Full report

Identifying finance needs for a just transformation of Indonesia's power sector

An analysis using the Just Energy Transition Finance Needs tool // JET-FIN

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IESR
Institute for Essential Services Reform

NEW CLIMATE INSTITUTE

Authors

Harry Fearnehough	NewClimate Institute
Reena Skribbe	NewClimate Institute
Lotta Hambrecht	NewClimate Institute
Farah Vianda	IESR
Putra Maswan	IESR

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Additional resources

This report is accompanied by the JET-FIN tool, a publicly available Excel file, which includes core data, calculations and related analysis set out in this document.

The JET-FIN tool is intended to improve access to key information to enable further analysis of potential pathways, updated data and alternative assumptions for the future development of Indonesia's electricity system. It can also be used as a tool to identify and analyse finance needs for electricity sector decarbonisation pathways in other countries.

Additional complementary quantitative analyses for employment (EIM-ES model) and health impacts (AIRPOLIM-ES model) that feed into the JET-FIN tool are also published alongside this report as well as a methodological appendix setting out the steps of our approach and data sources in greater detail. These materials are available for download from the publication page:

https://newclimate.org/resources/publications/identifying-finance-needs-for-a-just-transformation-of-indonesias-power

Contents

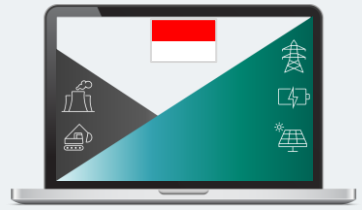
A note on reading this report…

This report is organised into discrete sections, which address different elements of potential finance needs for a just transformation of Indonesia's power sector. Whilst the list is not comprehensive, we have included selected finance needs we identify as most material in scale and relevance, in particular where they pose potential barriers to the smooth transition of the energy sector.

Each section can be read in isolation and is intended as a standalone reference, although there are inevitably clear interlinkages between them. In each section (e.g. fossil phase-out; clean build-up, employment, etc.) we aim to first set out the headline issue or challenge presented by the energy transition, before outlining the key steps of our approach to identifying finance needs and then reporting our findings with accompanying discussion.

Greater detail on our methods and data for each core section are provided in a separate document for readers looking to better understand our approach or use it for their own purposes, available for download here.

Accompanying Excel-based tools (JET-FIN, EIM-ES and AIRPOLIM-ES) with relevant data and calculations are published alongside this study to enhance transparency, allow others to view more detailed results, test alternative data and assumptions as well as apply the models to alternative countries, or contexts. These are available online at: https://newclimate.org/resources/publications/identifying-finance-needs-for-a-just-transformation-of-indonesias-power



List of abbreviations

AIRPOLIM:	Air Pollution Impact Model
APS:	Announced Pledges Scenario (in IEA Energy Roadmap)
CAPEX:	Capital expenditures
CCS:	Carbon Capture and Storage
CFPP:	Coal-fired power plant
CIPP:	Comprehensive Investment and Policy Plan
EIM-ES:	Economic Impact Model for Electricity Supply
GFANZ:	Glasgow Financial Alliance for Net Zero
GCPT:	Global Coal Plant Tracker
GoI:	Government of Indonesia
IEA:	International Energy Agency
IESR:	Institute for Essential Services Reform
IHD:	Ischemic heart disease
IPG:	International Partners Group
IPP:	Independent power producer
IUP:	Izin Usaha Pertambangan (mining licence holders)
JET-FIN:	Just Energy Transition Finance tool
JETP:	Just Energy Transition Partnership
LCOE:	Levelized cost of electricity
LRMC:	Long-run marginal cost
LUT:	Lappeenranta-Lahti University of Technology
MEMR:	(Indonesian) Ministry of Energy and Mineral Resources
NO_x:	Nitrogen oxides
NZE:	Net Zero Scenario (in IEA Energy Roadmap)
OPEX:	Operational expenditures
QGIS:	Open-source Geographical Information System mapping software
PLN:	Perusahaan Listrik Negara (Indonesian state-owned utility)
$PM_{2.5}$:	Particulate matter
PPA:	Power purchase agreement
RUPTL:	Recana Usaha Penyediaan Tenaga Listrik (electricity business plan)
SO_2:	Sulphur dioxide
WACC:	Weighted average cost of capital
VSL:	Value of a statistical life
YLL:	Years of life lost

Summary

Key findings

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In the context of Indonesia embarking on a transition of its electricity system the objective of this report is to identify and approximate key finance needs to support its successful delivery

CONTEXT

The Government of Indonesia agreed in November 2022 to cooperate with a number of other governments as well as private sector banks towards a range of decarbonisation and economic development goals.

Indonesia's Just Energy Transition Partnership (or 'JETP') places a central focus on peaking and then cutting power sector emissions with the support of public and private finance.

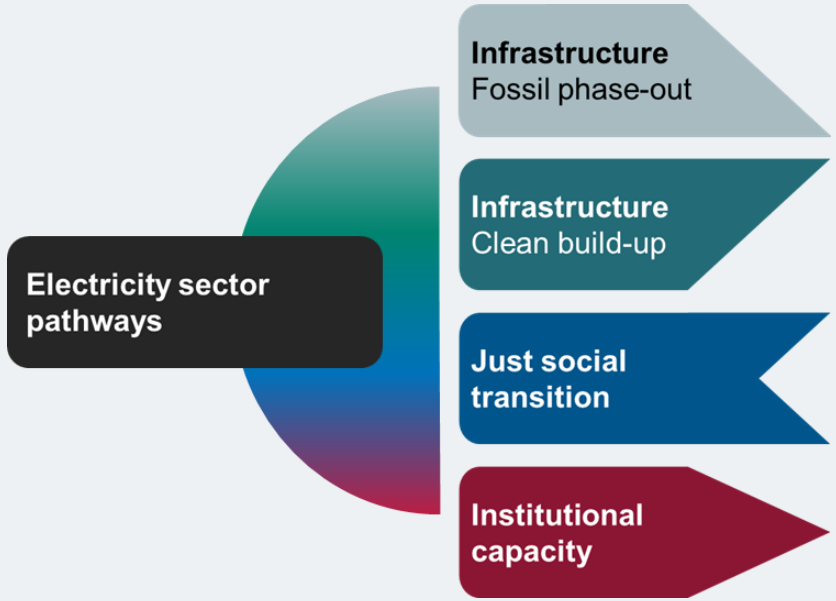
OBJECTIVE

To help inform critical considerations in kick-starting the shift from fossil fuel reliance to clean technologies and to better understand the scale and type of investment needed for a Paris-aligned just energy transition, we have developed an open-source Excel model, 'JET-FIN'.

This tool facilitates analysis of key finance needs for a just energy transition in Indonesia's power sector, covering different pathways and allowing users to adjust critical parameters to test their influence on potential investment needs over time. Due to its modular setup, it can also be applied to different scenarios and other country contexts.

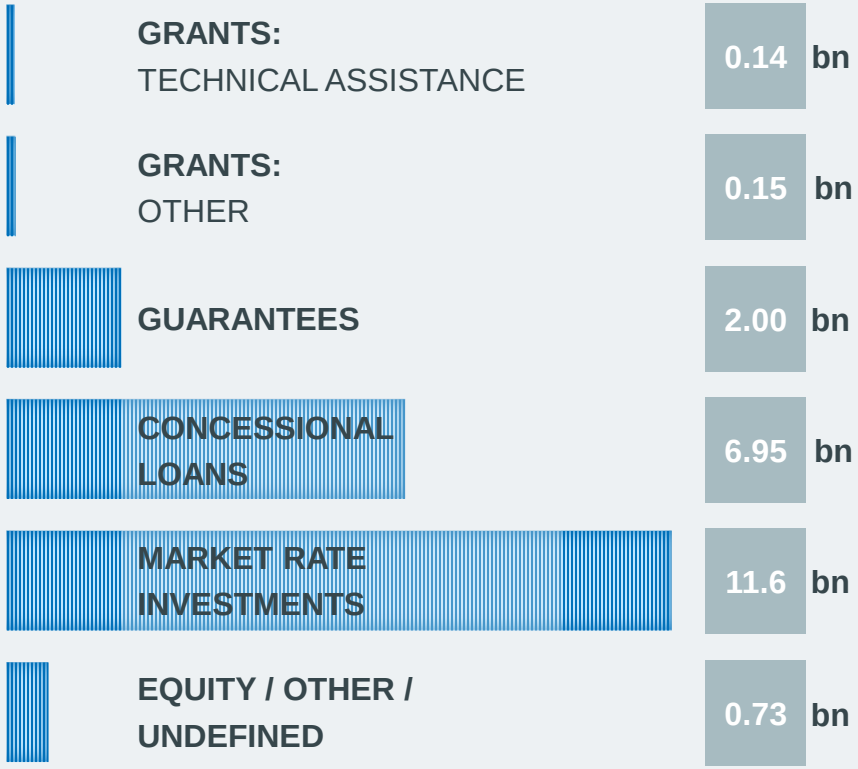
APPROACH

Our analysis takes electricity sector pathways and steps through key elements of the energy transition in Indonesia that require financing.



MENU OF FINANCIAL INSTRUMENTS

The JETP support put forward to date by the IPG and GFANZ of USD 22bn represents a range of different financial instruments, with the vast majority of funding in the form of market rate investments and concessional loans



Source: Authors analysis of CIPP (JETP Secretariat, 2023)

For each area of finance needs covered by our analysis we include a high-level traffic light assessment and brief commentary on the potential relevance of the different financial instruments on offer to meet identified finance needs in Indonesia.

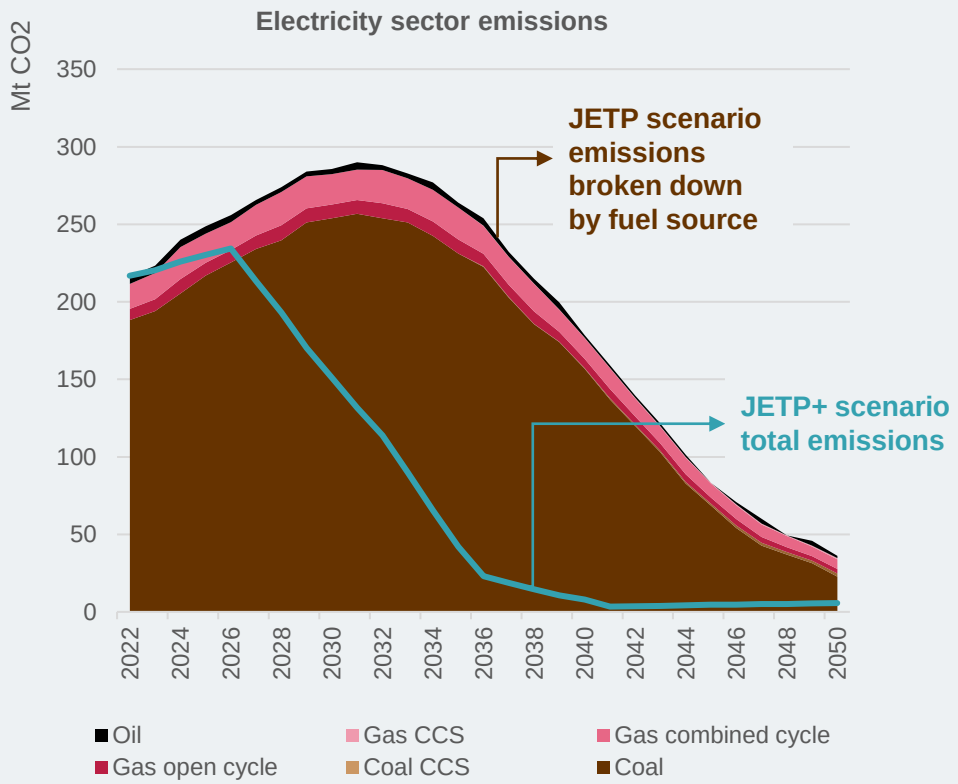
The USD 22bn funding proposal set out in the Comprehensive Investment and Policy Plan (CIPP) is intended as catalytic investment to raise climate ambition and promote sustainable development objectives in the Indonesia electricity sector over the next 3-5 years.

It is clear that this funding alone is only a fraction of the finance needs required to deliver a just energy transition and will require major additions from further private sector actors, the Government of Indonesia (GoI) as well as potentially future additional public financial support from International Partner Group (IPG) members.

Electricity sector pathways

Indonesia's JETP sets out a pathway to first limit, and then cut, emissions from Indonesia's electricity sector and help drive its economic growth through rapid scaling-up of renewable energy, firmly grounded in a vision to become a developed country by the time it marks 100 years of independence in 2045

- We analyse finance needs for two scenario pathways: the '**JETP** scenario' that aligns with the JETP targets as well as a '**JETP+** scenario' that explores the implications for a more ambitious, 1.5C-aligned, temperature rise trajectory.
- Both scenarios represent a **major transformation from how electricity is generated in Indonesia today**, with a clear shift away from a reliance on coal, towards building up a clean and reliable power system based on renewables and greater interconnection within and between the islands of the vast archipelagic nation to meet rising demand.
- Capacity to supply electricity in the JETP scenario is set to pivot **away from large fossil-fuelled plants to 500 GW of renewable energy**
- Cumulative emissions, which are the critical determinant of global warming impacts, from 2022-2050 are around 5.6 $GtCO_2$ (billion tonnes) in the JETP scenario, and less than half this level, at 2.4 $GtCO_2$, in the JETP+ scenario.



Source: NewClimate, IESR.

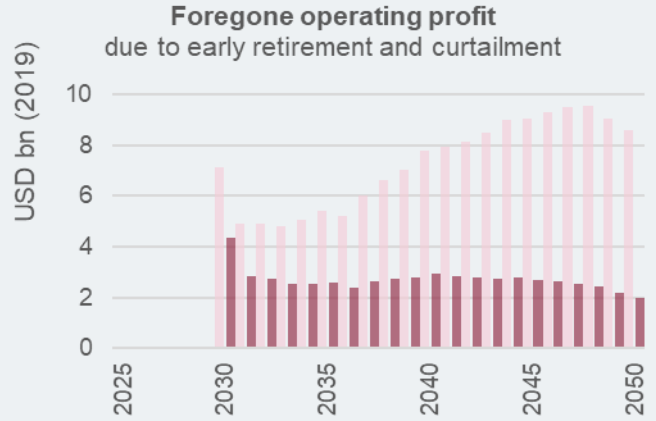
Infrastructure
Fossil phase-out

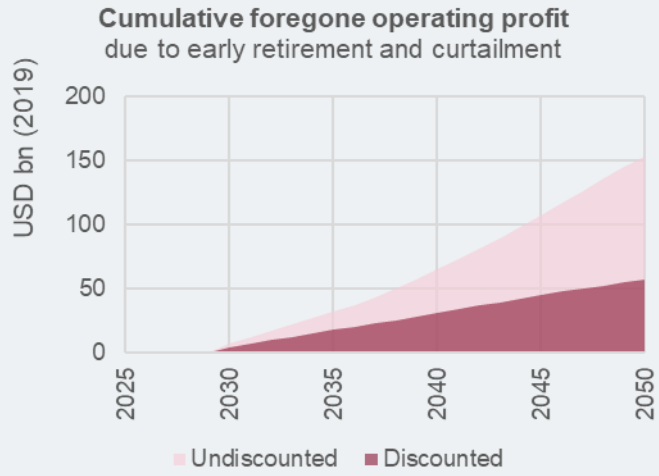
1/2

Limiting the use of existing and new coal plants is fundamental to accelerating the transition.

Public finance, in combination with policy reform, could play a role in establishing incentives to bring forward coal plant retirement and restrict operations.

- Installed **coal capacity in Indonesia is expected to reach around 70GW by 2030, almost doubling in the current decade**, driven largely by off-grid (captive) plants used by industry. Reducing coal plant lifetime or curtailing their usage is critical to aligning with JETP objectives.
- We estimate coal plant owners may face potential losses from the transition in the order of **USD 20-60 billion** (in present value terms) to meet the JETP scenario targets, and around *double* this amount to deliver the more ambitious, 1.5°C-aligned JETP+ scenario.
- These estimates are **highly sensitive to key analytical assumptions**, such as determining the technical lifetime of coal plants, how to discount future potential cashflows and the counterfactual against which losses are measured.
- **Public finance** (from the GoI and international donors, such as the IPG) can play a role in providing compensation for these losses. However, given scarce public funds, **policy reform** is also critical.





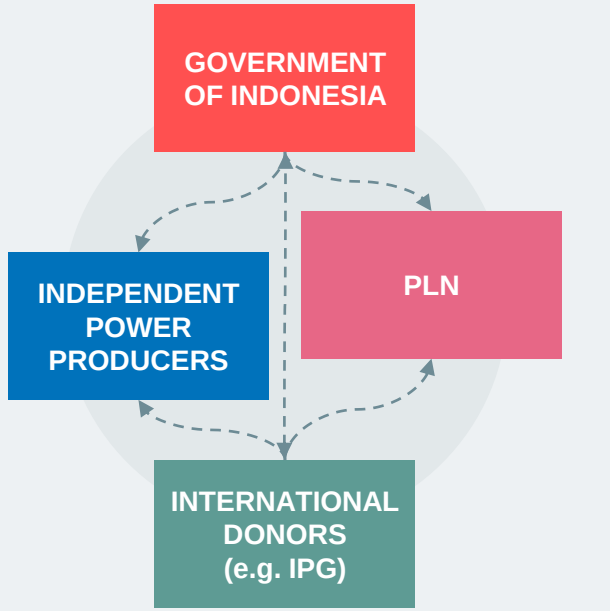
Source: NewClimate, IESR.

Infrastructure
Fossil phase-out

Sharing the burden of potential losses from reducing the lifetime and operation of the coal fleet is a critical part of delivering a successful transition.

The precise scale and form of any compensation will require more data and depend on detailed negotiations between key stakeholders.

- The IPG has committed to provide climate finance to accelerate Indonesia's energy transition. It can support the coal phase-out through **expanding both its provision of grants as well as offering concessional loans to IPPs and PLN** that enable them to offset potential coal plant losses through benefiting from the commercial opportunities available in the rapid renewable energy expansion.
- We estimate that a **carbon tax applied to coal generation, starting at USD 2 per tCO_2 today and rising incrementally by just USD 2-3 per tCO_2 each year**, could raise government revenues in the order of USD 60-80bn (present value terms) providing another possible source of funds to compensate potential coal plant owner losses in the JETP scenario. Under such an approach carbon prices would remain well below social costs of emissions arising from climate change and reflect a similar order of magnitude to health costs from coal generation.
- Coal plant owners may need to bear some of the potential losses as they would have **factored 'stranded asset' risk into their investment decisions**. A large share of Indonesia's coal fleet entered operations after the Government ratified the Paris Agreement in 2016, with the need to rapidly decarbonise the global economy apparent well before then.



Infrastructure
Fossil phase-out

As retiring plants early or reducing their operations does not offer a direct return on an investment, grants are a potential instrument to help incentivise reducing coal generation. However, the current grant offering from the IPG is extremely limited, meaning concessional loans for new investments may offer the most feasible route to compensating potential losses.

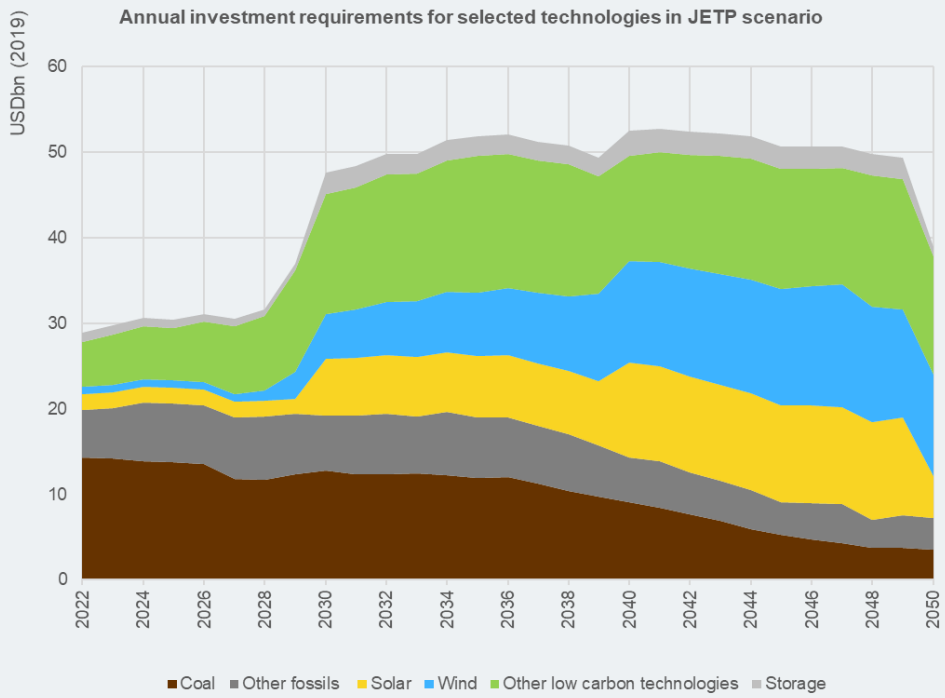
Breakdown of available JETP funding

GRANTS: TECHNICAL ASSISTANCE	Support development of early-retirement planning, analysis and stakeholder engagement to determine profile of phase-out, support implementation, provide legal advice, etc.
GRANTS: OTHER	Directly contribute to negotiated compensation packages provided to plant owners for early-retirement or curtailment
GUARANTEES	Not relevant
CONCESSIONAL LOANS	Indirect compensation provided to coal plant owners (incl. PLN) with conditions to re-invest in renewables, storage or critical grid infrastructure that enables higher renewables penetration
MARKET RATE INVESTMENTS	Not relevant
EQUITY / OTHER / UNDEFINED	Not relevant

Infrastructure
Clean build-up

Delivering the JETP goals requires a major pivot in investments in the Indonesian energy sector away from fossil fuel infrastructure towards a rapid scaling-up of renewable capacity, energy storage and new and improved grids

- Cumulative investments to supply electricity under the JETP scenario reach USD 1.3 trillion over the period to 2050, **USD 0.9 trillion** of which is channelled to renewable technologies.
- Annual total finance needs for electricity supply technologies are in the order of USD 50 billion from the 2030s.
- Additional investments of around USD 0.5 trillion up to 2050 are required to expand and enhance transmission and distribution grids.
- Targeted, short term support to selected renewables can help catalyse their initial development. Public financial support, in the form of subsidies, of around **USD 300 million**, could help deliver 10GW of utility solar PV in 2025 at the same cost of operating existing coal plants.
- To align with the JETP scenario, we estimate that by 2030 an injection of around USD 4 billion of public subsidies could enable cost competitive deployment of 2GW of rooftop PV and 5GW onshore wind, helping catalyse their initial roll-out.



Source: NewClimate, IESR.

Notes: 'Other low carbon technologies' include geothermal, hydro, nuclear and biomass technologies.

Estimated investment requirements cover capital and operational expenditures, including spending on fuel.

Infrastructure
Clean build-up

The majority of investments in clean build-up should offer commercially attractive rates of return, although concessional finance can serve as a valuable tool to kick-start investments in solar PV and other renewables, as well as critical grid and storage infrastructure. Limited grant-based funding could support building administrative capacity early on.

Breakdown of available JETP funding

GRANTS: TECHNICAL ASSISTANCE	Support aspects such as planning, permitting, design of new regulation, general sector analysis and stakeholder engagement to facilitate a rapid roll-out of clean technologies
GRANTS: OTHER	Targeted support to fund critical grid infrastructure that improves energy access and enables integration of renewables into remote areas which are otherwise commercially unattractive
GUARANTEES	Potential role to allow public development banks to leverage more, early investment to accelerate the transition and raise ambition
CONCESSIONAL LOANS	Provided to investors (incl. PLN) to fund less mature and higher cost renewables as well as storage and grid infrastructure that is essential to enable integration of renewables
MARKET RATE INVESTMENTS	Key source of funding to catalyse the roll-out of critical, low-cost, renewable technologies and demonstrate their value to commercial investors
EQUITY / OTHER / UNDEFINED	A range of different instruments are potentially relevant depending on specific project characteristics and timing in the clean build-up

Just social transition

As the JETP pathway entails socio-economic reform extending beyond the core of the energy sector it offers an opportunity to address long standing structural injustices and promote more equitable outcomes for all.

Our analysis focuses on a limited set of finance needs and indicators, zooming in on the domestic coal sector.

Key **principles** to describe justice

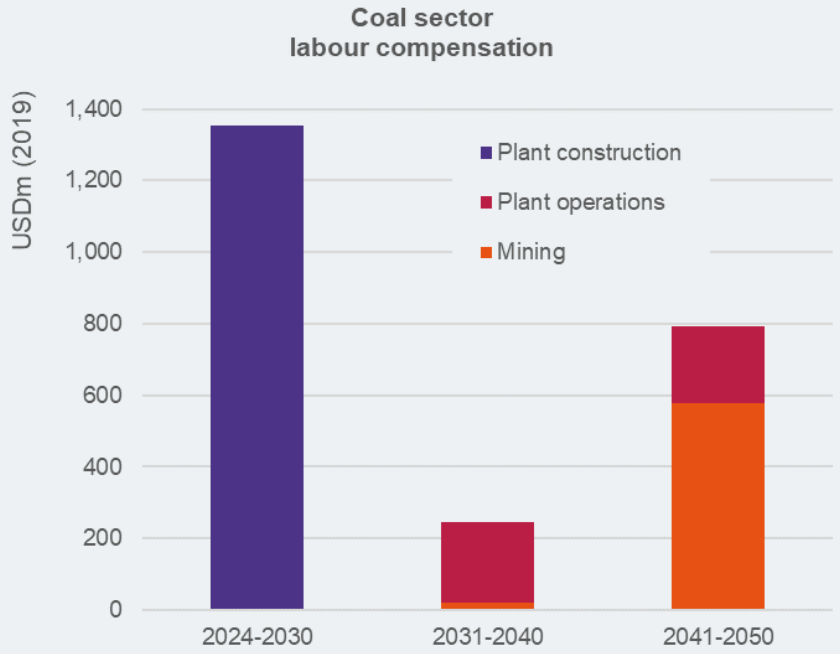
- **DISTRIBUTIONAL JUSTICE**
- **PROCEDURAL JUSTICE**
- **RECOGNITION JUSTICE**
- **STRUCTURAL JUSTICE**

- In the context of an energy transition, justice needs to be understood across all levels of governance, including both national and sub-national levels.
- To address the needs of the most vulnerable to climate change and the energy transition it is crucial to examine local contexts and give a voice to those typically structurally underrepresented in planning and decision processes.
- Given the critical role today of coal in Indonesia's energy sector and broader economy, we focus our analysis on identifying finance needs to support **workers and communities dependent on coal value chains**, the **rehabilitation of coal mining sites** and we explore the **health impacts from operating coal plants**.
- Our assessment is not comprehensive and further complementary work could focus on wider needs for regional development and boosting opportunities for all genders, youth and vulnerable groups.

Just social transition

Empowering workers dependent on coal-value chains to take advantage of the new job opportunities created by the transition requires early planning and mobilising financial and institutional capacities today

- Today, the Indonesian economy is powered by a large and growing fleet of relatively young coal plants. With coal generation capacity set to almost double nationally this decade, the domestic coal value chain **maintains hundreds of thousands of jobs, concentrated in a few regions of the vast archipelagic nation**.
- Coal workers **risk being left behind in Indonesia's energy transition without targeted investments** in the expansion of re-training opportunities, measures to facilitate their re-location, as well as provisions for temporary income support.
- Our analysis of a selection of measures for the JETP scenario indicates a potential need to offer support packages totalling around **USD 2.4 billion** for employees in the coal sector that are potentially disadvantaged by the energy transition. Expanding this to further measures beyond the scope of our quantitative analysis would increase finance needs.
- Under the more ambitious JETP+ scenario support requirements may be similar or even fall as the coal workforce avoids continued growth this decade.



