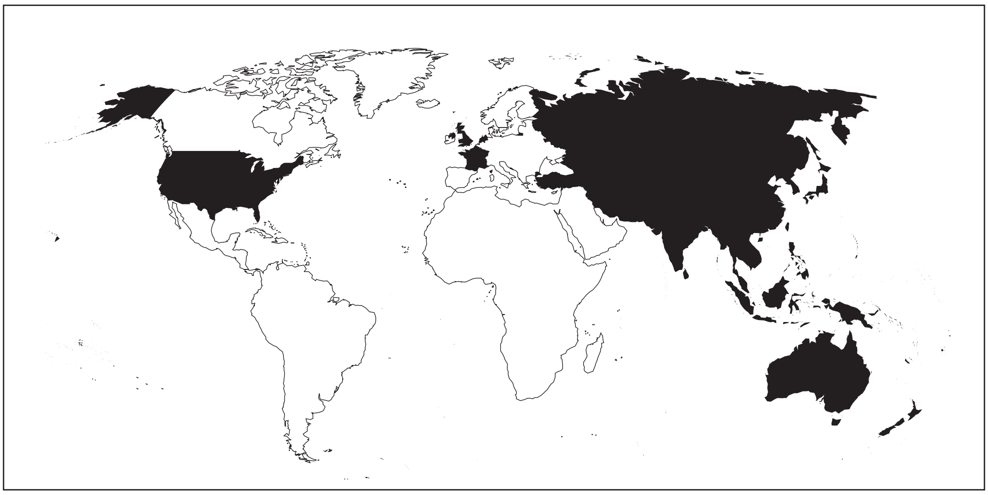
Socio-economic Opportunities from Phasing Out the Use of Coal in Viet Nam

ESCAP
Economic and Social Commission for Asia and the Pacific



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The principal authors of the report were Samantha Sharpe, Elsa Dominish and Yohan Kim, University Technology Sydney, Institute for Sustainable Futures.

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Glossary

ADB Asian Development Bank

BAU Business as usual

CO_2 Carbon emission

GHG Greenhouse Gas

GW Gigawatts

IBC Issue Based Coalition

IEA International Energy Agency

JETP Just Energy Partnership

LNG Liquid Natural Gas

NDC Nationally Defined Contribution

PDP-8 Power Development Plan 8

Executive Summary

Ambitious decarbonization will drive energy transition

Viet Nam has set the goal of achieving net zero by 2050 and updated the country's National Determined Contributions (NDC) at COP27 meeting in 2022. Viet Nam's 2030 unconditional and conditional GHG emissions reduction targets have been increased from 9 per cent and 27 per cent to 15.8 per cent and 43.5 per cent compared to business-as-usual (BAU), respectively. The energy sector is of particular focus for decarbonization as this sector account for the majority of Viet Nam's current and forecast emissions.

The transition pathways for the Viet Nam electricity generation sector show a strong increase in renewable energy generation capacity in the short to medium term, to ensure that the majority of Viet Nam's electricity is generated from renewable sources by 2030, and to create the trajectory to meet net zero goals by 2050. In addition to increased renewable energy generation capacity, additional grid infrastructure and battery storage will be required to ensure stability and flexibility of the electricity sector. Increased energy efficiency activities are also needed to efficiently meet Viet Nam's rapidly increasing industrial demand. These changes in generation, grid infrastructure and energy efficiency will need to be front loaded into the energy transition - ramping up in 2020s and 2030s to ensure the net zero trajectory. This also means the employment implications – both job growth and skill development needs will also need to be short term considerations.

Energy transition will trigger socio-economic opportunities and challenges

Energy transition and specifically coal phase out, will have significant socio-economic impacts. Many of these impacts are positive. New employment will result from activities in constructing and maintaining renewable energy generation capacity, transmission, and grid augmentation, as well as in energy efficiency activities. This employment growth will outnumber job losses associated with coal phase out.

There are also significant health and environmental co-benefits from coal phase-out through reduced impacts of air and soil pollution. Specific analysis of health and environmental benefits available for Viet Nam show the benefits of coal exit in Viet Nam by 2050 valued at $3.6 billion for human health, and $1.2 billion for environmental damage reduction, with a total benefit of $4.8 billion in 2023 USD. There is a spatial element to these co-benefits, with areas adjacent to coal mines and coal power plants - that are currently most impacted by pollution – also able to benefit most from this reduced pollution.

As coal starts to play a decreasing role within electricity generation in Viet Nam, and as global action for coal phase out continues, coal mining activities will phase out. The key decade for coal phase out will be in the mid 2030 through to mid-2040s. Just transition processes require long timelines to ensure alternative pathways for affected workers and communities are established, so initiating and creating community momentum for just transition planning processes should commence in 2020s. Viet Nam has adequate time available to plan for transition in coal dependent communities and plan for repurposing and reuse of coal assets.

Energy transition will also have a strong spatial dimension – new renewable energy generation will not be located in the same places as coal power generation. This means the benefits and impacts of coal-phase out will not be evenly distributed but concentrated in certain places. This is why coal dependent communities require specific strategies to deal with these concentrated impacts.

Employment implications and the need for Just Energy Transition

Employment changes will be one of the most obvious impacts of energy transition. A Just Energy Transition ensures that while decarbonizing global economies, we also plan for positive outcomes for those communities and people negatively affected by these actions. This includes creating pathways to other viable and decent employment for people in jobs and occupations that decline or are phased out, as well as ensuring that social protection is available to help these people on this journey.

In the energy sector – transferrable skills exist – workers in the current energy system can transition into new energy jobs if given opportunities to access retraining. Even so, it is unlikely that supply will not be able to keep up with demand for skilled employment in the transforming energy system – dedicated policy and investments will be required to ensure that demanded skills are readily available in local labour markets.

Another element of just transition will be ensuring that newer sub-sectors of the energy industry – including in renewable energy generation, are also able to provide decent and good work and security of tenure, to attract the required skilled labour. There is also an opportunity to address women's long-standing under-representation in the sector by providing a gender transformative lens to skills development and labour market policies to create pathways for more women to enter the energy sector.

Just energy transition policy mix

Policy will play a critical role in initiating and coordinating energy transition and ensuring that the energy transition is also a just transition. Key policy elements that need to be in place include:

- Linking energy system transition to labour and employment and regional development policies
- Providing coordination and integration including through new institutional development
- Availability and coverage of social protection
- Providing comprehensive skills development and reskilling pathways
- Ensuring adequate, accessible and suitable forms of financing are available
- Enabling knowledge sharing and learning across public policy actors

This report seeks to focus on the socioeconomic aspects of phasing out coal in Viet Nam and the opportunity to shift coal-related assets and communities towards new development models. The aim is to highlight the specific situation and opportunities in Viet Nam and help stimulate discussion among public and private actors on the current state-of-play for coal phase down, by identifying impacts and opportunities as well as opportunities and responses for transitioning coal dependent communities and repurposing coal assets.

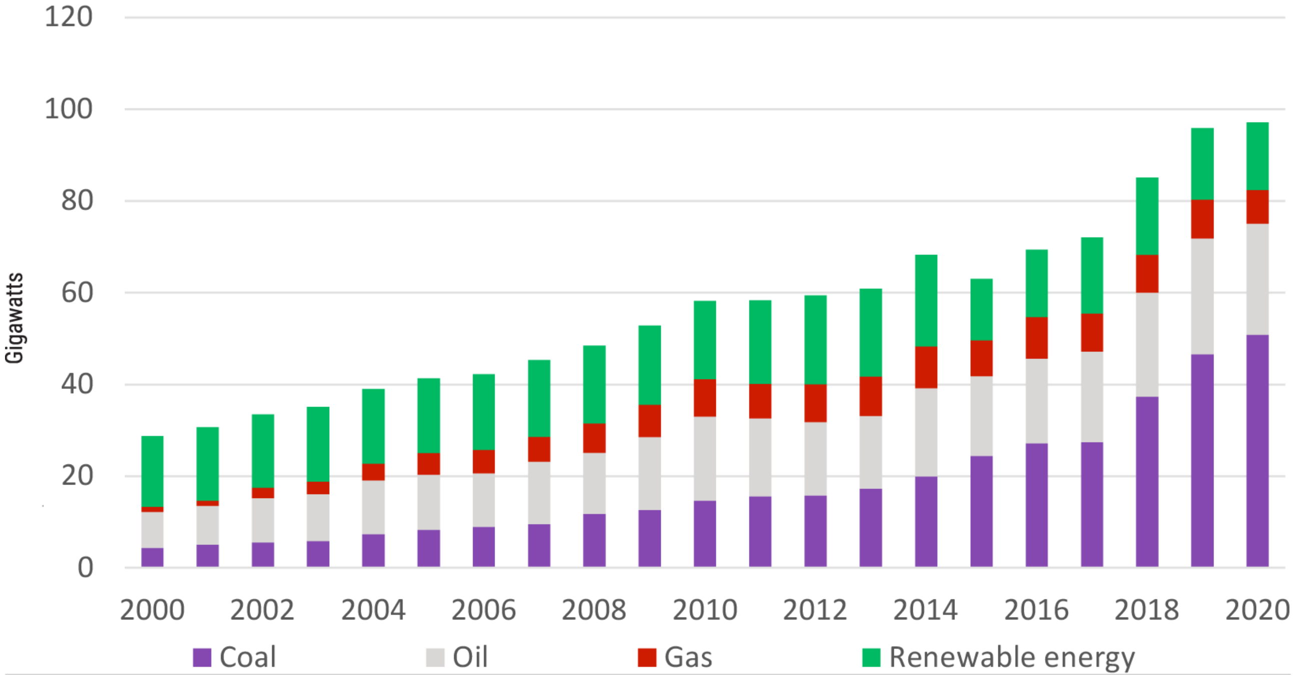
CHAPTER 1

The Role of Coal in Viet Nam's Development

Meeting ambitious sustainability goals, including for net-zero CO_2 emissions by 2050, requires a dramatic transformation of energy systems around the world, involving a massive scale-up of renewable energy and widespread electrification to avoid the worst impacts of climate change and keep global warming well below the 2-degree pathway. The rapid phase-out of unabated coal is critical in this effort - the use of coal in electricity power generation accounts for the largest share of global energy-related CO_2 emissions, at nearly 30 per cent, with industrial use of coal for the manufacturing of steel, cement and other products comprising another 10 per cent.

The Asia-Pacific region is by far the largest current user of coal, comprising nearly 80 per cent of the world's consumption in 2021 (IEA, 2022). The ready availability of cheap coal across Asia-Pacific economies has underpinned economic growth models, and coal-related industries have emerged as major sources of employment. In many emerging and developing economies of the region, coal has formed the central pillar for the expansion of power generation capacity. Despite the United Nations calling urgently for the phase-down of coal-fired generation, over 180 gigawatts (GW) of capacity are now under construction in the Asia-Pacific, notably in China, India, Indonesia, Viet Nam, Bangladesh,

Figure 1. **Total energy supply in Viet Nam**



Source: ESCAP calculations based on IEA World Energy Balances (2022).

Pakistan, the Philippines, and Cambodia. State-owned enterprises and public finance institutions act as major sources of finance for many of these plants.

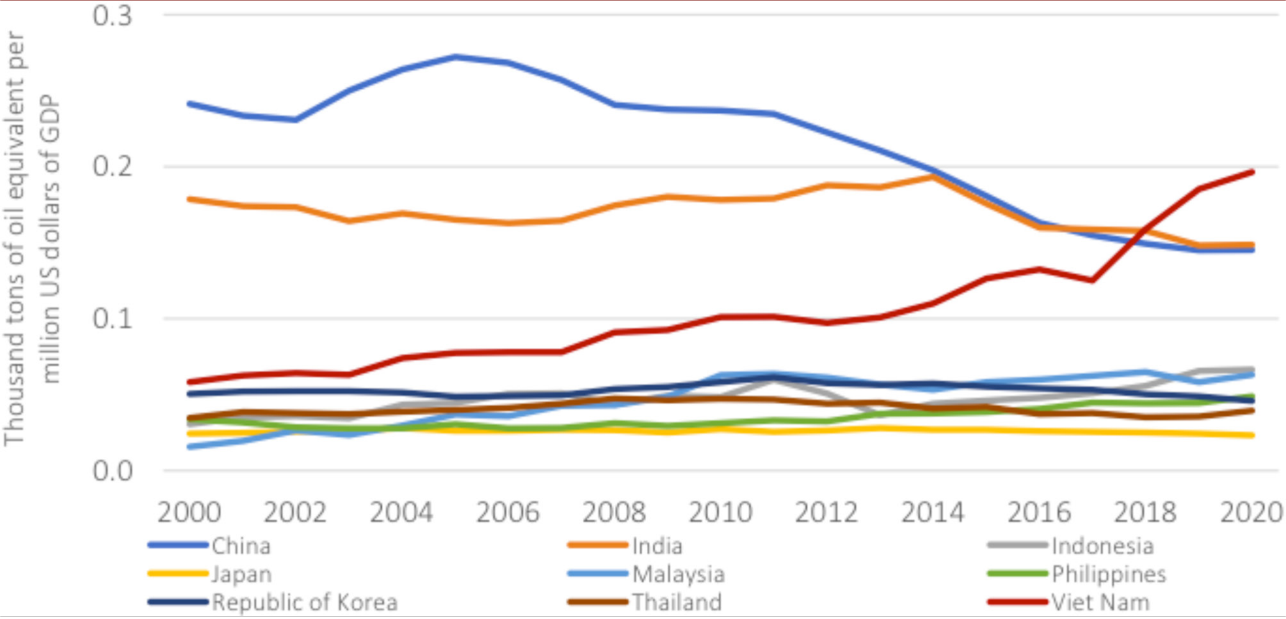
On the back of a fast-growing economy, Viet Nam's energy demand has expanded by two-thirds since 2010. Much of this new demand has been met with coal. The use of coal in Viet Nam accounted for over 50 per cent of the country's total energy supply in 2020, with that share more than doubling over the previous decade (Figure 1) overleaf.

