

ANGUL

PLANNING
A JUST ENERGY TRANSITION AND
A NEW GREEN ECONOMY

iFOREST

INTERNATIONAL
FORUM
FOR ENVIRONMENT,
SUSTAINABILITY
& TECHNOLOGY

SUMMARY FOR STAKEHOLDERS

Angul is the epicenter of Odisha's coal mining and industrial economy which is expected to grow significantly over the next 10 years. However, the state is also highly vulnerable to climate change impacts. Ushering a green industrialisation along with coal transition, therefore, lies at the core of planning a just transition.

The study on just transition for Angul was undertaken to evaluate how Odisha's largest coal mining and industrial district can strategically plan for a just energy transition and simultaneously build a green economy in the coming decades.

A. Key observations

1. Coal mining and coal-based industries are growing in Angul; coal production will peak in the next 10 years.

Angul is currently India's third largest coal producing district, accounting for over 12% of the total production. In 2020-21, coal production of 96.7 million metric tonnes (MMT) was recorded from nine mines - eight opencast (OC) and one underground (UG).

The industrial landscape of the district is also highly coal-dependent. There are four thermal power plants (TPPs), including two captive plants, with combined capacity of 6.2 gigawatts (GW). Additionally, one 1.3 GW ultra-supercritical TPP is in the pipeline. Besides, there is an integrated steel plant of 6 million metric tonnes per annum (MMTPA) production capacity (with a plan to increase production to 25 MMTPA), an aluminium smelter and a planned aluminium park, a fertilizer plant, and several medium and small-scale industries.

Overall, coal mining along with the industrial sectors account for nearly 61% of the district's gross domestic product (GDP). The service sector has a share of 26%; the agriculture and the forestry sectors combined have a share of 9%.

Coal production is expected to increase steeply over the next 10 years, with expansion of existing mines and opening of new mines. If all the proposed mines come into production, the district's coal production will peak at 308.8 MMT in 2033 – more than three times the current production. The contribution of coal mining and coal-based industries to the district's GDP will, therefore, increase further.

2. 29% of all workers – approximately 168,000 workers – are directly employed in coal mining, coal-based industries, and coal transport sectors; 69% of them are informal. Total number of workers engaged in coal mining and coal-dependent industries will at least double in the next 10 years, a large share of them will be contractual and informal workers.

One in three workers in the district are currently engaged in the coal industry (coal mining, coal washeries and coal transport) and coal-based industries (TPPs, steel and aluminium). The workforce exhibits a high proportion of informality. About 69% of the workers are informal.

The share of contractual and informal workers is going to increase significantly in the next 10 years as coal production capacity will increase nearly three times, with proportionate increase in worker demand. A significant part of the increased production will be met by engaging mine development operators (MDO) and contractors through 'fixed term employment' contracts. The proportion of informality will also increase considering simultaneous rise of odd-jobs in the coal economy.

The steel, aluminium and ancillary industries will also have a huge worker demand with planned expansions in the coming years. These industries will engage contractual and informal workers as well.

3. Under the current policy scenario (CPS), coal production will start reducing only from 2040 onwards, and will be phased out by 2070. In an ambitious Net Zero-2050 (NZ-2050) scenario, in which production will have to be phased out by 2050 to meet 1.5°C climate goals, 75% of new coal mines have a high risk of becoming stranded assets.

In CPS, which assumes that the operational and upcoming coal mines will continue to produce as per their existing mining plan and will have a full operational life without much disruption, the last mine in Angul can be closed in 2070. There will be only one forced closure and 240 MMT of production will be foregone.

However, under an ambitious NZ-2050 scenario, about 75% of the new coal mines, that will commence operation by 2030, will have to forego 30%-60% of their lifetime coal production.