Source: NewClimate, IESR.

Just social transition

Grants are the most relevant financial instrument to provide a safety net for coal sector workers, funding a range of policy support measures to facilitate re-employment and relocation as well as temporary income support. Concessional finance could help incentivise renewable project developers to support coal workers transitioning to the renewables sector.

Breakdown of available JETP funding

GRANTS: TECHNICAL ASSISTANCE	Support establishment of training facilities, and design of early retirement and re-skilling programmes, including knowledge share from countries further advanced in coal transition
GRANTS: OTHER	Provide direct support to finance early retirement, re-training, relocation or similar programmes for workers and their dependent communities
GUARANTEES	Limited relevance – potential role to enable development banks to fund training programmes
CONCESSIONAL LOANS	Limited relevance – potential role to support renewable project developers to establish training centres or apprenticeship schemes, targeted at former coal workers
MARKET RATE INVESTMENTS	Not relevant
EQUITY / OTHER / UNDEFINED	Not relevant

Just social transition

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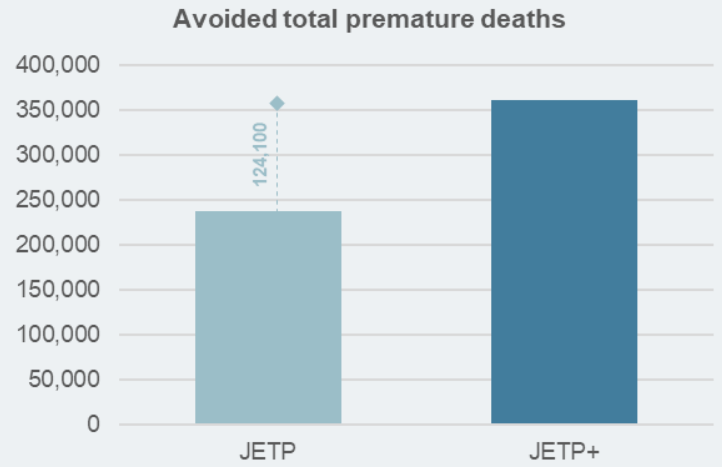
Coal phase-out and the accompanying reduction of air pollution significantly reduces the mortality risk from air pollution, saving hundreds of thousands of lives and delivering major socioeconomic benefits

- Combustion of coal is associated with dangerously high levels of air pollution that have severe health impacts for the exposed population. Indonesia has one of the largest operating coal fleets worldwide and a substantial pipeline of new plants set to go online this decade.
- Early phase-out of coal materially improves air quality, particularly for those living in the vicinity of coal plants, leading to substantial health benefits and improvements in economic well-being, such as reducing instances of lung cancer, stroke, and heart disease.
- Our analysis shows that phasing-out coal to align with the JETP scenario can avoid at least **240,000 premature deaths** from today until 2050. Increased ambition in the JETP+ scenario can save an additional **120,000 lives** until mid-century.



Just social transition

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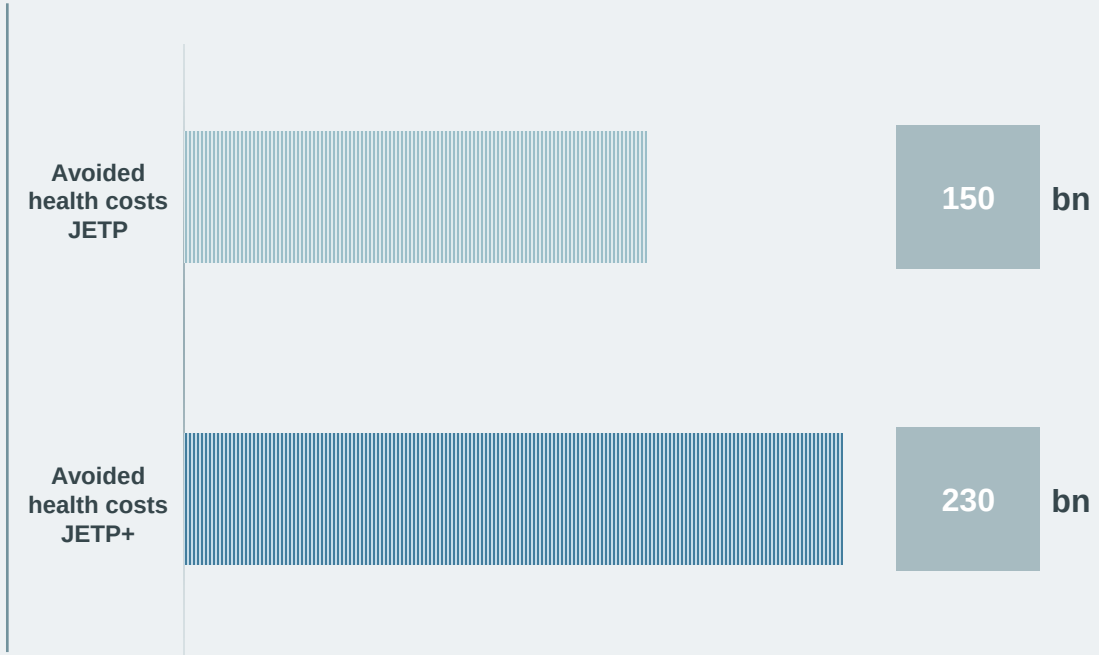
Cost from avoided health impacts through the reduced operation of coal plants accumulate to more than USD 150 billion in the JETP scenario and to around USD 230 billion in the more ambitious JETP+ scenario



- Avoided economic costs from reduced levels of air pollution in both the 2°C and the 1.5°C scenario are substantial, accounting for **12% and 18% of Indonesia's current annual GDP**, respectively.
- These positive externalities (or *avoided* negative externalities) represent the economic value of the overall health benefits to society from cleaner air.
- On average there is an **economic welfare benefit from improved health of approximately USD 30 for each MWh** of coal generation reduced in the JETP and JETP+ scenarios *in addition* to the climate benefits of cutting around 1 tCO_2/MWh.
- **Avoided costs from reduced air pollution alone are, in both scenarios, several times greater than the USD 22bn** in international finance committed by the IPG and GFANZ as part of the JETP.

Institutional capacity

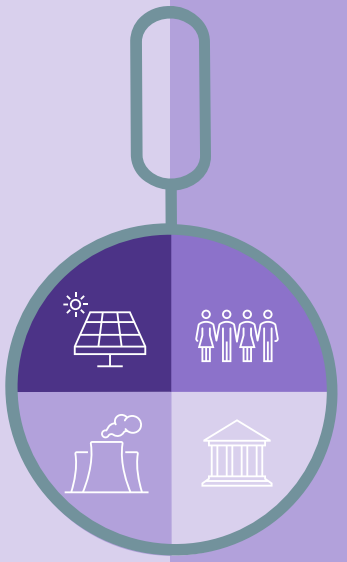
Successful implementation of a just energy transition requires the development and strengthening of institutional capacity, with a specific focus on fostering collaboration between all levels of governance

- Indonesia's energy transition can boost jobs, drive industrial growth, enhance energy access and improve air quality over the next decades, amongst a range of other transformational benefits of a cleaner, sustainable energy system.
- For Indonesia to take advantage of the wealth of opportunities and safeguard against key risks, the energy transition must be accompanied by additional institutional capacity-building.
- A successful energy transition relies not just on deploying new technologies but is equally dependent on political and institutional integration into the overarching planning process.
- Our qualitative findings indicate a need to boost resources, knowledge, legal frameworks and communication between departments, amongst other elements, at both national and regional levels of government.

All countries need to rapidly limit and then cut the use of fossil fuels this decade to achieve the goals enshrined in the Paris Agreement.

The urgency to decarbonise the Indonesian energy system implies a fundamental shift in the technologies, governance structures and stakeholders that underpin the sector today.

- Despite commitments to "freeze" the coal pipeline in the JETP Joint Statement, **installed coal capacity is projected to almost double during the 2020s to approximately 70GW**, which will give Indonesia the fourth largest coal fleet in the world behind China, India and the US.
- Some of this capacity needs to **retire well before its technical lifetime** and much of it will need to **limit their operations** in order to align with the JETP targets.
- At the same time **renewable sources of energy need to ramp up at pace**, with solar PV the cheapest option to spearhead this change.
- And major **upgrading and additions to transmission and distribution grids** are needed to facilitate the flow of electricity from new generation sites to demand centres.



Indonesia's JETP represents a major step on this journey.

The process and first iteration of the CIPP demonstrate recognition of the challenge and provide an increasing body of work to steer the direction of new investments and policy reform.

- The transition has a huge potential to provide **commercial opportunities** to investors looking to actively participate in driving the transition, to **create jobs** and provide **health benefits**. But many vulnerable groups – in particular coal-dependent communities – will require **support to navigate the changes**.
- **Our analysis indicates the magnitude of finance needed across a number of areas to deliver a just transition.** Given the size and complexity of the challenge there is a clear need for continued private and international public (e.g. IPG) finance to complement spending by PLN and the Government of Indonesia.
- **And critically, mainstreaming justice is required** across all levels of governance, including enhancing the transparency and inclusiveness of decision-making as well as in the focus for channelling financial and institutional support.

Delivering the JETP goals requires a major pivot in investments away from fossil fuels towards a rapid scaling-up of renewable capacity, storage and grids

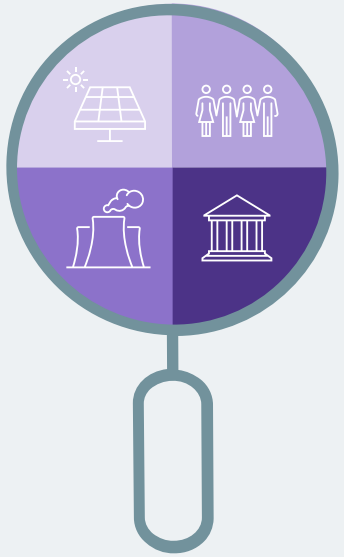
We estimate almost **USD 1 trillion** of investment is required to 2050 in renewable technologies for the JETP scenario, presenting major opportunities for public and private investors to participate in driving clean energy growth. Around **USD 4.3 billion** of public subsidies would help catalyse a cost competitive roll-out of new solar PV and wind this decade.

Limiting the use of existing and new coal plants is fundamental to accelerating the transition

Our analysis suggests coal plant owners may face potential losses from reduced use of their assets in the order of **USD 20-60 billion** to meet the JETP scenario targets. Sharing this burden between owners, the Government and IPG members, is critical for success. An incrementally rising carbon tax is one instrument that could raise revenues to compensate losses.

Phasing-out coal will deliver enormous health benefits to Indonesians

We find limiting coal use to align with the JETP scenario can avoid **240,000 premature deaths** up to 2050 in Indonesia and neighbouring countries, delivering economic benefits of **USD 150 billion**. These alone well exceed both coal plant owner potential losses and the volume of funding committed as part of the JETP.



Management of a just transition for workers requires early planning to mobilise financial and institutional capacities today

Our analysis for the JETP scenario indicates a potential need to offer support packages for reskilling, relocation and to cover temporary income losses, totalling at least in the order of **USD 2.4 billion** for employees in the coal sector that are disadvantaged by the energy transition. And further measures to boost economic activity in coal regions and support the social transition, beyond the scope of our analysis, will add to overall finance needs.

To capture the opportunities presented by the energy transition it must be accompanied by enhanced institutional capacity

To effectively manage the change, new and enhanced institutions at both national and sub-national levels need to cover activities such as system planning, licencing, policy implementation as well as key aspects to enshrine justice throughout the process, including overarching governance structures, labour and social protection, and environmental safeguards.

Introduction

Context and objectives

IESR Institute for Essential Services Reform

NEW CLIMATE INSTITUTE

Our objective is to carry out a transparent exploration of key finance needs to catalyse Indonesia's energy transition

Context

- The Government of Indonesia (GoI) agreed in its JETP Joint Statement with the International Partners Group (IPG) in November 2022 to cooperate towards a range of decarbonisation and economic development goals.
- These include **peaking power sector emissions in 2030 at no more than 290 $MtCO_2$**, reaching **net zero emissions by 2050** and increasing the **renewable energy share in the power mix to at least 34% by 2030**.
- The IPG – made up of the US, Japan, Germany, the UK, France, Canada, Italy, the EU, Norway and Denmark – is mobilising an initial commitment of **USD 22bn** (USD 12bn public finance & USD 10bn private finance from members of the Glasgow Financial Alliance for Net Zero, or GFANZ) to spend over the next three-to-five years in support of achieving the JETP targets.

Objective of the work

- To help inform critical considerations in kick-starting the transition from fossil fuel reliance to clean technologies we have developed an **open-source Excel tool**, **'JET-FIN'**, to estimate key finance needs for a just energy transition in Indonesia's power sector. The tool estimates the amount of public and private finance required to fulfil the JETP targets set out in the Joint Statement that are aligned with a 2°C temperature rise pathway. It also covers analysis of additional pathways and allows users to adjust critical parameters to test their influence on potential investment needs, broken down into different areas and over time.
- We split our findings into the finance needs for **phasing-out coal-fired power plants (CFPP)**, looking both at early retirement of coal units and at curtailment of generation from remaining units; investment needs for a **clean build-up** of new infrastructure; as well as exploring certain implications for **justice in the transition**, particularly economic and health impacts as well as mine rehabilitation; and possible expansion and adjustments to **institutional capacity**.
- This allows users to transparently identify:
  - ☑ Key drivers for finance needs in Indonesia's just transition
  - ☑ Priority areas for public finance to deliver a just transition
  - ☑ Additional finance required for Indonesia to shift to a more ambitious power sector trajectory
  - ☑ Impacts from the transition on sustainable development indicators such as employment and health

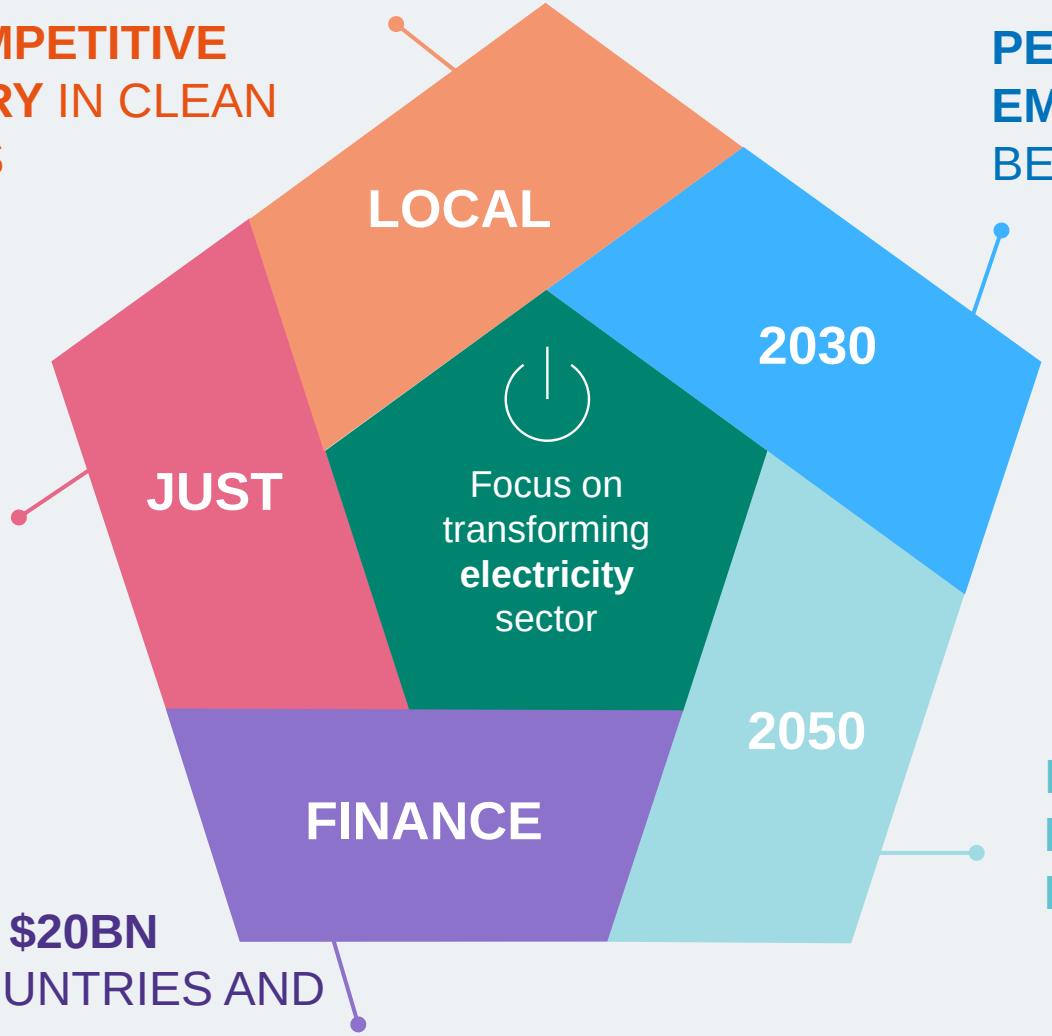
Indonesia agreed a Just Energy Transition Partnership with the G7, Denmark and Norway at the G20 summit in Bali in November 2022

DEVELOP A **COMPETITIVE LOCAL INDUSTRY** IN CLEAN TECHNOLOGIES

PEAK POWER SECTOR EMISSIONS AT OR BELOW 290 $MTCO_2E$

INCREASE RENEWABLE SHARE TO AT LEAST 34% OF TOTAL GENERATION BY 2030

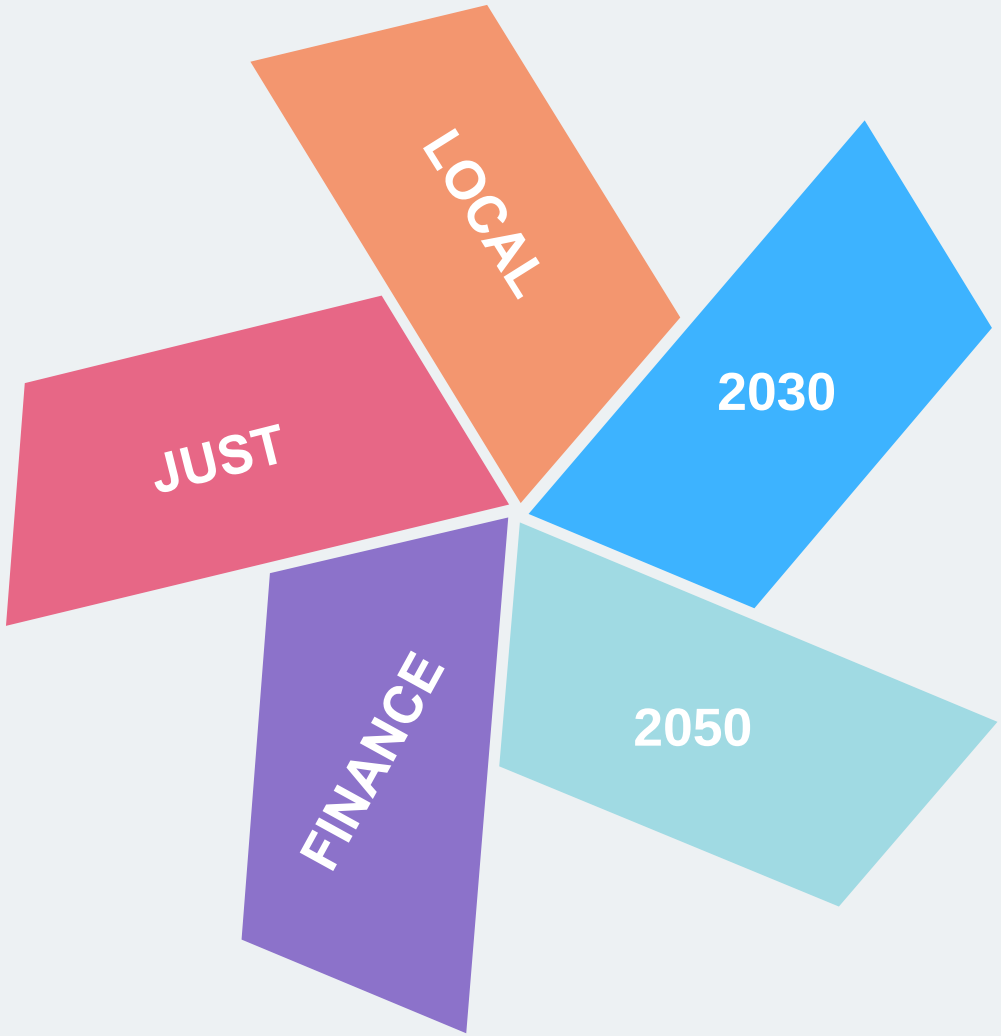
DELIVER A **JUST ENERGY TRANSITION FOR WORKERS AND COMMUNITIES**, PARTICULARLY THOSE DEPENDENT ON COAL



REACH **NET ZERO POWER SECTOR EMISSIONS** BY 2050

MOBILISE INITIAL $20BN FROM DONOR COUNTRIES AND PRIVATE BANKS

Throughout 2023 the JETP secretariat has coordinated an evolving work programme to develop a plan to deliver the targets



Nov 2022

JETP announced on 14 November 2022 at G20 Summit in Bali

Feb – Apr 2023

Formation of JETP secretariat and coordination platform

Establishment of initial working groups, covering:

- Technical
- Policy
- Finance
- Just

May – Nov 2023

Development of the first version of the Comprehensive Investment and Policy Plan (CIPP) agreed by GoI and IPG

A library of official documents, relevant studies and other resources related to the Indonesian JETP and CIPP are maintained on the SEA Information Platform for the Energy Transition, SIPET.

The first version of the CIPP, published in November 2023, limits its scope to the on-grid system, with further work scheduled to develop a comprehensive plan extending to off-grid power

JETP Joint Statement (November 2022)

Peaking total power sector emissions (on + off grid) in 2030 at 290 $MtCO_2$

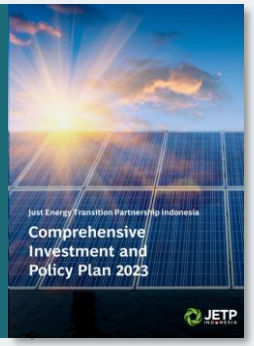
Net zero emissions by 2050

At least 34% RE penetration by 2030

On-grid power sector emissions in 2030 at 250 $MtCO_2$

Net zero emission in the on-grid system by 2050

At least 44% RE penetration in the on-grid system by 2030



CIPP 2023 (November 2023)

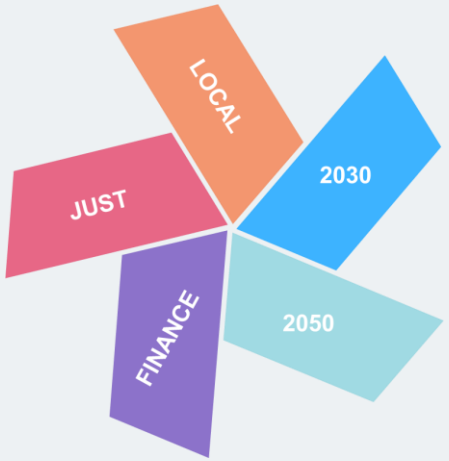
Following the discovery of a significant captive coal pipeline that could potentially lead to at least 30 GW of operational coal capacity by 2030, "*analysis by the JETP Technical Working Group has suggested that reaching all the joint conditional targets may not represent a realistic decarbonization pathway*" (CIPP 2023).

As a result, the Government of Indonesia and the IPG agreed to first focus on a pathway for Indonesia's **on-grid power system**, with a subsequent study planned on the decarbonisation roadmap for Indonesia's off-grid system.

This agreement resulted in new targets that reflect a **weakening of** ambition. Total power sector emissions in 2030 could reach around 400 $MtCO_2$ without major intervention, which is no longer aligned with a 2°C temperature rise pathway.

As an indicative estimate, 30 GW of coal capacity operating at a 55% capacity factor emits approximately **145 $MtCO_2$** per year. Additional gas and oil-fuelled captive plants would add to the total off-grid emissions.

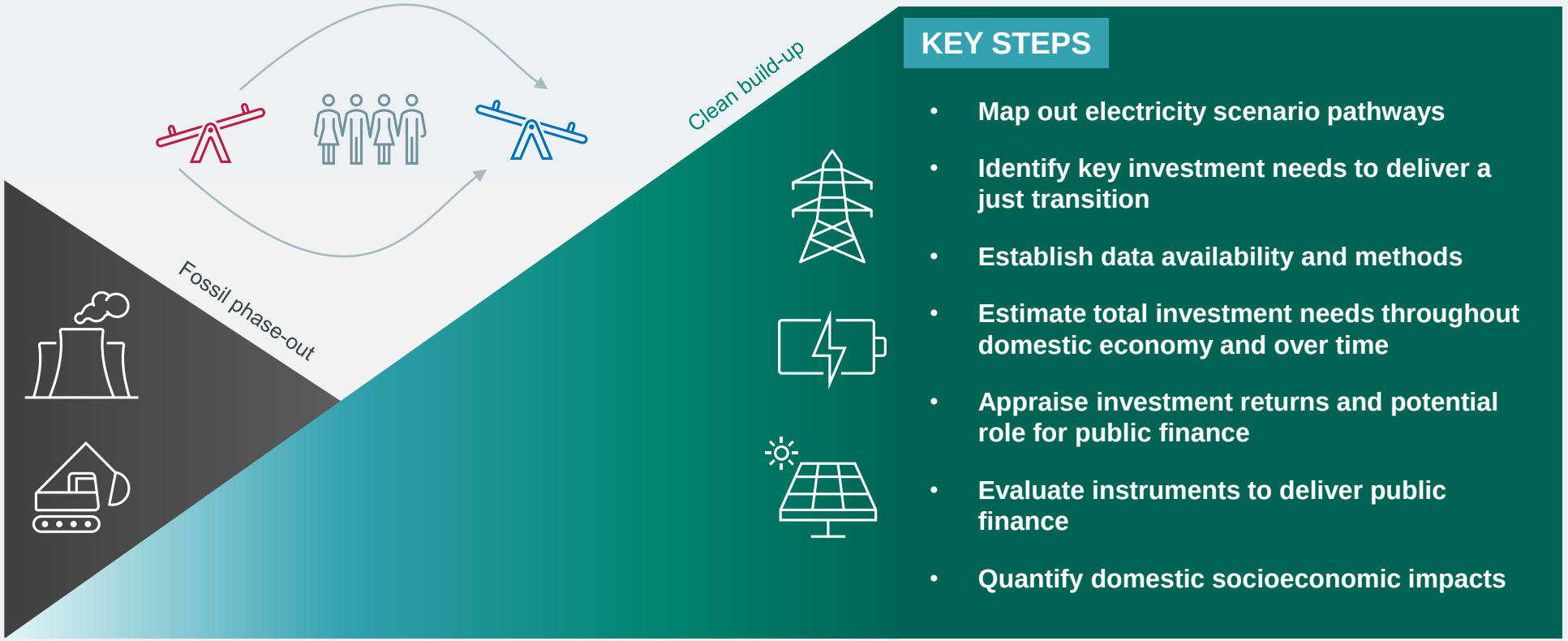
The analysis in this study remains focused on pathways for the full on- and off-grid power system aligned with the targets agreed in the JETP Joint Statement



- The intention is that the CIPP is a "*living document*" with annual updates. It is expected that the next iteration of the CIPP features an updated set of JETP targets that includes a decarbonisation pathway for the off-grid system.
- As work on the CIPP continues, including incorporating a decarbonisation strategy for the off-grid system, a clearer picture should emerge around the level of ambition required to achieve the targets set out in the JETP Joint Statement (**a 2°C temperature rise aligned pathway for Indonesia's electricity sector**) as well as the statement's commitment between the GoI and IPG to "*pursue an accelerated and ambitious just energy transition that supports a trajectory that keeps a warming limit of **1.5°C above pre-industrial levels within reach***".