Coal's role in fueling the power sector has accounted for most of its expansion. In 2020, coal accounted for around half of electricity generation. Viet Nam's coal power capacity stands at nearly 25GW, with over 6GW under construction and another 2GW in the pre-construction development phase. In the current Power Development Plan (PDP-8) around 30GW of operating coal power is expected by 2030. In this sense Viet Nam can still be seen as a country where coal use is expanding (Steckel and Jacob, 2021).

The energy system, and coal in particular, has strong linkages with socio-economic development in Viet Nam. Coal-related industries employ approximately 320,000 people with coal mining employing activities employing 200,000 in 2020 (ADB, 2021) and the coal-oriented power sector employing over 120 thousand (ESCAP 2022). Coal has increasingly underpinned economic growth and Viet Nam's coal energy intensity - a measure that quantifies the ratio of coal energy supplied to the economy per unit of economic output - has risen strongly over the past two decades (Figure 2). Compared with other large economies in East, Southeast and South Asia, Viet Nam stands out as the most economically dependent on coal-based energy, with little progress to date in decoupling this relationship.

The increasing coal dependence in Viet Nam has contributed to elevated local air pollution and environmental challenges for communities, while climate change has exposed regions, such as the Mekong Delta, to increased physical risks of climate change such as flooding. Viet Nam has a high level of exposure to climate related hazards – including an increased severity and frequency of extreme weather events and sea level rises. In the Global Climate Risk Index 2020, Viet Nam was the

Figure 2. **Coal energy intensity of gross domestic product (GDP) for select countries in Asia**



Notes: GDP is expressed in constant 2015 United States dollars.
Source: ESCAP calculations based on IEA World Energy Balances (2022) and UN Statistics Division.

6th most affected country in the world in terms of climate variability and extreme weather events from 1999-2018 (ESCAP, 2022). A sea level rise of 1 meter would impact 16.8 per cent of the Red River Delta population, 1.5 per cent of coastal provinces' population, 17.8 per cent of Ho Chi Minh population and 38.9 per cent of the Mekong Delta population (Tuyet, Hanh et al 2020).

However, recent momentum towards coal has shifted. As deployment of solar PV and wind power have surged, on the back of favorable economics, and challenges have emerged in developing and financing new coal-fired power plants, Viet Nam has begun to pare back the expansion of coal in the power sector. The Eighth National Power Development Plan (PDP-8) foresees a stronger role for expanding renewables, especially wind power, over the next decade. It has also upped the role of gas power. The PDP calls for phasing out the use of unabated coal power by 2050, with all remaining coal power plants to be converted to run on biomass or ammonia. It also sees a declining role for gas power by mid-century, with renewables comprising at least two-thirds of capacity by this time (see Chapter 2 for more details).

The Government has made a high-level commitment to reach net-zero emissions by 2050 and an international consortium is providing funding and technical assistance through an announced $15.5 billion Just Energy Transition Partnership agreement (see Box 1). Nevertheless, without more comprehensive policy design and implementation around coal phase-out and an accelerated scale-up of renewables including managing related socio-economic impacts and opportunities, Viet Nam remains at risk of not meeting its ambitious decarbonization goals.

Decision makers around the world increasingly recognize the environmental and economic benefits of shifting from coal. Nearly all coal demand comes from countries who have now set net-zero emissions goals. The Glasgow Climate Pact adopted at COP26 calls for "accelerating efforts towards the phasedown of unabated coal power". There are significant opportunities to remediate, restore and repurpose coal-related assets, land, and communities and to support shifts towards more sustainable development models. Realizing such opportunities requires long-term vision and commitment by decision makers to put in place strategies and measures that address the social aspects of transitions. The intertwined nature of state-owned enterprises and carbon-intensive sectors in Viet Nam shapes the dimensions of opportunities and challenges in the development of new industries and the ability to attract new forms of capital and investment.

Box 1. **Viet Nam's Just Energy Transition Partnership aims to catalyze a sustainable shift**

As countries seek to meet sustainability goals and align with a pathway consistent with more ambitious net zero emissions objectives, improving the cost and availability to finance is essential. Just Energy Transition Partnerships (JETPs) are new models for financing clean energy transitions, including through managing the phase out of coal and supporting transitions for affected workers and communities.

In 2022, Viet Nam announced a JETP with the International Partners Group who committed $15.5 billion to fund energy transition investments[a]. Half of this is to come from donors, led by the European Union and United Kingdom, while the other half is to be mobilized by the private sector, led by the Glasgow Financial Alliance for Net Zero.

The JETP aims to support accelerated action for Viet Nam's energy transition, including –

- Net zero emissions in energy by 2050
- Power sector emissions peak in 2030 with a greenhouse gas (GHG) limit of 170 million tons of carbon dioxide equivalent ($MtCO_{2e}$), down from a baseline of 250 $MtCO_{2e}$ in 2035
- Renewables account for 47 per cent of power generation by 2030 (from a baseline of 36 per cent)

Such objectives are consistent with ambitious energy transition pathways and are also taken into account by the PDP-8 (see Chapter 2). However, JETP funds account for only a fraction of the $135 billion of investment required, under current plans, for the power sector by 2030. As such JETPs can be seen as catalytic – mobilizing investment and finance in targeted ways to accelerate clean energy transitions more broadly. The success of Viet Nam's JETP will hinge on the effectiveness and timeliness of implementation across multiple dimensions, including the energy system, financing, governance, and socioeconomic aspects of transitions.

a European Commission (2022) Political Declaration on establishing the Just Energy Transition Partnership with Viet Nam available at https://ec.europa.eu/commission/presscorner/detail/es/statement_22_7724

In response to the broader challenges of climate change and clean air, the UN system has formed a regional task force – the Issues-Based Coalition (IBC) on Climate Mitigation and Air Pollution, comprising ESCAP, UNEP, ILO and UNFCCC. The purpose of the IBC is to coordinate the UN response to the cross-cutting challenge of climate change and air pollution in the region, help realize synergies among related areas of work of different UN entities and serve as a platform to reach out to non-UN stakeholders. The work of the IBC includes the objective of accelerating the Phase Down of Coal in Asia-Pacific countries.

In 2021 ESCAP partnered with Climate Analytics to produce a report titled "Coal phase out and energy transition pathways for Asia and the Pacific" (2021). That report characterized the ongoing expansion and drivers of coal power in the region. It set out potential pathways and benefits for transitioning to renewables-based systems. It recommended stronger renewables policies as well as shifts in financial support to achieve this.

This report seeks to build further on these efforts with a specific focus on the socioeconomic aspects of phasing out coal in Viet Nam and the opportunity to shift coal-related assets and communities towards new development models. By examining the specific circumstances in Viet Nam, it will provide an overview to public and private actors on the current state-of-play for coal phase down, identifying impacts and opportunities as well as responses for transitioning coal dependent communities and repurposing coal assets.

The rest of this report is structured as follows, Chapter 2 provides an overview of energy transition pathways in Viet Nam, providing a high-level summary of the various energy system modelling studies that have been completed in Viet Nam in recent years. These studies identify and emphasis different energy system options and impacts.

Chapter 3 looks specifically at implications of energy transition on employment, skills, industrial relations, and health and environmental benefits of phasing out coal. Chapter 4 provides an overview of the responses and opportunities for transitioning coal dependent communities – drawing on illustrative global examples of other regions that have made similar shifts away from coal. Chapter 4 also looks at opportunities for repurposing coal assets specifically power plants and mines.

Chapter 5 examines the policy, institutional and enabling environment required for supporting just energy transition. The final Chapter provides conclusions and recommendations for further actions and analysis to support Viet Nam's energy transition.

CHAPTER 2

Energy Transition Pathways in Viet Nam

Viet Nam announced the goal of achieving net zero by 2050 to the international community at the COP26 and then updated Viet Nam's National Defined Contributions (NDC) at COP27. The updated NDC increased the country's 2030 unconditional and conditional GHG emissions reduction targets from 9 per cent and 27 per cent to 15.8 per cent and 43.5 per cent compared to BAU, respectively. The energy sector is of particular focus for emissions reduction, as this sector accounts for the majority of Viet Nam's current and forecast emissions.

Viet Nam has one of the fastest growing greenhouse gas (GHG) emissions profile in Asia. Without effective action to change trajectory, Viet Nam's emissions are projected to reach up to 1,495.4 million tonnes of CO_{2e} by 2050, with 81 per cent of these emissions coming from the energy sector (WWF, 2023). This concentration of emissions in the energy sector results from Viet Nam's increasing reliance of coal fired electricity generation, and rapidly increasing energy demand from industry, as Viet Nam continues to develop its industrial base.

To achieve the net zero goal, Viet Nam will need to rapidly accelerate its energy transition, with a critical element being the transition away from coal generated electricity for both current and future energy demand. Viet Nam's energy transition is focused on decarbonizing current electricity generation; while introducing energy efficiency and renewable energy into the electricity system to ensure that future electricity demand is met with clean energy. The growth of renewable energy generation needs to be rapid. In all the energy transition scenarios developed for Viet Nam in the last few years[1] renewable energy is expected to produce over half of Viet Nam's electricity by 2030 and 90 - 100 per cent by 2050. The rapid uptake of renewables will also need to be supported by implementing comprehensive energy efficiency strategies at both industrial and household scales, the introduction of additional energy storage capacity as well as significant investments in grid augmentation and transmission infrastructure. As more clean electricity becomes available electrification of other currently carbon intensive activities such as transportation and industrial processes will become possible, further driving electricity capacity demand.

Corresponding to the phase up of renewable energy and other associated investments in the energy sector, there will also need to be a planned phase down of coal fired power stations, as well as reduction of coal focused activities within the economy. Viet Nam's PDP-8 provides the baseline vision for energy transition in Viet Nam's electricity sector. Its approval in May 2023 confirms a rapid planned increase in renewable power. By 2030 nearly half of installed electricity capacity is expected to come from renewable sources, at over 70GW, with hydropower and wind (onshore plus offshore) each accounting for nearly one-fifth of total capacity. Solar power (utility scale plus distributed) will approach 10 per cent of capacity. By 2050, PDP-8 foresees renewable power comprising two-thirds to three-quarters of total generating capacity, depending on local conditions.

Coal-fired power is seen comprising one-fifth of capacity, at 30 GW, by 2030, with its contribution

1 EREA and DEA (2022), Teske et al (2019), WWF (2023), US Aid (2021)

falling to zero by 2050. Gas-fired power – mostly fueled by liquified natural gas (LNG) - is planned to expand to account for a quarter of power by 2030 and reach over 37GW, before falling to the low single digits in share terms by 2050. Notably, the PDP-8 sees 26-32GW of coal power being converted to run on either ammonia or biomass by 2050, suggesting a stronger role for the repurposing of current coal-fired electricity power plants rather than retiring them outright. Most gas power plants are also foreseen as transitioning to hydrogen as their primary fuel by 2050 (Barnes, 2023).

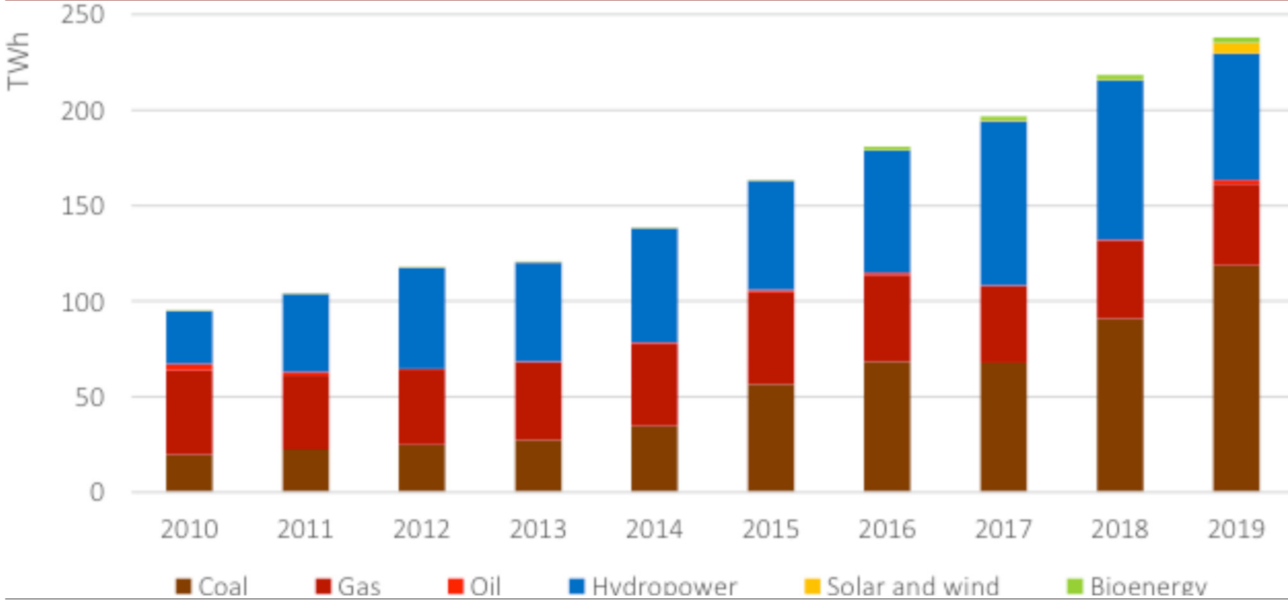
Each of these changes will have socio-economic impacts individually and through interactions in the wider economy. This Chapter provides a high-level synthesis and summary of the various scenarios developed for energy transition pathways for Viet Nam undertaken in the past five years studies, highlighting the key decision and leverage points for Viet Nam's net zero transition. This provides an overall energy transition context to the discussions in subsequent Chapters on socio-economic opportunities and the phase out and re-use/ repurposing of existing coal assets.