Figure 1: Coal mine closure schedule under CPS

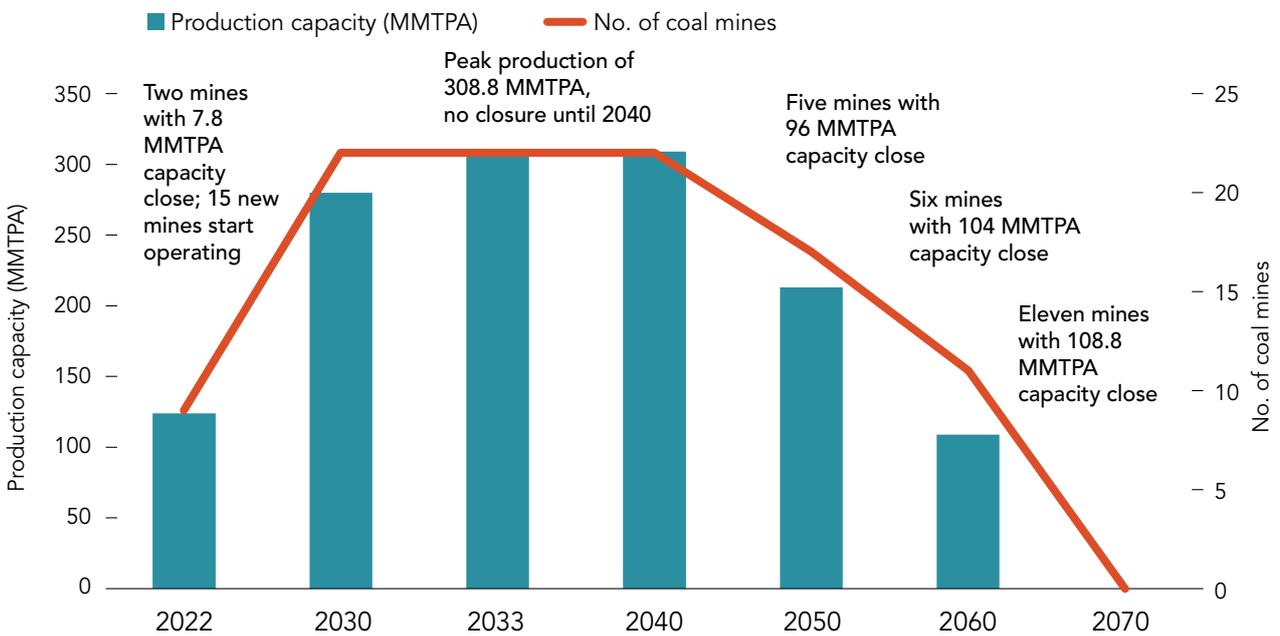
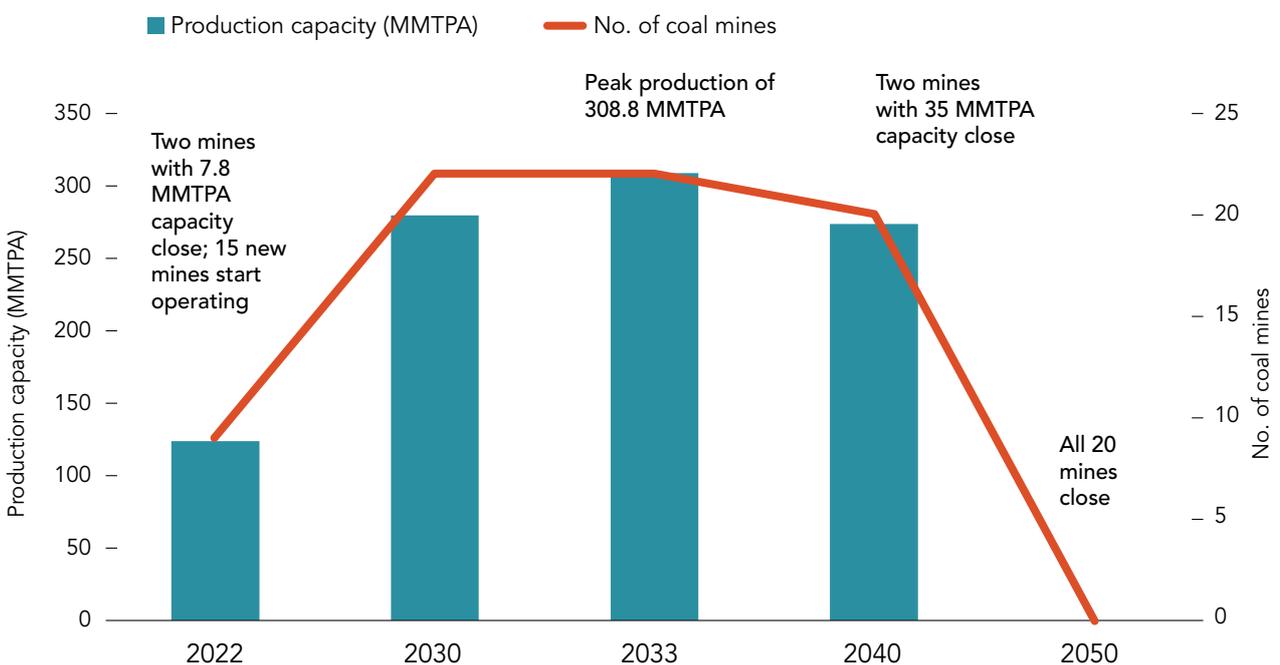


Figure 2: Coal mine closure schedule under NZ-2050



4. Several coal-based thermal power units will start closing after 2025 due to age and their inability to meet environmental norms. If no new power plants are constructed apart from those in the pipeline, in both CPS and NZ-2050 scenarios, coal-based power production can be phased out by 2050.