- Civil society groups have raised concerns questioning the inclusiveness of the process amongst Indonesian stakeholders to develop the CIPP, given that civil society input was limited and public consultation on the draft only open for a window of less than 2 weeks (for the English version, and around 3 days for the Indonesian language version).
- To deliver an energy transition with justice at its core it is crucial to engage civil society and the general public in a manner that allows their perspectives to guide the direction and evolution of the strategy.
- Subsequent analysis to build on the findings in this study can be conducted following the inclusion of the total power sector roadmap in an updated iteration of the CIPP.

The core scope of our analysis is to identify critical finance need elements and set out a range of appropriate methodological options to estimate them, in an open-source tool



KEY STEPS

- Map out electricity scenario pathways
- Identify key investment needs to deliver a just transition
- Establish data availability and methods
- Estimate total investment needs throughout domestic economy and over time
- Appraise investment returns and potential role for public finance
- Evaluate instruments to deliver public finance
- Quantify domestic socioeconomic impacts

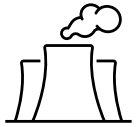
Detailed focus to 2030; less granular after

The JET-FIN tool is designed in a modular manner that users can also apply to additional scenarios or in other country contexts

Delivering an energy transition in Indonesia requires channelling finance to a broad range of capital, labour and social projects

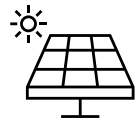
Infrastructure
Fossil phase-out

- Early retirement of coal plant
- Restricted operation of coal plant
- Reduced coal mining activity
- Decommissioning of plants / mines
- Repurposing or remediation of sites



Infrastructure
Clean build-up

- New renewable energy
- New power storage solutions
- New and upgraded grid connections
- Energy efficiency measures
- System management / balancing
- New manufacturing for components



Just social transition

- Support to retiring workforce
- Re-skilling / training programmes
- Economic diversification from coal
- Relocation support
- Community investments
- Education and skilling new workforce
- Health benefits
- Access to affordable and reliable energy

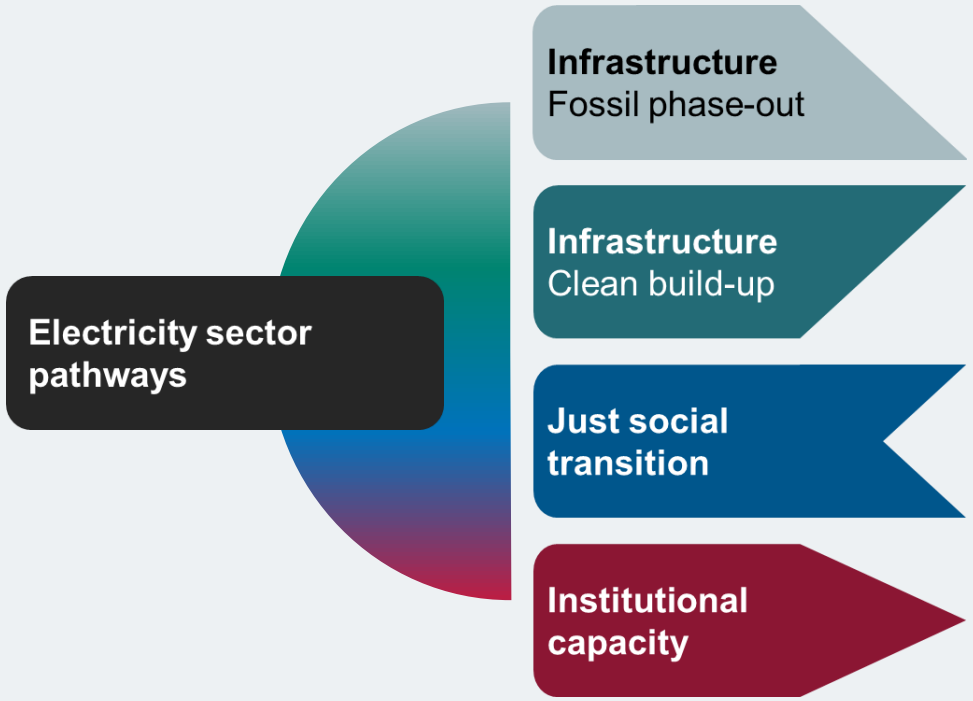
Institutional capacity

- Sector planning and delivery
- Project permitting / licencing
- Monitoring progress
- New policy development
- Public engagement and awareness

Our analysis aims to estimate finance needs for a broad range of the key elements outlined in the categories above, focusing on those we identify as most material in scale and relevance, in particular where they pose potential barriers to the smooth transition of the energy sector. We do not cover all items in the analysis that follows due to limited data availability and resource constraints.

In the sections that follow we first set out the core electricity sector pathways which form the basis of our subsequent analysis.

We then step through key elements of the energy transition in Indonesia that require financing, outlining our approach, the findings in terms of potential finance needs, and the suitability of different financial instruments.



APPROACH

Explanation of methods and key data and assumptions to estimate finance needs. More detail on our approach is included in a separate document.

FINDINGS

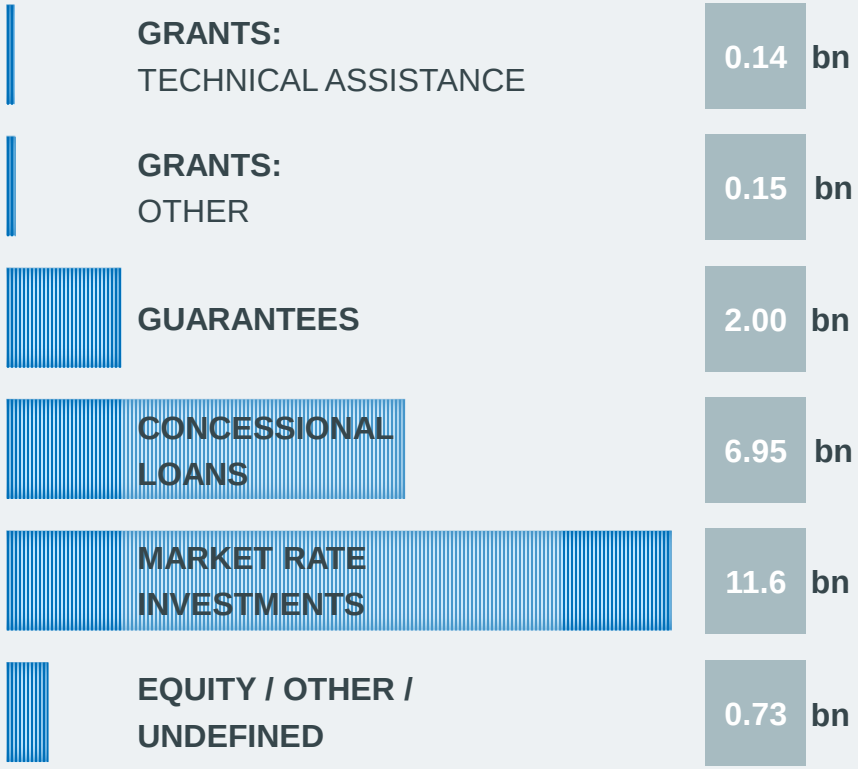
Estimates of finance needs for different elements of delivering a just energy transition.

MENU OF FINANCIAL INSTRUMENTS

See next slide.

MENU OF FINANCIAL INSTRUMENTS

The JETP support put forward to date by the IPG and GFANZ of USD 22 billion represents a range of different financial instruments, with the vast majority of funding in the form of market rate investments and concessional loans



Source: Authors analysis of CIPP (JETP Secretariat, 2023)

At the end of each section we include a high-level traffic light assessment and brief commentary on the potential relevance of the different financial instruments on offer to meet identified finance needs.

The USD 22bn funding proposal set out in the CIPP is intended as catalytic investment to raise climate ambition and promote sustainable development objectives in the Indonesia electricity sector over the next 3-5 years.

It is clear that this funding alone is only a fraction of the finance needs required to deliver a just energy transition and will require major additions from further private sector actors, the Government of Indonesia as well as potentially future additional public financial support from IPG members.

Electricity sector pathways

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Electricity sector pathways

We analyse finance needs for two scenario pathways, one that aligns with the JETP targets as well as one that explores the implications for a more ambitious, 1.5ºC-aligned, trajectory

SETUP

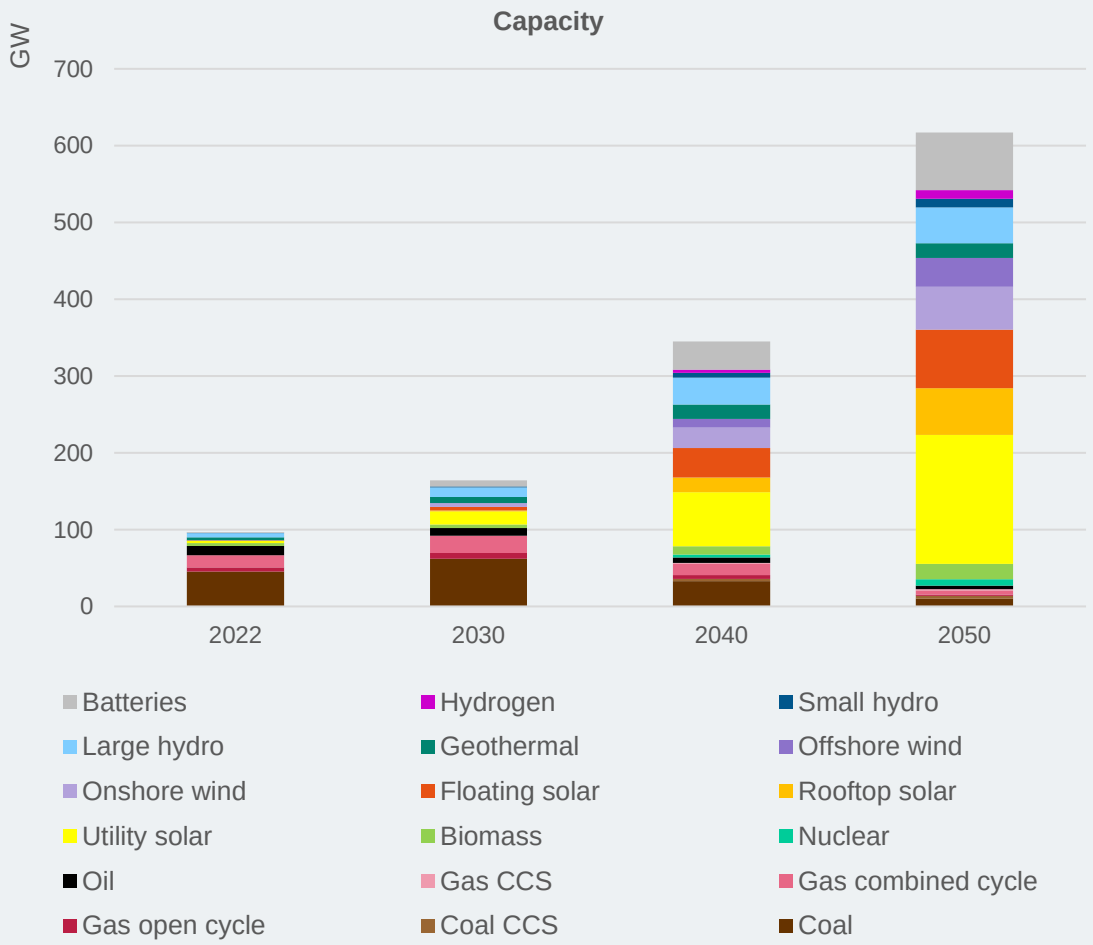
- **ROBUST MODEL**: National energy system modelling with a robust and transparent set of data inputs, assumptions and calculations is a fundamental starting point to identify energy transition finance needs.
- **COMPREHENSIVE DATA**: Model setup should incorporate the best available information in terms of technology, costs, policy, demand growth, deployment rates, etc., and test a range of sensitivities, informed by literature and stakeholder consultation.
- **AMBITIOUS**: The development of energy transition pathways should be informed by the latest scientific evidence on the alignment of emission trajectories with the global temperature goals enshrined in the Paris Agreement.

OUR APPROACH

- Our analysis is based on existing modelled pathways, jointly developed by the International Energy Agency (IEA) and the Indonesian Ministry of Energy and Mineral Resources (MEMR), as an input.
- We use the IEA Roadmap's Announced Policies Scenario ('APS'), which is the basis of the JETP Joint Statement targets, to inform a 'JETP' scenario. We also use its more ambitious 'NZE' scenario that represents a 1.5°C-aligned pathway for the Indonesian energy sector, to inform a 'JETP+' scenario.

- We extract public data from the IEA's report, including annual capacity, generation, storage, grid expansion requirements, etc., and map these in the JET-FIN tool to a more granular technology list.
- Our interpretation of the pathways is complemented by a range of additional data sources, including: the Global Energy Monitor; the information platform SIPET; the Danish Energy Agency and MEMR's Technology Costs Catalogue; IESR's Deep Decarbonization report, amongst others, as well as expert inputs.
- Further details of our methodology are set out in the Methods Appendix and are also available to review in the JET-FIN tool.

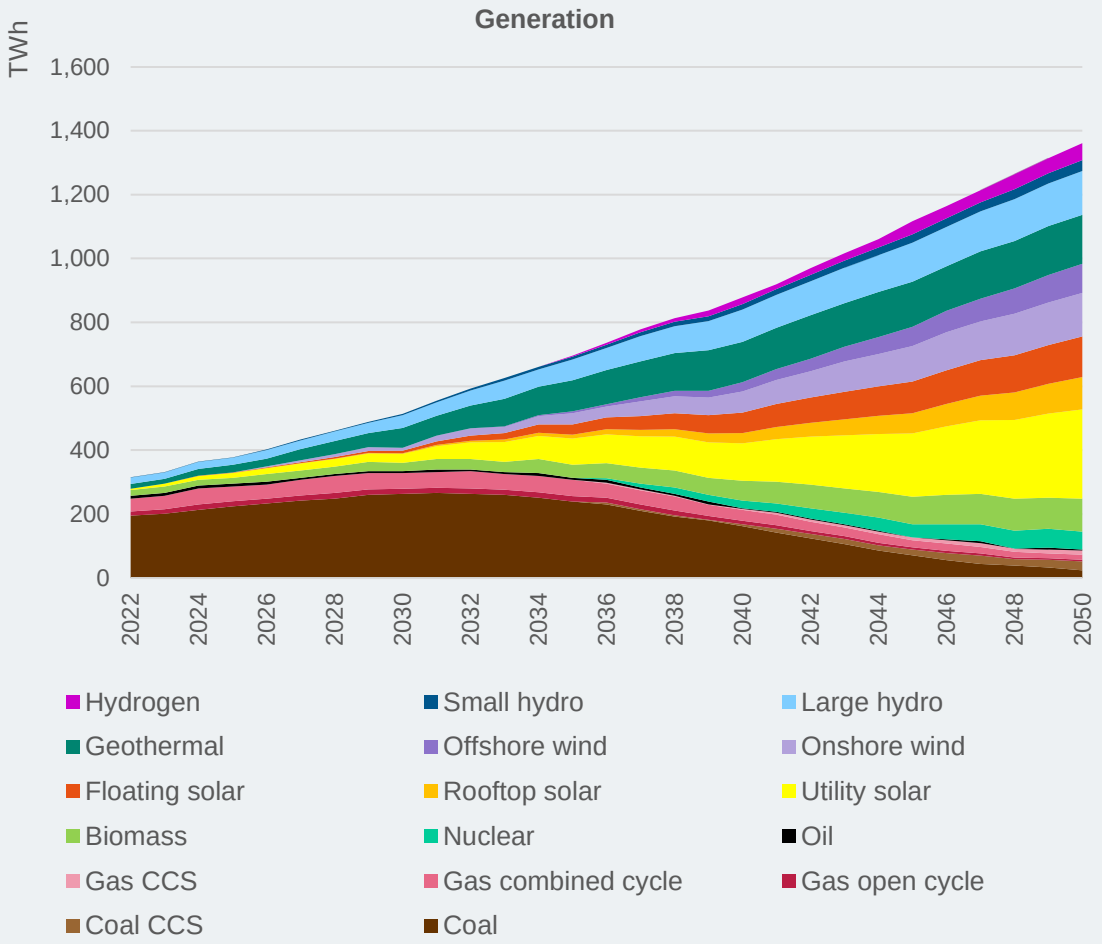
Capacity to supply electricity in the JETP scenario is set to transform from large fossil-fuelled plants to 500 GW of renewable energy



- 'JETP' scenario is based on the IEA's APS, reaching net zero electricity sector CO_2 emissions by 2050.
- Electricity generation capacity in Indonesia rises from around 100 GW today of mostly large fossil fuelled power plants to integrate 500 GW of renewable energy technologies by 2050.
- Solar PV accounts for the largest share of capacity in the system by 2040, expanding from negligible levels today to 23 GW in 2030, 130 GW in 2040 and around 300 GW in 2050.
- The IEA's APS scenario adds around 10 GW of new coal capacity by 2030, which we adjust upward to reflect the latest estimates that around 30 GW of new on- and off-grid coal plants are added this decade, taking total coal capacity to approximately 70 GW.
- With the expansion of intermittent renewable energy sources, the need for storage solutions increases, with battery capacity set to double each decade up to 75 GW by 2050.

Source: Authors analysis based on IEA (2022) and additional sources (see detailed methodology in the Methods Appendix).

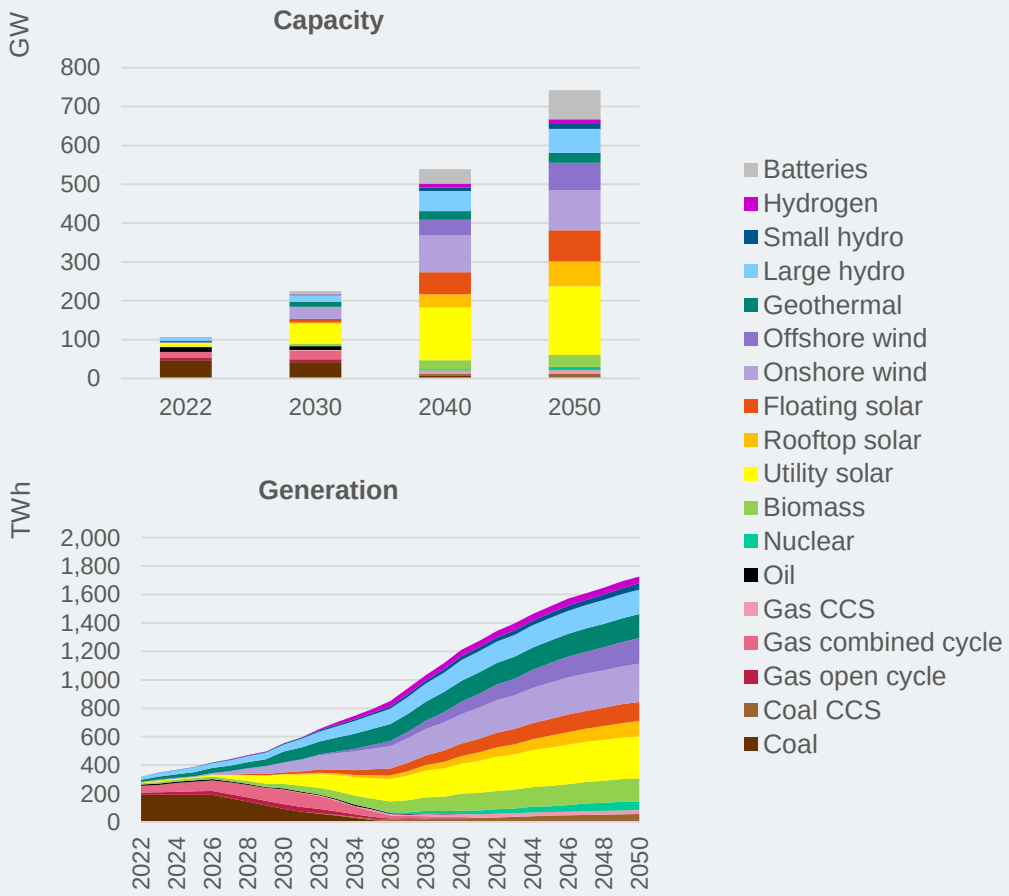
Electricity generation in the JETP scenario increases steeply from today's levels to meet rising demand, with solar PV driving the majority of new additions



- Total electricity supply increases more than five-fold in the coming decades driven by economic and population growth as well as electrification of other energy end uses, reaching 1,400 TWh in 2050.
- Generation from coal plants – which currently accounts for more than half of total national supply – peaks around 2030 at 260 TWh and steadily declines thereafter until it contributes less than 2% of total generation by 2050.
- Wind and solar PV are the largest contributors to electricity supply over time and will account for more than 50% of supply by 2050.
- There is also significant expansion of supply from wind, hydro, geothermal as well as biomass to meet rising demand.

Source: Authors analysis based on IEA (2022) and additional sources (see detailed methodology in the Methods Appendix).

Under the JETP+ scenario the 1.5ºC-aligned transition away from coal, oil and gas begins immediately, accelerated by rapid scaling-up of renewables

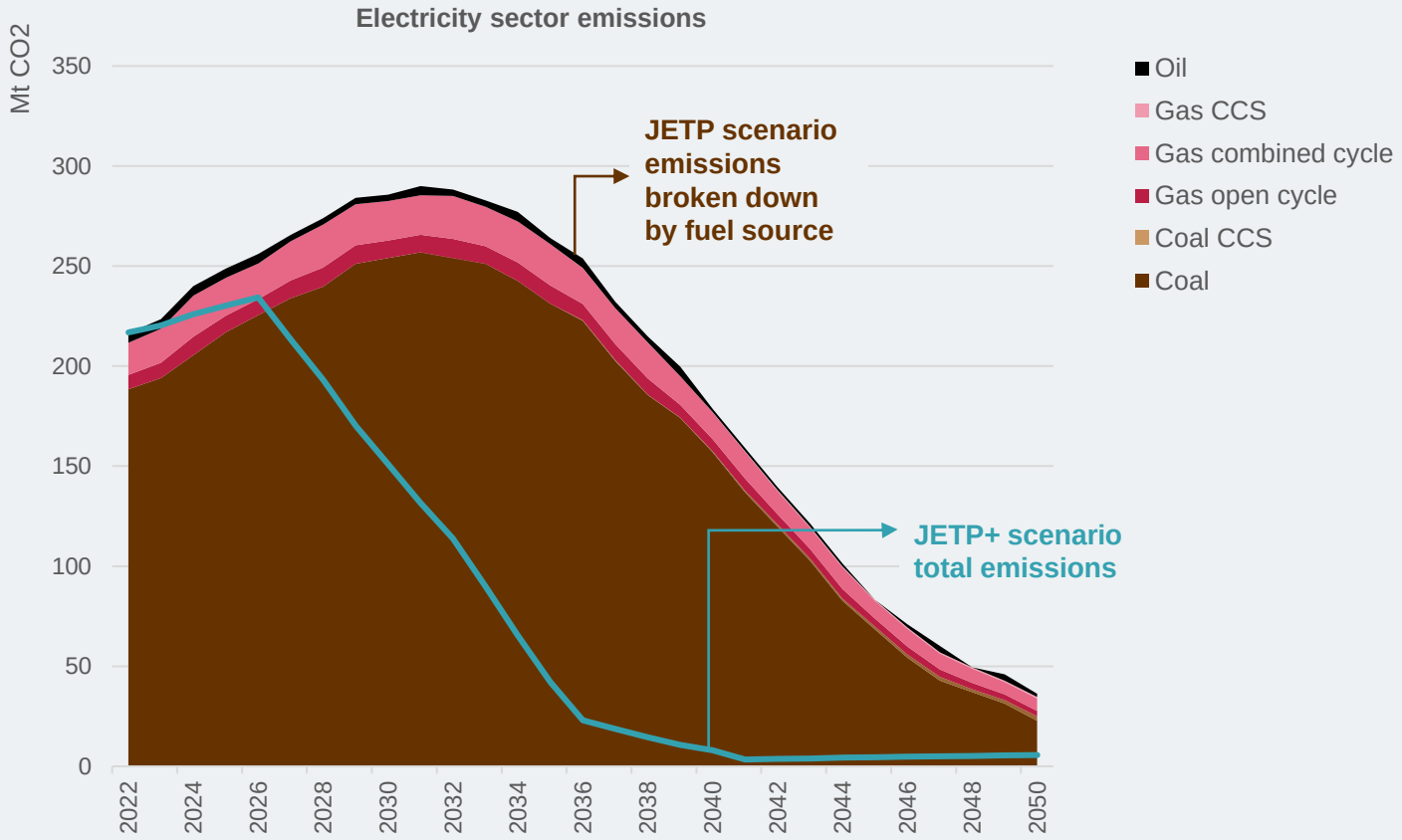


- 'JETP+' scenario is based on the IEA's NZE, reaching net zero electricity sector CO_2 emissions by 2040.
- Coal phase-out starts earlier than in the JETP scenario, already beginning in the mid-to-late 2020s, shortly followed by gas-fired generation phase-out starting in 2031.
- Solar PV capacity rises rapidly to just over 60 GW by 2030, 230 GW by 2040 and exceeding 300 GW by 2050.
- Large amounts of wind (onshore and offshore) capacity is also added, reaching 170 GW by 2050.

- Total generation rises much faster than in the JETP scenario, reflecting earlier and more electrification of other energy end uses, growing to over 1,700 TWh by 2050.
- By 2050 solar PV accounts for approximately 540 TWh of output, and wind for 450 TWh, between them making up almost 60% of total supply.
- Biomass and geothermal also play a major role, each with a share of approximately 10% of national generation in 2050.

Source: Authors analysis based on IEA (2022) and additional sources (see detailed methodology in the Methods Appendix).

Emissions peak in the JETP scenario at around 290Mt in 2030, falling to around 36Mt by 2050, although still exceed the carbon budget for a 1.5ºC-aligned pathway by more than two-fold



- Following the IEA's APS, power sector emissions in the JETP scenario peak around 2030 at 290MtCO_2, falling to 180Mt in 2040, and 36Mt by 2050.
- In the JETP+ scenario, emissions remain lower and start falling earlier to align with a 1.5℃ pathway for the Indonesian energy sector. They peak around 2026 at approximately 230Mt before falling rapidly to less than 10Mt a year by 2040.
- Cumulative emissions, which are the critical determinant of global warming impacts, from 2022-2050 are around 5.6 GtCO_2 (billion tonnes) in the JETP scenario
- The carbon budget in the JETP+ scenario is less than half this level, with cumulative emissions to 2050 of 2.4 GtCO_2.

Source: Authors analysis based on IEA (2022) and additional sources (see detailed methodology in the Methods Appendix).