The several major studies undertaken in recent years to map energy transition in Viet Nam have each taken a different focus on different aspects of energy transition, including identifying scenarios for peak coal consumption (US Aid 2021), 100 per cent renewable energy scenarios for Viet Nam (Teske et al 2019; WWF, 2023) and energy system transition (including 100 per cent renewable scenarios) (EREA and DEA, 2022). They all highlight broadly similar trajectories for energy transition, but with different areas of focus, and each highlight in detail specific aspects of energy transition and the wider implications of these issues in the economy.

2.1 Current energy mix and forecast demand growth

As of 2019 the energy mix for the electricity sector in Viet Nam was 64.8 per cent fossil fuels (predominantly coal fired electricity generation), hydroelectricity 34.9 per cent, with the remaining electricity sourced from solar PV, wind, and biomass (see Figure 3). The energy intensity of the economy was 4.8MJ/US$1,000 in 2018 (ESCAP 2022).

Figure 3. **Power generation in Viet Nam**



Source: ESCAP 2022

Energy demand is rapidly rising from the industrial sector. By 2050 electricity consumption is expected to double (compared with the BAU), to meet this demand electricity generation capacity will need to increase significantly over the coming decades, in one scenario to more than 2200GW of installed capacity by 2050 – 30 times larger than the current generation capacity of 76GW (US Aid 2021).

Projected increases in energy demand are being driven by the industrial sector, which is estimated to grow at an annual rate of 10 per cent up until 2030, accounting for 66 per cent of total energy demand, compared with 10 per cent in the residential sector, 15.9 per cent in the transport sector and 5.1 per cent for the commercial sector (ESCAP 2022). Industrial demand emerges from the following sub sectors – food processing (16 per cent), automotive and machinery (14.6 per cent) and textiles, apparel, and leather sector (11.6 per cent) (ESCAP 2022).

In all scenarios for energy transition there are four key pillars of change:

- Rapidly increasing renewable energy generation capacity for electricity.

- Limited to no new coal fired electricity generation and the planned scale down of coal fired electricity generation assets.

- Investments is grid augmentation, transmission infrastructure and energy storage to integrate renewable energy generation.

- Focus on energy efficiency at industrial and household levels.

Each of these pillars are discussed in further detail below.

2.2 Renewable energy

In 2019 16.7 per cent of total final energy consumption was derived from renewable sources and based on the then trajectory (of PDP7) was expected to increase to 18.8 per cent by 2030 (ESCAP, 2022). The primary sources of new renewable based power production would be solar (75 per cent) and wind (21 per cent), with the electricity system also rely on large storage capacity.

GIS analysis shows Viet Nam has abundant renewable energy resources – including wind, solar and hydro. The rapid deployment of renewable energy generation capacity over the next decade, increasing by 60 per cent in the more conservative scenarios of renewable energy deployment, and over 100 per cent in scenarios with high and early renewable deployment will transform the Viet Nam electricity generation sector.

The WWF (2023) study developed 3 different scenarios for the energy sector in Viet Nam out to 2050, i) a Business-as-usual scenario, in line with scenario A1 as reflected in the November 2022 draft PDP-8, ii) 80 per cent renewables by 2050 scenario, and iii) 100 per cent renewables scenario by 2050. The three scenarios take account of existing policies and regulations impacting on the development of the energy system, as well as developing assumptions about the future development and application of policy in key areas such as energy efficiency, and energy consumption in the development of five major sectors in Viet Nam – the industrial sector, transport sector, household sector, commercial sector and agriculture, forestry, and fishing sector.

In the two renewable energy scenarios fossil fuels diminish in the energy supply, and emissions drop accordingly. Total emissions increase with the BAU scenario, while in the two RE scenarios emissions peak in 2030, and are significantly lower in 2040, and are at net zero for the 100 per cent RE scenario in 2050 (WWF 2023).

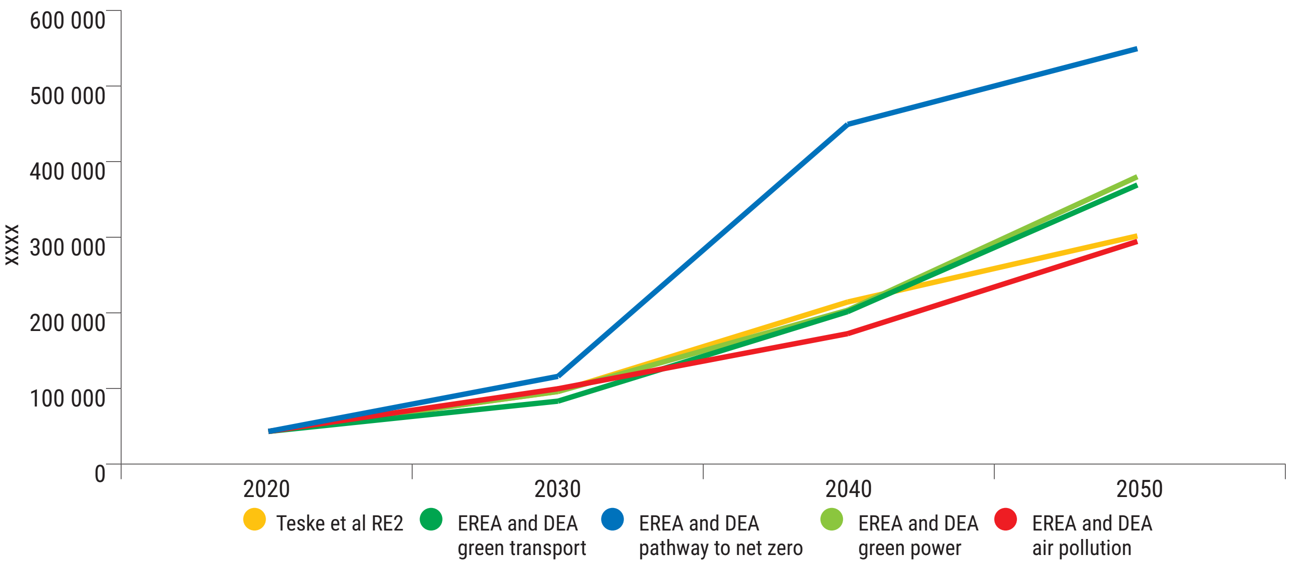
Teske et al (2019) also created a baseline, and two scenarios of renewable energy uptake - RE1 where only approved new coal generation comes online, and energy generation investment is prioritized to renewables rather than fossil fuels. The second renewable energy scenario - RE2 assumes an even faster uptake of renewables supported by policy, faster electrification of industrial processes, energy sector competition in renewable generation and no new coal generation after 2019.

Under the RE1 scenario renewable energy will contribute 38 per cent of electricity produced in 2030 and 75 per cent by 2050, and with higher generation contributions from onshore and offshore wind resources in the RE2 scenario renewable energy will make up 50 per cent of electricity produced in 2030 and 90 per cent in 2050 (Teske et al, 2019). Figure 4 provides summary analysis of the various scenarios for renewable energy generation capacity for energy transition, including the recently approved PDP-8.

Decline in fossil fuel use through corresponding increases renewable energy generation is also dependent on the cost of RE equipment – with most of the renewable energy scenarios assuming a rapid decrease in the cost of renewable energy costs, as well as reduction in the costs of battery storage equipment, as well as cost reductions in the required grid and transmission infrastructure for increased renewable generation and storage capacity in the energy system (Teske, et al 2019; US Aid 2021).

Scenario analysis is also complemented by economic analysis of costs and benefits to the energy sector and wider economy. Costs are calculated using - capital costs (based on country-specific data) for land, building, machinery, equipment and civil

Figure 4. **Projected pathways for renewable energy generation capacity**



Source: ESCAP 2022

works; operation and maintenance costs for fuel, labour and maintenance; decommissioning costs including retirement of power plants; costs relating to environmental remediation, regulatory frameworks and demolition; sunk costs in terms of existing infrastructure investments that may be retired before working lifetime; and external costs – including any additional externalities that impose costs on society[2]. GHG abatement costs are also included with avoided CO_2 generation assessed on a monetary value based on various levels of carbon price.

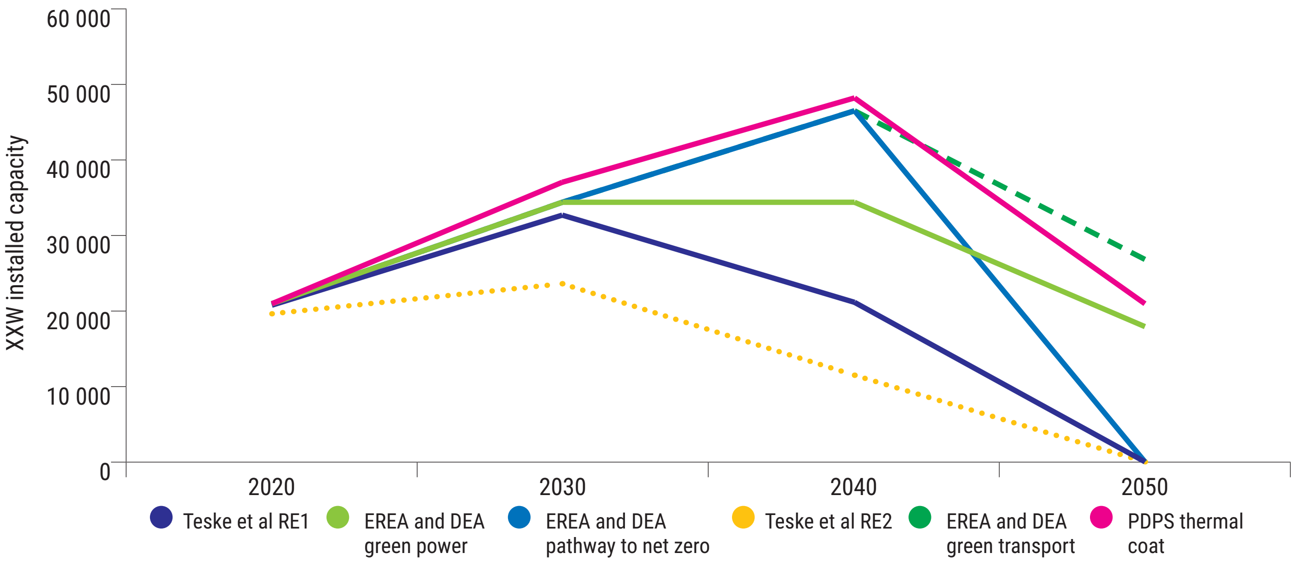
2.3 Coal phase out trajectories

Viet Nam currently has 24 coal mines operating (GEM, 2023) and with an estimated recoverable coal reserve of 46 million tonnes. Domestic coal production is fully utilized, and Viet Nam has been increasingly reliant on importing coal for power generation. Coal imports into Viet Nam doubled between 2016 and 2018 and doubled again between 2018-2019 (GEM,2023).

With increasing renewable energy generation there is also a changing profile for coal fired electricity generation. The various energy transition scenarios analyzed in the Chapter for Viet Nam see continued although reduced coal thermal electricity generation out to 2050, with scenarios with higher renewable energy uptake meaning peak coal consumption will occur in 2040. The US Aid (2021) report specifically deals with identifying scenarios for peak coal consumption. Seven scenarios are developed including a base case scenario[3] where GHG emissions from the power sector peak around 2040, which two years earlier than the estimated peak of 2042 in the BAU scenario in PDP-7. Across all the scenarios coal consumption peaks between 2024 ($100/ton CO_2 price) and 2044 (BAU case). The scenario based on no new coal generation sees a peak in 2030, a high Renewable energy target sees coal peaking in 2042, with a low cost RE scenario seeing peaks in 2029. These results emphasize the integral relationship between renewable energy costs and energy transition implementation.

In Teske et al (2019) coal is phased out by 2050 in both the RE scenarios, and WWF (2023) have coal generation phased out by 2050 in the 100 per cent scenario, with marginal thermal coal capacity in the 80 per cent scenario. Similar results are found in the EREA and DEA (2022) study, where in all scenarios except the net zero scenario, including some coal generation in the electricity generation capacity mix – in all but the BAU and Green Transport mix these

Figure 5. **Projected pathways for coal phase out in energy transition scenarios**



Source: ESCAP 2022

2 Although health benefits from reduced air pollution are not comprehensively considered in all the studies.

3 Implementation of current renewable energy target, similar to scenario S1B in the draft PDP-8 version 3.

assets are not generating electricity, but converted to run on either ammonia or biomass, rather than coal.

Figure 5 provides a summary of the different trajectories of coal phase out in terms of installed capacity – coal fired power generation continues to grow into 2030 – although the different scenarios show differing rates of growth. Coal utility for electricity generation peaks between 2030 and 2040, although in the scenarios aimed at for achieving net zero by 2030 this coal peak is in the early 2030s. This suggests that the critical 10-15 years for coal transition planning will be from now until the early 2040s, if the net zero target is to be actively pursued.

2.4 Energy Efficiency

Policy settings for energy efficiency include the Viet Nam Energy Efficiency and Conservation program, specific programs scaling up industrial energy efficiency – including training, business case development and financing options, as well as policy to implement minimum performance standards and labelling of electronic equipment. Each of the energy transition scenarios include assumptions for continuing implementation of energy efficiency activities, with particular focus on the industrial and household sectors. None of the studies present specific analysis of energy efficiency opportunities by sector, but rather use broad estimates from IEA. The lack of more detail and country/sector specific assumptions underlines substantial data gaps in understanding the current energy use and energy intensity of industrial production in Viet Nam, with knowledge gaps in being able to specify energy efficiency opportunities in both a technical and implementation sense. Information gaps also exist in business case development such as cost benefit and payback analysis. Addressing these issues as well as strengthening requirements for specific auditing and reporting for large energy users in Viet Nam is required to support industrial investment and implementation in new energy efficiency technologies (WWF, 2023).

The IEA studies identify electric motor driven systems as one of the major energy uses in the industrial sector – at a global scale these motor systems account for some 69 per cent of electricity use, with energy efficiency opportunities in these systems providing potential saving of up to 4 - 15 per cent of this electricity consumption by introducing upgraded equipment and processes, with payback periods in the range of 3 to 4 years. The WWF (2023) study assumes 10 per cent and 14 per cent energy efficiency saving potential is achieved in their 80 per cent and 100 per cent renewable scenarios. Teske et al (2019) assumes 5 per cent annual increase in energy efficiency uptakes is achieved.