Closure of coal-based power plants in Angul will start this decade. Five captive-power units with a combined capacity of 600 megawatts (MW) are already aged between 33-36 years, and will struggle to meet the new emission standards. While, 30% of the installed capacity (6.2 GW) are currently below 10 years of age, by 2050 all the TPP units can be retired as they will be older than 35 years. Under NZ-2050, only the upcoming ultra-supercritical TPP will face an early closure.

Figure 3: Power plant closure schedule under CPS

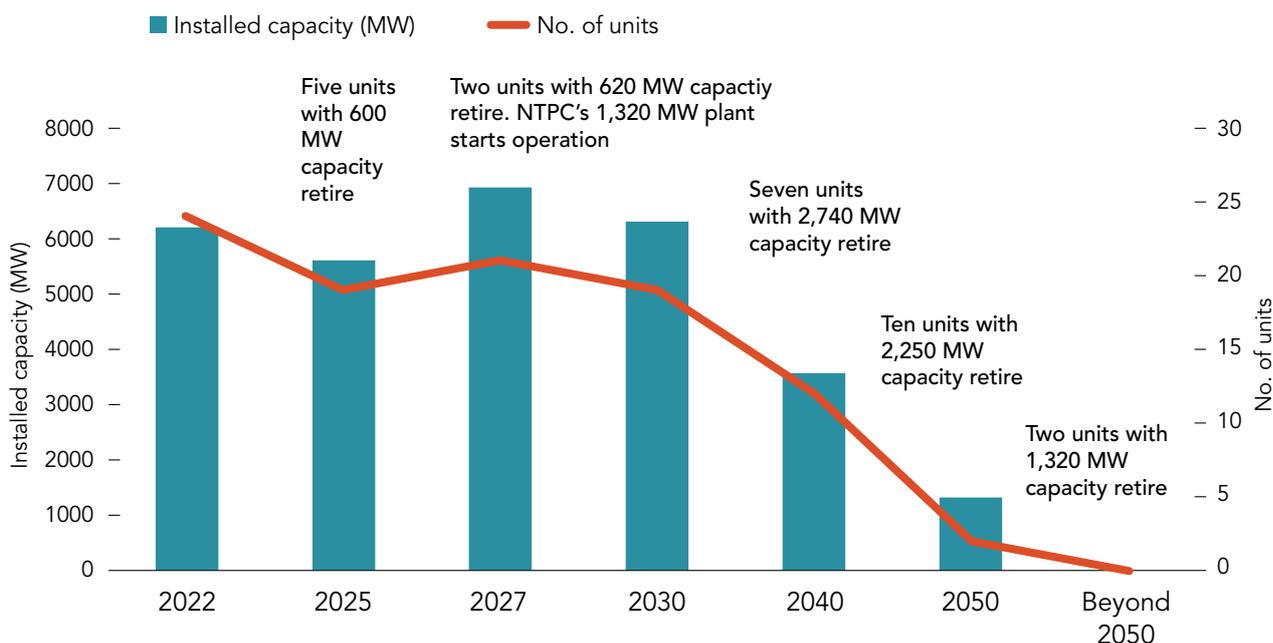
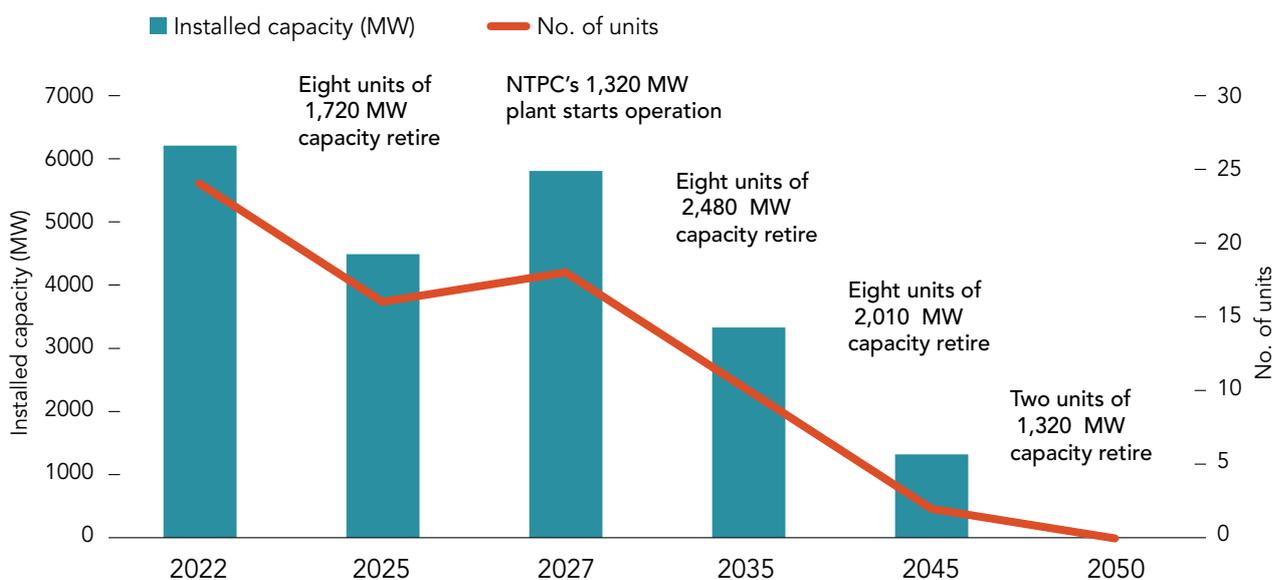