Infrastructure: Fossil phase-out

Finance needs to support fossil phase-out

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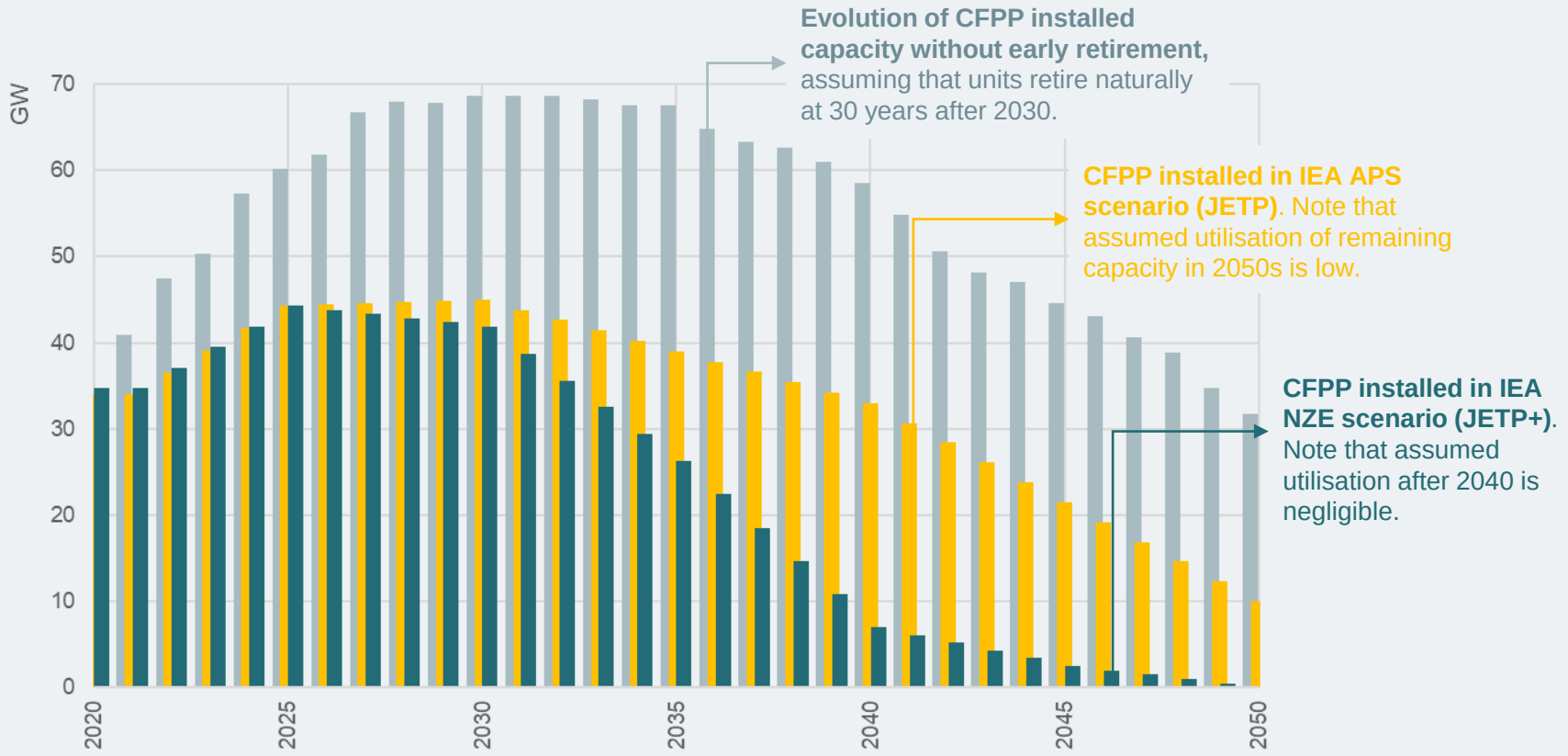
Infrastructure
Fossil phase-out

Installed coal capacity in Indonesia is expected to reach around 70GW by 2030, almost doubling in the current decade, driven largely by off-grid (captive) plants used by industry. Reducing their lifetime or usage is critical to aligning with JETP objectives.

- Operation of the full coal fleet at technically feasible capacity factors (85%) could lead to emissions from CFPP in 2030 of approximately **300 $MtCO_2$ from on-grid plants, plus an additional 200 $MtCO_2$ from off-grid plants.**
- Whilst there are key uncertainties particularly around the captive coal fleet, this would lead to emissions well above the JETP targets.
- Either early retirement of coal units, or curtailing their operation, or *both*, is critical to limiting sector emissions.



Source: NewClimate, IESR own analysis based on Global Coal Plant Tracker (Jan 2023) and interpretation of unabated coal capacity in IEA (2022)

Public finance, in combination with policy reform, could play a role in establishing incentives to bring forward coal plant retirement and limit operations

- In the absence of a transition of the energy sector away from its current reliance on coal towards clean, renewable energy sources, coal plant owners would likely be able to operate their assets for longer, and at higher capacity factors (particularly in the 2030s and 2040s) than under pathways aligned with the goals of the Paris Agreement.
- **An ambitious energy transition is therefore likely to reduce coal plant owner earnings**, in turn reducing the value of their assets.
- **For independent power producers (IPPs)**, existing long-term contracts to sell defined quantities of their electricity may require revision.
- **For the state-owned vertically integrated utility Perusahaan Listrik Negara (PLN)**, it will need to increasingly build its own, or procure electricity from, renewable sources instead of meeting demand with its coal fleet.
- Targeted public finance can compensate for some of the losses coal plant owners potentially face as part of negotiated deals to either retire assets early or curtail their operations (or both).
- To limit the burden on scarce public finances – both from the GoI or from international donors, such as the IPG – **policy reform is also critical to shifting incentives for investors to align with the JETP targets**, e.g. through increasing the level of carbon pricing on coal generation.
- In this section we derive estimates of the order of magnitude of potential losses for coal plant owners that may arise from the transition against the counterfactual scenario in which coal plants continue to operate at relatively high utilisation rates for their technical lifetimes (i.e. without major policy reform).

Targeted public finance can compensate for some or all of the losses coal plant owners / operators potentially face as part of negotiated deals to either retire assets early or curtail their operations (or both)

- We carry out a deep-dive analysis using the JET-FIN tool of the existing *and* planned coal plant fleet in Indonesia to estimate potential compensation for coal plant owners to incentivise:

A. Early retirement of plants

Closure or re-purposing of units prior to end of their technical lifetime

B. Curtailment of operations

Flexible operation of plants which reduces their capacity factors to below their typical / expected levels

KEY STEPS

1. Determine the list and capacity of coal units operational in each year and the order of prioritisation for early retirement
2. Determine the total need in each year over modelling horizon to retire plants early
3. Apply early retirement profile to coal fleet according to prioritisation
4. Determine the need to reduce coal generation (curtailment) from remaining plants in each year over modelling horizon
5. Apply curtailment of generation profile to remaining operational coal fleet
6. Estimate potential compensation for plants retiring early and/or curtailing generation using different approaches

Infrastructure
Fossil phase-out

APPROACH

There are different possible approaches to estimate the amount of appropriate compensation required to offset potential losses and agree commitments for early retirement or curtailment with coal plant owners

- In Indonesia coal plants are either owned by the state-owned utility PLN, or by IPPs who typically have long-term power purchase agreements (PPAs) of around 25-30 years with PLN to offtake their electricity output under ‘take-or-pay’ contractual terms.

Breakdown of existing + pipeline of approximately 70 GW of CFPPs in Indonesia

Possible estimation methods to determine potential losses

Foregone operating profit

Estimate of the net operating profit the unit would have continued to earn in the years between its early retirement and the end of its technical lifetime in order to pay back upfront capital costs and provide a return on the investment

Capital recovery

Estimate of the net operating profit the unit would require in each year between its early retirement and the end of its technical lifetime in order to recover upfront capital investment (i.e. avoid making a loss)

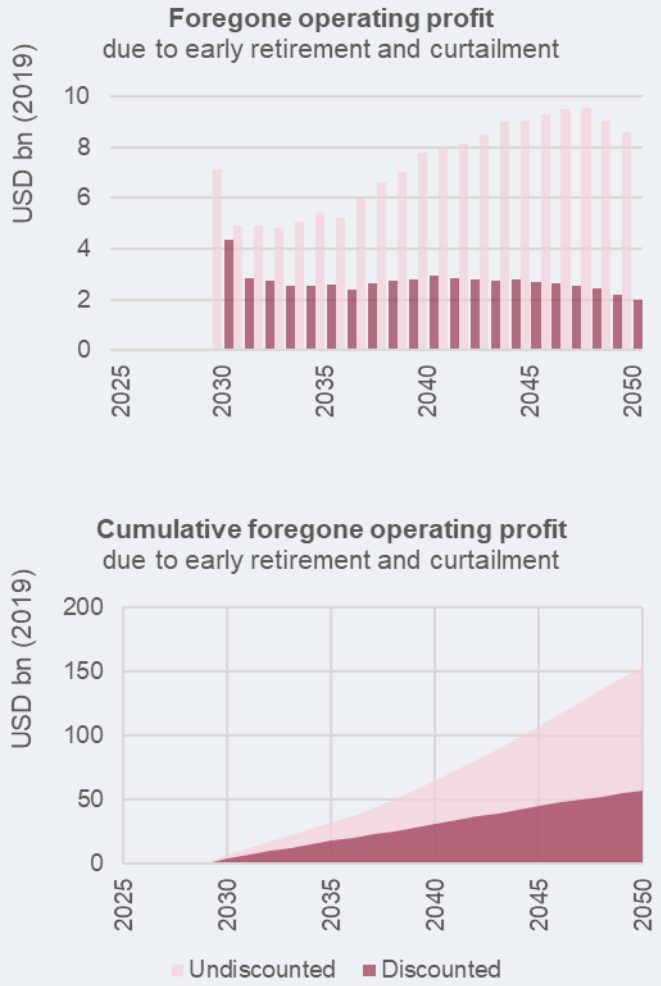
Book value

Bespoke valuation of the plant at a given point in time taking into account its physical condition as well as projections of future revenues and costs (typically based on confidential data hence not used here)

Selection of either one of these methods, or alternative approaches, as well as the critical details of precise data inputs and assumptions, will ultimately be decided by parties negotiating a compensation agreement. Estimates here are intended to provide an order of magnitude assessment of potential amounts at the national system level under certain defined parameters.

Current valuation of coal plant foregone operating profits to align with the JETP scenario is approximately USD 60 billion

Foregone operating profit

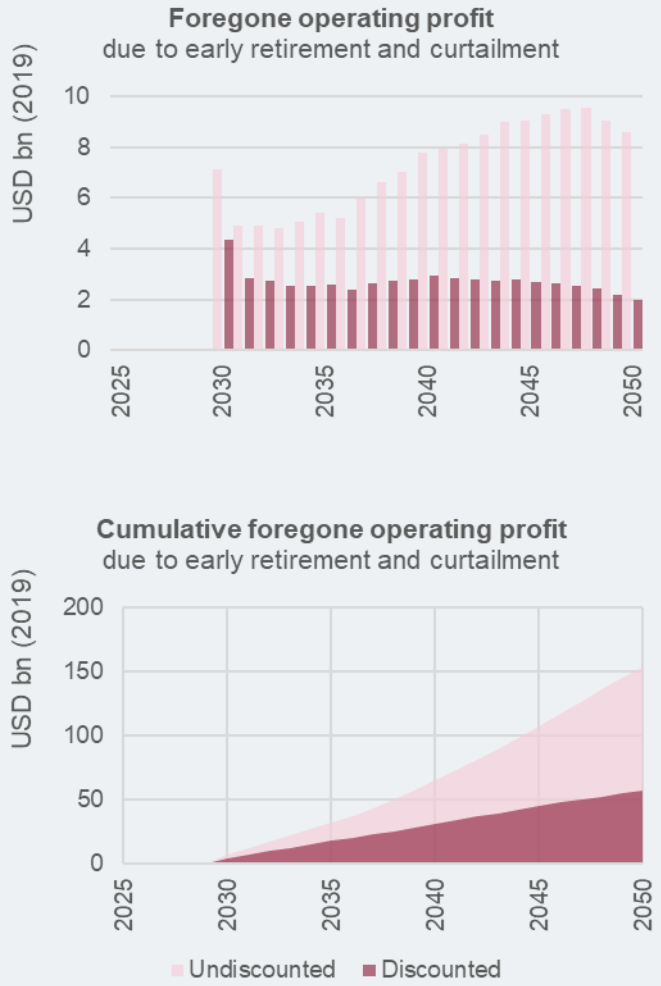


Source: NewClimate, IESR.

- We apply a default annual discount rate of **5%** (user configurable in the JET-FIN tool) to estimated future foregone operating profits or capital recovery needs expressed in present value terms, i.e. the amount plant owners may be willing to accept today to agree to the future early retirement and/or curtailment required by the scenario.
- The light shaded bars in the charts show the undiscounted estimates, expressed in 2019 USD prices. The darker shaded bars reflect their present value (also in 2019 USD), after applying the discount rate.
- The choice of discount rate has a strong influence over the results and there is no definitive answer to which rate to apply. In this case an appropriate discount rate should at least reflect any social preference for receiving a payment today over receiving it in future years. Discounting future values between 2-4% to reflect this time preference of money is common, although some economists elect to apply rates above and below this range depending on the context and their estimation method. In addition, the discount rate should also capture (perceived or actual) risk that anticipated future revenues may not be received in full.
- Under higher discount rates the valuation in today's terms for foregone profit (or capital recovery needs) in the future is reduced. This may be appropriate, for example, if asset owners already perceive material risks that they will not be able to earn their initially expected operating profit, due to policy interventions such as carbon pricing.

Current valuation of coal plant foregone operating profits to align with the JETP scenario is approximately USD 60 billion

Foregone operating profit

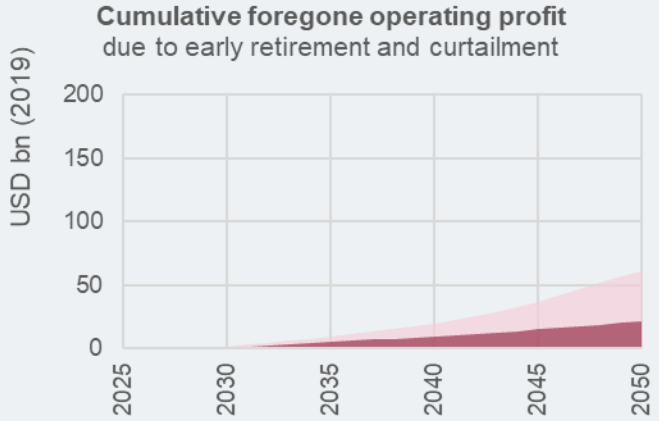


- Foregone operating profits initially spike in 2030 as we assume no early retirement or curtailment in the 2020s (user configurable).
- Foregone operating profits from reduced coal generation rise during the 2030s and 2040s reaching almost **USD 10bn** (undiscounted) in 2048.
- Total values are relatively evenly split between foregone operating profits due to early retirement and those due to additional curtailment of generation.
- Cumulative coal plant foregone operating profits are **USD 31bn** in the period to 2040 and **USD 57bn** by 2050 (all estimates discounted at 5% per year).
- These values correspond to potential coal plant owner losses of approximately **USD 30 per MWh of reduced generation** (weighted average across the coal fleet).

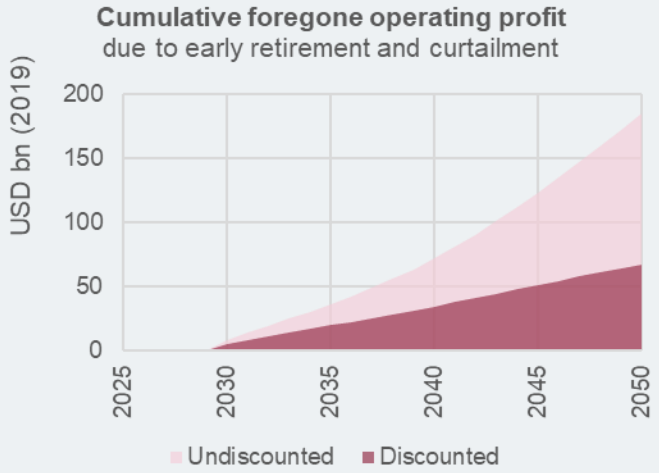
Source: NewClimate, IESR.

Limiting the analysis to reductions in generation below 55% utilisation would cut estimated losses to USD 21 billion, although longer lifetime assumptions can raise estimates materially

Foregone operating profit



- **Limiting the analysis to cover foregone operating profit only up to a 'base' capacity factor of 55%** (compared to default of 80% for units connected to the Java-Bali grid, and 86% for all others) reduces cumulative foregone operating profits to **USD 9bn** in the period up to 2040 and **USD 21bn** by 2050 (all discounted).

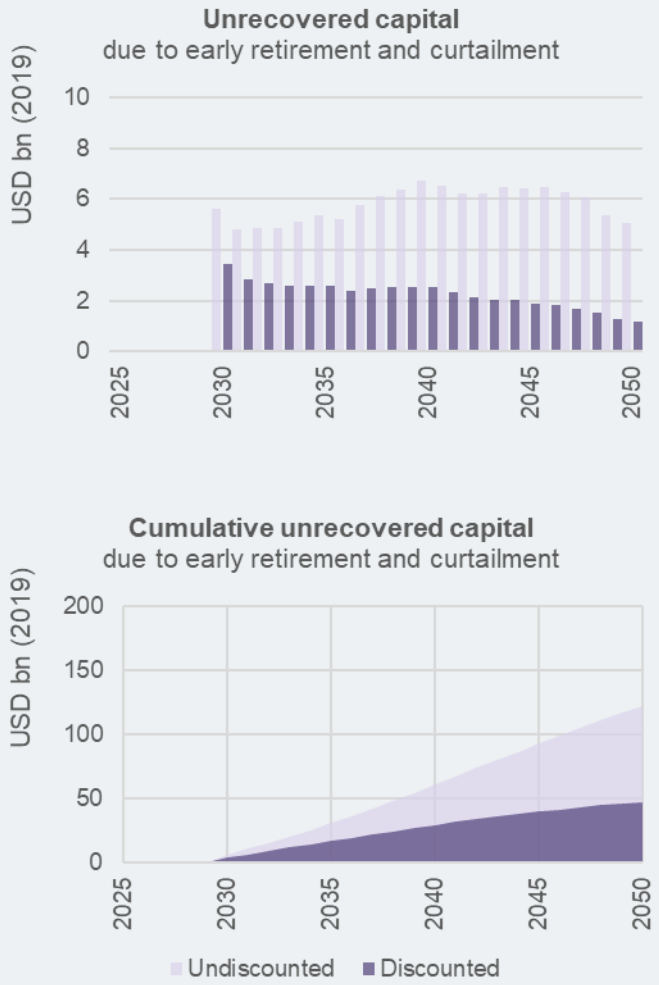


- **If the default assumption on the natural lifetime of all coal plants is raised from 30 to 40 years**, the cumulative foregone operating profits rise to **USD 35bn** in the period up to 2040 and **USD 67bn** by 2050 (all discounted).

Source: NewClimate, IESR.

The current valuation of coal plant owners' capital recovery needs to align with the JETP scenario are slightly lower at USD 50 billion

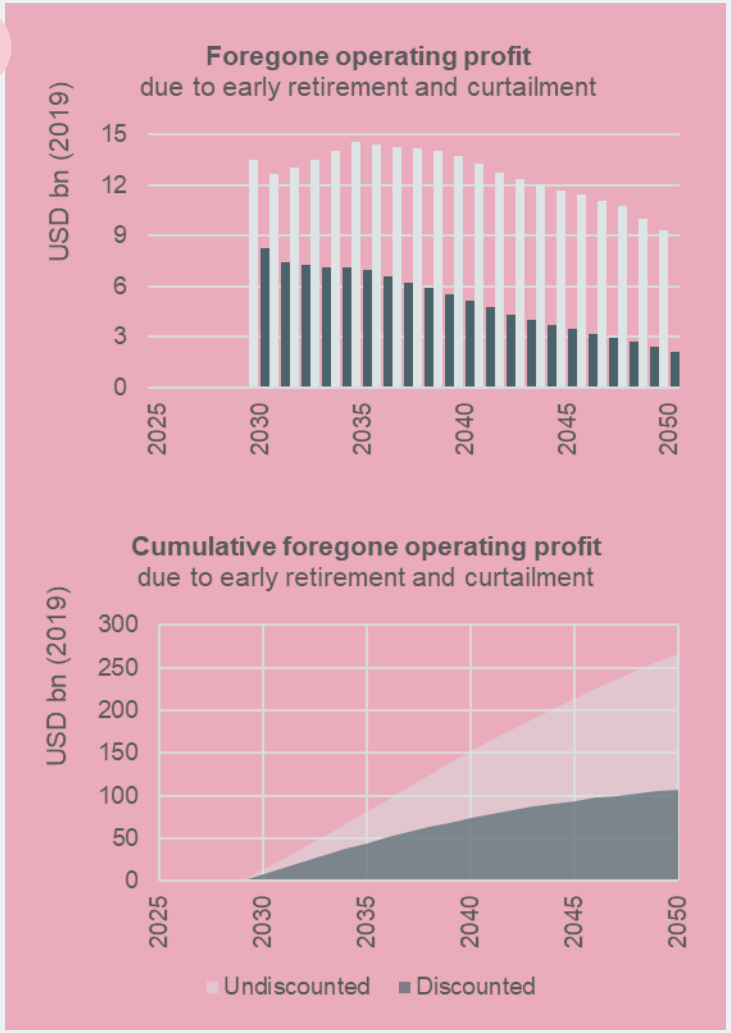
Capital recovery

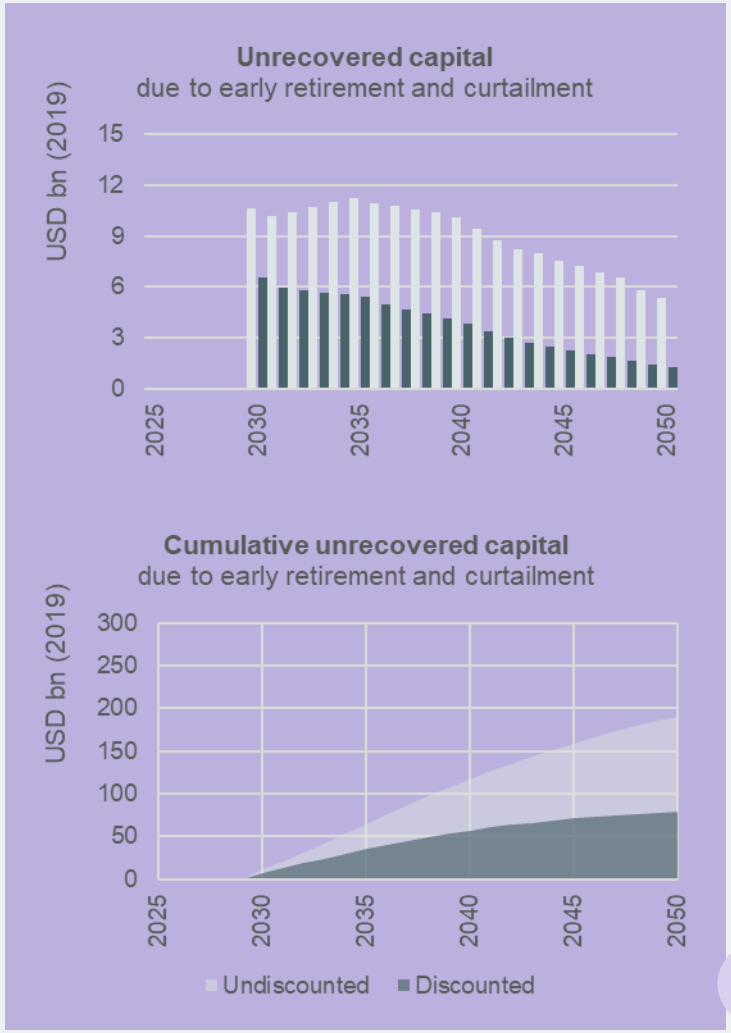


Source: NewClimate, IESR.

- Estimates are lower using the capital recovery approach as they do not cover any potential positive return on the investment for coal plant owners.
- Cumulative unrecovered capital is **USD 29bn** in the period to 2040 and **USD 47bn** up to 2050 (all estimates discounted at 5% per year) under our default set of assumptions.
- These values correspond to potential coal plant owner losses of approximately **USD 20 per MWh of reduced generation** (weighted average across the coal fleet).
- **If the default assumption on the natural lifetime of all coal plants is raised from 30 to 40 years**, the estimates of cumulative unrecovered capital rise to **USD 34bn** in the period up to 2040 and **USD 59bn** by 2050 (all discounted). In this case we assume investors recover their upfront capital spending over a longer period. There is typically therefore a larger amount of unrecovered capital at the point of either early retirement or when plants are required to cut their generation.

Cutting coal plant capacity and generation to align with the more ambitious JETP+ scenario would raise estimates to USD 80-110 billion by 2050 depending on the approach



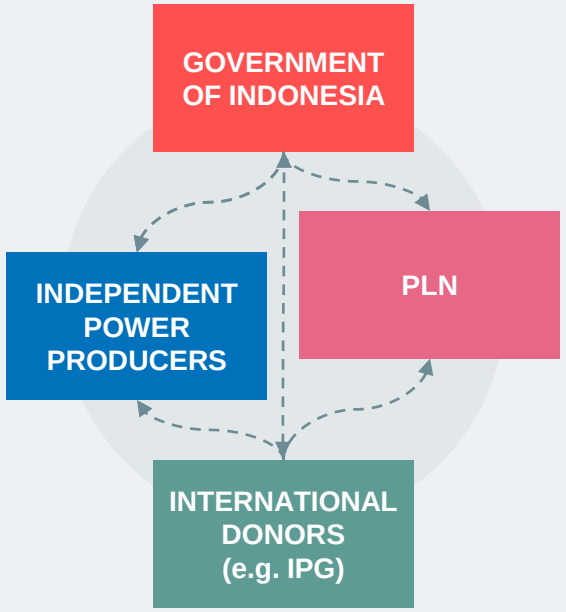


All estimates to align with the NZE scenario presented here based on default assumptions of 30-year natural lifetime for CFPPs, estimates of reductions in generation relative to default capacity factor of 80% for units connected to the Java-Bali grid, and 86% for all others, and applying a 5% discount rate.

Source: NewClimate, IESR.

Sharing the burden of potential losses from reducing the lifetime and operation of the coal fleet is a critical part of delivering a successful transition

Potential losses will need to be shared between the plant owners themselves, who would have factored in such risks to some degree at the time of making their investment decisions, as well as the GoI and the IPG, as part of their JETP commitment to accelerate the transition



- The IPG – a group of wealthy countries with a high responsibility for historic emissions – has committed to provide climate finance to accelerate Indonesia's energy transition. It can support the coal phase-out through **expanding both its provision of grants as well as offering concessional loans to IPPs and PLN** that enable them to offset potential coal plant losses through benefiting from the commercial opportunities available in the rapid renewable energy expansion.
- We estimate that a **carbon tax applied to coal generation, starting at USD 2 per tCO_2 today and rising incrementally by just USD 2-3 per tCO_2 each year**, could raise government revenues in the order of USD 60-80bn (present value terms) providing another possible source of funds to compensate the potential losses for both PLN and IPPs over the period to 2050 in the JETP scenario.
- Under such a policy, the carbon price would rise to around USD 20/tCO_2 in 2030 and USD 45/tCO_2 in 2040, which is well below central estimates of the global climate costs of emissions and a similar order of magnitude to health costs from coal generation (see analysis below on health benefits)
- Coal plant owners may need to bear some of the potential losses as they would have **factored 'stranded asset' risk into their investment decisions**. A large share of Indonesia's coal fleet entered operations after the Government ratified the Paris Agreement in 2016, with the need to rapidly decarbonise the global economy apparent well before then.