Accessing and implementing energy efficiency will require significant policy development in Viet Nam, as well as programs for awareness and capacity building with industries and households. The capacity building will need to include specific industry level guidance, cost-benefit analysis and implementation case studies. Energy efficiency implementation will also require significant training and new skill development in a broad range of established occupations, as well as the expansion and proliferation of new occupations in energy management. Understanding and mapping skill development pathways for energy efficiency skills in the Viet Nam education system will be important to identify ways to accelerate requisite skill development. Demand for energy efficiency-related skills and occupations will rapidly grow as energy efficiency activities expand and become more important in decarbonization and energy productivity. Ensuring pathways for new workers to enter will be critical to ensure the pace of transition is not slowed by labour and/ or skill shortages.

2.5 Investment requirements and energy security benefits

The rapid growth of solar and wind power generation in the 2020s and 2030s will require significant investments in transmission and distribution grids. Transmission capacity is a current bottleneck especially in the north of Viet Nam - by 2030 an estimated 12GW of interregional transmission capacity will be required (40 per cent increase compared with current capacity) (EREA and DEA, 2021). This grid augmentation will also be required for energy system stability as coal fired power plants start exiting the generation network.

To date, electricity networks investment has largely been carried out on the balance sheet of state-owned utility, Électricité du Vietnam (EVN). However, EVN faces persistent financial pressures and posted a $1.55 billion loss in 2022 in the face of rising costs for fuels and transmission spending (Minh, 2023). Efforts to put EVN on firmer financial footing, as well as considering ways to enable private investment in transmission will be critical to enhancing grid stability and integrating larger shares of variable renewable energy resources.

The green transition of the power system will be very capital-intensive and in the EREA and DEA analysis could require annual investments of up to $167 billion in 2050 in the NZ scenario, which is equivalent to around 11 per cent of the projected national GDP in 2050 (EREA and DEA, 2022). The composition of total power system costs will shift, with less spending on fuels but higher capital expenditure requirements as investment are made in installing renewable energy generation and transmission and grid infrastructure. Financing these capital costs will be a critical component of Viet Nam's energy transition pathway.

In addition to reducing fuel costs, reaching net zero can help improve long term energy security for Viet Nam by greatly reducing reliance on fuel imports and lower import costs – for example Viet Nam reaches energy self-sufficiency by 2050, under the NZ scenario from EREA and DEA study (2022). Reducing import dependence reduces the economic impacts of international fuel price variations, such as we are currently experiencing, and allows Viet Nam's economy to be more resilient to future energy shocks.

Future energy scenarios for Viet Nam also include an increase in gas as a fuel source – mostly in the form of imported Liquefied Natural Gas (LNG). This continued reliance of imported fuel sources would negate some of the impacts of renewable energy on energy independence for Viet Nam. Although the focus of this report is on coal phase out – effectively reducing emissions will require addressing all sources of fossil fuel-based energy generation.

2.6 Key messages

The transition pathways for the Viet Nam electricity generation sector show a strong increase in renewable energy generation capacity in the short to medium term, to ensure that the majority of Viet Nam's electricity is generated from renewable sources by 2030, and to create the trajectory to net zero by 2050. In addition to increased renewable energy generation capacity, transmission, and distribution grid infrastructure, as well as battery storage will be required to ensure the stability and flexibility of the electricity sector will be required. Energy efficiency activities will need to significantly ramp up to efficiently meet Viet Nam's rapidly

increasing industrial demand. These changes in generation, grid infrastructure and energy efficiency will need to be front loaded into the energy transition - ramping up in 2020s and 2030s to ensure the net zero trajectory. This also means the employment implications – both job growth and skill development needs will also need to be short term considerations.

As coal starts to play a decreasing role within electricity generation in Viet Nam, coal power plants and as global action for coal phase out continues, coal mining activities will phase out. The key decade for coal phase out will be in the mid 2030 through to 2040s. Just transition processes require long timelines to ensure alternative pathways for affected workers and communities are established, so initiating and creating community momentum for just transition planning processes should also commence in 2020s.

This trajectory suggests that Viet Nam has significant opportunities to benefit from employment growth associated with decarbonizing electricity supply – although some skills and knowledge gaps are expected and will need to be addressed in energy efficiency, renewable power generation as well as grid infrastructure development and management.

The ramping up of renewables and energy efficiency in the coming decade will more than compensate for any employment transition losses associated with the phase-out of coal assets – which will largely occur in the 2030's and 2040s. Viet Nam has sufficient time to plan for the transition of these impacted workers, communities, and assets. This is the subject of the following Chapter.

CHAPTER 3

Socio-Economic Implications of Energy Transition

3.1 Employment impacts

The transition of our global energy systems to ecologically sustainable systems will also have significant socio-economic implications including on employment. These implications include: the creation of new green jobs and new industries; minor to major changes in existing jobs and occupations with the addition of new skills and practices; and the phase-out of some jobs and occupations associated with carbon-intensive activities. Whilst positive changes to employment and economic output are welcome and anticipated, this is not the case for neutral and especially negative impacts. These negative impacts can create fear and resistance, slowing the green transition. These changes to employment and their consequences are also not shared evenly across geographies or sectors, with concentrations of people and communities advantaged and disadvantaged by the green transition due to the carbon intensity of existing industrial activities. In the context of Viet Nam the geography of these employment impacts are not well explored (ILO, 2021 a recent addition). As with the energy transition, employment changes will accelerate over the coming decade in Viet Nam – therefore understanding and planning for socio-economic implications and opportunities will be a critical component of the energy transition.

Coal-related industries in Viet Nam employ approximately 320,000 people with coal mining employing activities employing 200,000 in 2020 (ADB, 2021) and the coal-oriented power sector employing over 120,000 people (ESCAP 2022). With energy transition phasing out the use of coal and coal fired electricity generation – much of this employment will also evolve over the coming decades. Some coal power stations will transition to different fuel sources – such as ammonia or biomass – so employment will remain with some requirements for additional skills. Other employment will phase-out and new employment pathways will need to be created for these workers. While employment growth in renewable energy sectors and energy efficiency sectors are estimated to more than outweigh any job losses – the geography, occupations, skill levels, wages, and may not be the same, or will require further enhancements.

Teske et al (2019) is the only one of analyzed recent energy transition reports to also include employment factors[4]. Employment factors or the number of jobs estimated to be created/ lost per unit of capacity are estimated and these are separated into manufacturing, construction, operation, and maintenance, and per unit of primary energy for fuel supply. This is combined with a decline factor, which reduced employment by a decreasing amount per year to take account of increasing efficiency of new technologies, which in turn will require less employment. Employment factors are further contextualized for Viet Nam by including the percentage of local manufacturing and domestic fuel production determined for the Asia region, the percentage of world trade in coal and gas fuels, and the traded renewable components that originates in each region; and a 'regional job multiplier',[5] which indicates how labour-intensive the economic activity is in that region compared with the OECD, which is used to adjust the OECD employment factors because local data are not available (Teske et al 2019).

4 Current work is underway to support the Just Energy Transition pathway in Viet Nam which will includes employment analysis.

5 See Table 1 for further details

Table 1. Employment impacts of energy transition scenarios

Thousand jobs	2015	Reference 2025	Reference 2030	Reference 2050	Renewables 2025	Renewables 2030	Renewables 2050	Renewables 2 2025	Renewables 2 2030	Renewables 2 2050
Coal	113	236	117	76	84	71	141	78	65	0
Gas, oil and diesel	10	28	18	21	28	23	23	17	15	10
Nuclear	-	-	-	-	-	-	-	-	-	-
Renewable	129	115	245	210	406	587	423	522	699	501
Total jobs	251	378	380	308	519	681	587	616	780	511
Construction and installation	79	146	132	99	81	194	218	122	220	144
Manufacturing	51	82	78	56	308	352	248	352	407	243
Operatios and maintenance	18	38	53	77	32	47	72	39	60	95
Fuel supply (domestic)	103	113	118	75	98	87	44	100	92	30
Coal and gas export	-	-	-	-	-	-	-	-	-	-
total jobs (thousands)	251	378	380	308	519	681	587	616	780	511

Source: Teske et al (2019)[7]

Teske et al's (2019) analysis shows that employment growth is associated with all their (3) scenarios, with strong growth in the renewable energy sectors for both renewable scenarios (RE1 and RE2) out to 2050. This job growth is more than anticipated jobs losses in the coal mining and coal electricity generation sectors. As Table 1 highlights the RE1 scenario produces twice the overall employment in the energy sector from 250,000 today to 520,000 by 2025, with a further increase of 130,000 jobs by 2030 (Teske et al 2019). The analysis shows under the RE2 scenario an overall number of jobs in 2025 and 2030 as 100,000 higher than under the RE1 scenario, and at 2050 approximately 200,000 more than under the Reference scenario.

This analysis only includes estimates of direct employment creation. This employment growth would also induce other employment in the economy – as income from energy transition would increase overall economic activity. Induced employment has been estimated in other studies, suggesting an induced employment effect associated with the income and investment from energy transition of 2 jobs for every 1 additional energy system job (Okunlola, et al. 2019). The same study estimated employment based on MWh of electricity from different sources – with solar and wind as creating 3.5 jobs and 2.8 jobs respectively per MWh capacity, compared with coal (1.4 jobs) (Okunlola, et al. 2019).

This concurs with global IEA estimates that suggest replacing coal power plants with solar or wind will more than double the number of jobs per average MW capacity, however replacing coal with gas alone will lead to job losses of around 0.5 job losses per average installed MW (IEA, 2020).

The energy efficiency sector would also create employment. One of the major additional co-benefits of energy efficiency, aside from more efficient production and associated reduced carbon emissions, is job creation, with many measures taken to improve the efficiency of cities, buildings and transport systems being labour intensive, and need to be undertaken close to where populations and industry are located (IEA, 2020). Employment impacts of energy efficiency were not explored in any of the current studies, but at the global level, IEA estimates that in 2019 some 10.9 million workers are employed in end use energy efficiency activities, and with this figure to grow rapidly as energy

6 Employment factors were created using a bottom-up approach – that analyzed different sources of employment data for renewable energy projects from academic literature and relevant reports. This data mainly covered projects from OECD countries, from this a table of employment factors were created. Limitations in the analysis include that it was developed from limited number of cases, especially from non-OECD countries. These factors were further customized for geographic regions by applying labour productivity information. Further details are available at Rutovitz, J., Dominish, E. and Downes, J. 2015. Calculating global energy sector jobs: 2015 methodology. Prepared for Greenpeace International by the Institute for Sustainable Futures, University of Technology Sydney

efficiency activities are increasingly applied in the energy system (IEA, 2020).

In terms of impacts of phasing out coal employment a recent ILO study on the impacts of phasing out of coal mining activities found that the direct effect of the closure of all mines will be a decrease in wages by 0.6 per cent and an indirect effect of a further decrease of 1.4 per cent in wages due to layoffs by suppliers of coal mines. An induced effect (wages) will be a drop in wages by $1.72 billion (2012 prices) because of the decrease in consumption demand of households in the case of mine closures (ILO, 2021). The study highlighted these impacts would be concentrated in coal mining regions and would likely represent an under-representation of impacts as they were based on input-output tables from Viet Nam in 2012 and the coal mining sector has grown rapidly in the past decade.

The phase-out of coal power plants and the associated employment in these plants would also add to these impacts. Although in Viet Nam up to 28GW of coal power plants are expected to transition to different fuels sources – which would limit employment losses. Repurposing and reusing coal assets – especially when part of wider strategies for regional economic diversification have the potential to significantly offset employment losses with coal phase out, but these reuse opportunities require planning and investment. This is discussed further in Chapter 4.

3.2 Skills demand in energy transition

The energy sector requires high-skilled workers – with 45 per cent of the workforce requiring some degree of tertiary education. Less the 10 per cent of energy employment is in low-skilled labour (IEA 2021). In Viet Nam of the new jobs expected to be created in the renewables sector in wind and solar, around 25 per cent are expected to be high-skilled (Okunlola et al, 2019). The demand for high-skilled workers in the power sector will increase further after 2030, and therefore enhancing the training capacity of universities and technical schools to develop the skilled workforce will be an integral part of energy transition.

Developing the supply of new skills needed is a key concern in managing an accelerated energy transition. Skills are available in adjacent industries - making it possible for employees in carbon intensive parts of the energy system to transfer to other parts of the energy system, with companies creating upskills/ reskilling relationships with universities to enable transfer of employees rather than recruit of new employees - especially if in tight labour market for these skills (IEA, 2021). This may limit job losses especially in coal fired electricity generation if pathways for occupations can be created in renewable energy electricity generation, but this requires specific interventions by enterprises and government.

Other evidence highlights the impact of limited local technical expertise in solar and wind power, requiring project developers to either recruit engineers from other sectors or recruit foreign trained experts – this situation suggests a strong need in Viet Nam to align course development and student intakes in relevant degrees/ areas for renewable energy sectors to fully reap the benefits of potential employment gains from energy transition (Okunlola et al, 2019).

3.3 Quality as well as quantity of new employment

Quality of employment is as important as quantity, and ensuring new work in the energy sector is also quality and decent work will require attention and interventions. A large proportion of energy sector employment especially associated with the installation of solar and wind energy, as well as energy efficiency retrofits, will fall into construction industry categories – where wage premiums are less available and working conditions can be more vulnerable in terms of employment tenure and workplace safety than the coal-based energy jobs they are replacing. Employment demand for construction jobs will be significant, and although this demand will be sustained over the coming decades, at the individual job level the work will be temporary and site specific.

Across most employment scenarios for energy systems transition up to 80 per cent of the jobs created by 2030 will be in construction and installation (Okunlola, et al. 2019). In these newer clean energy sectors, as they are less established, they have less union representation and /or experience with social dialogue processes. Efforts will be required to ensure

construction and installation work is seen as good employment – attracting decent wages, security, and conditions, as well as developing needed industrial relations institutions include ensuring freedom of association and social dialogue processes.