Figure 4: Power plant closure schedule under NZ-2050



5. Investments in coal-based power generation risk becoming stranded assets, as renewable-based electricity along with storage is likely to be cheaper than coal post 2030.

Thermal power plants in Angul produce some of the cheapest electricity in the country. The generation cost of electricity currently ranges from ₹2.65 to ₹2.95 per kilowatt-hour (kWh). Cheap coal and coal-based power is driving the coal industry in the district. New TPPs for the utilities and captive power plants for the aluminium refinery and steel plants are in the pipeline presuming availability of cheap coal in the coming years. However, the economics of electricity generation from coal vis-à-vis renewables will dramatically change in the next 10 years.

Modelling undertaken by iFOREST to compare the levelized cost of electricity (LCOE) from various energy technologies shows that, presently solar photovoltaic (PV) is the cheapest source of energy in Angul during the day time; even cheaper than pithead captive power plants.

The analysis shows that by 2025, the LCOE for Solar PV with 25% battery energy storage systems (BESS) will be ₹4.3/kWh, compared to ₹4.2/kWh for a pithead super-critical TPP. In 2030, the cheapest source of electricity will be from solar PV with storage. The LCOE for a solar PV plant with 50% BESS will be ₹4.8/kWh, as compared to ₹4.9/kWh for super-critical and ₹5.6/kWh for Integrated Coal Gasification Combined Cycle (IGCC) plants.

This essentially suggests that there is a limited window to invest in coal-based TPPs. After that, renewables with storage will outcompete coal-based power. This will also have major repercussions for coal demand from Angul. Therefore, coal mining in the district should be planned keeping in mind the projected demand from coal-consuming sectors, such as, coal-based power. Else, there will be risk of stranded assets in the coal mining sector due to lack of demand.

Table 1: Levelized Cost of Electricity (₹/kWh)

| Technology | 2022 | 2025 | 2030 |
|---------------------|------|------|------|
| Super-critical TPP | 3.6 | 4.2 | 4.9 |
| IGCC power plant | 4.2 | 4.9 | 5.6 |
| Solar PV | 3.1 | 2.9 | 2.7 |
| Solar PV + 25% BESS | 4.7 | 4.3 | 3.8 |
| Solar PV + 50% BESS | 6.3 | 5.7 | 4.8 |

6. Pollution is a major concern in Angul-Talcher coal belt.

The Angul-Talcher industrial cluster is classified as a 'critically polluted area' by the Central Pollution Control Board. Large-scale industrial activities in the district have been contributing to the pollution of air and water, among which coal mining activities, and emissions and discharges from the TPPs are major ones.

Talcher and Angul municipalities are also among the 132 'non-attainment' cities as per the National Clean Air Program (NCAP). Three river stretches flowing along Angul and Talcher are among the most severely polluted river stretches of the country.

Mining and industrial expansion will exacerbate the situation if adequate safeguards for pollution mitigation, waste management and material circularity are not enforced. Besides, upcoming mines will lead to diversion of additional 3,000 hectares of forestland, which also has implications for the local environment.