Infrastructure
Fossil phase-out

As retiring plants early or reducing their operations does not offer a direct return on an investment, grants are a potential instrument to help incentivise reducing coal generation. However, the current grant offering from the IPG is extremely limited, meaning concessional loans for new investments may offer the most feasible route to compensating potential losses.

GRANTS: TECHNICAL ASSISTANCE	Support development of early-retirement planning, analysis and stakeholder engagement to determine profile of phase-out, support implementation, provide legal advice, etc.
GRANTS: OTHER	Directly contribute to negotiated compensation packages provided to plant owners for early-retirement or curtailment
GUARANTEES	Not relevant
CONCESSIONAL LOANS	Indirect compensation provided to coal plant owners (incl. PLN) with conditions to re-invest in renewables, storage or critical grid infrastructure that enables higher renewables penetration
MARKET RATE INVESTMENTS	Not relevant
EQUITY / OTHER / UNDEFINED	Not relevant

Infrastructure: Clean build-up

Financing clean energy infrastructure needs

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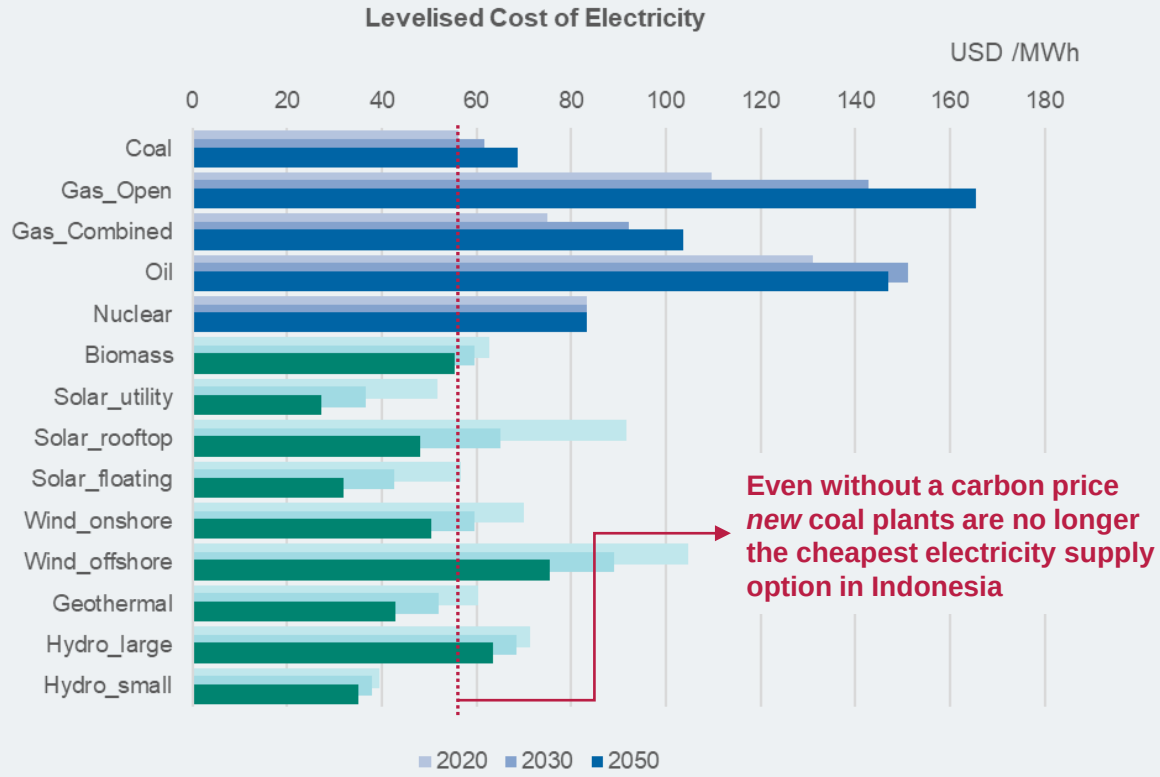
Infrastructure
Clean build-up

Delivering the JETP goals requires a major pivot in investments in the Indonesian energy sector away from fossil fuel infrastructure towards a rapid scaling-up of renewable capacity, energy storage and new and improved grids

- **Renewable technologies are already the lowest cost options for capacity additions in Indonesia**, particularly utility-scale solar PV, hydropower and geothermal, when compared in terms of their levelised cost of generating electricity, even when calculated with *no carbon price*.
- **Policy reform is key to catalysing both investment as well as permitting and planning procedures**, given the nascent status of intermittent renewables in Indonesia's electricity mix today.
- **Grid extensions and improvements to existing infrastructure** are also critical to facilitating the growth in solar PV and ensuring reliable matching of supply and demand centres.



Source: Authors own analysis of Danish Energy Agency and MEMR's Technology Costs Catalogue.

Notes: Levelised costs calculated assuming a 10% discount rate for all technologies as well as technical capacity factor assumptions, e.g. 85% for coal plants. Today coal plants operate at significantly lower capacity factors (~60%) due to overcapacity, which increase their overall cost per MWh of output.

Infrastructure
Clean build-up

Finance needs to deliver a 'clean build-up' of energy infrastructure in the coming decades are large and investments will need to mostly offer commercially attractive returns, supported by targeted public funds

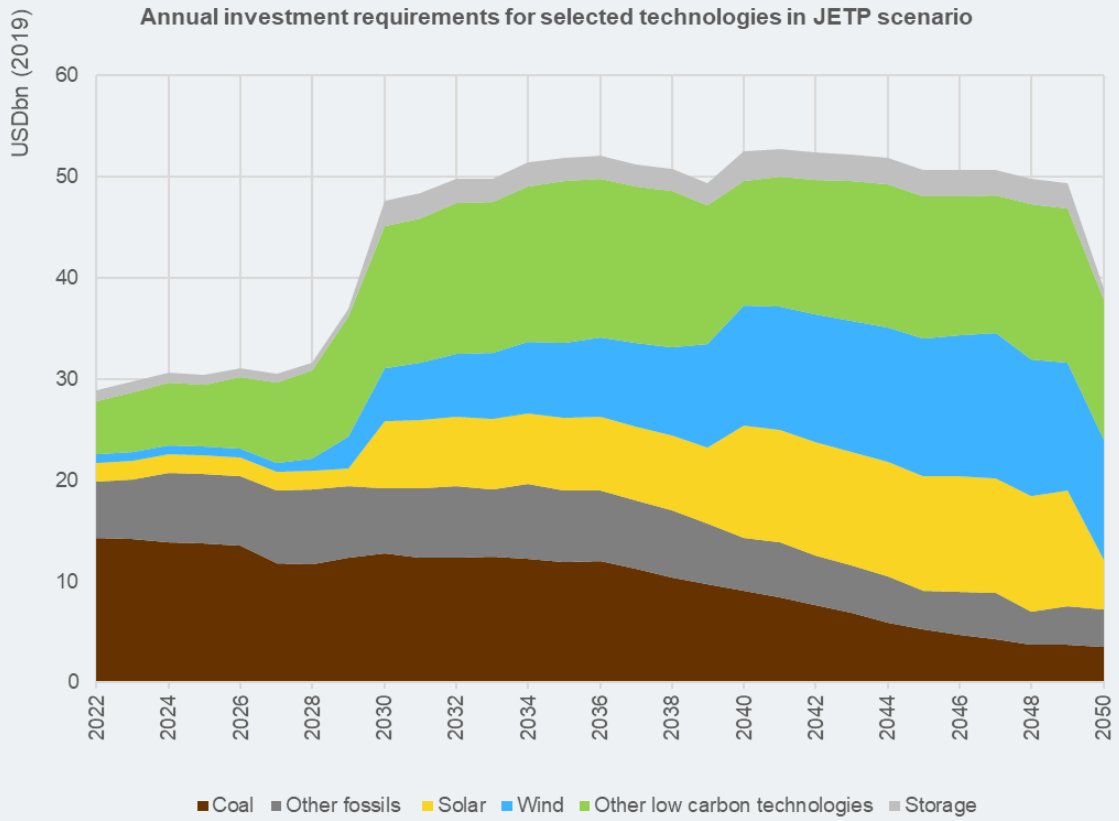
- We calculate the total investment needs for a 'clean build-up' by estimating the following costs for key technology types in each year and applying these to the electricity scenario pathways:
  - **UPFRONT CAPITAL EXPENDITURE (CAPEX)**
  - **FIXED OPERATIONAL EXPENDITURE (OPEX),**
  - **VARIABLE OPEX**
  - **FUEL**
  - **(CARBON EMISSIONS – USER CONFIGURED)**

KEY STEPS

1. Determine new capacity and grid addition requirements by technology in each year for the scenario pathway
2. Determine the total operational capacity and generation by technology and year over the modelling horizon
3. Identify estimates of relevant costs to plan, construct and operate capacity over time as well as cost of capital (WACC)
4. Multiply capacity additions, as well as operational capacity and generation in each year by relevant costs
5. Identify potential role for public finance to unlock required private / commercial investments

Cumulative investments to supply electricity under the JETP scenario reach USD 1.3 trillion over the period to 2050 with annual finance needs in the order of USD 50 billion from the 2030s

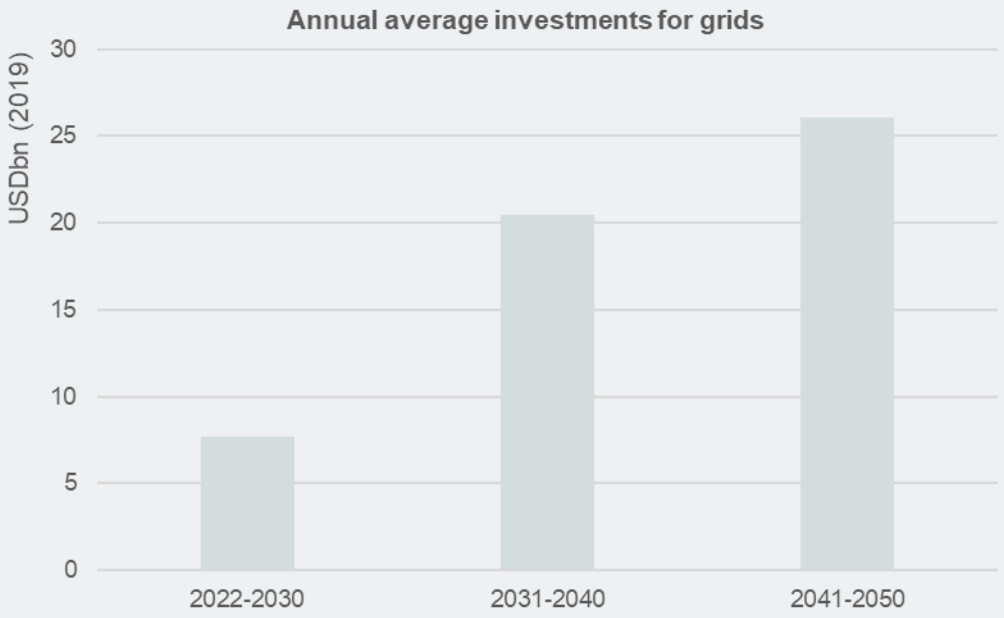
- Major investments are needed to expand and operate generation capacity in Indonesia in the coming decades to meet rising electricity demand.
- Total annual investments in the JETP scenario are in the order of **USD 30bn** this decade, rising to around **USD 50bn** by the early 2030s.
- Investments in renewables and other low carbon technologies remain somewhat limited this decade, ramping up significantly from the start of the 2030s and accounting for **USD 0.9tn** of the total USD 1.3 trillion in investments estimated over the period to 2050.
- Coal and other fossil fuels continue to dominate investments in new capacity and generation in the 2020s, declining gradually thereafter.
- Fossil fuels account for around **USD 0.4tn** of investment needs to 2050, the vast majority of which are fuel costs.



Source: NewClimate, IESR.

Notes: 'Other low carbon technologies' include geothermal, hydro, nuclear and biomass technologies. Estimated investment requirements cover capital and operational expenditures, including spending on fuel.

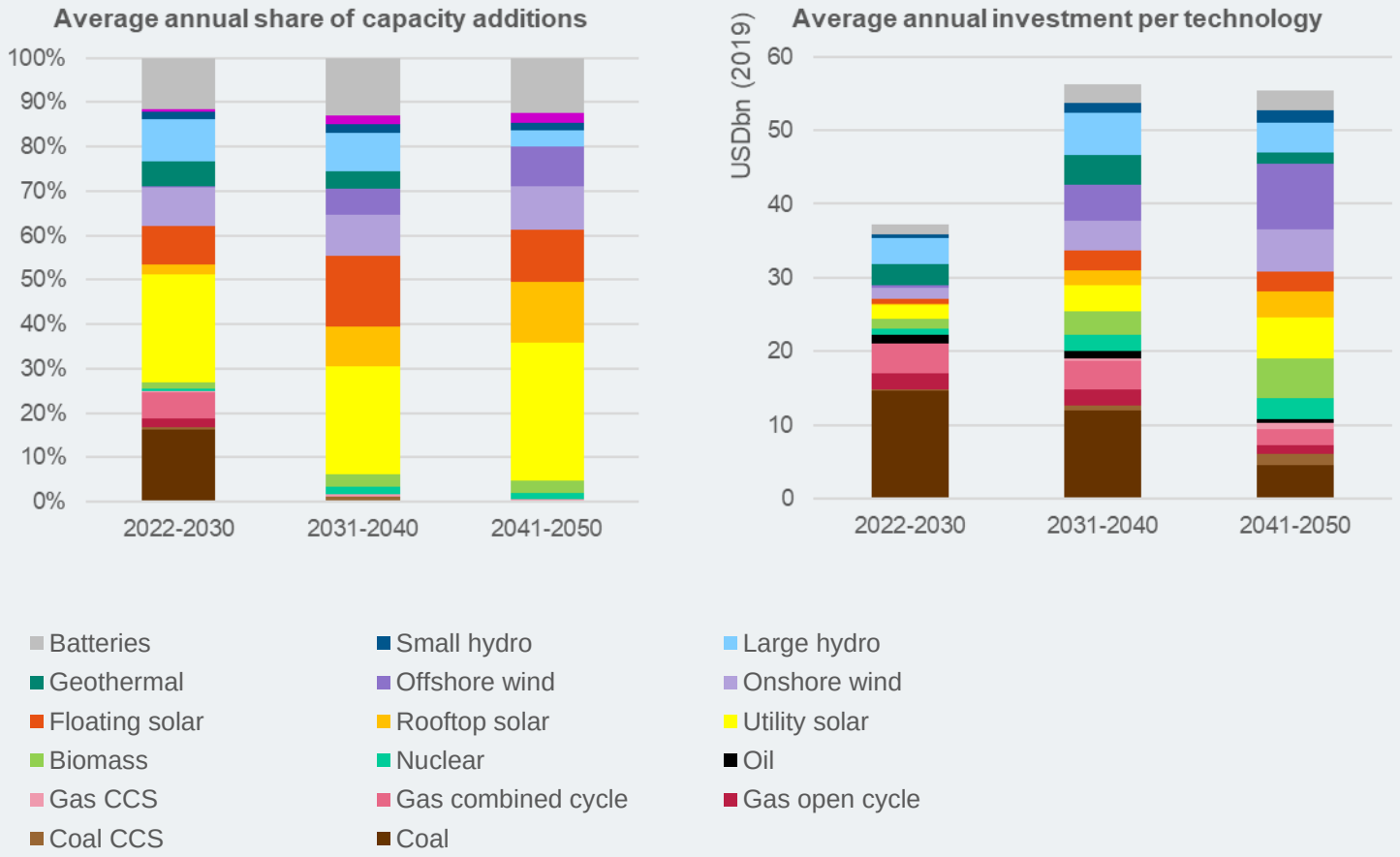
Significant additional investments of around USD 0.5 trillion up to 2050 are required to expand and enhance transmission and distribution grids



- Expanding and enhancing transmission and distribution grids are a critical component of both decarbonising the Indonesian electricity grid and meeting growing demand.
- Major new interconnectors between and within islands are needed to improve the reliability of the grid and connect demand centres to an increasingly geographically diverse array of renewable energy sources.
- IEA estimates indicate grid investments of around **USD 8bn per year** are needed this decade, rising sharply to **USD 20bn** in the 2030s and further increasing to around **USD 26bn** per year in the 2040s.
- Grid investments account for around **USD 0.5tn** to 2050, on top of the USD 1.3 trillion required to expand and operate generation capacity (previous slide).

Source: Authors analysis based on IEA (2022). As noted in the methodology slides, due to their bespoke nature we do not include any new analysis on grid investment requirements in the JET-FIN tool.

Whilst capacity expansion in the JETP scenario shifts towards solar and wind from 2030s investments in coal value chain remain locked-in

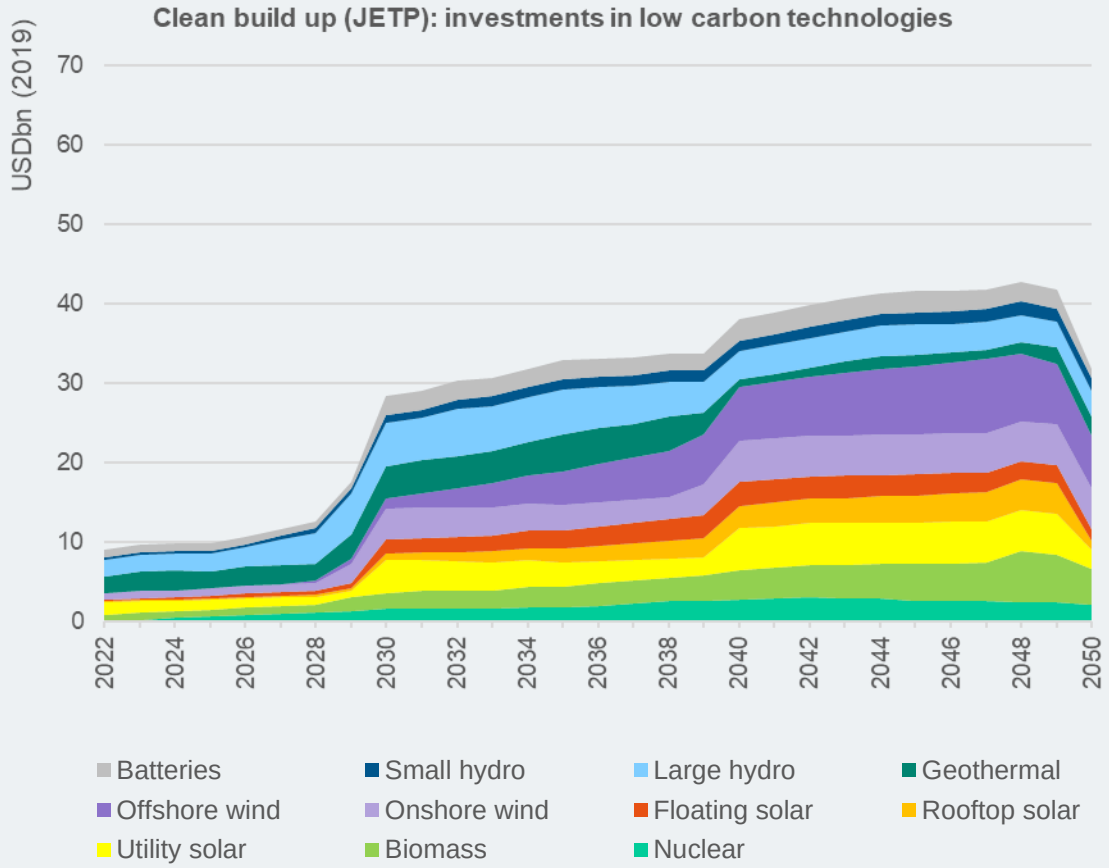


- Investments of around USD 18bn are channelled into building new coal plants between 2023 and 2028, roughly equivalent to spending on expanding solar PV capacity this decade in the JETP scenario.
- These investments, combined with existing capacity, lock-in continued major investments in fossil fuel value chains, particularly in the supply of coal and gas as fuels.
- Average investments in fossil fuel capacity expansion, plant operation and fuel remain around today's level of USD 20bn per year through the 2030s, only halving in the 2040s.

Source: NewClimate, IESR.

Clean build up finance needs for the JETP scenario, mostly for capacity expansion, rise to almost USD 30 billion per year by 2030 and USD 40 billion by 2040

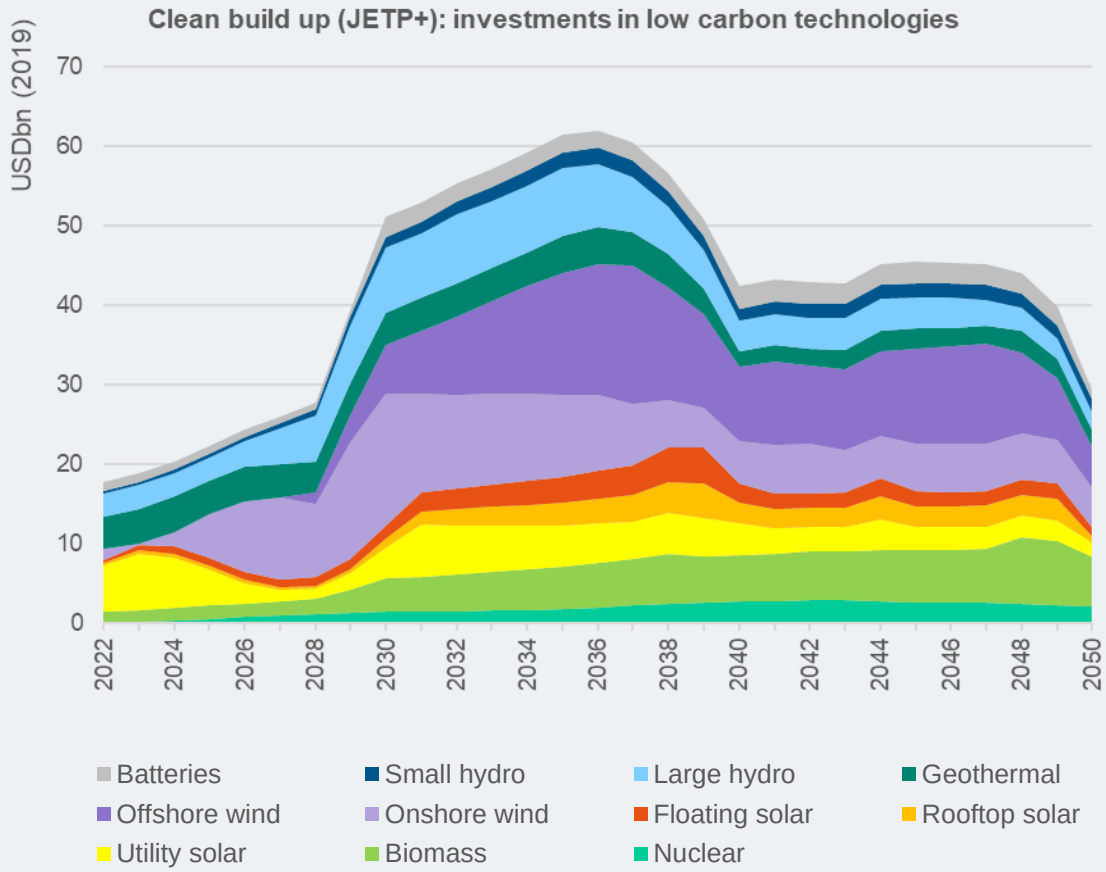
- Finance needs to expand clean electricity supply technologies rise this decade reaching almost **USD 30bn** by 2030 in the JETP scenario and continue an upward trajectory to more than **USD 40bn per year** by early-2040s.
- Geothermal and hydroelectric power projects account for the largest share of renewable investments initially, with solar and wind playing a much larger role from the early 2030s.
- Investment requirements for solar PV (which, along with small-scale hydro, is the cheapest technology option in Indonesia on a levelized cost basis) rise from around **USD 2bn per year** this decade, to **USD 7bn per year** in the 2030s and **USD 11bn per year** in the 2040s.
- Cumulative investment needs are in the order of **USD 200bn** over the period to 2050 for solar PV and **USD 225bn** for on- and offshore wind capacity expansions.
- Battery storage is increasingly added to facilitate more intermittent generation over time, with investment requirements ranging between **USD 2-3bn per year** from 2030.
- The JETP scenario also includes a role for nuclear energy in the fuel mix from the 2030s. Given the long lead times for planning and constructing nuclear plants, investments would need to already start soon, although it is unclear if the Government of Indonesia will pursue such a strategy.



Source: NewClimate, IESR.

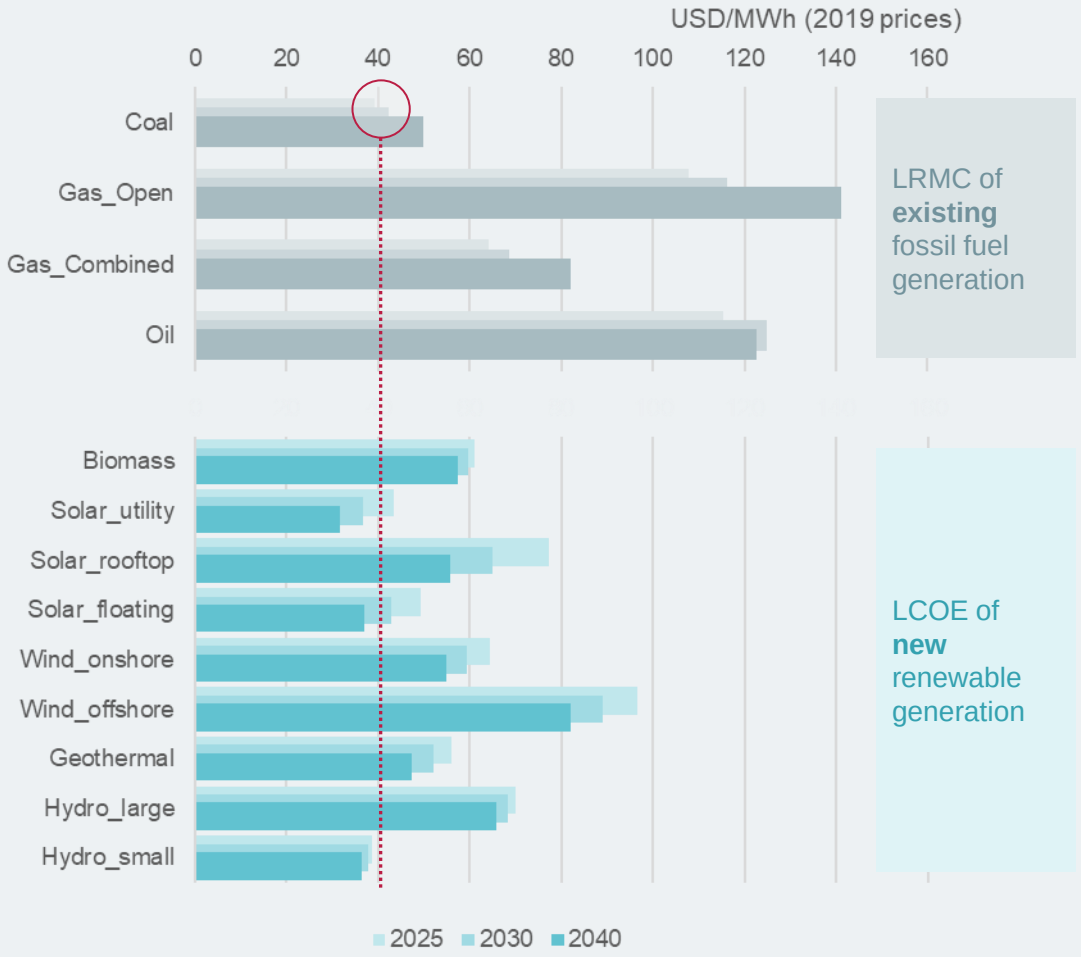
To move onto a 1.5°C-aligned pathway, the JETP+ scenario requires more and earlier investment into renewable energy sources

- To align with the 1.5°C goals of the Paris Agreement, the expansion of clean technologies needs to accelerate at a much faster rate than in the JETP scenario.
- Renewable capacity expansion requires annual investments of USD 25bn by 2025, rising to around USD 50bn by 2030.
- All renewable technologies are deployed earlier and faster in the JETP+ scenario with higher investment requirements in all areas.
- Cumulative investments in solar PV to 2050 are only slightly higher than in the JETP scenario at around **USD 230bn** as total installed capacity by 2050 is similar in both scenarios, although roll-out occurs earlier to meet the tighter emission constraints of the JETP+ scenario.
- Investments in wind technologies however are significantly higher in the JETP+ scenario as almost double the capacity is needed by 2050. Cumulative investments in on- and offshore wind reach **USD 450bn** by 2050.