3.4 Gender dimensions of energy transition

Women workers are strongly under-represented in the energy sector - only accounting for 16 per cent of global employment. In Viet Nam, female workforce participation rates are the highest across the region – at 73 per cent in 2019 (ILO, 2021b). However, for the utilities sector (including the energy sector) women only make up 27 per cent of the workforce, and just 16 per cent of management positions in the Utilities sector (ILO, 2020). These figures are replicated for the renewable energy sector – although there are examples of women-led large and medium-sized renewable energy firms in Viet Nam (US AID, 2017).

Policy frameworks and labour market activities are needed to increase women's participation in the energy sector workforce. Although women may be under-represented in energy sector and coal mining jobs, employment losses associated with phase out can affect women as much as men, in that women are likely to be over-represented in indirect employment in coal dependent regions such as in wholesale and retail trade, and working in shops and restaurants (ILO, 2021).

Transition policies need to consider income protection and active labour market policies for workers both directly and indirectly impacted (World Bank, 2018). Further, research has shown that women respond differently to men in terms of labour market policies and are better able to take up new opportunities through active labour market policies – if they are offered and effectively targeted with a gender responsive lens (ILO, 2021, 2021a).

3.5 Health and environmental impacts

Analysis suggests that the health and environmental impacts of addressing carbon emissions through the phasing out of coal fired electricity generation and related activities would more than outweigh any economic impacts. This includes direct costs associate with addressing stranded assets – coal power plants retired before their technical lifespan, but also discrepancies between the domestic costs of decarbonization and the collective global benefits of reducing climate change impacts – making phasing out coal a no-regrets strategy (Rauner et al, 2023).

Viet Nam has already documented the heavy cost of health impacts from air pollution associated with coal power generation. In 2015, 4,300 premature deaths were associated with $PM_{2.5}$ and ozone exposure in adults and children. By 2030 this air pollution is expected to result in 21,100 premature deaths annually. See Figure 4 below. Other analysis

Figure 6. **Estimates of premature deaths from air pollution associated with coal electricity production in Viet Nam**

		Number of premature deaths	
		2015	Projected to 2030
$PM_{2.5}$ exposure to adults	Stroke	1 670	8 200
	Ischemic heart disease	1 130	5 210
	Lung cancer	310	2 300
	Other cardiovascular diseases	350	1 420
	Respiratory disease	500	2 710
$PM_{2.5}$ exposure to children	Lower respiratory infections	60	130
Pzone exposure to adults	Respiratory disease	240	1 170
	Total	4 300	21 100

Source: Myllyvirta, 2015

shows the total costs of air pollution on human health impacts of the energy systems in the base/ reference case would triple out to 2050, with the health-related costs of increasing pollutants nitrogen oxide (NOx), sulphur dioxide (SO2) and particulate matter 2.5 (PM 25) increasing from US$4.6bn to US$13.3 bn in 2050 (WWF 2023). Currently the road transport sector contributes most to air pollution at an annual cost of US$1.9bn, but by 2030 the industrial and power sectors will both overtake - contributing 47 per cent, 24 per cent and 19 per cent respectively, if the base case pathway is followed (WWF, 2023).

The modelling of human health and environmental benefit of coal exit for Viet Nam has been developed by ISF, utilizing the modelling approach and data from Rauner et al. (2020)[7].

Coal exit in Viet Nam is estimated to be valued to be $3.6 billion in for human health, and $1.2 billion for environmental damage reduction, with a total benefit of $4.8 billion in 2023 USD.

Other location specific environmental impacts include soil pollution from coal mining activities. The Red River delta is one of the country's two major rice growing areas, as well as one of the two main locations for mining activities. The Delta area is highly vulnerable to natural hazards and human-induced environmental change (Yuen et al., 2020).

7 For an overview of the approach to developing the benefits associated with health impacts see Annex 1

Rice is also grown in Quang Ninh, another major coal mining region (see Figure 8 in the following section) and studies have found that overburden and acid mine drainage from coal mining has contaminated agricultural soils in the area (Martinez et al., 2013). Studies of the composition of rice paddy soil in Cam Pha, Quang Ninh province near the open pit coal mine of Coc Sau found high concentrations of cadmium, copper, and lead. Native rice plants have adapted to grow in these soils and levels of cadmium, copper and lead from these paddy fields exceed permitted levels in foods, which can lead to metal accumulation and severe disease (Martinez et al., 2013). There is evidence that coal mine waste rocks are the source of these metals in the Cam Pha rice paddies, which release these trace elements into agricultural soils where they become bioavailable to food crops (Marquez et al., 2018).

3.6 Key messages

This Chapter has shown energy transition and specifically coal phase out, will have significant socio-economic impacts. Many of these impacts are positive. Employment impacts will result from new activities in constructing and maintaining renewable energy generation capacity, transmission, and grid augmentation, as well as in energy efficiency activities. This employment growth will outnumber job losses associated with coal phase out.

In the energy sector – occupations in coal power plants have transferable skills that workers can take with them into renewable energy jobs. There are examples of the energy sector providing additional

skills development in partnership with universities and technical institutes, to power sector workers to anticipate the transition and also address future skill and labour shortages. Even so, it is unlikely that supply will keep up with demand for skilled employment in the transforming energy system – dedicated policy and investments will be required to ensure that demanded skills will be able to be readily found in local labour markets.

Newer sub-sectors of the energy industry – including renewable energy, do not have the same foundation of industrial relations experience and institutions – so in creating this new employment, efforts will also be required to ensure that decent work, security of tenure, freedom of association and social dialogue also become part of work in these new energy sectors. Ensuring workers moving into the emerging energy sector are not disadvantaged in working conditions compared with the established energy sector will be important in attracting the required skilled labour. There is also an opportunity with providing a gender transformative lens to skills development and labour market policies for the energy sector that women's long-standing under-representation in the sector can also transition.

There are spatial dimensions to energy transition – in that carbon intensive electricity generation will not necessarily be located in the same places as renewable energy resources. This means the benefits and impacts of coal-phase out will not be evenly distributed, but rather concentrated in certain places. This is why coal dependent communities require specific strategies to deal with these concentrated impacts. This is discussed in further details in the following Chapter.

This Chapter has also highlighted significant health co-benefits from coal phase-out through reduced impacts of air and soil pollution. Specific Viet Nam analysis in this Chapter shows the benefits of coal exit in Viet Nam by 2050 is valued to be $3.6 billion in for human health, and $1.2 billion for environmental damage reduction, with a total benefit of $4.8 billion in 2023 USD. There is a spatial element to these co-benefits as well, with areas adjacent to coal mines and coal power plants - that are currently most impacted by pollution – also able to benefit most from this reduced pollution.

CHAPTER 4

Responses and Opportunities for Transitioning Coal Communities and Assets

The phase out of fossil fuels, including the use of coal for electricity generation is a necessary step in decarbonizing our economies, and being able to meet global commitments encompassed in the Paris Agreement to avoid the effects of dangerous climate change. This transition will not be without costs, and jobs, and enterprises and communities that are concentrated around carbon intensive industries need to be supported to make the shift. Transition will be a context specific process, with higher burdens in some geographical regions and in some industries and occupations – these hotspots will require specific responses and investments to ensure transition but also a just transition. The transition process is only beginning in Viet Nam, and there are many knowledge and information gaps that need to be addressed in understanding and planning responses for transition in the Viet Nam context

This Chapter looks discusses responses available for a just energy transition in Viet Nam, by identifying opportunities, with examples for transitioning coal assets, industries, and communities to more sustainable and inclusive models of development with analysis on potential applicability to Viet Nam.

4.1 Coal mining

Coal mining in Viet Nam is predominantly located in the north of the country, in the Red River Delta and Northeast regions close to Hanoi and the coast – see Figure 7 for further detail. Most of the coal fired power plants are also located in the same regions, although they are less concentrated with plants also located in the centre and south of the country.

Coal resources are distributed across Viet Nam (Nguyen et al. 2021). The most important coal basins are the Quang Ninh and Red River Delta basins, where the majority of coal is mined, and there are also basins identified in the North of Viet Nam in Thai Nguyen, Bac Kan, North Path, Da River, Ca River, Na Duong, in the Centre at Nong Song and Ba River, and in the South in the Mekong River Delta (Mijał, 2018).

These two basin areas are adjacent to each other. The Quang Ninh basin is close to the coast, close to the UNESCO World Heritage site and important tourism location of Ha Long Bay (Minh Ha-Duong et al., 2016). Coal is also exported to the international coal market, primarily from Cam Pha port (Mijał, 2018). The Red River Delta is south and west of Quang Ninh. It is the most populous and densely populated region of the country, with 30 per cent of the country's population, including the capital Hanoi and port city of Hai Phong.

The majority of mining takes place in Quang Ninh, and large mines in the basin include Vang Danh, Cao Son, Trang Bach, Hon Gai, Nam Mau, Coc Sau, Khe Tam, Thong Nhat, Deo Nai, Khe Cham, Mao Khe, Ha Tu, Nga Hai, Mong Duong and Uong Bi (Uong Thuong-Dong Vong) with production more than 1 million tones to per year (GEM, 2023). The two largest mines are in the Red River Delta basin, Binh Minh and Khoai Chau II. There are 24 mines with more production of more than 0.4 million tonnes per year which produced approximately 46 million tonnes (GEM, 2023). There are smaller mines but without data on their number or location, but with suggestions there could be as many as 200 mines (Minh Ha-Duong et al., 2016).

Figure 7. **Main coal deposits and mining regions in Viet Nam**

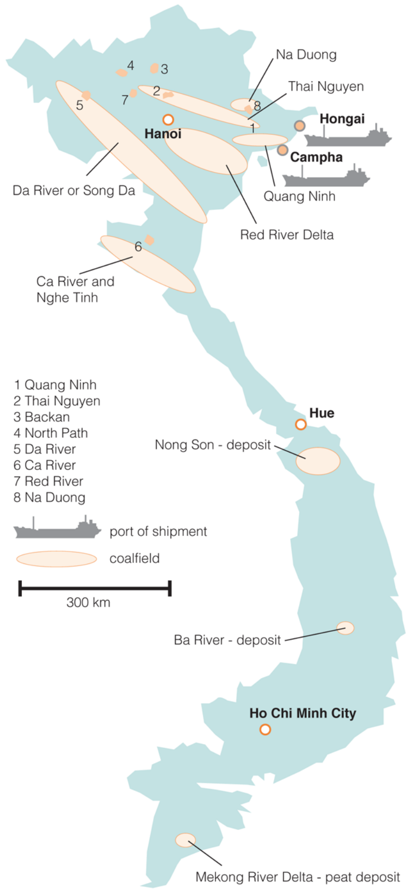


Figure 7 **Map of Vietnam's coal reserves** (Ritschel and Schiffer, 2007; Bui and Drebenstedt, 2004)

