for the Lusatian district. Again, these differences can be explained by the differences in the mine type, lease area, liabilities of companies etc.

Table 5.2: Cost factor for reclamation and repurposing of coal mines

Particulars	Mpumalanga	Lusatia
Per unit cost of reclamation and repurposing ($ millions per MTPA)	28.9	17.2

Source: iFOREST Analysis

5.3 Green energy investments

There are no similarities in green energy investments, mainly because South Africa has projected the total investments required to meet its NDC targets. In contrast, TJTP's of Silesia and Lusatian district have only planned for additional investments, over and above the investments made through the EU and national programmes. Also, being a global South country, South Africa has projected the magnitude of resources it would require to transition to green energy and hence the support it would need from the developed countries.

Table 5.3: Cost factor for green energy investments

Particulars	South Africa	Silesia	Lusatia
Per unit green energy investments $ million per MW of TPP decommissioned)	5.1	0.1	0.1

Source: iFOREST Analysis

5.4 Just Transition investments in coal regions

There are remarkable similarities in the way just transition investments have been planned for Mpumalanga, Silesia and Lusatian district (Brandenburg). For instance, the cost for economic diversification per MW of power plant capacity decommissioned is very similar in Mpumalanga, Silesia and Lusatia. Likewise, the total just transition investments (excluding decommissioning costs and green energy investments) per MW of power plant capacity decommissioned is very similar. This can be explained by the fact that the just transition goal of all three regions is to phase down thermal power generation (and not coal mining). The cost factor for community resilience is also similar.

But, there are differences in the cost factor related to labour support. Mpumalanga has a much higher cost factor than Silesia and Lusatia. This could be because of many factors, including labour costs and laws related to compensation and retirement. Also, Lusatia may have allocated fewer resources because the labour transition in Germany is also being supported through federal programmes.

Table 5.4: Summary of just transition cost factors of Mpumalanga, Silesia and Lusatian district (Brandenburg)

Cost component	Units	Mpumalanga	Silesia	Lusatia	Average
Economic diversification	$ million per MW of TPP decommissioned	0.16	0.19	0.16	0.17
	$ per affected person	411	731	420	520
Community resilience	$ (PPP) per affected person	366	471	441	426
Labour support	$ per affected worker	22,100	14,285	6,315	
Planning and Governance	As percentage of JT investments	2.4%	4.2%		3.3%
Total JT investments (excluding decommissioning costs and green energy investments)	$ million per MW of TPP decommissioned	0.27	0.33	0.32	0.31
	$ (PPP) per affected person	1,505	1,750	1,097	1,450

Source: iFOREST Analysis

For certain cost components, PPP seems to provide similar cost factors, whereas MER seems more suitable for others. A deeper analysis indicates that where the cost component has a larger share of infrastructure investments, MER is more appropriate; if the cost component has more human resource investments, then PPP provides similar cost factors.

6. Conclusion

The just transition investment plans of coal-dependent regions can be split into different cost components based on specific expenditure objectives and targeted goals. The cost factors for the various cost components can also be derived from the just transition investment plans of coal regions.

The detailed analysis of the just transition investment plans of three coal regions – the Mpumalanga province of South Africa, the Lusatia district in the Brandenburg province of Germany and, the Silesia province of Poland – reveal similarities in some cost factors. For instance, community resilience investments are about 20% of the total just transition investments across the three regions. The average investment for economic diversification is estimated to be $0.17 million per MW of decommissioned TPP, while the requirement for community resilience is about $ (PPP) 426 per affected person. However, variations are also noted across these regions for green energy investment and labour support requirements. This is primarily due to pre-existing and supplementary investments being directed towards social infrastructure and economic diversification. These cost factors will get more refined as many more regions of the world, especially from the global South, develop their just transition investment plans.

Understanding the cost components and factors is crucial to estimate the funding support that coal-dependent economies, especially in the global South, will need in the coming decades. While the investment requirements may vary across regions, this study has identified the main cost components and factors that can be considered for just transition planning and investments in countries like India.