Source: NewClimate, IESR.

Whilst following the JETP scenario is likely to decrease electricity generation costs over time, running existing coal plants remains one of the cheapest options today, acting as a barrier to new renewables

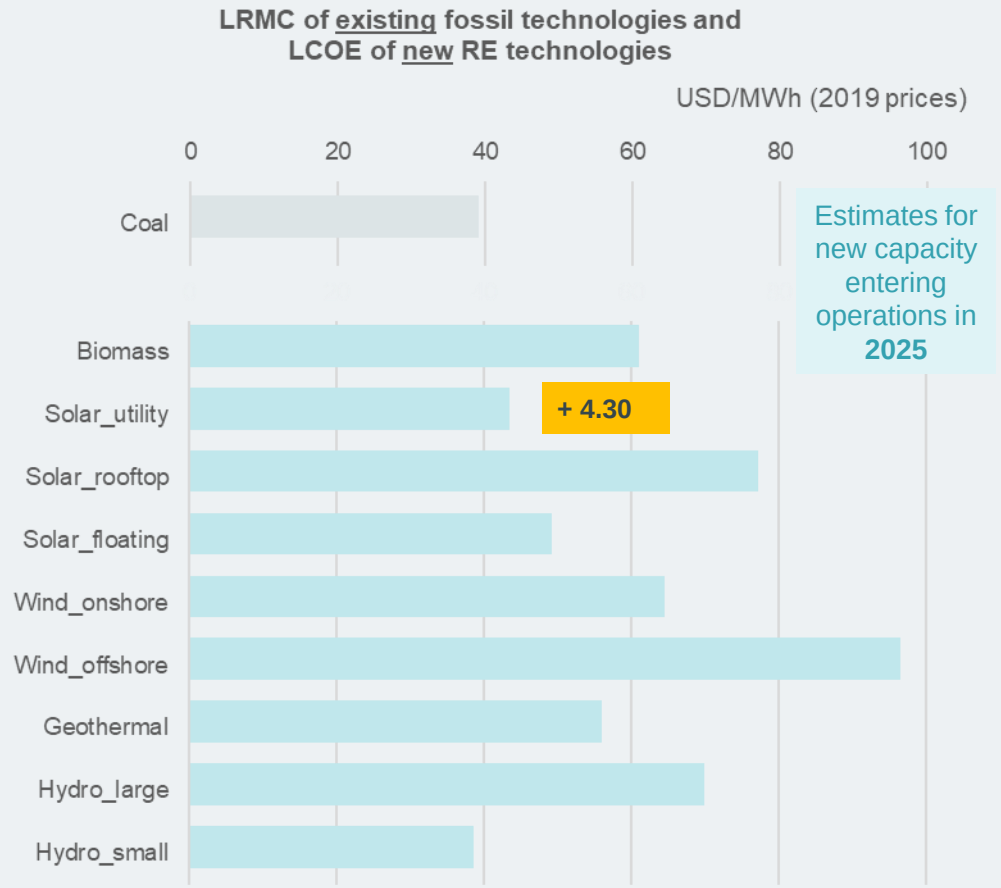


- The IEA Roadmap's system modelling shows that average electricity generation costs decline over time in their Announced Pledges Scenario (APS), which we use to inform our JETP scenario, from approximately USD 80/MWh today to around USD 65/MWh by 2030 and beyond (in 2021 prices) in the absence of a carbon price [see Fig 3.6, p92 in IEA report].
- The JETP scenario therefore is unlikely to raise electricity costs and prices faced by consumers and may in fact facilitate increased access to electricity through declining prices over time.
- However, running *existing* (i.e. already built) coal plants remains one of the cheapest forms of electricity generation today, without a material domestic carbon price. This acts as a barrier to catalysing the rapid roll-out of renewables required in the JETP and JETP+ scenarios.
- Existing coal plant electricity generation costs are approximately **USD 40/MWh** in 2025 (covering fixed and variable opex and fuel costs, which reflect their long-run marginal cost, or LRMC).

Source: Authors own analysis of Danish Energy Agency and MEMR's Technology Costs Catalogue.
Note: Levelised costs calculated assuming a 10% discount rate for all technologies.

Targeted, short term support to selected renewables can help catalyse their initial development, with around USD 300 million of public finance able to deliver 10GW of utility solar PV in 2025 at cost of existing coal

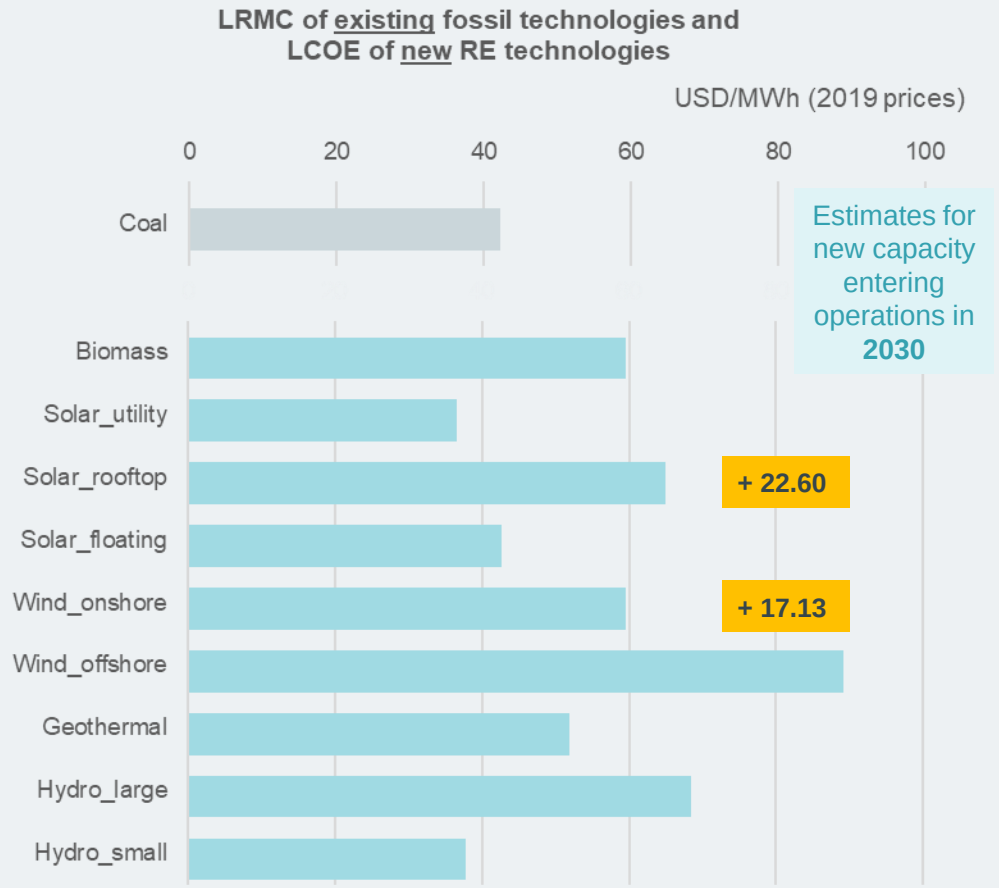
- For new renewables projects, **starting operations in 2025**, levelized costs of electricity (LCOE) are higher than the long-run marginal cost (LRMC) of coal plants, with the exception of smaller scale hydroelectric power plants.
- To catalyse the development of key renewable technologies, the Government of Indonesia / PLN could provide *targeted and time limited* support (potentially drawing on international finance as part of the JETP) to bridge the difference.
- Utility scale solar PV represents the lowest cost option. Public finance needs to allow utility-scale solar PV entering operations in 2025 to reach cost parity with the LRMC of coal plants are approximately **USD 4.30/MWh**.
- Estimated support costs for the deployment of 10GW utility solar PV in 2025 – as required in the JETP scenario – are in the order of **USD 80m** in the first year, declining to zero by 2031 as the LRMC of coal increases due to rising fuel and operational costs.
- Total public finance support requirements to add 10GW utility solar PV in 2025 are approximately USD 307 million over the period to 2030, or **USD 279m** if applying a social discount rate of 3.5%.



Source: Authors own analysis of Danish Energy Agency and MEMR's Technology Costs Catalogue for new and existing capacity in 2025.
Note: Levelised costs calculated assuming a 10% discount rate for all technologies.

By 2030 around USD 4 billion of public finance support could shift to the likes of rooftop PV and onshore wind to boost roll-out

- **By 2030** new utility and floating solar PV are already cheaper than existing coal on a per unit basis.
- Rooftop solar PV is more expensive, but presents a number of advantages that are not fully captured in a simple cost comparison analysis. In particular, rooftop PV does not compete with other uses (e.g. food production) for land and, through community-based development, can both improve electricity access in remote areas as well as raise engagement of households and small businesses to share in the benefits of the energy transition.
- Onshore (and offshore) wind also represents a critical component for achieving both JETP and JETP+ scenarios.
- Total public finance support requirements to add **2GW rooftop solar PV** and **5GW onshore wind** in 2030 – as required in the JETP scenario - are approximately **USD 690m** and **USD 3.2bn**, respectively, over the period to 2050 (applying a social discount rate of 3.5%).

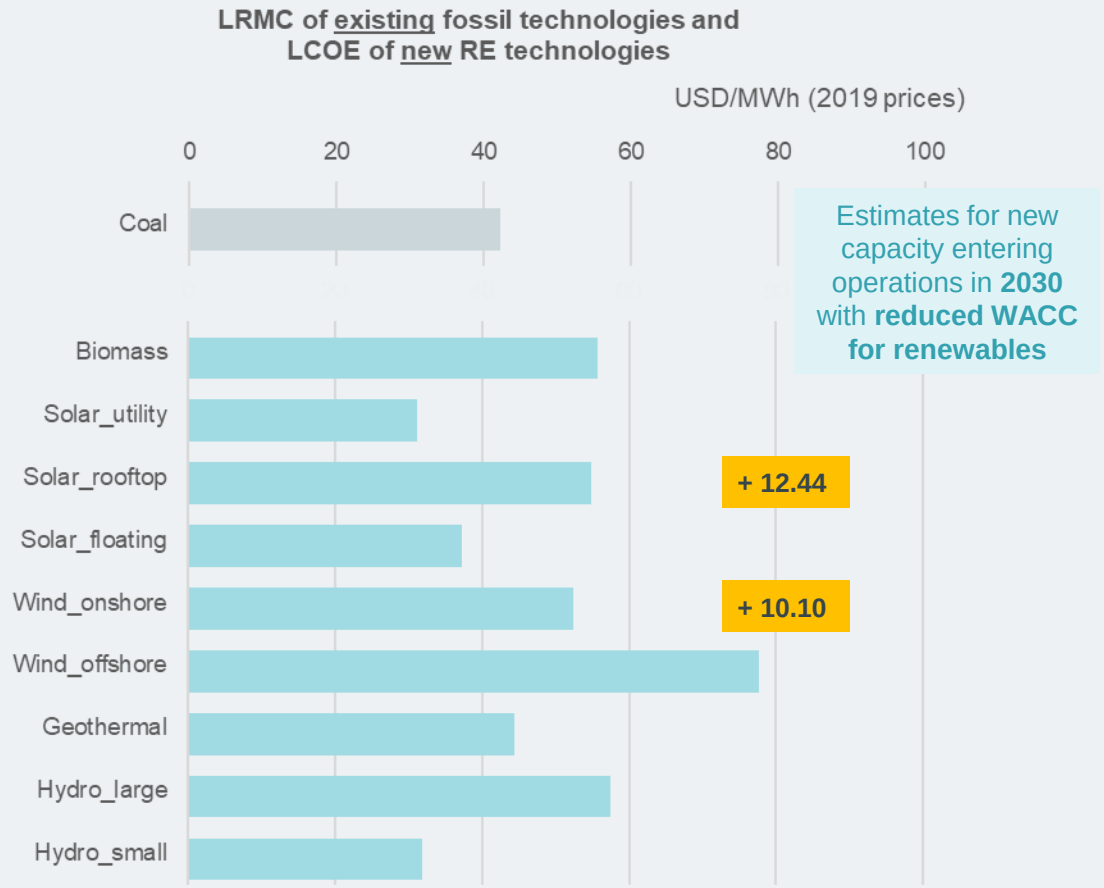


Source: Authors own analysis of Danish Energy Agency and MEMR's Technology Costs Catalogue for new and existing capacity in 2030.
Note: Levelised costs calculated assuming a 10% discount rate for all technologies.

Policy interventions that help de-risk renewable investments and/or a carbon price can materially reduce potential public finance support needs

- **Policy interventions to improve the investment climate for new renewables** by removing, or limiting, certain risks can materially cut potential public support requirements.
- Implementing initiatives, such as reforming minimum local content requirements, improving and standardising PPAs, establishing clear procurement processes and speeding up licensing, etc., can serve to de-risk investments in renewables and lower financing costs.
- As an illustrative example, **cutting the WACC for renewable technologies by 200 basis points**, from 10% to 8%, reduces the LCOE of rooftop solar PV by USD 10/MWh and onshore wind by USD 7/MWh.
- This would lower the estimates of public finance support requirements **to add 2GW rooftop solar PV and 5GW onshore wind in 2030** to approximately **USD 285m** and **USD 0.9bn**, respectively, over the period to 2050 (applying a social discount rate of 3.5%).
- **Introducing a carbon price** on all fossil fuel generation of approximately USD 10/tCO_2 would have a similar impact. A carbon price of USD 20/tCO_2 would make rooftop PV and onshore wind costs in 2030 on par with existing coal.

  (Every USD 1/tCO_2 carbon price serves to raise the short and long-run marginal cost of coal-fired generation by approximately USD 1/MWh)



Source: Authors own analysis of Danish Energy Agency and MEMR's Technology Costs Catalogue for new and existing capacity in 2030.
Note: Levelised costs calculated assuming a 10% discount rate for coal, **and 8% for renewable technologies**.

Infrastructure
Clean build-up

The majority of investments in clean build-up should offer commercially attractive rates of return, although concessional finance can serve as a valuable tool to kick-start investments in solar PV and other renewables, as well as critical grid and storage infrastructure. Limited grant-based funding could support building administrative capacity early on.

GRANTS: TECHNICAL ASSISTANCE	Support aspects such as planning, permitting, design of new regulation, general sector analysis and stakeholder engagement to facilitate a rapid roll-out of clean technologies
GRANTS: OTHER	Targeted support to fund critical grid infrastructure that improves energy access and enables integration of renewables into remote areas which are otherwise commercially unattractive
GUARANTEES	Potential role to allow public development banks to leverage more, early investment to accelerate the transition and raise ambition
CONCESSIONAL LOANS	Provided to investors (incl. PLN) to fund less mature and higher cost renewables as well as storage and grid infrastructure that is essential to enable integration of renewables
MARKET RATE INVESTMENTS	Key source of funding to catalyse the roll-out of critical, low-cost, renewable technologies and demonstrate their value to commercial investors
EQUITY / OTHER / UNDEFINED	A range of different instruments are potentially relevant depending on specific project characteristics and timing in the clean build-up

Just social transition

IESR Institute for Essential Services Reform

NEW CLIMATE INSTITUTE

Just social transition

Embarking on an energy transition with justice at its heart is a major challenge.

As the JETP pathway entails a much wider socio-economic reform extending beyond the core of the energy sector it offers an opportunity to address long standing structural injustices and promote more equitable outcomes for all.

The general justice framework often referred to in literature names **four main principles** to describe justice:

DISTRIBUTIONAL JUSTICE	**Refers to the distribution of both spatial and temporal benefits and costs across society**, e.g. job opportunities / losses in a particular region, or provision of affordable energy
PROCEDURAL JUSTICE	**Refers to the inclusion, transparency, and accessibility of the process**, e.g. involvement of relevant stakeholders and civil society representatives in planning and decision-making
RECOGNITION JUSTICE	**Refers to the recognition that equality does not mean justice – while humans have equal rights there might be substantial differences in their needs**, e.g. due to income disparities or qualifications
STRUCTURAL JUSTICE	**Refers to recognition of existing and prevailing injustices within the system**, e.g. current access to secure electricity, or capacity to influence decision-making

Just social transition

Embarking on an energy transition with justice at its heart is a major challenge.

As the JETP pathway entails a much wider socio-economic reform extending beyond the core of the energy sector it offers an opportunity to address long standing structural injustices and promote more equitable outcomes for all.

- These four overarching pillars are a good starting point to think about justice.
- In the context of an energy transition, justice needs to be understood, with relevant processes implemented, across all levels of governance. This includes both national and sub-national levels as well as representatives spanning all actors within the economy, given the relevance and importance of energy.
- To address the needs of the most vulnerable to climate change and the energy transition it is crucial to examine local contexts and give a voice to those typically structurally underrepresented in planning and decision processes.

"A Just Transition is an energy transition in which the resulting social, economic, and environmental risks and opportunities are equitably distributed among stakeholders according to their capacity and conditions affirmatively enable vulnerable stakeholders to mitigate the risks and capture benefits from opportunities"

As defined in Indonesia's CIPP (JETP Secretariat, 2023)

Just social transition

Our analysis focuses on a limited set of finance needs and indicators, zooming in on the domestic coal sector

- Given the critical role today of coal in Indonesia's energy sector and broader economy, in this report we focus our analysis on identifying finance needs to support **workers and communities dependent on coal value chains**, the **rehabilitation of coal mining sites** and we explore the **health impacts from operating coal plants**.
- A core focus of the JETP Joint Statement is the "*implementation of concrete actions achieving a just energy transition for workers and communities, particularly those most affected by an energy transition away from coal.*"
- Our findings do not represent a comprehensive assessment of overall finance needs to facilitate a just transition, given the limitations in scope.
- Further complementary work – with both quantitative and qualitative dimensions – could focus on wider needs for regional development through stakeholder driven processes, including promoting new activities and companies, building infrastructure, creating incentives to relocate (public) jobs, making provisions to enhance affordable and reliable energy access, and more broadly boosting opportunities for women, youth and vulnerable groups.

Employment

Rehabilitation of mining sites

Health benefits

Employment focus

Financing to support a just social transition

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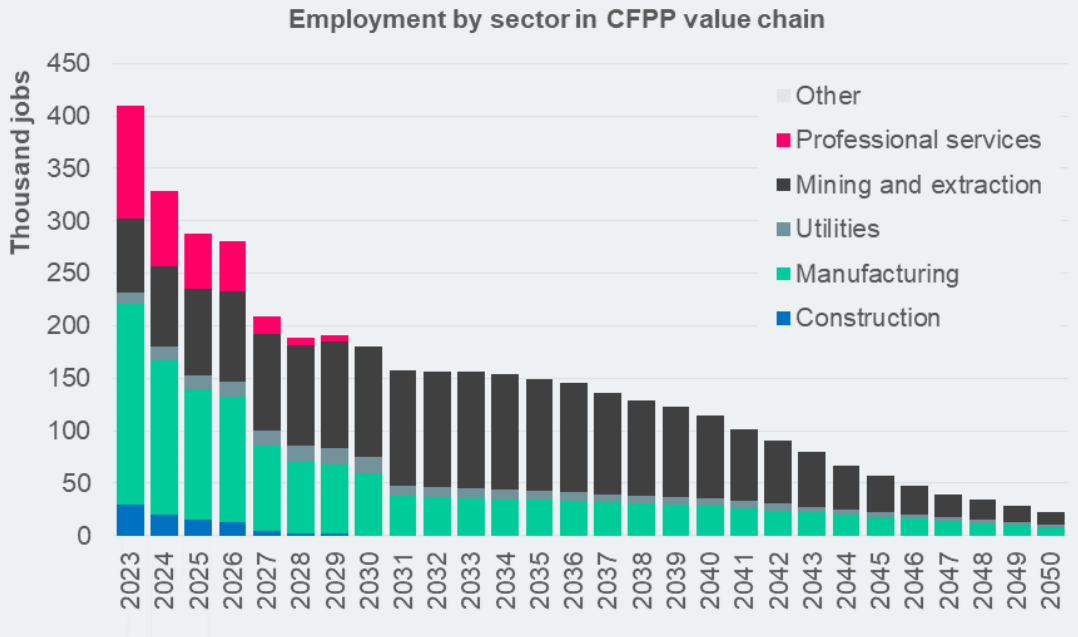
Just social transition

The workforce supported by the coal value chain in Indonesia will shrink over the course of the energy transition, requiring policy as well as financial support measures to ensure justice is at the heart of the JETP

- Indonesia's coal sector currently employs around 400,000 workers in jobs related to electricity supply (e.g. excluding coal mining for export, or industrial use of coal).
- This is set to halve this decade under the JETP scenario, with initial job losses primarily amongst those involved in planning and constructing new coal plants as well as domestic manufacturing of component parts.
- Throughout the 2030s and 40s workers in upstream mining activities as well as those operating and maintaining coal plants will continue to exit the sector.
- The JETP process needs to set out clear provisions to support coal workers as well as the communities that depend on them.



Source: NewClimate, IESR own analysis using EIM-ES

Just social transition

APPROACH

To deliver on the key objectives of a JUST energy transition, vulnerable communities – particularly in regions dependent on coal mining and its use – are likely to need support to ensure they benefit from the opportunities of a growing clean energy system

- We assess potential finance needs to support a just transition focusing on coal-sector workers and their communities.
- Coal mining, as well as a large share of coal power plants, are concentrated in East and North Kalimantan and South Sumatra.
- We estimate the potential number of workers that may require support due to reduced employment opportunities over time and approximate potential public funding needs to support either early retirement (for older workers) or retraining and relocation.
- Our quantitative estimates only cover a subset of likely overall costs to support workers and affected communities to successfully transition away from coal sector activities.

KEY STEPS

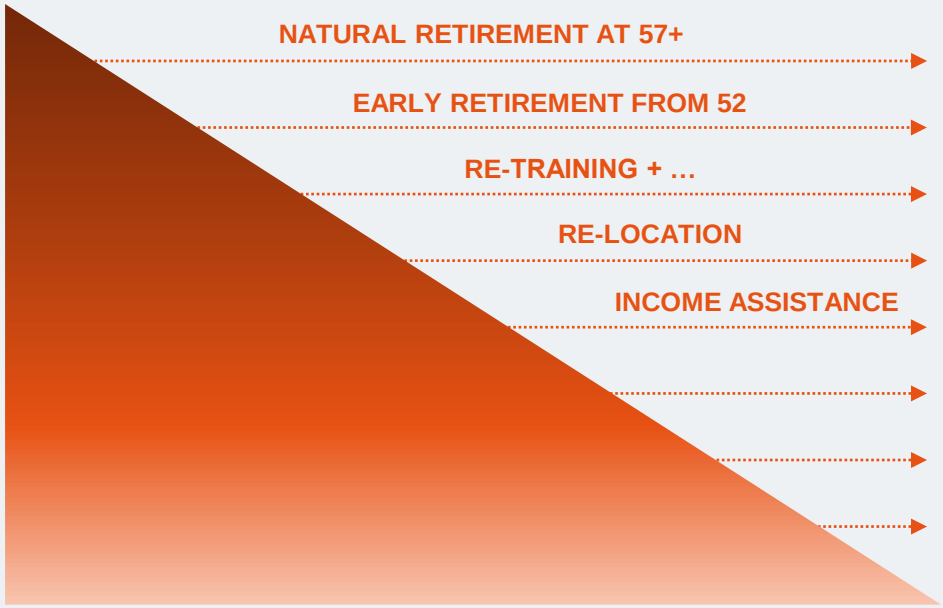
1. Estimate annual employment across electricity supply technologies for scenarios in Economic Impact Model for Electricity Supply (EIM-ES)
2. Deep-dive focus on coal sector jobs, broken down into jobs supported by capital expenditure, operations and mining
3. Identify estimates of age profile of current coal sector workforce and model natural annual turnover of employees
4. Determine annual estimates of workers exiting coal sector and whether suitable for early retirement or retraining
5. Identify potential costs to support early retirement or retraining / relocation of coal workers that stand to lose their jobs over time

Just social transition

Natural retirement, early retirement and re-training provide pathways for workers to transition out of the coal industry in the long-term and can be accompanied by further measures that compensate workers' financial losses directly

BREAKDOWN OF EMPLOYMENT IMPACTS INTO THREE CORE ELEMENTS OF COAL VALUE CHAIN

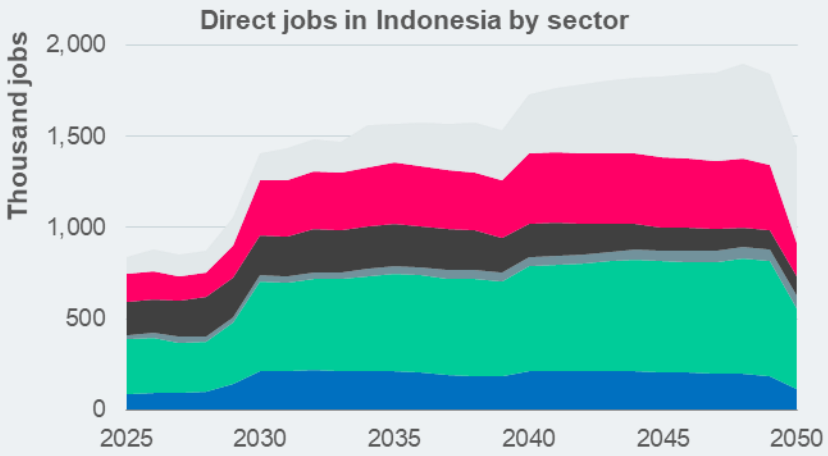
- Coal plant construction
- Coal mining
- Coal plant operations and maintenance

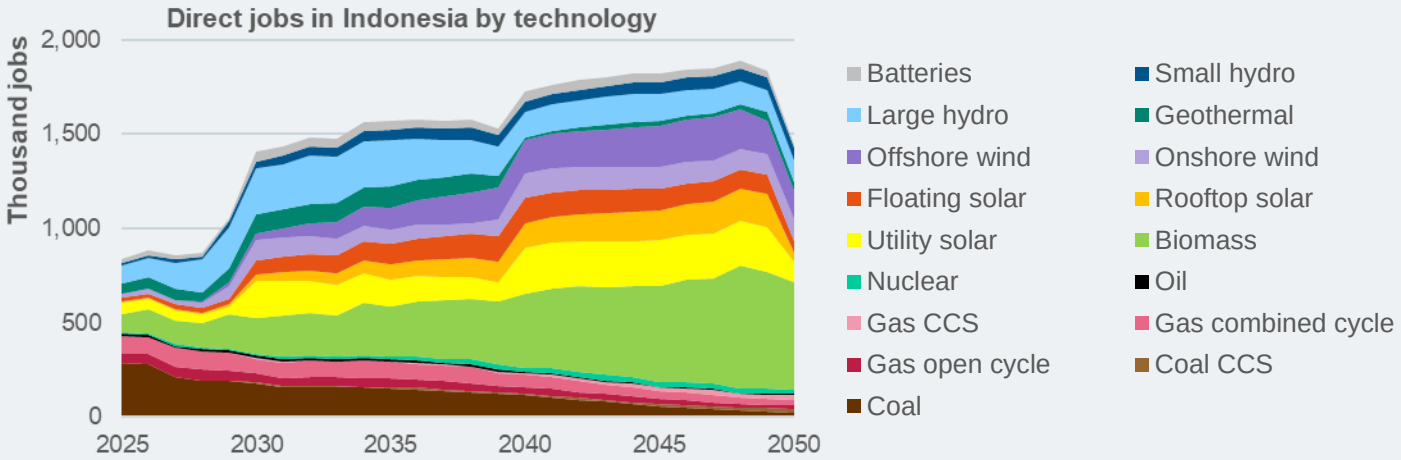


The employment transition may impose significant financial burdens to families of coal workers who are laid off or voluntarily choose to leave their jobs as a result of the phase-out of coal from the Indonesian, as well as global, energy system. In the short-term, households facing a loss of income could be supported through **temporary income assistance**, paid until workers successfully find re-employment.