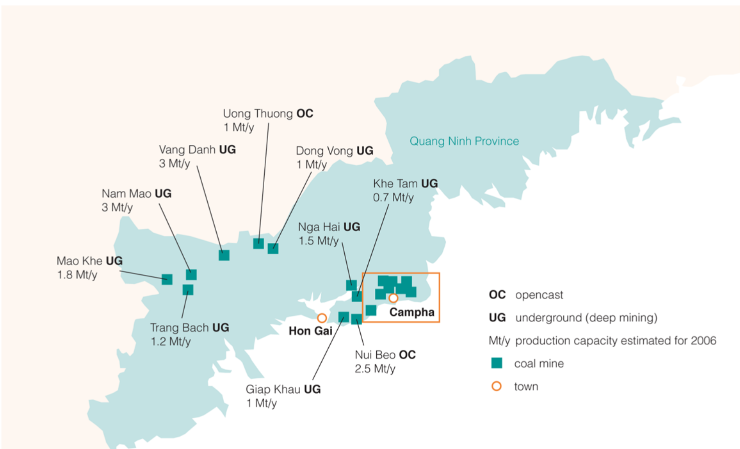


Figure 8 **Coal deposits in Vietnam**

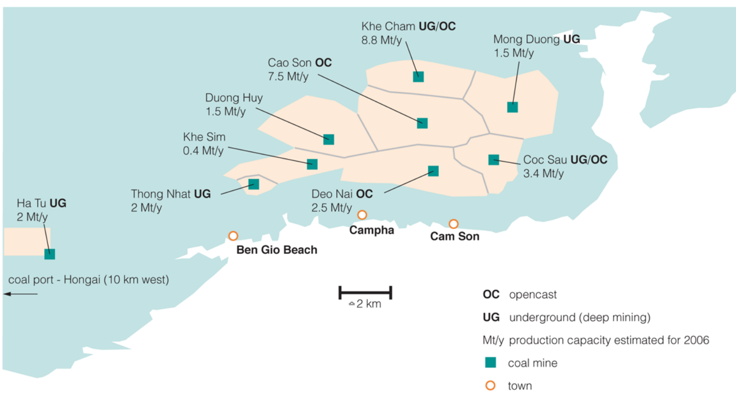
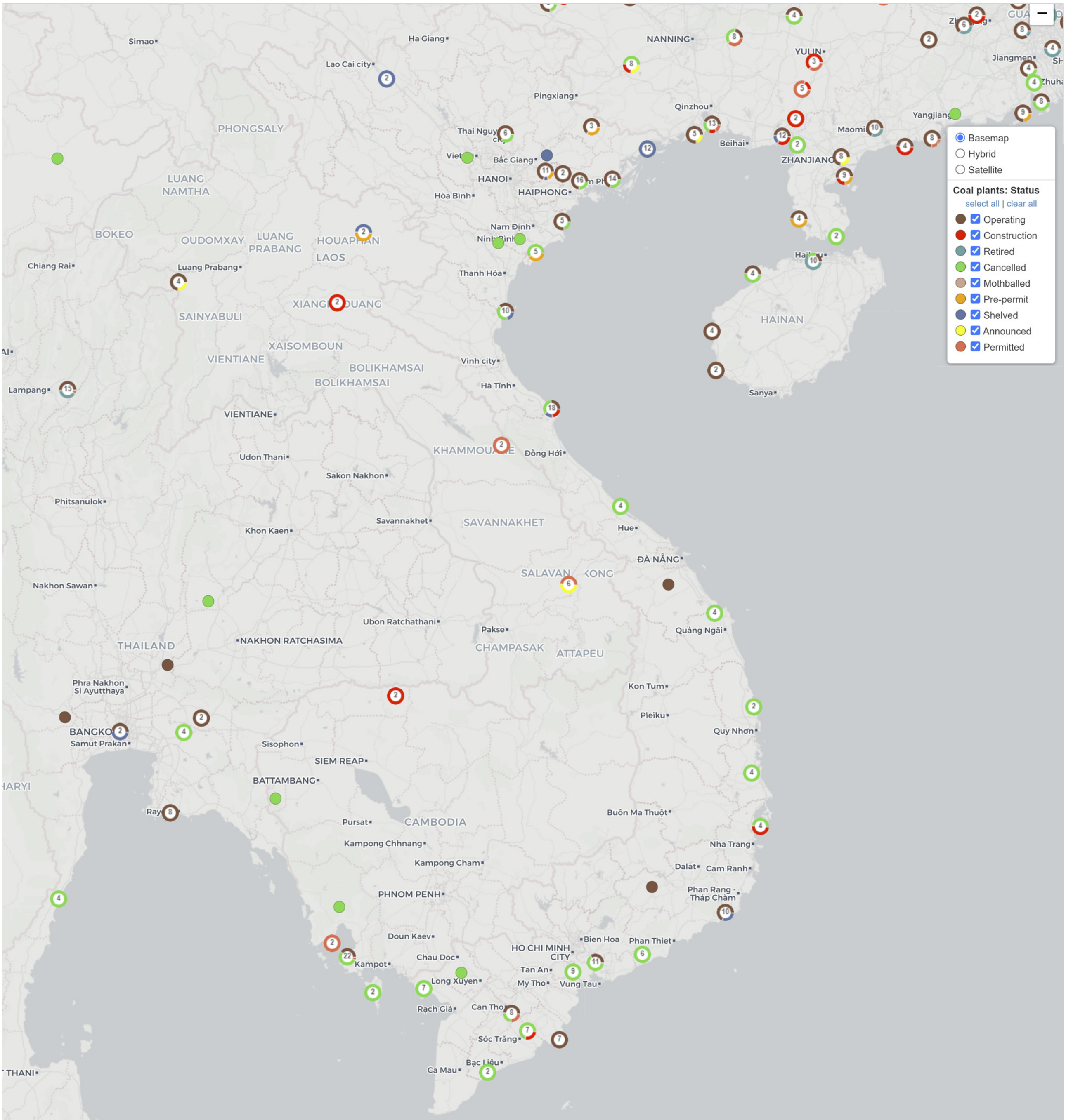


Figure **Major coal mines around the Campha region**

Source: Mijał, 2018

Figure 8. **Location, size and status of operating and in-progress coal power plants in Viet Nam**



Coal plant tracker map (Brown are operating, red under construction)
Source: GEM 2023

4.2 Coal fired power plants

Viet Nam was the fifth highest country in terms of new coal fired power plant capacity in 2022, adding 1,920 MW. However, in 2022 most of the remaining planned coal capacity was shelved or cancelled (17.7 GW) (GEM, 2023a). See Figure 8 for an overview of the location, size and status of coal fleet. Viet Nam's coal power plant fleet is very young - nearly 80 per cent of capacity was installed in the last 10 years and 95 per cent in the last 20 years (GEM, 2023a).

The majority of coal plants are located in the North of the country, in the North East and Red River Delta Regions. Power plants are co-located close to mining regions, as well as close to major demand from the city, and close to the main coal port of Cẩm Phả in Quang Ninh. There are also plants located close to demand in the centre and south of the country.

There are 25 plants with 73 units in operation, with a total capacity of 24.6 GW as of 2022. In addition, there is 6.1 GW in construction, 1.2 GW at pre-permit stage. 18.9 GW has been shelved and 47.3 GW of planned plants have been cancelled between 2010 and 2022 (GEM, 2023a).

4.3 Repurposing coal assets

Repurposing coal assets can help mitigate some of the negative impacts of their phase out or early retirement. There are different options for repurposing or re-using coal power plants and coal mine assets.

There is a range of criteria to consider when assessing options for repurposing coal power plants including technical, commercial, regulatory, social, and environmental criteria (CIF, 2023). The options for repurposing have been classified into five broad categories: electricity generation, energy storage, hydrogen/ammonia production, carbon sink and non-energy, non-carbon uses (CIF, 2023). Figure 9 provides an overview of these five categories.

CIF (2023) have also identified four different strategies for repurposing coal power plants:

1. **Location only re-use** – examples include repurposing the site of the coal power plant for renewable energy generation such as solar (PV) power plant, wind farm, or if in a coastal location providing interconnection hubs for offshore wind, various forms of energy storage green hydrogen and ammonia production as well as reforestation, energy crops or other commercial uses.

2. **Partial equipment reuse** – which could include repurposing the plant for industrial uses such as ore processing, cement processing, fertilizer production, as well as options to transition to gas/ carbon capture and storage (CCS) plant.

3. **Process integration** – including transitioning plant to various forms of geothermal and thermal energy and energy storage.

4. **Complete asset reuse** – where the fuel source is replaces but the complete existing equipment is

Figure 9. **Categories for repurposing coal fired power plants**

Electricity generation	Energy storage	Hydrogen/ ammonia production	Carbon sink	Non-energy non-carbon use
Biomass-fired boiler	Flywheel	“Green” hydrogen production	Direct air capture of CO_2	Commercial use
Geothermal plant	Li-ion BESS	Ammonia production	Reforestation in urban areas	Process industries
Municipal waste-fired boiler + CCS	BESS + synchronous condenser			Agrivoltaics
Natural gas-fird\ed boiler + CCS	Molten salt thermal energy storage			
NGCC plant with CCS	Compresed air energy storage			
Nuclear SMR	Volcanic stone thermal energy storage			
Offshore wind	MGA technology thermal storage			
Onshore wind farm	Second-life use of EV batteries			
RNG-fired boler	Redox flow BESS			
Solar PV powerplant	Meta-air BESS Gravity-based storage			

Source: CIF, 2023.

utilized – including biomass fired boiler, municipal waste fired boiler with CCS and renewable gas fired boilers.

The work CIF (2023) completed highlights the combination of techno-commercial, regulatory, and contractual and social and environmental criteria that need to inform repurposing options. Techno-commercial criteria for repurposing coal power plants including considering older, increasingly unreliable plants for repurposing, and then also preferencing larger sized and more integrated plant.

In terms of regulatory and contractual criteria this is also highly dependent on the local regulatory context and performance of plant. Power plants in Viet Nam operate with defined contractual arrangements with the State. These contractual arrangements will have an agreed output, compensation, and lifetime operation terms. Alongside these contractual arrangements plants also need to operate within regulatory restrictions. Power plants targeted for repurposing would be those at the later stages of their contractual arrangements and/ or plant with poor regulatory track record, such as in emissions performance.

The social and environmental criteria need to assess the willingness or commitment of local stakeholders, and this is dependent on analysis of various costs and benefits – benefits in terms of reduced air, water and soil pollution, but costs in terms of local

Box 2. **Approaches for prioritizing coal power plant interventions in Viet Nam**

How should coal power plant interventions be prioritized? Understanding the performance of existing plants in terms of their energy system, economic, environmental, and social characteristics can provide a useful starting point for building the case for coal transitions and determining which plants could be repurposed, retrofitted, or retired early. Such metrics can demonstrate the value associate with transitioning plants from both a private and societal perspective, and support more optimal decision making.

Several international initiatives seek to increase transparency and provide decision-making tools for transitioning coal power fleets. For example, the Coal Asset Transition Accelerator applies a Multi Criteria Analysis to identify and rank coal plants best placed for retirement. That framework is based on three criteria: how early retirement could affect the energy security of the local power grid; whether the power plant is economically viable, and how the removal of the plant can contribute to carbon emission reductions.[a]

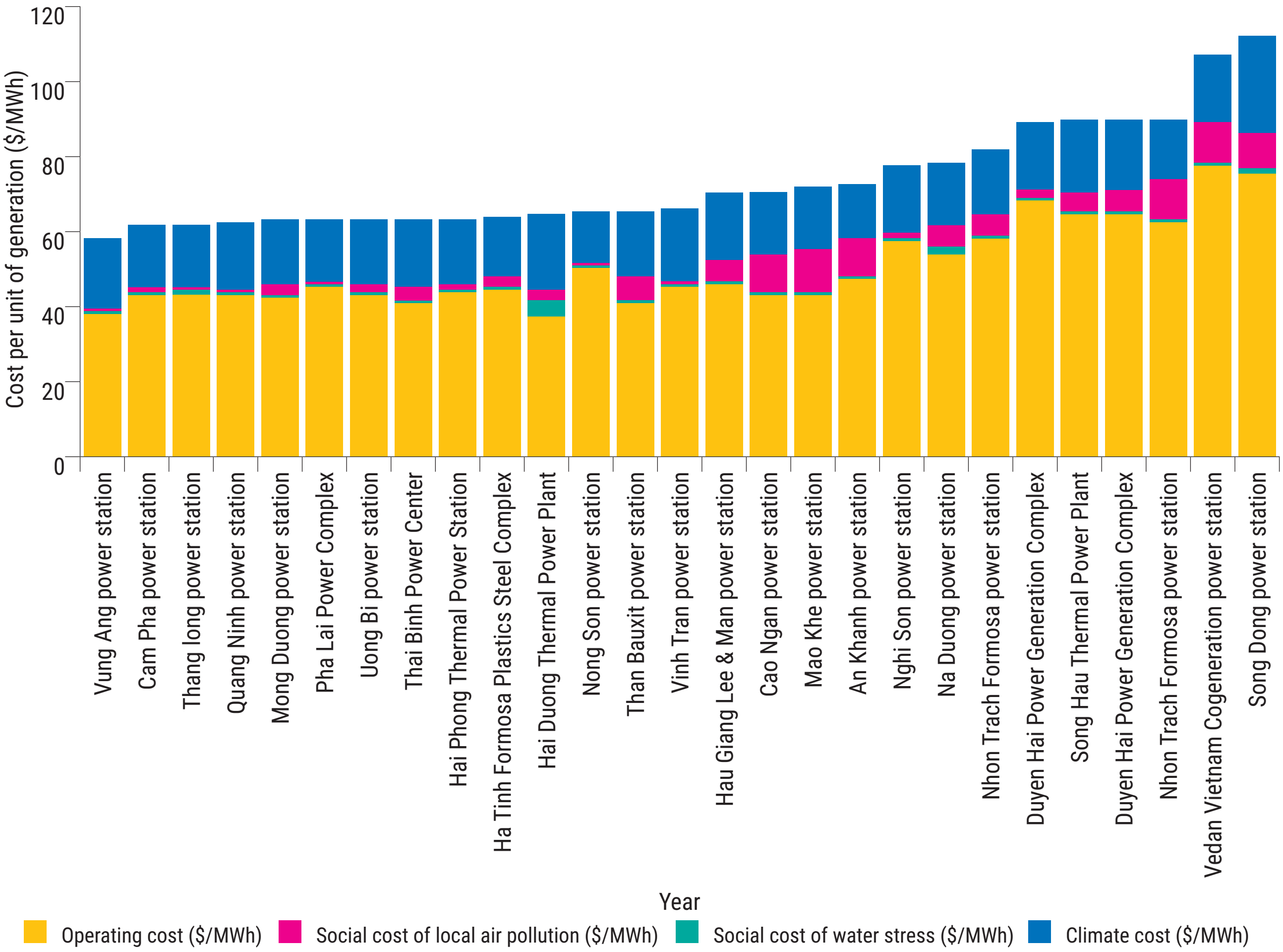
The Coal Asset Transition Tool is an open data project, which tracks coal power plant metrics and provides a high-level screening based on multiple sustainability factors.[b] Assessing total plant costs including operating costs, and externalities associated with local air pollution, water stress and global climate change, can help assess the private and public case for transitions. Estimates of these values to the coal power fleet in Viet Nam reveals a wide range of cost estimates and suggests that transitioning plants at the upper end of the spectrum may provide particularly high impact in terms of societal benefits (Figure 10).

Such approaches provide important complements to more detailed technical and economic analyses, including dynamic power system modelling. The value of such analyses in facilitating transitions also depends on the design and implementation of appropriate policy and financial mechanisms to manage interventions for individual plants.

[a] Carbon Trust, *The Carbon Trust to take core role in new initiative to accelerate the transition away from coal power to clean energy* (2021). Retrieved from: https://www.carbontrust.com/news-and-insights/news/the-carbon-trust-to-take-core-role-in-new-initiative-to-accelerate-the-transition-away-from-coal-power-to-clean-energy

[b] TransitionZero, *Coal Asset Transition* Tool (2023). Retrieved from: https://www.transitionzero.org/products/coal-asset-transition-tool

Figure 10. **Operating, social and climate costs of existing coal power plants in Viet Nam**



Source: Calculations based on TransitionZero, Viet Nam Coal Asset Transition Tool (2023).

direct and indirect employment and how this affects the local economy. Repurposing strategies can be mechanisms to avoid employment losses and provide further momentum for local economic diversification – dependent on the repurposing strategy selected and how well this is integrated and leveraged into other additional economic development investments in the local economy.

There are significant opportunities for considering repurposing coal power assets in the North of Viet Nam. There is good overlap with renewable energy generation in the areas where plants are concentrated, as well as considerable time available to plan repurposing and develop strategies with the local community. The coal power station fleet in Viet Nam is relatively young, and as coal power stations are phased out in 2030s and 2040s repurposing these assets is a viable option in mitigating the costs associated with early retirement.