B. Planning a Just Transition

1. Angul must use its coal to power a green economy.

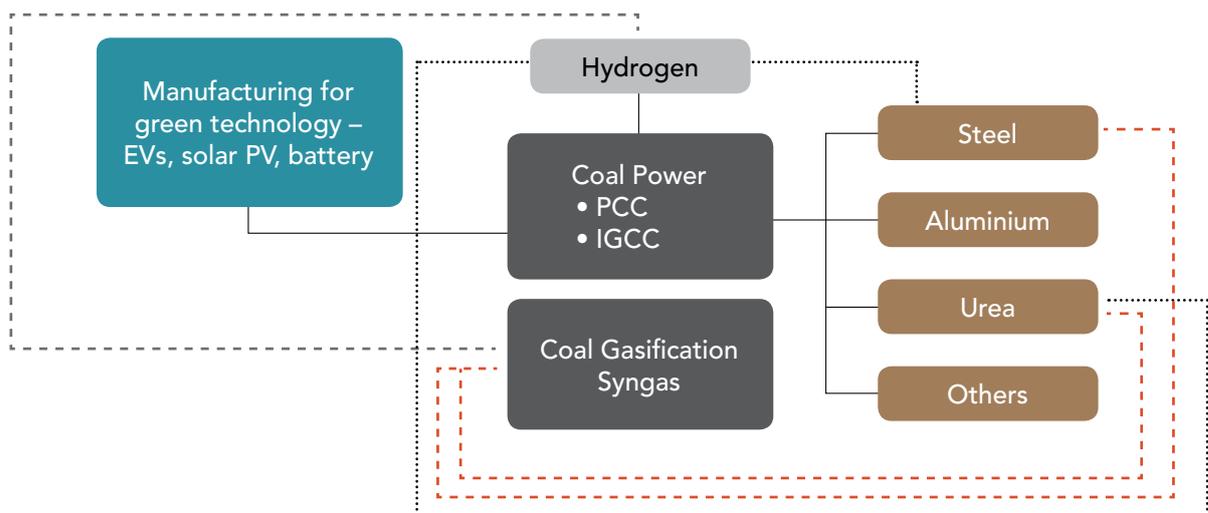
There is an enormous opportunity to build a green industrial economy by using cheap coal over the next 10 years. The green industrial transition can be planned in two phases - a 'Brown Phase' and a 'Green Phase'.

In the Brown Phase (the next 10-15 years), the focus should be to build the backbone of the green industry using coal in the most environmentally responsible manner. Angul can maximise the potential of its coal resources, using it for power generation through super-critical and ultra-supercritical TPPs, and production of grey hydrogen through coal gasification.

Electricity generated through such technologies can be used to build the green manufacturing sector which is energy intensive. This will include, manufacturing of electric vehicles (EVs), solar PVs and battery for storage, which will also boost domestic manufacturing of high-value products and support the 'Make in India' initiative. The grey hydrogen will be used to build the base for producing green steel and green urea.

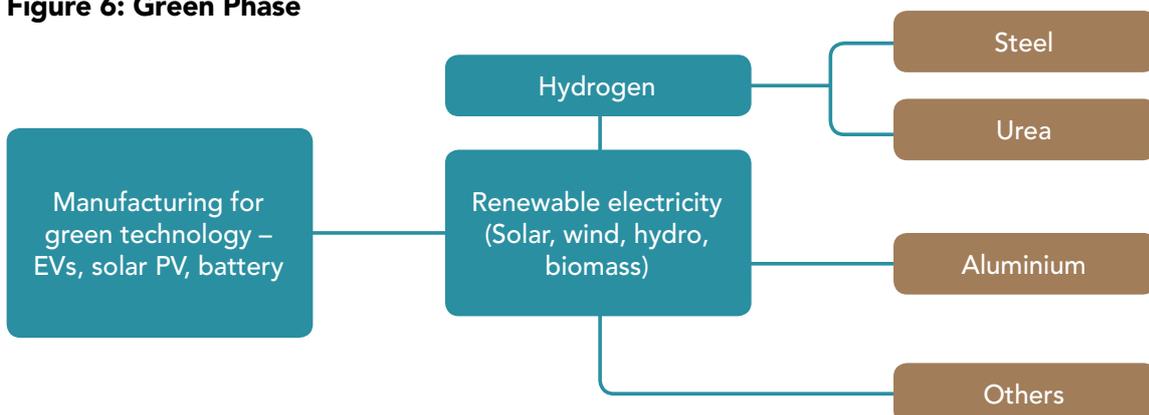
The phase will also involve incentivising investments to exploit the RE potential of the district and increase its share in the energy mix, as Angul has about 10.8 GW of solar potential.