Annexures

Annexure 1: Investment plan under South Africa's JET IP, 2023-2027

Investment need	Description	Amount (ZAR billion)	Amount ($ million)
National infrastructure investments			
Coal plant decommissioning	In alignment with the energy policy of South Africa, Eskom plans to close seven coal plants by the end of 2030 and two more by 2035, out of a total of 15.	4.1	258.3
Transmission	Large-scale and rapid investment in renewable energy, particularly in the Northern and Eastern Cape will require massive investments in transmission grid development. The existing grid infrastructure is largely designed to evaluate power out of Mpumalanga to the rest of the country.	131.8	8,303.40
Distribution	Large-scale investment will be required in distribution grids to facilitate the connection of new RE projects, enable large-scale distributed generation, electricity access and to provide for offtake agreements, as well as the modernize the distribution grid and address infrastructure gap.	13.8	869.4
New solar PV capacity	For setting up new solar PV plants, within a wider objective of repowering/repurposing of retiring TPPs.	233.2	14,691.60
New wind capacity	For setting up new wind projects	241.7	15,227.10
New battery capacity	For setting up battery storage facilities, within a wider objective of repowering/repurposing of retiring coal plants.	23.1	1,455.30
Mpumalanga just transition investment needs			
Repurposing coal plants	Social investment to support local communities and supply chain developments for new energy technologies	3.4	214.2
Repurposing coal mining land	Remediating and repurposing coal mining land for new public and private use, including abandoned and closed and operating mines	13	819
Improving infrastructure for development	Infrastructure upgrades in roads, water, digital, energy access, education, and training facilities, to attract investors and improve lives	12.3	774.9
Diversifying local economies	Creating and supporting small-scale livelihood opportunities in surrounding communities and nurturing new economic pathways for coal mining regions through new investments and support for incubators, accelerators, and early-stage ventures. Many current enterprises will be impacted by coal closure (trucking, rail related services, accommodation, food, caring and others)	24	1,512.00

Annexure 1 continued.

Investment need	Description	Amount (ZAR billion)	Amount ($ million)
Caring for the coal workforce	Managing workforce transitions through reskilling, support for mobility, retraining, redeployment, placement, and temporary income support.	5.6	352.8
Investing in youth and preparing future generation for the transition	Tackling youth unemployment through education, soft skills training, work experience opportunities, and placements	0.7	47.3
Planning for success	Conducting a comprehensive assessment of coal asset closures to support provincial and municipal preparedness	0.3	18.9
Instituting policies for post mining redevelopment	Promoting policy alignment and ensuring financing for responsible mine closures and pathways for post-mining rehabilitation and repurposing	0.1	3.2
Building capacity for success	Providing budget support to relevant government agencies; budget support for establishing a local secretariat; along with technical assistance and project funding linked to demonstrations, pilots, incubators, and accelerators.	1	63
Just transition in electricity sector			
Manufacturing and localizing clean energy value chain	Expanding capacity in the clean energy value chain, including renewable energy, battery storage, transformers, lines, components, and associated value chains. Local manufacturing for clean energy.	1.6	100.8
Piloting social ownership models	Testing diverse models for the social ownership of electricity generation and building capacity in communities to participate effectively. Community ownership in renewable energy increased; sustainable models identified.	1.65	103.95
NEV sector investment needs			
Industrial development and innovation	Supply chain investments for the NEV value chain, including existing automotive component supply chain and the energy storage value chain for both mobility and stationary applications.	41.4	2,608.2
Public transport	Support investments in public transport such as buses, taxis, and fleets; Funding the charging infrastructure and energy storage (including associated infrastructure); Supply chain investments in the local assembly.	6.1	384.3
Mobility emissions abatement	Decarbonizing the NEV market segments for goods and services logistics, private transport, and government fleets; Charging infrastructure and energy storage (including associated infrastructure).	6.8	428.4

Annexure 1 continued.

Investment need	Description	Amount (ZAR billion)	Amount ($ million)
Early adoption and innovation	Supporting investments in early adoption projects for NEV and the development of a local supply chain and innovation ecosystem – the support will also include the sharing of intellectual property, patents, and technology partnerships between IPG and South African institutions, innovators, and entrepreneurs; Charging infrastructure and energy storage (including associated infrastructure).	1.8	113.4
Technical assistance	Sector research and planning to accurately assess integration and interdependencies; market opportunities and timing; detailed socio-economic and techno-economic studies to support investment planning, just transition planning, reskilling programmes; and R&D support.	1.6	100.8
NEV deployment support	Funding to reduce the NEV purchase price (to fast-track price parity to 2027) and the private cost of charging infrastructure, and to facilitate the fast-tracking of the public charging infrastructure deployment.	70.4	4,435.2
Green hydrogen sector investment needs			
Project feasibility costs	For green hydrogen projects in aviation fuel, e-methanol, fuel cell, green ammonia, green steel, hydrogen mobility and infrastructure.	4.51	284.13
Capital costs	For green hydrogen projects in aviation fuel, e-methanol, fuel cell, green ammonia, green steel, hydrogen mobility and infrastructure.	163.5	10,300.5
Port project development	For Boegoebaai port project- a potential large scale export programme for green hydrogen.	1	63
Port infrastructure capital	Full run rate cost of over the project life cycle of Boegoebaai port, excluding the upgrades that might be required for ports of Ngqura, Saldhana Bay and Richards Bay.	150	9,450
Skills development investment needs			
Skills hub/ platform for JET and the Future of Work	The formation of a national-level strategic 'skills hub or platform' to inform, anticipate, coordinate, and integrate skills needs and plans for a just energy transition in South Africa.	0.05	3.15
Pilot skills development zone in Mpumalanga, Eastern Cape and Northern Cape	The development of new models for place-based skills planning, provision, and integration with value chains impacted by energy transitions or offering linked opportunities for employment and livelihoods in these localities.	1.6	100.8

Annexure 1 continued.