There is also sufficient time to plan and bring the local community on board – the community would benefit from reduced air, soil and water pollution and associated health impacts, as well as the opportunity to redeploy these assets into economic development and diversification strategies in these populace regions with unique tourism, agricultural and other sectoral opportunities.

4.4 Previous experience of coal community transitions

Although in terms of overall number of jobs, coal mining makes up a small fraction of total employment in Viet Nam, the job losses associated with power station and mine closures in coal-dependent regions, as well as the loss of indirect jobs in their industrial ecologies, will have a deep negative effect on the labour markets, economies and livelihoods of local communities (ILO, 2021).

A review of coal transitions in four countries, Germany, Poland, South Africa and Indonesia identified three key areas to address in the transition (Mey et al, 2019). Each of these countries are at different stages of coal phase out transition, but relevant findings across each of the cases are identified:

5. **Building a social compact and institutional coordination and funding:** An agreement between relevant stakeholders, including local (particularly affected communities), regional, national, and some cases international is ideally established at the beginning of the process. This agreement includes considerations such as the process, the implementation and the desired outcomes of the transition. The importance of this has been shown in Poland and South Africa, where political roadblocks to the transition have emerged – the labour movement has wound back support for the transition because of the failure to pre-plan and invest in just transition measures for the first closures of coal plants. In contrast, Germany has secured more political support through though pre-planning and investment in just transition measures. The German Commission on Growth, Structural Change and Employment ("Coal Commission") is a platform to bring together relevant stakeholders, including representatives of local communities, to plan for the future of coal dependent regions and negotiate how resources and allocated and invested.

6. **Planning for closures:** To ensure local communities can adjust to closures, it is essential that the coal mining and power industry plan for closures and support the transformation process. This includes facilitating the economic transition for workers, rehabilitating degraded areas, and compensating or undertaking long term environmental tasks (e.g., water balance). Site remediation is important to improve the quality of the local environment and can be an important source of low and mid-skilled work at the most acute point of the transition when redundancies are fresh.

7. **Economic diversification, job creation and community benefits:** Development of renewable energy can lead to new employment opportunities production, construction and maintenance, but policies are required to ensure that new job opportunities and realized, including through the provision of retraining, as jobs may not be located close to or in similar work to job losses. Local economic diversification is also important. Examples from Poland and Germany have shown that diversification into new industries and services can reduce the economic disruptions

of coal phase out (see Mey et al. 2019 for further details), but this requires early planning, coordinated policy and initiatives from a range of stakeholders including NGOs, communities, and local governments.

4.5 Key messages

Coal mining and many coal power plants are concentrated in the north of Viet Nam. Coal mining activities are very concentrated in the most populated regions, and close to major agricultural regions - with one of top two important rice areas adjacent to the coal mining areas. These regions also have unique geography and tourism opportunities – as part of the Red River Delta and very close to major tourism site of Ha Long Bay.

Although the coal power station fleet in Viet Nam is relatively young, as coal power stations are phased out in 2030s and 2040s repurposing these assets is a viable option in mitigating the costs associated with early retirement. This Chapter identified a range of strategies for repurposing as well as criteria for considering different assets. There is good overlap with renewable energy generation in the areas where plants are concentrated, as well as considerable time available to plan repurposing and develop strategies with the local community – that could benefit from reduced air, soil and water pollution and associated health impacts, as well as the opportunity to redeploy these assets into economic development and diversification strategies in these populace regions with unique tourism, agricultural and other sectoral opportunities.

CHAPTER 5

Policy Mix for Just Energy Transition

A Just Energy Transition ensures that while working towards a more ecologically sound economy, we also plan for positive outcomes for those communities and people negatively affected by global efforts to decarbonize including for people in jobs and occupations that decline or are phased out, there are pathways mapped to other viable and decent employment, and that social protection is available to help these people on this journey.

The Paris Agreement recognizes the employment impacts in carbon intensive sectors. The ILO with their Just Transition Guidelines, as well as other institutions such as the World Bank have developed policy frameworks to help consider these employment impacts and work on ways for optimally addressing these impacts while progressing with energy transition.

5.1 The Just Transition policy mix

Policy will play a clear and influential role in initiating and shaping energy transitions, as well as ensuring that the resulting transition is just, by also considering and mitigating negative socio-economic impacts. Viet Nam is in the early stages of just transition planning for the energy sector, and as the JET partnership process evolves are more context specific perspective of the Just Transition policy mix in Viet Nam will become evidence. This section highlights relevant policy needs and gaps from global experience of just energy transition to date.

The policy mix for energy transition, is broad, and encompasses many policy fields including development and employment policy, energy policy, industry policy, training, and skills development, as well as sectoral level policies and policies at different jurisdictional levels. This broad array means that in addition to policy mix, policy coherence and coordination are also critical issues in the successful implementation of policies for promoting green jobs. Policy coherence means that interacting policy areas are aligned to meet broader energy transitions objectives – such as training and skill development policy aligned with the pace and location of development of renewable energy projects to ensure that a skilled labour force is available to undertake the work according to transition timelines, but also so local people, including those in carbon intensive industries can access new employment opportunities.

Energy transition will require identifying and implementing the country-specific policy mix (Sharpe and Martinez, 2021). This is a daunting task for many countries, while there is strong progress in many countries to map emissions reduction and energy transition trajectories, through Nationally Determined Contributions (NDCs) and associated development planning processes and polices, there is less emphasis on implementation, and integration to ensure optimal energy as well as socio-economic outcomes. Just transition policy frameworks such as those developed by international institutions such as the ILO and World Bank are currently being used to assess and plan for a just energy transition – but this work is also new for many policy officials and institutions. There is evidence from previous industrial transitions – these have not been on the same scale or timescale as the proposed energy transition. This means awareness raising and capacity building is also required with a broad set of public and private actors – to ensure these actors can effectively participate in just energy transition planning (Sharpe and Martinez, 2021a).

New sources of information and knowledge are also required, as well as ways of sharing knowledge including new institutions. Returning to the policy coherence example discussed above – where renewable energy capacity installation is matched with appropriate skill and labour force development – this requires new knowledge about what skills are required, how occupations will change, what appropriate methods will be used to develop skills in the workplace (e.g., on-the-job learning) as well as how curriculum needs to be updated, and then sharing knowledge across the sector with relevant stakeholders to ensure that public and private actors work in concert, with public interventions supporting private sector development and vice versa.

5.1.1. Energy system transition linked into labour and employment and regional development policies

The impacts of energy sector transition will be distributed different across geography and sectors. Understanding how impacts will manifest in these different contexts will be an essential first step in just energy transition planning.

In areas where coal assets currently exist, and where carbon intensive industries make up a significant proportion of the local economy, planning for energy transition needs to be integrated into the existing policy and institutional landscape, to ensure that decarbonization and changes to energy systems, such as renewable energy infrastructure and retirement of coal power plants, also consider the socio-economic impacts of change. But conversely, that regional economic development plans also consider how energy transition can be used to leverage and accelerated local development. One critical dimensions of the socio-economic impacts is the employment dimension, but as early chapters of this report have shown health and environmental impacts are also significant and largely positive. Ensuring these impacts and implications are adequately mapped and incorporated into decision making will help guide just energy transition.

Regional and local government authorities will be key actors in these activities – they will require resources including information, knowledge, networks as well as financial resources to be able to undertake these tasks. Building grass roots civic capacity and support for energy transition will also be critical in these communities.

5.1.2 Providing coordination and integration including through new institutional development

As the energy transition is far-reaching and involves many public institutions, how policy is coordinated across government and the economy is integral to its success. Part of the policy mix also needs to consider how policies are coordinated and coherent. In Chapter 4, the analysis of previous examples of energy transition highlighted the importance of careful planning and coordination, and how this can be best achieved by some form of new institutional development – such as the Net Zero Authority (National level) and the Latrobe Valley Authority (sub-national, regional level), and the German Commission on Growth, Structural Change and Employment ("Coal Commission") as a platform to coordinate relevant stakeholders, including representatives of local communities, to plan for the future of coal dependent regions and negotiate how resources and allocated and invested.

There are limited examples of these types of new institutions in Asia, and relevance for the local context is a critical success factor for these types of institutions, so developing and trialing experimental models of these types of coordinating institutions in Asia, and evaluating, analyzing and sharing this information on their role and performance in energy transition will be necessary to support just energy transition in Viet Nam, but then also sharing this experience with other Asia-Pacific countries.

5.1.3 Availability of social protection

The availability of social protection for workers and communities who are affected by energy transition – both directly and indirectly will be a critical enabler of just energy transition. A comprehensive social protection system includes measures that enhance the adaptive capacity of individuals and communities to absorb and respond to shocks (ILO 2019). Measures include affordable health care, unemployment protection and facilitated early retirement for workers of advanced age at risk of losing their jobs due to phase-outs of carbon-intensive industries.

Ensuring social protection also achieves just energy transition objectives in carbon intensive regions and sectors, as well as with target vulnerable groups such as women and young people. These groups may require specific interventions or conditions – planning and implementation of social protection and active labour market programs as part of just energy transition will need to actively involve these groups.

5.1.4 Skills development and reskilling pathways

Policies and mechanisms that are matched to skills demand and supply for energy transition will ensure timely and efficient energy transition that maximizes employment opportunities. The ability to pre-empt and anticipate skills demand and transition options for workers in carbon intensive sectors to move into low carbon sectors would minimize employment disruption and smooth the energy transition. Skills gaps are forecast to be a barrier to energy transition.

Skills development will require skills development policies but also actions by the institutions that provide and assess these skills such as Vocational and Technical Training organizations. Skills needs and where competencies for existing occupations will need to be enhanced are available from other jurisdictions globally – a key action would be to translate and contextualize this mapping for Viet Nam.

5.1.5 Adequate and accessible financing

The capital requirements for energy transition in Viet Nam are vast – when we consider the whole energy system and the infrastructure that will be required. The financing and funding needs of just energy transition will also be immense, but multifaceted – some investments requiring large one-off investments, other activities requiring smaller ongoing community scale investments. The challenge in financing will be to develop systems and mechanisms that can provide adequate finance in a form that is accessible and with timing that enables leverage and co-investment to make transformative changes to the energy system and the lives of impacted communities and workers.

5.1.6 Enabling knowledge sharing and learning

Just transition planning is a new skill set for policy makers globally. For many countries in Asia, energy transition and how to create, translate and implement this transition are emerging policy issues with corresponding policy skills and capacity gaps (ASEAN 2021).

In the situation of coal phase-out change is readily identifiable in specific regions and communities, making it easier to work out where interventions need to take place. Less obvious is the transition pathways for impacted workers and communities to new employment and livelihoods, especially when obvious low carbon industrial activities such as renewable energy do not always readily match to the region as it transitions away from coal. Even when these matches occur, significant planning, dialogue and investments are required over a sustained period to build up the economic diversity and other opportunities needed for the transition of these workers and communities.

Although transition will be a context specific process for each community – there are many aspects of the trial and error of the transition processes that can be shared and learned from, developing processes for sharing knowledge at the global, national, and local levels will make it easier to access this relevant experience and expertise.

CHAPTER 6

Conclusions

Viet Nam announced the goal of achieving net zero by 2050 to the international community at the COP26 and then updated Viet Nam's National Determined Contributions (NDC) at COP27 in which the country's 2030 unconditional and conditional GHG emissions reduction targets have been increased from 9 per cent and 27 per cent to 15.8 per cent and 43.5 per cent compared to BAU, respectively. The energy sector is of particular focus as this sector account for the majority of Viet Nam's current and forecast emissions.

The transition pathways for the Viet Nam electricity generation sector show a strong increase in renewable energy generation capacity in the short to medium term, to ensure that the majority of Viet Nam's electricity is generated from renewable sources by 2030, and to create the trajectory to net zero by 2050. In addition to increased renewable energy generation capacity, transmission, and grid infrastructure, battery storage will be required to ensure the stability and flexibility of the electricity sector, as well as energy efficiency activities to efficiently meet Viet Nam's rapidly increasing industrial demand. These changes in generation, grid infrastructure and energy efficiency will need to be front loaded into the energy transition - ramping up in the 2020s and 2030s to ensure the net zero trajectory. This also means the employment implications – both job growth and skill development needs will also need to be short term considerations.

As coal starts to play a decreasing role within electricity generation in Viet Nam, and as global action for coal phase out continues, coal mining activities will phase out. The key decade for coal phase out will be in the mid 2030 through to 2040s. Just transition processes require long timelines to ensure alternative pathways for affected workers and communities are established, so initiating and creating community momentum for just transition planning processes should also commence in 2020s.

Coal phase out will have significant socio-economic impacts. Many of these impacts are positive. Employment impacts will result from new activities in constructing and maintaining renewable energy generation capacity, transmission, and grid augmentation, as well as in energy efficiency activities. This employment growth will outnumber job losses associated with coal phase out.

In the energy sector – occupations in coal power plants overlap in terms of skills and competencies with renewable energy generation, and in a tight labour market for these skills employers, enterprises, and relevant institutions such as universities and training institutes can work on transitioning these workers into renewable energy-based employment. Even so, it is unlikely that supply will keep up with demand for skilled employment in the transforming energy system – dedicated policy and investments will be required to ensure that demanded skills will be able to be readily found in local labour markets.

Newer sub-sectors of the energy industry – including renewable energy, do not have the same foundation of industrial relations experience and institutions – so in creating this new employment, efforts will also be required to ensure that decent work, security of tenure, freedom of association and social dialogue also become part of work in these new energy sectors. Ensuring workers moving into the emerging energy sector are not disadvantaged in working conditions compared with the established energy sector will be important in attracting the required skilled labour. There is also an opportunity with providing a gender transformative lens to skills development and labour market policies for the energy sector that women's long-standing under-representation in the sector can also transition.