Figure 5: Brown Phase



Post 2035, industries in Angul must decisively move to a Green Phase, with the focus to shift to RE, green industrial processes, and maximising material circularity. This will be aided by availability of cost-competitive RE-based electricity (with storage), green hydrogen, technological advancements, and an established ecosystem for supporting these industries and ancillary processes.

Figure 6: Green Phase



In this phase, the steel industry should move to production of green steel by utilising green hydrogen. Similar transformation should happen with green urea. In addition, material circularity in the sector should be improved through better utilisation of high-quality scrap in Electric Arc Furnace (EAF). In India, EAF-based steel already accounts for 29% of steel production, which the expanding steel industry in Angul and Odisha should build upon. For the aluminium sector, there should a shift to use RE-based electricity and the use of aluminium scrap, to reduce carbon footprint.

2. Pollution mitigation, environmental remediation, and circular economy practices will be essential to support sustainable growth.

Mining and industrial expansion will exacerbate environmental pollution and resource degradation, if adequate safeguards are not enforced. At the same time, environmental and carbon footprint of the extractive and manufacturing industries must be minimised through responsible mining (green mining) and environmental practices.

To ensure responsible environmental practices, scientific closure of coal mines, through planning for ecological restoration, remediation and repurposing of land will be required. Industrial pollution standards must be made stringent to ensure that the pollution is within the carrying capacity of the local airshed, water bodies and land. Reuse, recycling, and safe disposal of waste, especially fly ash, slag and other wastes will be equally important. Overall, supporting circular economy practices will be essential through legislative and non-legislative measures. Else, the economy will become highly unsustainable.

3. Repurposing of mining and industrial land will be crucial for environmental sustainability, industrial development, and economic diversification.

In Angul, about 33,000 hectares of land can be available for repurposing over the next three to four decades following closure of coal mines and TPPs. Over 93% of the land will be available from coal mine closures.

Besides restoration of green covers, a significant proportion of this land will be primed for investments in various economic activities that can help to diversify the economy, augment clean energy production and generate local employment. Considering the land availability in the district, some of the potential investments include, installation of solar PVs, development of industrial and food parks, fisheries, and tourism. Ensuring repurposing of mining and industrial land will also prevent the need to divert agriculture and forest land for greenfield development.

4. Angul will not experience major job loss till 2040. In fact, there will be a significant increase in coal-dependent jobs over the next 10 years. To meet the skill requirements of both the brown and green economy, significant investments in skilling programmes and technical education are necessary.

Unlike the old coal mining districts, where coal mines closures will lead to significant job losses in the next 10-15 years, Angul will experience increase in coal-related jobs to meet the requirement of three-fold increase in coal production.

Job loss is not a challenge in the existing coal mines and power plants as well. The operational mines and power plants of the public sector undertakings—Mahanadi Coalfields Limited (MCL) and NTPC Limited—have an aging workforce. About 61% of employees of MCL engaged in Angul mines are already above 40 years of age; their retirement can be made co-terminus with mine closures. About 70% of the employees in power plants operated by NTPC Limited are also above the age of 40 years. For many of them the retirement can be co-terminus with the plant closure; the rest can be shifted to the new plant. Securing pension, therefore, is the key issue for the departmental employees.

For the informal and contractual workers, skilling is the key requirement. Currently, about 69% of the workers in the coal mining and coal-based industries are informal. Their low skill levels have compromised their ability to secure dignified jobs and better wages. The current hiring practices indicate that the share of low-waged contractual and informal workers in the coal industry is going to increase significantly. These workers need to be skilled to secure better paying and dignified jobs.

There will also be a huge demand for skilled workers for building the economy, both during the Green Phase and the Brown Phase. New skills will be required to develop the RE sector, green manufacturing, green industrial expansion, and associated infrastructure development in the coming years. Deployment of massive skilling and reskilling programmes through government and industry support will be necessary to have a prepared workforce for these industries. Simultaneously, investments in education, as well as vocational and skill training institutes will be required to prepare the workforce for future jobs.

Overall, Angul can continue to generate high quality jobs and build a sustainable economy, if the district plans the industrial and labour transition together. With no major coal closures happening until 2040, and simultaneously prospects of green industrial growth (including in steel, aluminium, fertilizer, small and medium enterprises, and others that the region might attract), a timely intervention will help create good jobs in the district.