Investment need	Description	Amount (ZAR billion)	Amount ($ million)
Mobilise allocations to JET from existing public and private post school education and training (PSET) funding per annum		1	63
Municipal electricity support			
Infrastructure: distribution maintenance	To address the municipal distribution grid maintenance backlog through capital investments and capability enhancements.	200	12,600
Infrastructure: distribution modernization for NEVs	To strengthen the municipal grid for NEVs.	73	4,599
Infrastructure: electrification backlog	Extend the INEP to connect more households.	45	2,835
Operational: demand side management	Demand side management investments in the built environment to extend existing plans. Limited support is available through DBSA's Revenue Enhancement Programme (ZAR21 million per year for three municipalities).	0.5	31.5
Operational: energy access design	Grant funding to analyze and test how increasing energy access could be partially covered from existing financial flows to municipalities, together with modelling impacts on electricity and broad municipal	0.1	6.3
	finance, and pilot implementation. This will be connected to broader modelling designed to understand how subsidies (national and local) and tariffs can be better structured to unlock suppressed demand in low-use households.		
Capability and capacity	Grant funding for institutional support and capacity building to undertake cost-of-supply studies, tariff designs, technical skills upgrades, electricity planning (distribution and generation), NEV planning, along with the local JET planning, energy investment, and procurement. Extra municipal and centralized/external capacity is required to enable implementation.	0.23	14.49
Collective planning		0.03	1.89
Municipal revenue modelling	Research and modelling to understand the dynamics of subsidization and local cross-subsidization between grid/electricity users, as well as the impacts of alternative electricity revenue models on municipal finances. Flexible research facilities are needed for implementation aligned with local priorities and using local role players and skills.	0.2	12.6

Source: South Africa's Just Energy Transition Investment Plan, 2023-27

Annexure 2: Investment plan under Silesia TJTP, 2021-2030

Objective	Brief description	Amount (€ million)	Amount ($ million)
Innovative economy of mining subregions			
Development of the potential of high technologies and institutions supporting innovation towards climate neutrality	Development of R&D and associated infrastructure to contribute to the transformation. Supporting creation and development of companies in technology parks and hubs. Development of competences of people employed in technological parks, hubs and design centers.	35	39.2
Development of research and development potential and conducting R&D and implementation works	Construction and development of R&D infrastructure in enterprises and their consortia, in particular in the field of climate neutral technologies.	100	112
Diversification and development of resource and energy saving economy in mining subregions			
Diversification of enterprises from mining subregions, including activities for circular economy	Production, logistics and R&D investments necessary to change the profile of activity and/or introduce new products, services, processes or conquer new markets in large enterprises. along with the development of competences of people employed in large enterprises and SMEs. Investments to reduce the consumption of primary raw materials (including water) in production processes, implementation of clean technologies in order to significantly reduce waste generation and increasing the recycling of materials.	295.5	330.96
Strong entrepreneurship of mining subregions			
Support creation of new companies and ease of business	Construction and development of supporting infrastructure entrepreneurship, creating new companies and running a business. Start-up support for new enterprises.	149.5	167.44
Support for the development of enterprises classified as regional technological specializations	Investment in enterprises in industries included in the Technology Development Program of Silesia.	140	156.8
Improvement of competitiveness of micro and small enterprises undergoing transformation	Investments to increase the competitiveness of SMEs.	90	100.8
Economic diversification of mining subregions	Leverage inherent potential of mining subregion for transformation.	35	39.2

Annexure 2 continued.

Objective	Brief description	Amount (€ million)	Amount ($ million)
Balanced energy development in mining subregions			
Energy development based on renewable energy sources	Construction of renewable energy installation in post mining and post-industrial areas, and building distribution and storage infrastructure. Support distributed energy initiatives (energy cluster, co-operatives, prosumer energy communities).	300	336
Effective use of post-industrial areas of mining subregions for economic, environmental and social purposes			
Mitigation of the effects of industrial activity, including mining, on the environment, improvement of biodiversity indicators in areas used for environmental purposes	Reclamation and remediation, of post-industrial areas, reducing risks of improperly stored wastes and decontamination of post-industrial sites.	70	78.4
Improvement of water conditions in the mines impact area		**15**	**16.8**
The use of post-industrial areas for the development of the region	Preparation of post-industrial areas intended for economic activities.	328	367.36
Systematic land management of post-industrial areas	Planning, inventorization and valuation of post-industrial areas.	20	22.4
An effective system enhancing mobility in mining subregions			
Development of environmentally friendly transport in mining subregions	Infrastructure for zero-emission and non-motorized transport.	30	33.6
Attractive, effective education and raising qualification in mining subregions			
Creating conditions for professional development	Support for workers in transition by reskilling.	100	112
Development of vocational education	Development of vocational education for reskilling to a green and digital economy. Comprehensive support to educational institutions for vocational education.	238	266.56
Targeted development of higher education oriented to the needs of green economy		37	41.44

Annexure 2 continued.