There are significant health and environmental benefits associated with coal phase out – including reduced impacts of air and soil pollution. As well as other economic benefits such as more efficiency energy productivity, energy independence, and reduced fuel costs from electricity demand. Policy will play a critical role in initiating and coordinating energy transition and ensuring that the energy transition is also a just transition. Key policy elements that need to be in place include:

- Linking energy system transition to labour and employment and regional development policies
- Providing coordination and integration including through new institutional development
- Availability of social protection
- Skills development and reskilling pathways
- Adequate and accessible financing
- Enabling knowledge sharing and learning.

Annex 1

Methodology for estimating health and environmental benefits of coal phase out in Viet Nam.

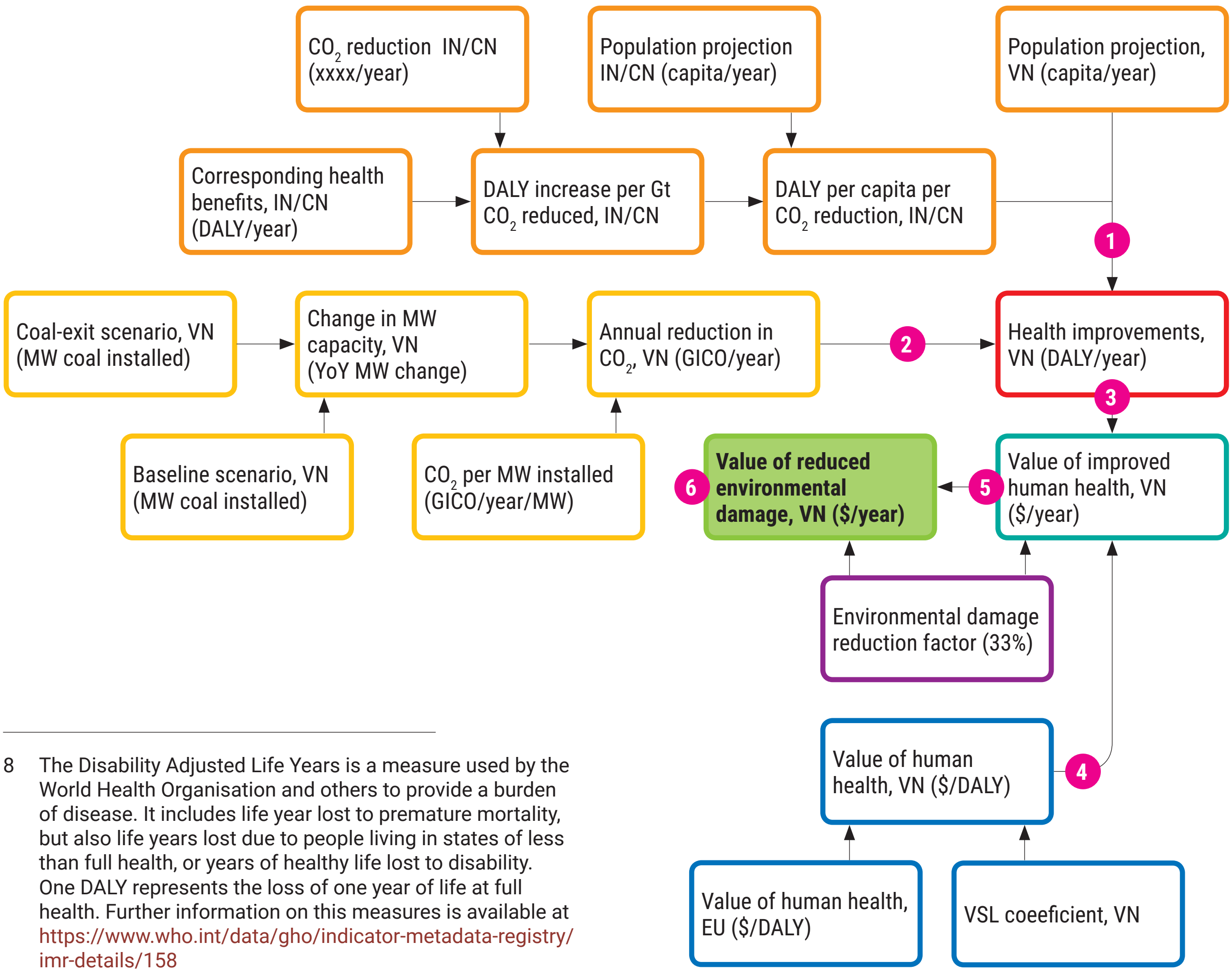
This analysis first investigated the relationship between CO_2 reduction (Gt CO_2/year) and the corresponding health benefit (DALY/year[8]) for China and India as presented in the Rauner et al (2020) paper. After accounting for each country's population size, each gigaton of CO_2 reduced results in an additional 0.5 day of disability-adjusted life day (DALD) lived per person, per year.

The Coal-Exit scenario (EREA and DEA – presented in the previous Chapter) is compared against baseline scenario (PDP-8) to derive the change in MW capacity each year. An estimate of CO_2 generated per MW of installed capacity is estimated to be 6.3 MtCO_2 /year per 1000 MW, assuming 80 per cent capacity factor. This two information are combined to calculate the marginal reduction in CO_2 for each year. (1) and (2) are combined to calculate the marginal health improvements from coal-exit scenario.

The base value of human health (DALY) is estimated to be $118,421 (USD)/DALY for EU-28 in 2005 (Rauner et al., 2020). This value reflects the amount a person is willing to pay to mitigate the mortality risk of one life year and the risk of one life year of nonoptimal health. A value transfer coefficient (VSL) specific to Viet Nam (available for 2020, 2030, 2040 and 2050) is applied to derive the value of human health for Viet Nam over time. (3) and (4) are multiplied to derive the final value of improved human health from coal exit.

Using a rough ratio of environmental damage reduction to human health improvements (1:3), it is also possible to estimate the value of environmental damage reduction at a high level.

Schematic overview of modelling approach



8 The Disability Adjusted Life Years is a measure used by the World Health Organisation and others to provide a burden of disease. It includes life year lost to premature mortality, but also life years lost due to people living in states of less than full health, or years of healthy life lost to disability. One DALY represents the loss of one year of life at full health. Further information on this measures is available at https://www.who.int/data/gho/indicator-metadata-registry/imr-details/158

References

ADB. (Asian Development Bank) .2021. 'ADB Support for a Just and Affordable Energy Transition'. July 22 2021. https://events. development.asia/system/files/materials/2021/08/202108-adb-support-just-and-affordable- energy-transition.pdf. WRONG ADDRESS!!

ASEAN. *Regional Study on Green Jobs Policy Readiness in ASEAN*.; ILO and ASEAN: Bangkok, Thailand, 2021

Barnes, M. (2023) "Viet Nam Government Approves Power development Plan 8". *Viet Nam Briefing*, available at https://www.vietnam-briefing.com/news/vietnam-power-development-plan-approved.html/, accessed 8 July 2023.

CIF (Climate Investment Funds). 2023. ReACT: A simplified guide to repurpose coal assets. March 2023. Clean Technology Fund: Washington DC. USA.

Global Energy Monitor. (2023). Global Coal Mine Tracker, April 2023 release.

Global Energy Monitor. (2023a). Boom or Bust - Tracking the Global Coal Pipeline. https://globalenergymonitor.org/wp-content/uploads/2023/03/Boom-Bust-Coal-2023.pdf, accessed 7th June 2023.

EREA & DEA (2022) *Viet Nam Energy Outlook Report 2021*, available at https://efaidnbmnnnibpcajpcglclefindmkaj/https://ens.dk/sites/ens.dk/files/Globalcooperation/vietnam_energy_outlook_report_2021_english.pdf

IEA (International Energy Agency).2020. World Energy Employment 2019. Available at https://www.iea.org/reports/world-energy-employment/overview, accessed 14th July 2023.

IEA. 2022. World Energy Outlook 2022. Available at https://www.iea.org/reports/world-energy-outlook-2022, accessed 14th July 2023.

ILO (International Labour Organization).2015. 'Guidelines for a Just Transition towards Environmentally Sustainable Economies and Societies for All'. available at https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/ publication/wcms_432859.pdf. Accessed 7th June 2023.

ILO. 2019. Green Jobs and a Just Transition for Climate Action in Asia and the Pacific; ILO Regional Office of Asia and the Pacific: Bangkok, Thailand, 2019.

ILO. 2020. ILOSTAT Database, Female Workforce Participation in Viet Nam.

ILO. 2021. A just energy transition in Southeast Asia: The impacts of coal phase-out on jobs, 2021, ILO: Bangkok available at https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/documents/publication/wcms_845700.pdf, accessed 7th June 2023.

ILO. 2021a Women in Mining; Toward Gender Equality. S.l.: Sectoral Policies Department. ILO. Geneva.

ILO. 2021b. ILOSTAT Database, Utility Sector Workforce Characteristics

Marquez, J. E., Pourret, O., Faucon, M. P., Weber, S., Hoàng, T. B. H., & Martinez, R. E. (2018). Effect of cadmium, copper and lead on the growth of rice in the coal mining region of Quang Ninh, Cam-Pha (Viet Nam). Sustainability, 10(6), 1758.

Martinez, R. E., Marquez, J. E., Hòa, H. T. B., & Gieré, R. (2013). Open-pit coal-mining effects on rice paddy soil composition and metal bioavailability to Oryza sativa L. plants in Cam Pha, northeastern Viet Nam. Environmental Science and Pollution Research, 20, 7686-7698.

Mey, F., Briggs, C., Setton, D., Dominish, E., Rutovitz, J., Nagrath, K. (2019) Case studies from transition processes in coal dependent communities. Prepared by ISF and IASS for Greenpeace Germany. Sydney and Berlin.

Minh, A., (2023) "EVN reports $1.5b loss in 2022", VN Express International, March 31 2023, available at https://e.vnexpress.net/news/companies/evn-reports-1-5b-loss-in-2022-4588187.html, accessed 8 July 2023

Minh Ha-Duong, An Ha Truong, Nam Nguyen, Hoang Anh Trinh Nguyen (2016) Synthesis Report on Socio-environmental Impacts of Coal and Coal-fired Power Plants in Viet Nam. Clean Energy and Sustainable Development lab report, Hanoi. https://hal-enpc.archives-ouvertes.fr/hal-01441680/document.

Mijał, W. (2018). Coal mining and coal preparation in Viet Nam. Inżynieria Mineralna, 19.

Myllyvirta, Lauri (2015). "Impacts of planned coal-fired power plant expansion on air quality and health in Vietnam", presentation on 29 September 2015 at Conference "Coal & Coal-fired power plants: What have not been known?", Sustainable Energy Alliance, GreenID, Hanoi.

Nguyen, Q. N., Nguyen, V. H., Pham, T. P., & Chu, T. K. L. (2021). Current Status of Coal Mining and Some Highlights in the 2030 Development Plan of Coal Industry in Viet Nam. Inżynieria Mineralna.

Okunlola, A., Nagel, L., Helgenberger, S., Khanh, N.T., Dung, T.M., and Kovac, S. (2019) Future skills and job creation through renewable energy in Viet Nam: assessing the co-benefits of decarbonizing the power sector. Available at https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.cobenefits.info/wp-content/uploads/2020/08/COBENEFITS-Vietnam_Employment_Exec-Report.pdf, accessed on 9th July 2023.

Rauner, S., Bauer, N., Dirnaichner, A., Dingenen, R.V., Mutel, C. and Luderer, G., 2020. Coal-exit health and environmental damage reductions outweigh economic impacts. Nature Climate Change, 10(4), pp.308-312.

Sharpe, S.A., and Martinez-Fernandez, C.M. (2021). 'The Implications of Green Employment: Making a Just Transition in ASEAN'. *Sustainability* 13, no. 13: 7389. https://doi.org/10.3390/su13137389

Sharpe, S.A., and Martinez-Fernandez, C.M. (2021a) 'Just Energy Transition in Asia', *Diplomatic Journal for Global Energy Cooperation*, Vol 13, July 2021.

Steckel, Jan C., and Michael Jakob. (2021) "The political economy of coal: Lessons learnt from 15 country case studies." World Development Perspectives 24 (2021): 100368.

Teske, S., Morris, T., Nagrath, K., Dominish, E.; (2019) Renewable Energy for Viet Nam – A proposal for an economically and environmentally sustainable 8th Power Development Plan of the government of Viet Nam.

United Nations, Economic and Social Commission for Asia and the Pacific (ESCAP) (2021), Coal Phase Out and Energy Transition Pathways for Asia and the Pacific. Available at https://www.unescap.org/kp/2021/coal-phase-out-and-energy-transition-pathways-asia-and-pacific#:~:text=The%20'Coal%20Phase%20out%20and,Agreement%20and%20Sustainable%20Development%20Goals (accessed 7th June 2023).

United Nations, Economic and Social Commission for Asia and the Pacific (ESCAP) (2022). Energy Transition Pathways for the 2030 Agenda: SDG 7 Roadmap for Viet Nam.

Yuen, K. W., Hanh, T. T., Quynh, V. D., Switzer, A. D., Teng, P., & Lee, J. S. H. (2021). Interacting effects of land-use change and natural hazards on rice agriculture in the Mekong and Red River deltas in Viet Nam. Natural Hazards and Earth System Sciences, 21(5), 1473-1493.

World Bank. 2018. 'Managing Coal Mine Closure : Achieving a Just Transition for All'. https://openknowledge. worldbank.org/bitstream/handle/10986/31020/130659-REVISED-PUBLIC-Managing-Coal-Mine- Closure-Achieving-a-Just-Transition-for-All-November-2018-final.pdf?sequence=1&isAllowed=y.

WWF (Worldwide Fund).2023. Viet Nam's Energy Sector Vision: Towards 100% Renewable Energy by 2050. March 2023.

USAID Clean Power Asia. 2017. Gender Equality in Renewable Energy in the Lower Mekong: Assessment and Opportunities. Bangkok.

US AID (2021) US AID Viet Nam Low Emission Energy Program II (V-LEEP II) - Technical Report: Analysis of Peak Coal in Vietnam long-term power development planning scenarios. Available at https://pdf.usaid.gov/pdf_docs/PA00ZDD5.pdf, accessed 14th July 2023.