5. Ensuring safety net for contractual and informal workers will be essential through regulatory reforms.

Considering the trend of hiring of the PSUs, engagement of MDOs, and providing 'fixed term employment' contracts to workers, the workforce going ahead will be increasingly contractual in nature. The involvement of contractors and sub-contractors will also increase informality in the industrial sectors.

Therefore, ensuring wage security and safety net for the contractual and informal workers will be a key aspect. The existing provisions of the labour and industrial laws are not suitable to address the work security, wage, and compensation aspects, that will be a key issue for just transition and considering the nature of the future workforce. Reform in industrial and labour laws will be necessary to improve terms of engagement, retrenchment, compensations, etc. In the new economy, workers must be engaged through long-term contracts to ensure job security and entitlement of rights.

Besides, ensuring gender equality must be a focus of the new economy. As per the workforce assessment study undertaken by iFOREST, currently only 5% of women within the working age group are workers, while the corresponding proportion for men is 76%. The women also suffer from comparatively poor educational status, which undermines their ability to secure a well-paying job.

6. Responsible social and environmental investments will be important for building community resilience and ensuring environmental justice.

Angul has better development indicators and infrastructure as compared to many other coal districts of India. However, investments in social infrastructure will be necessary to overcome the developmental gaps, particularly in the rural areas where 80% of the district's population resides. This will include clean piped water supply to all households, improving healthcare access, increasing the use of clean cooking fuel, and improving health indicators of women and children.

A key focus of social infrastructure investments should be to build community resilience in face of an energy transition. Better infrastructure will also help to build local support for a just transition.

Environmental remediation and pollution mitigation will be important for a critically polluted area like Angul-Talcher. Legacy pollution issues related to extraction, processing, and combustion of coal, from which the local community, particularly the poor and disadvantaged, has suffered need to be addressed while planning a new economy.

7. Angul has significant resources for implementing a just transition. Nearly ₹3 trillion can be available for supporting just transition through coal cess and District Mineral Foundation funds under accelerated climate action scenario.

Massive financial resources will be necessary for implementing just transition measures in Angul. This must be leveraged by optimising coal mining related funds, fiscal support of the government, private financing, and international support.

The public revenue that the government will earn from coal mining through coal cess (currently subsumed under the GST compensation cess) and the District Mineral Foundation (DMF) funds can be the seed money to facilitate the just transition process starting this decade. The purpose of these funds is also aligned with the goal of a clean environment, supporting clean energy and ensuring public good and social welfare.

A decadal assessment of potential funds available combining coal cess and DMF shows that over ₹1.9 trillion (US \$24 billion) can be available for such purposes over the next 20 years (even under NZ-2050 the funds remain nearly equal). This is the most crucial period for the government to plan a clean energy transition and a just transition to meet India's net zero emission reduction target. Even with an accelerated coal phase-down by 2050 (under NZ-2050 scenario) nearly ₹3 trillion (US\$ 38 billion) will be potentially available to support just transition.

Table 2: Estimated direct finance for just transition in Angul

| Sources of Financing | 2022-2030 | | 2031-2040 | | 2041-2050 | | 2051-60 | | 2061-70 | | Total | |
|---|--------------|--------------|----------------|----------------|--------------|--------------|--------------|----------|--------------|----------|----------------|----------------|
| | CPS | NZ-2050 | CPS | NZ-2050 | CPS | NZ-2050 | CPS | NZ-2050 | CPS | NZ-2050 | CPS | NZ-2050 |
| DMF (₹ billion) | 53 | 53 | 87.2 | 81.7 | 72.6 | 52.6 | 33.9 | 0 | 12.8 | 0 | 259.5 | 187.3 |
| Coal cess (₹ billion) | 594.7 | 594.7 | 1212.4 | 1,160.4 | 1,078.4 | 890 | 640.8 | 0 | 243.5 | 0 | 3,769.8 | 2,645.1 |
| Total direct finance for just transition (₹ billion) | 647.7 | 647.7 | 1,299.6 | 1,242.1 | 1,151 | 942.6 | 674.7 | 0 | 256.3 | 0 | 4,029.3 | 2,832.4 |

8. Deep stakeholder engagement will be necessary to build consensus for a just transition and ensure inclusive development.

Just transition planning in a major coal mining and industrial district like Angul must be inclusive and bottom-up. Considering that coal has been central to the region for nearly a century, the social acceptance of a coal transition and understanding of opportunities in the new economy will be crucial for implementing just transition measures. Having the support and confidence of the local community and various stakeholders will also be essential to support a four-decade transition process.