The geographical distribution of where current coal workers live and work and where new employment opportunities are located may pose another barrier to coal workers accessing new jobs. **Relocation allowances** can help alleviate some of the financial burdens of, for example, transportation, housing and other costs associated with moving, enabling workers find to re-employment sooner, as they do not have to rely on building up enough financial buffer for this kind of transition.

In the JETP scenario electricity supply sector jobs rise from around 0.8 million in 2025 to 1.8 million by the late 2040s with fossil fuel based employment steadily falling over time

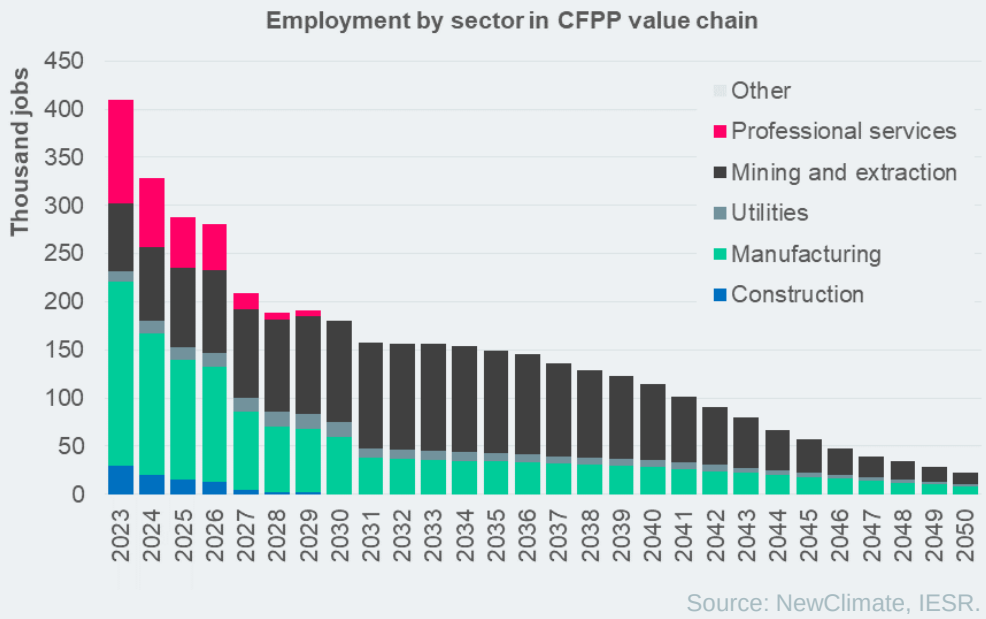




Source: NewClimate, IESR.

- Direct employment in the electricity supply sector doubles from around 0.8 million today by 2040 and continues to grow to around 1.8 million by 2050.
- Further indirect and induced employment stimulated by these investments in Indonesia represent additional impacts that are approximately twice as large again.
- Fossil fuel based jobs decline over time as first unabated oil, then coal and gas is phased-out of the electricity generation mix.
- Jobs in the construction and manufacturing sectors rise as more renewables are added to the system, creating jobs in both installing new capacity as well as their upstream value chains for domestic production of component parts.
- Around 300,000 new jobs are created in Indonesia in the solar PV sector by 2030, with a further 800,000 supported by other renewable technologies.
- The energy transition will represent a major shift in both the skills as well as the location of workers. Addressing this challenge requires early planning and major investment into training and education to sustainably grow a workforce to deliver and maintain the future electricity system.

Coal sector job losses occur first amongst those active in the construction of new plants, followed by operation and maintenance related jobs, then mining



Source: NewClimate, IESR.

1 Coal plant construction

Initial job losses in the coal value chain this decade are mostly in construction, manufacturing and professional services sectors as the pipeline of new coal plants dries up permanently.

2 Coal plant operations and maintenance

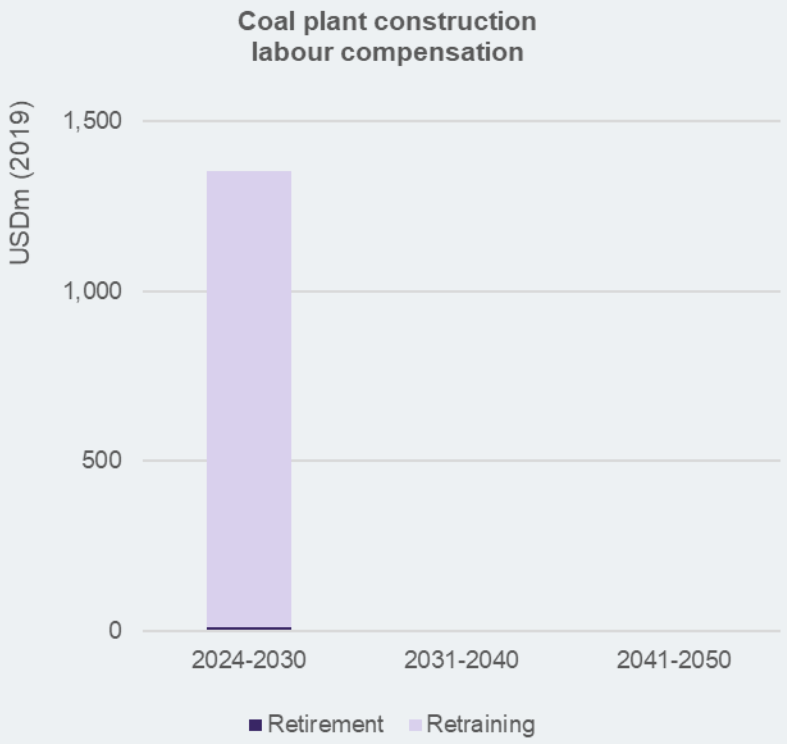
As coal generation falls through the 2030s and 2040s, employment in operating and maintaining coal plants (including manufacturing parts) steadily falls.

3 Coal mining

Most of the reduction in coal mining jobs to supply the domestic electricity sector, beyond the natural retirement of workers, occurs in the late 2030s and throughout the 2040s.

Our modelling of job impacts in Indonesia's mining sector, corresponds to the share of coal produced to meet domestic electricity demand. Today this is approximately one quarter of total domestic coal production, which is also exported or used in the industrial sector.

Potential compensation measures to support workers transitioning away from coal are highest this decade as construction of new plants abruptly ends in the JETP scenario



- The employment transition occurs fastest for workers involved in the development and construction of coal-fired power plants. The last on-grid coal-fired power plants are commissioned in 2027, with limited further construction of off-grid, captive coal plants potentially continuing until the end of the decade.
- Despite having a somewhat elderly workforce, employment opportunities shrink much more rapidly, so that the majority of workers are still suitable for re-training in the near future, rather than taking up either natural or early retirement.

- More than 200,000 workers may be affected by forced exits due to the reduction in job opportunities for developing new coal-fired power plants.
- We estimate potential support costs for retraining (and relocation) of **USD 1.3bn** this decade.

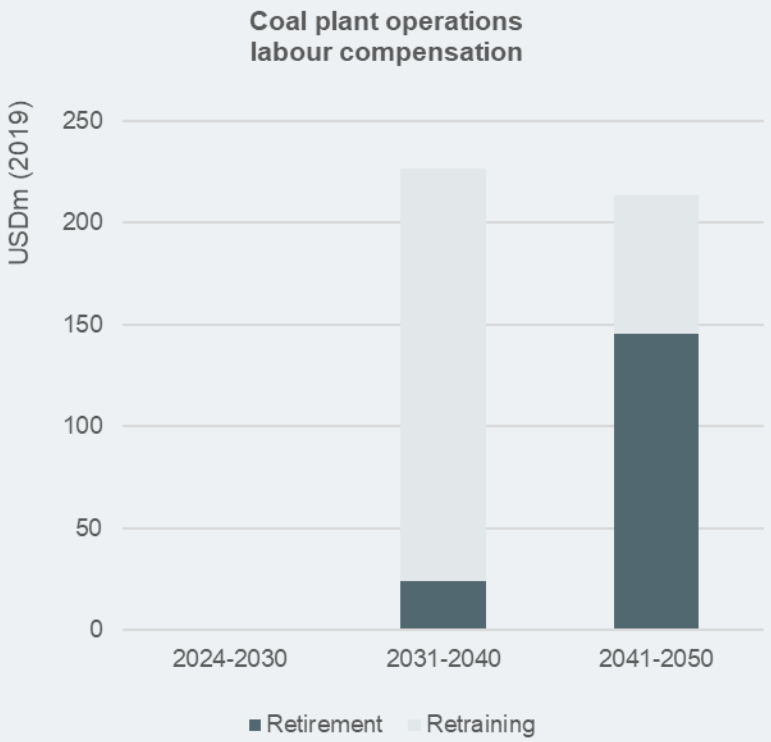
Retirement costs represent an estimate of early-retirement provisions for workers exiting the sector from the age of 52 (within 5 years of natural retirement).
Retraining costs include provisions for temporary income support, retraining / reskilling as well as relocation. See detailed methods in the Methods Appendix for more information.

Source: NewClimate, IESR.

Workers involved in operating and maintaining coal plants may require retraining support in the 2030s, with earlier retirement provisions more relevant in the 2040s

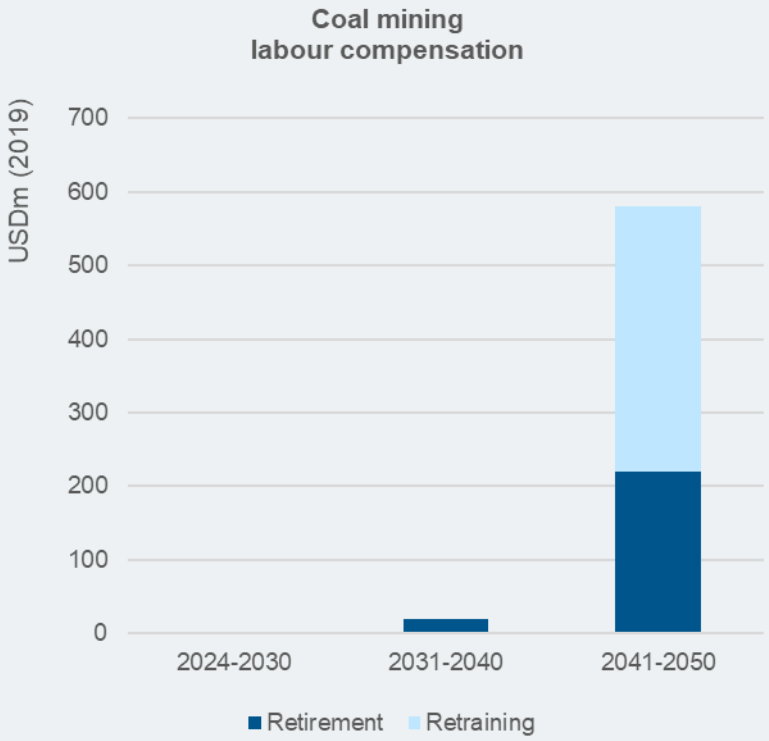
- As coal generation falls during the 2030s and 2040s some of the workforce will shrink through natural retirement.
- The workforce supported by the operation of coal-fired power plants is younger and requires exits additional to those from the natural turnover of employees sooner than the coal mining industry.
- Most of these exits in the 2040s include workers suitable for re-training (and potentially relocation) support to enable them to find alternative employment opportunities.
- As the workforce ages over time, a higher share of the exits in the 2040s are workers above the age of 52 who may be more suited to receiving early retirement support.

- The transition away from coal over time may affect in the order of 60,000 workers involved in coal plant operations and their maintenance.
- We estimate **USD 170m** may be needed to support early retirement and a further **USD 270m** for retraining costs.



Source: NewClimate, IESR.

Impacts of the transition are more limited initially for coal mining workers because the workforce is older with many employees retiring naturally without the need for additional support

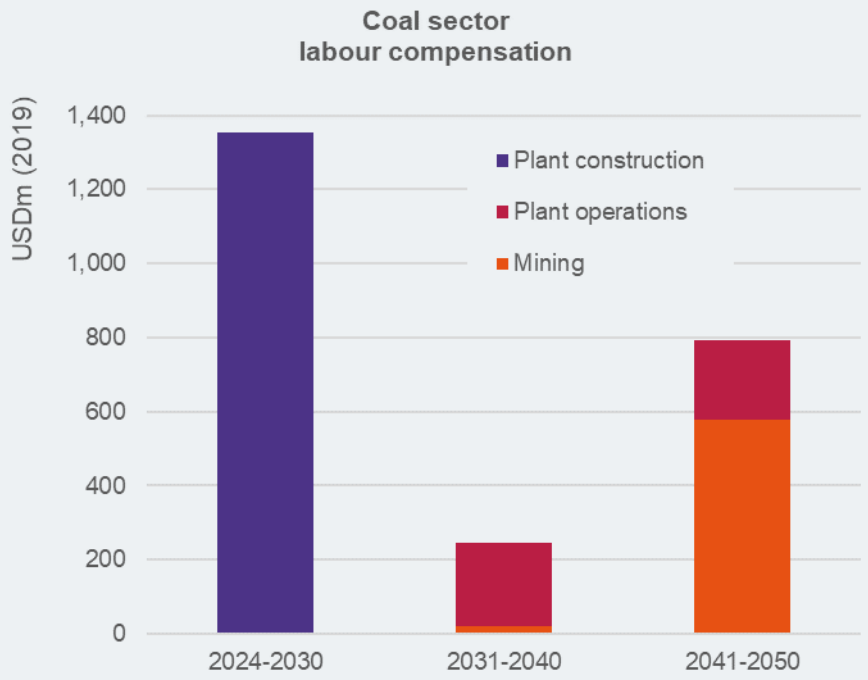


- Coal mining jobs also decline with falling coal generation. Impacts are more limited than for plant operations in the 2030s.
- Since the current coal mining workforce has a substantial share of older workers, downsizing of the workforce is possible through the natural retirement of older workers, aged 57 and above, up until 2038.
- After that, remaining older workers, aged 52-56, can be supported through early retirement for another few years, but the majority of workers remaining in the last decade of the transition period are aged 51 and below, and will be more suitable for re-training.

- The total number of mining sector workers potentially requiring early retirement or re-training support up to 2050 is around 70,000.
- We estimate early retirement support needs of **USD 240m** and retraining costs of **USD 360m**.

Source: NewClimate, IESR.

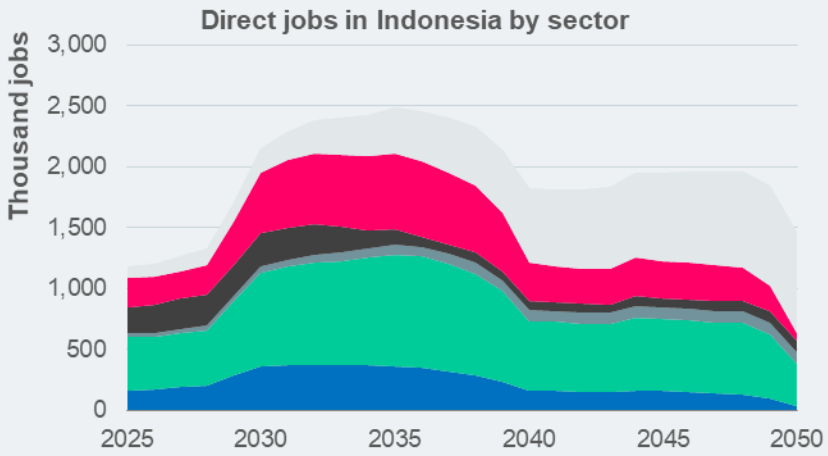
Support measures in the JETP scenario to compensate coal workers exiting the sector and to assist finding new opportunities could require finance in the order of USD 2.4 billion

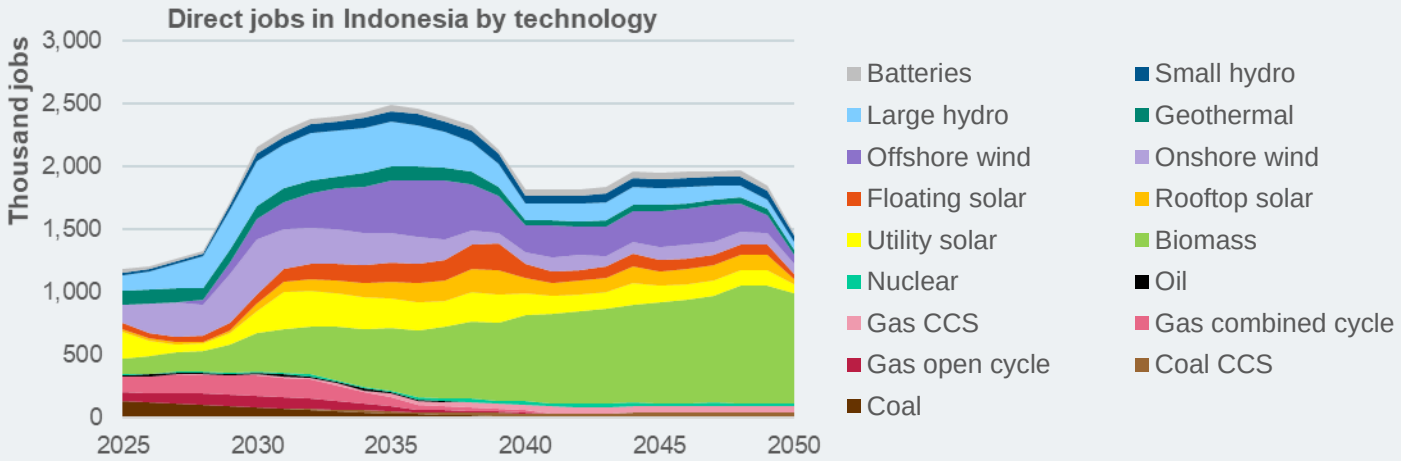


- Different phases of the coal value-chain will require different types of support at various times.
- Our analysis indicates a potential need to offer support packages totalling in the order of **USD 2.4bn** for employees in the coal sector that are potentially disadvantaged by the energy transition.
- This initial analysis is relevant to inform the possible magnitude of policy support requirements and the prioritisation of resources when developing a pathway for an energy transition designed around justice that aims to ensure coal sector workers are not left behind.
- However, further more detailed analysis is needed to inform specific policy planning and consider additional areas of support needs beyond those quantified here.
- Specialised training programmes, e.g. to provide the skills required for jobs in renewable industries, require significant forward planning to establish an educational profile of the existing workforce, assess the skill needs for future occupations, develop appropriate curricula and train educational staff.

Source: NewClimate, IESR.

The more ambitious JETP+ scenario creates more employment opportunities overall, although the faster fossil phase-out will mean earlier financial support needs for coal communities

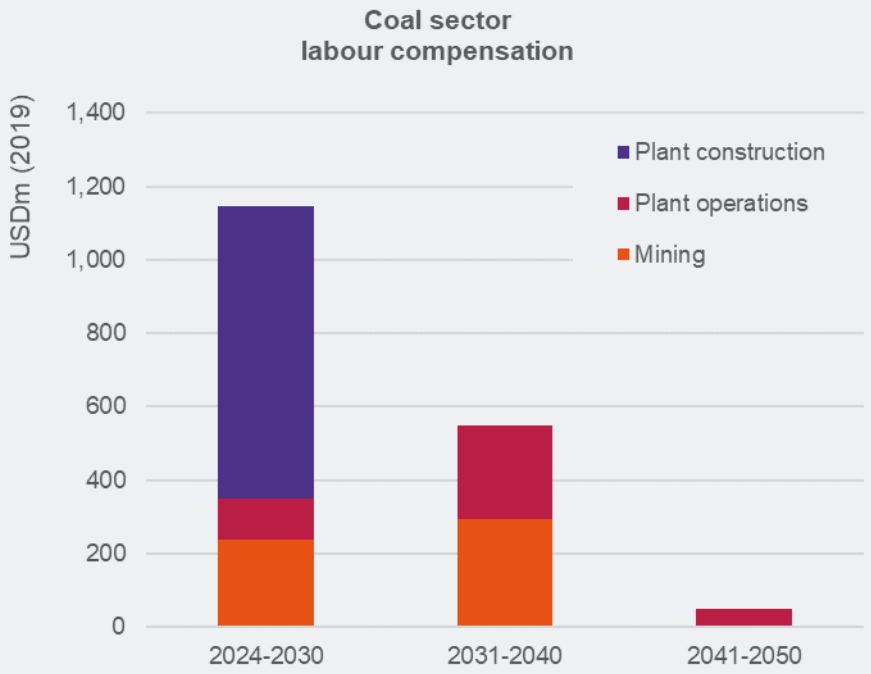




Source: NewClimate, IESR.

- In the JETP+ scenario, there is a steep rise in employment this decade and in the early 2030s to deliver an ambitious roll-out of renewables, particularly for solar PV and wind technologies.
- Electricity supply sector employment peaks at around 2.5 million direct jobs in 2035, followed by a slight decline and levelling off to 2 million jobs as the pace of new capacity additions slows.
- Under the JETP+ scenario unabated fossil fuel generation is phased-out by 2040. Domestic jobs in both coal and gas value chains fall faster than in the JETP scenario, requiring earlier financial support to smoothen the transition and assist workers and communities to access the opportunities presented by a sharp rise in demand for jobs in the renewables sector.

Overall support requirements to compensate coal workers are lower in the JETP+ scenario as there are fewer new entrants to the coal labour market this decade



- As coal use is lower during the 2020s (and beyond) in the JETP+ scenario there are fewer new entrants to the workforce this decade.
- This limits the potential size of the workforce that may require support, although the faster pace of the transition means a higher share of workers exit prior to their natural retirement age than in the JETP scenario.
- Our analysis indicates a potential need to offer support packages totalling in the order of **USD 1.7bn** for employees in the coal sector that are potentially disadvantaged by the more ambitious energy transition captured in the JETP+ scenario.

- Some countries (such as Poland, Spain, Canada and the UK) have also offered additional measures beyond further education and training courses, such as job-searching assistance, career counselling and mental health support, among others, to help workers improve their employability but also to help alleviate some of the personal burdens associated with their transition.
- Beyond the workers, local regions experiencing either an inflow and outflow of workers will require different measures to facilitate a structural transformation of their economies and local populations.
- We have not assessed these elements within the scope of this study.

Source: NewClimate, IESR.

Just social transition

Grants are the most relevant financial instrument to provide a safety net for coal sector workers, funding a range of policy support measures to facilitate re-employment and relocation as well as temporary income support. Concessional finance could help incentivise renewable project developers to support coal workers transitioning to the renewables sector.

GRANTS: TECHNICAL ASSISTANCE	Support establishment of training facilities, and design of early retirement and re-skilling programmes, including knowledge share from countries further advanced in coal transition
GRANTS: OTHER	Provide direct support to finance early retirement, re-training, relocation or similar programmes for workers and their dependent communities
GUARANTEES	Limited relevance – potential role to enable development banks to fund training programmes
CONCESSIONAL LOANS	Limited relevance – potential role to support renewable project developers to establish training centres or apprenticeship schemes, targeted at former coal workers
MARKET RATE INVESTMENTS	Not relevant
EQUITY / OTHER / UNDEFINED	Not relevant

Rehabilitation of mining sites

Financing to support a just social transition

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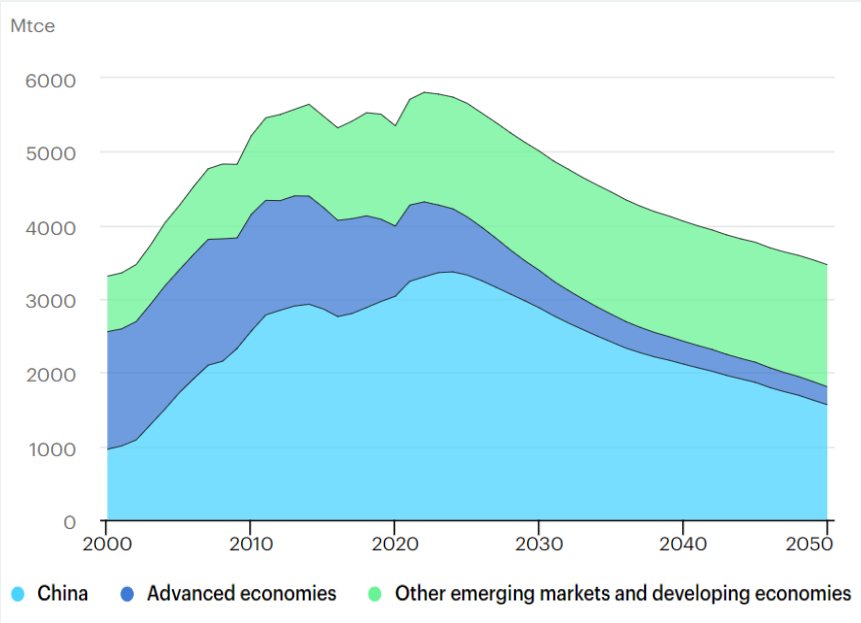
Just social transition

Rehabilitation of mining sites as they reduce their output and cease operations is important to limit environmental damage, restore natural ecosystems and repurpose land and infrastructure for future use

- **Indonesia's coal mining sector is one of the world's largest** and it makes a significant contribution to the economy through both domestic activities as well as export revenues.
- Activities are **concentrated in a small number of regions** including South Sumatra as well as South, Central, and East Kalimantan.
- Global coal demand is expected to peak this decade, increasing the risks for coal mining companies, their workforce and dependents, of early closure.
- Whilst there is currently no government phase-out plan in place for coal mining in Indonesia the **reduction in domestic coal demand** from the power sector, in-line with the JETP targets, coupled with **falling global demand**, presents a risk that mining areas are left untreated which can exacerbate environmental damage as well as worsen socio-economic opportunities in affected areas.