Objective	Brief description	Amount (€ million)	Amount ($ million)
Attractive and effective support system for the labour market of mining subregions			
Instruments related to intervention in the labour market to ensure continuation or change of professional path	Mobility support programmes/ investments for employees and employers undergoing structural changes. Placement of persons at risk of dismissal.	95	106.4
Intern-institutional co-operation in the labour marker	Coordination of various institutions to provide high quality services to the inhabitants of transition affected regions through reskilling, career support, vocational training, legal and psychological services.	4	4.48
Comprehensive support system for residents of mining subregions			
Level up activities of communities in the just transition process	Initiatives aimed at social integration, preserving regional identity, industrial heritage in the communities. Grant and civic budget for transformational initiatives.	41	45.92
Develop knowledge and skills for just transition	Strengthening the capacity of stakeholders for effective management of the transition. Monitoring and evaluation of the fairness of transformation in co-operation of all affected entities.	5	5.6
An effective socially responsible transformation management system in mining subregions			
Strengthening the institutional capacity, including of the staff implementing the transformation	Supporting the competences of employees of local government units, unions and associations for planning and implementation.	88.67	99.31
Open and coherent communication and dialogue with the communities of the region for building awareness			

Annexure 3: Investment plan under TJTP for the Lusatian District Brandenburg, 2021-2027

Description	Amount (€ million)	Amount ($ million)
Investments in public research centers and higher education institutions, directly related to research and innovation activities	44.5	49
Research and innovation activities, including networking, in public research centers, higher education institutions and centers of excellence (industrial research, experimental development, feasibility study etc)	13.9	15.3
Corporate development and internationalization from SMEs	78.7	86.5
Smart specialization skills development, industrial change, entrepreneurship and adaptability of companies to adapt to changes	4.3	4.7
Advanced support services for SMEs and SME association	11.1	12.2
Innovation processes in SMEs (in the areas of procedures, organization, marketing and community formations, as well as user and demand specific innovation)	13.6	15
Technology transfer and cooperation between company, research centers and higher education	7	7.7
Research and innovation processes, technology transfer and cooperation between companies, research centers and universities with main emphasis on low CO2 business, resilience and adjustment on the climate change.	37.2	41
Research and innovation processes, technology transfer and cooperation work between company with main emphasis on circular economy	17.1	18.8
Information and communication technologies: Broadband networks with very higher capacity (backbone/backhaul network)	51.6	56.8
Information and communication technologies: Broadband networks with very higher capacity (Access/subscriber connections until the distribution point for apartment buildings with fibre optic installation)	51.6	56.8
Information and communication technologies: Broadband networks with very higher capacity (Access/subscriber connections until the distribution point for business premises with fibre optic installation)	51.6	56.8
Information and communication technologies: Broadband networks with very higher capacity (Access/subscriber connections until the base station for modern wireless communication with fibre optic installation)	17.2	18.9
Energy efficiency and demonstration projects in SMEs	8.5	9.4
Energy efficiency and demonstration projects in large company	50	55
Solar Energy	1.9	2.1
Other renewable energy (including geothermal Energy)	1.9	2.1
Highly efficient combined heat and power, district heating and cooling	15.2	16.7
Water management and protection of water resources (including management from watersheds, measures to adjust to climate change, reuse and leakage reduction)	3.5	3.9
Support for eco-friendly production process and resource efficiency in SMEs	11.9	13.1

Annexure 3 continued.

Description	Amount (€ million)	Amount ($ million)
Support for eco-friendly production process and resource efficiency in large company	18	19.8
Protection of biological diversity, natural heritage and natural resources, green and blue infrastructure facilities	5.5	6.1
Eco-friendly public transport infrastructure	10	11
Eco-friendly rolling stock in the local transport	9	9.9
Infrastructure for alternative fuels	36	39.6
Educational institutions (Continuing education for adult)	43.3	47.6
Other social organizations contributing to local social inclusion	3.5	3.9
Support for self-employment and business start-ups	15.1	16.6
Support for the adjustment of workers, companies and entrepreneurs	11.5	12.7
Support to primary and secondary education	1.3	1.4

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