Developing an extensive stakeholder engagement and a participatory planning process, therefore, will be fundamental for a just transition. It is also an effective way of assessing the needs and aspirations of the local community and plan interventions accordingly for inclusive development.

C. Policy considerations

1. Just transition in Angul will be a time-consuming process; policy deliberation and planning must start now.

Achieving an industrial decarbonisation and a just transition for Angul will be a time-consuming process given the scale of coal mining, industrial operations, dependence of the local economy, and revenue flow for the government. A phase-wise planning will be necessary considering the timeframe of coal mine and TPP closures, and corresponding growth in green industries. A concrete cross-sectoral decarbonisation strategy, that also ensures inclusive growth, will be required to facilitate a just transition.

2. Conscious decision needs to be taken on capping coal production considering risks of stranded assets.

Investments in coal mining and coal-based power plants risk losing market value due to a number of factors, such as falling RE costs, technological disruptions and breakthroughs in industrial processes, government policies on clean energy, climate change and environmental pollution, and consumer choices for clean energy and sustainable materials. Therefore, investments without considering these factors have a huge risk of turning into stranded assets.

For Angul's energy, industrial and economic planning, these need to be factored in. While there will be untapped coal resources, a conscious decision needs to be taken on a coal production cap through co-operative decision making between the state and the central government.

3. Reform in mining and land-related regulations are required to ensure repurposing.

The current guidelines pertaining to closure of coal mines do not provide for repurposing of mining land. At present, post-closure land use is largely limited to plantations, because most of the mines have been opened by diverting forest land. Once mines are closed, the land will be transferred to the forest department again. This precludes the scope of utilising the land for developing new low-carbon industries. For new industries, virgin forest land and agricultural land will have to be diverted. However, such practice is not good for the economy or the environment.

To allow repurposing of mining land, comprehensive regulatory reform will be required. This will include revisions in mining, forest and relevant land-related laws.

4. Odisha Climate Change Action Plan needs to integrate just transition provisions.

The State Climate Change Action Plan needs to integrate principles of just transition to enhance climate change action. The next plan, which will be promulgated soon (as the current plan ends in 2023) need to include the following:

- Reclamation and repurposing of coal mining and industrial land and infrastructure to optimise environmental and economic benefits;
- Restructuring of the economy and industrial activities to support low-carbon development in the coal-dependent districts;
- Reskilling and skilling the workforce to prepare for the new green economy and build local employment opportunities in the green economy;
- Revenue substitution plan for the state and local government(s) aligning with the state's industrial and economic policy; and,
- Responsible social and environmental investments to improve development outcomes, alleviate poverty, create better living standards and quality of life, and build local resilience.

5. Development of a comprehensive renewable energy and green industrial policy will be required for the state.

The Government of Odisha has several policies which can aid growth of the RE sector and help to develop green manufacturing industries. However, these policies are currently fragmented and need to be consolidated to create a comprehensive policy framework.

It will, therefore, be important for the state government to develop a comprehensive policy for green energy and green industrialisation. This will support ease of doing business, boost economic growth and employment, and support a just transition.

6. Odisha will need a state-level just transition policy and plan.

Odisha is a highly coal-dependent state and is also vulnerable to the climate crisis. Therefore, a comprehensive state-level just transition policy and plan will be required to provide a framework for just transition and to build a new green economy in the coal districts. The policy should provide guidance for an integrated approach on economic, industrial, energy and labour decisions, that can facilitate just transition.

7. Formulation of a national just transition policy will support states like Odisha on inclusive climate action.

The formulation of a national policy will support a well coordinated and inclusive climate change action to achieve India's climate goals and the net zero emission target by 2070. With respect to just transition, the focus should be on:

- Low-carbon industrial and economic growth, with a specific focus on coal-dependent states.
- Economic diversification in fossil fuel dependent districts and states.
- Job creation in the renewable sector and green industries.
- Strengthening worker protection during the transition and in the low-carbon economy.
- Building community resilience.
- Equitable financing to ensure distributive justice.

Angul offers critical insights for the state government and India to start deliberation on a comprehensive just energy transition policy. This will be instrumental in shaping investment plans and governance mechanism in the coming years to support an equitable climate change action.



International Forum for Environment, Sustainability & Technology (iFOREST) is an independent non-profit environmental research and innovation organisation. It seeks to find, promote and scale-up solutions for some of the most pressing environment–development challenges. It also endeavours to make environmental protection a peoples’ movement by informing and engaging the citizenry on important issues and programs.

<https://iforest.global>