Global coal demand by region in the IEA's latest Stated Policies Scenario



Source: IEA, World Energy Outlook 2023

Just social transition

Whilst the responsibility for rehabilitating mining sites lies formally with the mining companies granted licences, limited compliance can adversely affect local communities or place a financial burden on the State

- Complete and accurate public data on coal mining activities and land area affected is challenging to identify.
- As of September 2023 the Ministry of Energy and Mineral Resources (MEMR) recorded 902 coal mining licence holders (Izin Usaha Pertambangan, or 'IUP').
- Each IUP is granted approximately 2,000-20,000 hectares (ha) of land for 10-15 years on average (PTBA), meaning somewhere in the order of 10 million hectares could potentially be affected by current coal mining production.
- All IUP holders must provide a reclamation and post-mining plan and allocate a financial guarantee for the activities before any extraction.
- However, regulatory compliance is limited and, whilst they could be subject to fines, some licence holders neglect their responsibility for either placing guarantees or performing land rehabilitation.

Reclamation

Carried out on a continuous basis following extraction from individual pits within a licenced mining area, e.g.:

- Ongoing restoration of land, i.e. filling and landscaping of open pits after use;
- Revegetation of mining sites;
- Water treatment.

Post-mining

Initiated within 30 days of completion of all extraction at a licenced area and can take 3 years, e.g.:

- Rehabilitation of land at the end of the mining process to its natural landscape and purpose;
- Demolition of mining facilities;
- Social, cultural, and economic development activities.

Modelling the costs for rehabilitation of mining sites, including repurposing the site to contribute to greater social and environmental justice

- We calculate the costs of reclamation and post-mining needs following coal mine closure and provide estimates of the investments needed to recover untreated land.
- Estimates are based on meeting the following regulations:
  - Law No.3 of 2020 concerning Mineral and Coal Mining
  - MEMR Ministerial Regulation No. 7 of 2014 concerning the Implementation of Reclamation and Post-mining
  - MEMR Ministerial Decree No. 1827 K/30/2018 concerning Guidelines of Good Mining Practice

KEY STEPS

1. Calculate the cost of activities included in the reclamation plan during the mining process as required by regulations
2. Calculate the cost of activities included in the post-mining plan after the mining closure as required by regulations
3. Identify estimates of the investments needed for recovery of abandoned and untreated land after the mining site closure
4. Identify the potential role of public finance in funding the environmental rehabilitation and social and economic development in the mining area

Additional sources of funding are likely needed to support environmental recovery of abandoned mining land as well as socio-economic development amongst local communities although data is limited

- Researchers identified approximately 3,000 mining pits that had not been re-claimed by the licence holders between 2014-2020 (JATAM, 2021). On the basis that a typical pit covers 15-20 ha on average, this corresponds to an area of approximately 45,000 – 60,000 ha of abandoned mining pits.
- Our analysis indicates that these pits alone would require reclamation and post-mining investments, including promoting social, cultural and economic development opportunities of around **USD 550-750m** in total.
- This is likely a **major underestimate of untreated land to date** given we were unable to identify a comprehensive overview of the status of reclamation and post-mining activities across all mining areas within the scope of this study. It also **does not include future sites that may be abandoned** without proper implementation of reclamation and post-mining activities.
- Poorly rehabilitated land can lead to water contamination for communities living in proximity to mining sites, security risks from landslides and exacerbates ecosystem damage as well as a host of further adverse environmental and social impacts. Further work is needed to better understand the scale of untreated mining land today, as well as the potential risk that this increases over time as mining activities continue.

Reclamation costs around **USD 12k per hectare**

Post-mining costs approximately **USD 110k per licence**

Land rehabilitation itself does not typically offer investors direct financial returns, despite clear societal benefits. Coal mining companies are responsible for associated costs as a condition of their licence. Public finance should avoid displacing funding from mining companies but may be needed to facilitate justice in areas where mining sites remain abandoned.

GRANTS: TECHNICAL ASSISTANCE	Support research and planning of rehabilitation programmes, or enforcement of existing regulation obliging mining companies to bear costs
GRANTS: OTHER	Direct financial support for land rehabilitation under conditions that safeguard against simply displacing funding responsibility of mining licence holders
GUARANTEES	Not relevant
CONCESSIONAL LOANS	Limited relevance, but may be an option in particularly instances for shifting abandoned land into an investment area, e.g. repurposing for solar PV development
MARKET RATE INVESTMENTS	Not relevant
EQUITY / OTHER / UNDEFINED	Not relevant

Health benefits of a just energy transition

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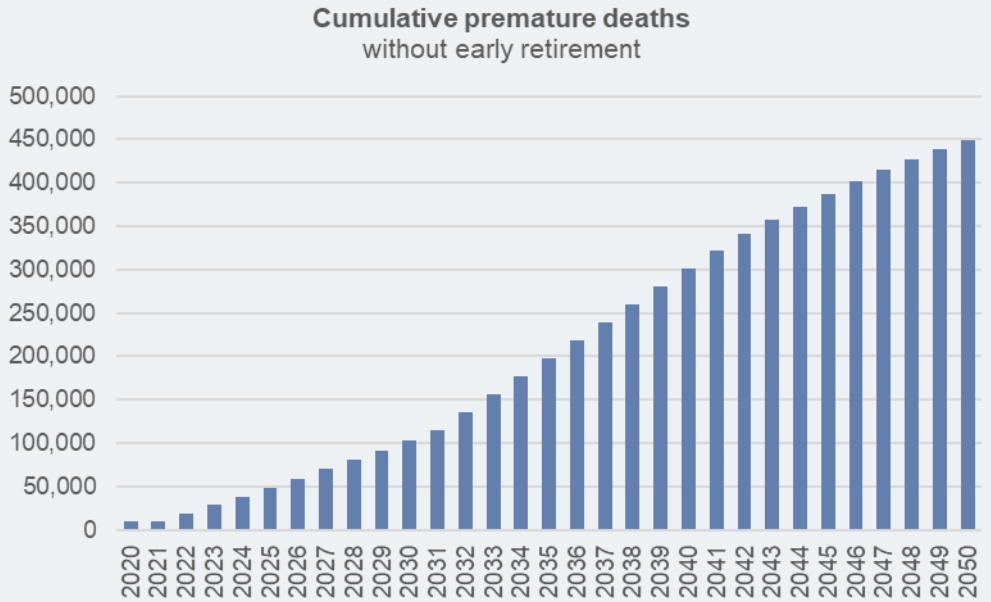
Just social transition

Coal plants are a major contributor to poor air quality, causing adverse health effects across the Indonesian population and beyond.

The energy transition offers an opportunity to improve air quality for millions of people and save hundreds of thousands of lives

- Globally, air pollution is associated with 7 million premature deaths each year. Coal combustion is a large contributor to elevated levels of air pollution risking hundreds of thousands of lives and costing billions of dollars.
- There are currently around 48 GW of operational coal plants in Indonesia and more than 20 GW* in the pipeline to come online by 2030.
- Without intervention air pollution from Indonesia's full coal fleet is set to worsen over the coming decades. We estimate the operation of existing and planned coal plants for their technical lifetime will cause at least 450,000 premature deaths by 2050.
- Early retirement of coal plants and generation curtailment lowers the level of ambient air pollution, improving the health and overall quality of life for the exposed population.



Source: NewClimate, IESR.

* Note that our analysis only includes estimates for health impacts from 64 GW (out of 73 GW) of on- and off-grid CFPP over the modelling horizon due to a lack of data availability on the size and location of off-grid CFPP. Our results therefore underestimate the overall magnitude of the likely health impacts from continued operation of coal plants without intervention, as well as the health benefits from early retirement and curtailment of generation in the JETP and JETP+ scenarios.

Just social transition

APPROACH

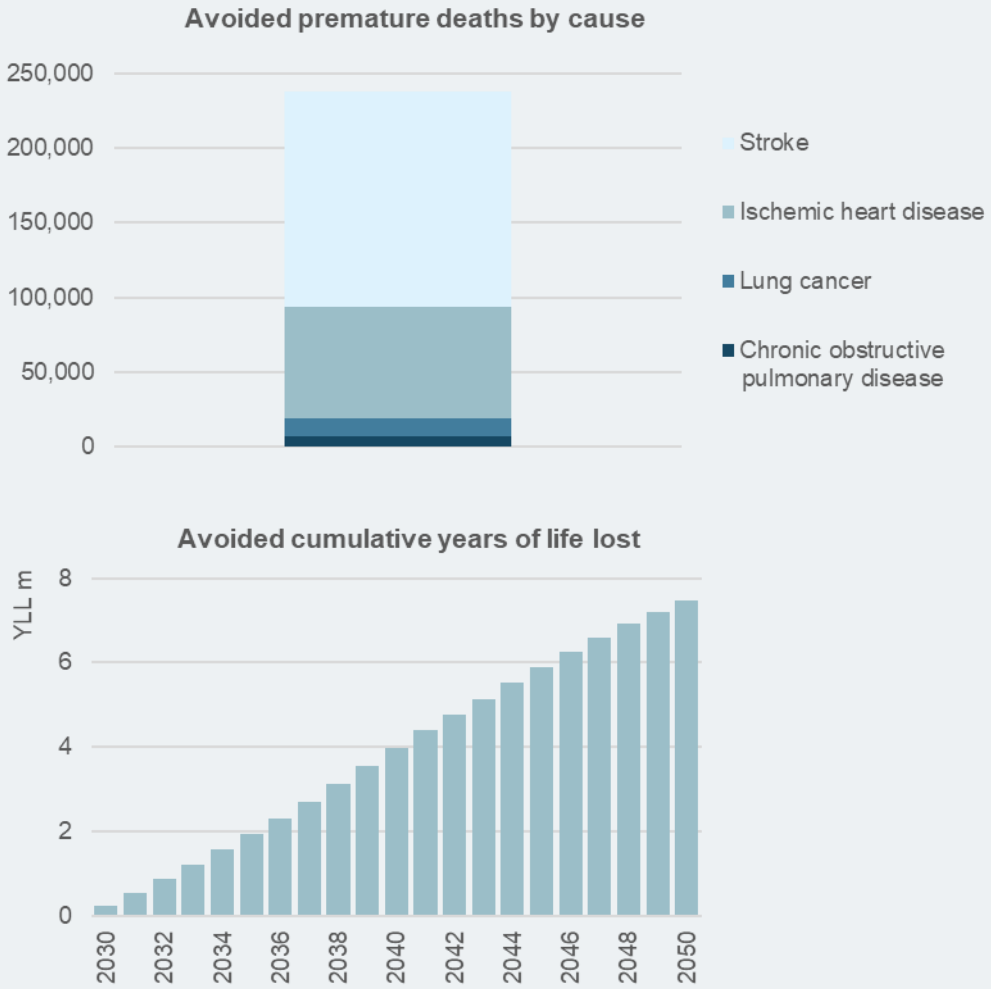
Our analysis of air pollution health impacts allows us to quantify the substantial health benefits from transitioning away from a heavy reliance on coal, both in terms of lives saved as well as a monetary equivalent of the health benefits

- We use an Excel-based tool, the AIRPOLIM-ES, to estimate the mortality risk to populations exposed to ambient air pollution originating from the combustion of coal and calculate the health benefits from both early retirement of coal plants as well as the curtailment of their generation in the JETP and JETP+ scenarios.
- Our individual plant-level estimates show the avoided premature deaths and avoided years of life lost, broken down into impacts from three different pollutants and four adulthood diseases.
- In addition, we also monetise the health impacts, estimating the avoided cost of reduced levels of air pollution.

KEY STEPS

1. Estimate annual emissions from coal-fired power plants for different pollutants
2. Map exposed population across four distance bands in Indonesia and beyond its borders
3. Calculate the intake fraction and change in concentration in ambient air pollution for each pollutant
4. Quantify health impacts from air pollution per coal unit through concentration-response functions
5. Estimate the corresponding socioeconomic costs using the metric 'value of statistical life'

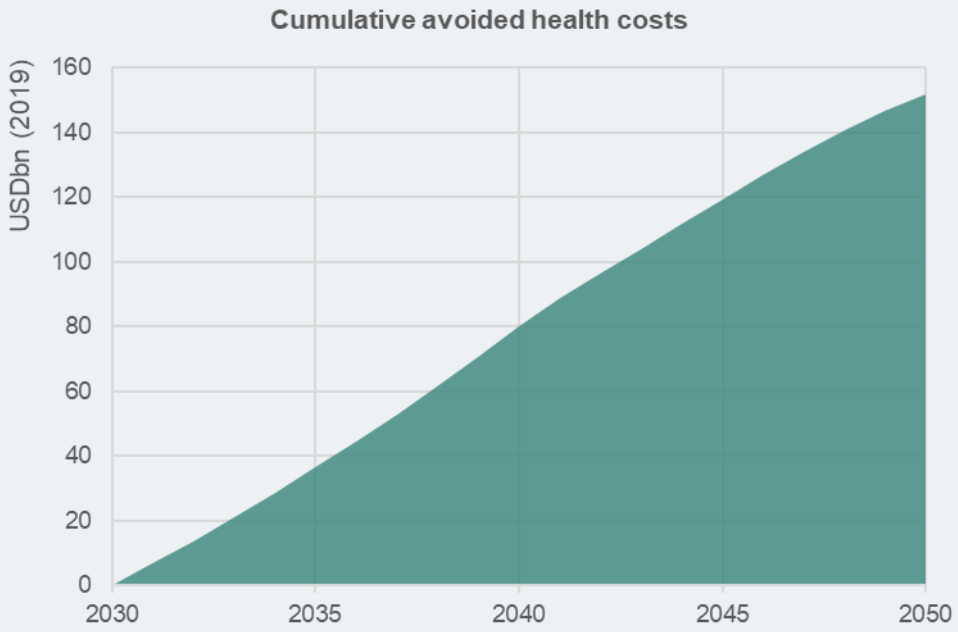
Early retirement and limiting the operations of coal plant to align with the JETP scenario can avoid at least 240,000 premature deaths particularly from reduced stroke and heart disease



- The reduced coal generation in the JETP scenario, through early retirement and curtailing generation, helps cut up to 65 $MtCO_2$ as well as thousands of tonnes of health hazardous pollutants including $PM_{2.5}$, SO_2, and No_x.
- Reducing levels of pollution significantly lowers the mortality risk from air borne diseases, such as lung cancer, stroke, and heart disease, across Indonesia as well as neighbouring countries.
- The phase-out of coal generation in the 2°C-aligned JETP scenario can avoid at least **240,000 premature deaths** or the equivalent of around **7.5 million years of life lost** between 2030 and mid-century.
- The majority of avoided premature deaths will occur on Java as it is the most density populated island with a substantial coal fleet.

Source: NewClimate, IESR.

Avoided health impacts in the JETP scenario deliver economic welfare benefits of at least USD 150 billion until mid-century

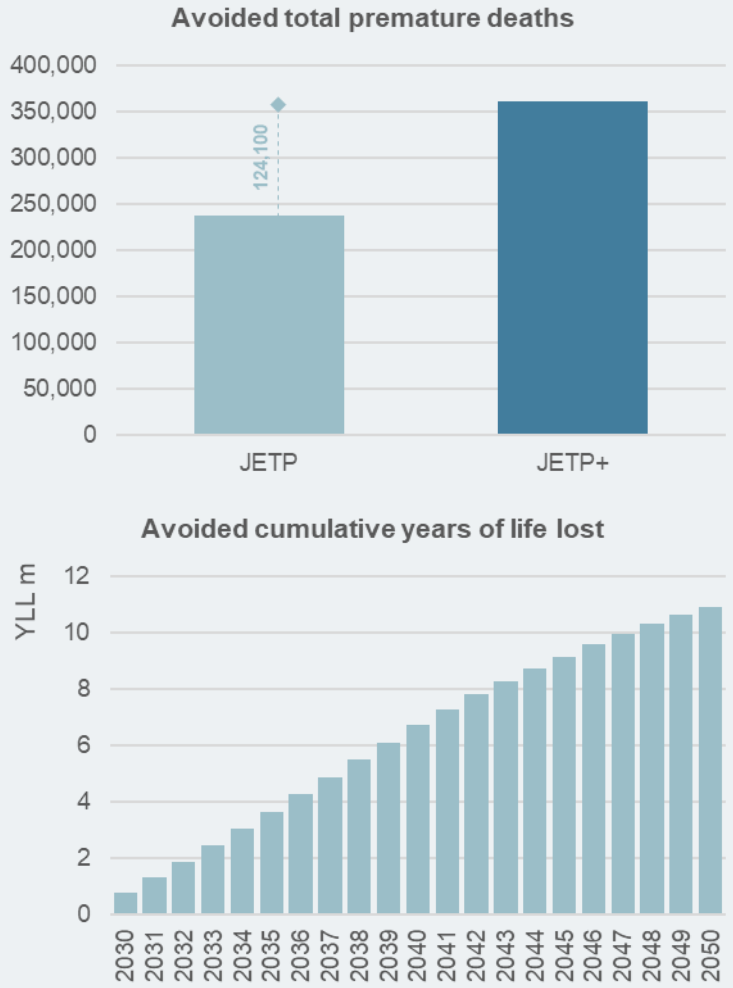


- High levels of air pollution and the corresponding impacts on mortality are connected to a decrease in economic well-being.
- Health benefits from reducing coal combustion in the JETP scenario represent a value of more than **USD 150bn** in monetary terms up to 2050.
- For context, these cumulative avoided health costs account for **12% of Indonesia's current annual GDP**. While the costs do not directly represent a loss in GDP, health impacts are proven to have a negative effect on economic growth (OECD, 2016).

The metric “value of statistical life” does not place a monetary value on individual life, rather it reflects an average value of what people are willing to pay to marginally reduce their risk of mortality from environmental pollution (for more information on how the value is calculated see OECD, 2012).

Source: NewClimate, IESR.

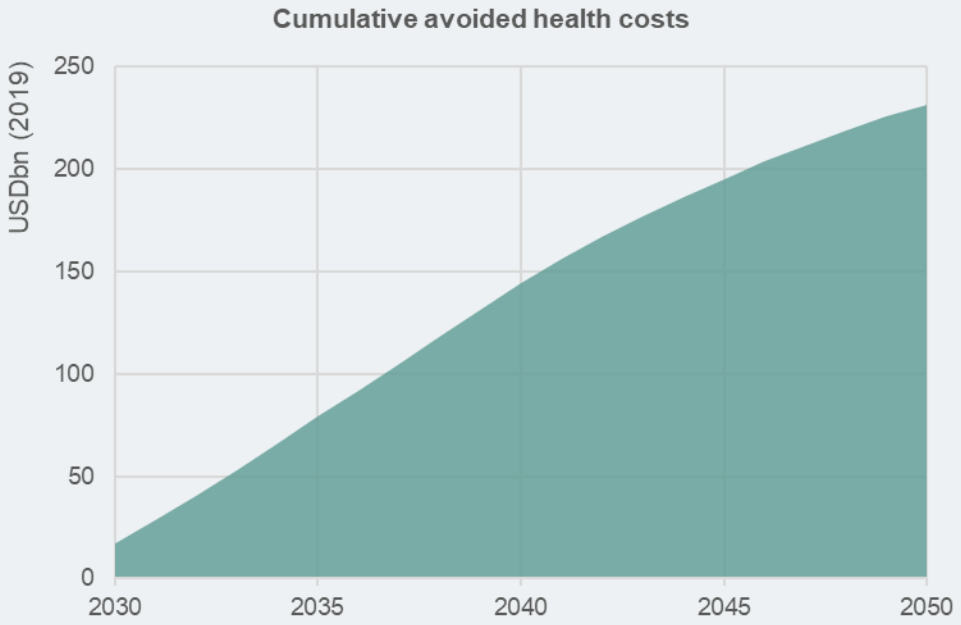
Reduced levels of air pollution through increased retirement and curtailment of coal plant in the JETP+ scenario can further reduce premature deaths by more than 30%



- Raising ambition to align with a Paris-compatible 1.5°C pathway can avoid more than **360,000 premature deaths** compared to full operation of both existing coal plants as well as the pipeline added this decade. This would represent an additional **120,000 lives saved** compared to the 2°C-aligned JETP scenario.
- Through the early retirement of coal plants and the curtailment of generation more than **11 million years of life lost** can be avoided from today until 2050, which is around **3.5 million years of life lost** more than in the JETP scenario.

Source: NewClimate, IESR.

The health benefits in the JETP+ scenario correspond to economic welfare benefits of more than USD 230 billion between 2030 and 2050

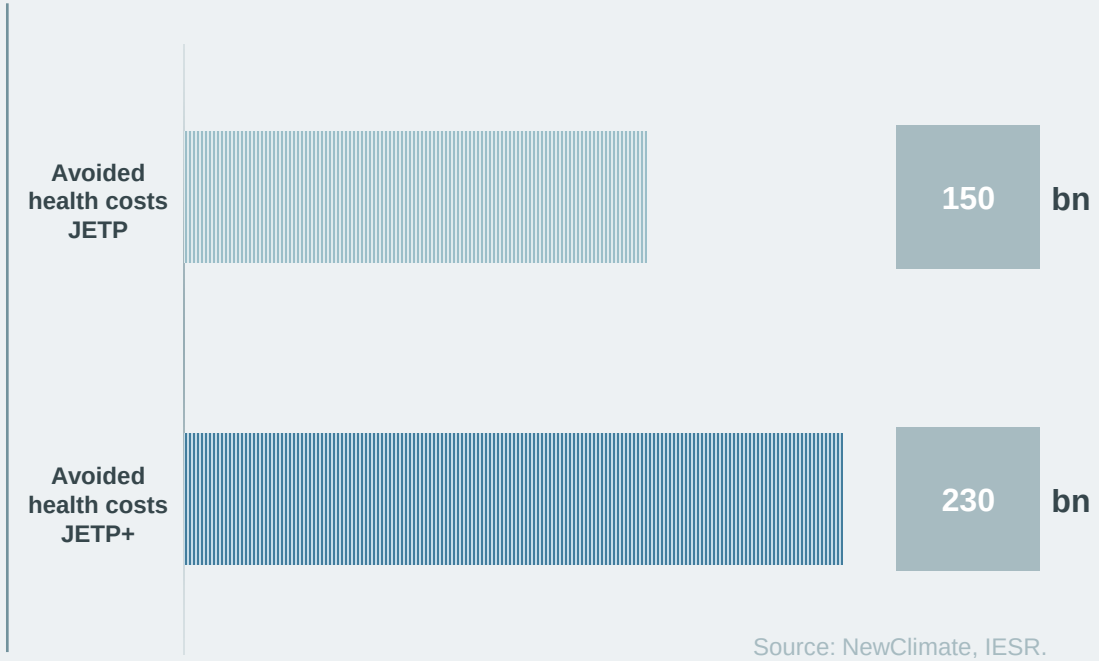


- Raising ambition to align with a 1.5°C pathway and the corresponding reduction of ambient air pollution leads to an avoided loss of economic well-being of around **USD 230bn** until 2050.
- These avoided health costs from the increased early retirement of coal and curtailment of generation make up almost **18% of the annual GDP** in Indonesia today.
- The accelerated coal phase-out in a 1.5°C-aligned pathway can save an additional **USD 80bn** compared to the 2°C JETP scenario.

Source: NewClimate, IESR.

Just social transition

Cost from avoided health impacts through the reduced operation of coal plants accumulate to more than USD 150 billion in the JETP scenario and to around USD 230 billion in the more ambitious JETP+ scenario



Source: NewClimate, IESR.

- Avoided economic costs from reduced levels of air pollution in both the 2°C and the 1.5°C scenario are substantial, accounting for **12% and 18% of Indonesia's current annual GDP**, respectively.
- These positive externalities (or *avoided* negative externalities) represent the economic value of the overall benefits to society from cleaner air.
- On average there is an **economic welfare benefit from improved health of approximately USD 30 for each MWh** of coal generation reduced in the JETP and JETP+ scenarios *in addition* to the climate benefits of cutting around 1 tCO_2/MWh.
- **Avoided costs from reduced air pollution alone are, in both scenarios, several times greater than the USD 22bn** in international finance committed by the IPG and GFANZ as part of the JETP.

Institutional capacity

Building institutional capacity
to facilitate a just transition

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Institutional capacity

Successful implementation of a just energy transition requires the development and strengthening of institutional capacity, with a specific focus on fostering collaboration between all levels of governance

- A successful energy transition relies not just on deploying new technologies but is equally dependent on political and institutional integration into the overarching planning process.
- Limitations in institutional capacity – particularly in the public sector – can act as a pivotal bottleneck for the effective implementation of an energy transition that is focused on justice.
- It is crucial to understand existing institutional capacity and identify key areas where expansion, or modification, of existing resources is required to plan, introduce and revise policies, support implementation of policies, monitor and guide developments, and engage stakeholders and the public for the energy transition.
- Given the broad relevance of the energy sector as both a basic service and critical driver of economic activity, all levels of government need to actively engage and cooperate to mainstream justice across national and sub-national policies.

Institutional capacity

APPROACH

Successful delivery of the just energy transition requires building institutional capacity to support a growing energy sector, particularly between national and sub-national government

- Due to limited data availability and the wide range of different potential governance approaches, resource and financial needs estimates for building institutional capacity included within the scope of this study are only indicative of scale and largely qualitative.
- We draw on parallel research to identify the institutional capacity needs for a just transition in Indonesia conducted by IESR and the Stockholm Environment Institute, which will be published in early 2024.*
- The findings from this study indicate that subnational government entities, in particular, are unaware of the changing energy landscape and the implications this will have for their administration.

KEY STEPS

1. Identify all relevant national and sub-national government departments that need to be involved in planning the energy transition
2. Develop a framework for institutional capacity across all relevant levels of governance
3. Develop questionnaires and interview government officials to take stock of their current available capacity and identify future needs to successfully steer the energy transition
4. Conduct focus group discussions to validate the responses and compare those with results from the literature review and institutional capacity framework
5. Identify required capacity and capacity gaps for different levels of governance

*This independent study is conducted as part of the Just Transition Project funded by the Ford Foundation.

Our analysis identifies a number of critical institutional gaps today amongst national and regional government departments that, if addressed, could better enable an orderly, smooth energy transition

National Government

- **Lack of communication between government bodies,** both horizontally (with fellow ministries) and vertically (with sub-national level agencies). Today, the national government only engages with a small number of sub-national governments.
- **Frequent job transfers of personnel leads to a lack of experts in national government bodies.** A high staff turnover with limited handover can lead to knowledge loss and increased need for repeated training programs.
- **Coal is still commonly understood as a major energy resource going forward.** Even though the national government has signed and ratified the Paris Agreement and committed to stop the development of new coal plants, the longer-term national planning still promotes fossil fuel-based energy consumption, e.g. as evidenced through the heavy reliance on carbon capture and storage technologies in the government's net-zero emissions scenario.

Regional Government

- **There is no legal framework to implement a just energy transition at the sub-national level.** Regional governments cannot allocate funding to projects that enhance justice without specific regulations mandating it, which often leads to the complete absence of just transition programmes at the sub-national level.
- **Human resource capacity for technical skills is scarce.** Necessary skills in renewable energy planning and economic diversification are crucial to enable a just transition, however those are currently the least available capacities.
- **Responsibilities regarding renewable energy projects are not clearly allocated between authorities.** Without a centralized planning and permitting agencies, responsibilities are split across different authorities which significantly increases the bureaucratic burden for investors, disincentivising private investments.

Source: IESR (2024)

Institutional capacity can include resources within Government ministries, state-owned entities such as PLN, as well as sub-national public resources that provide governance and administrative support

Key institutional capacity needs to facilitate a JETP-aligned power sector transition

- Institutions and staff are needed to support the education, (re)employment and potentially re-location of workers exiting fossil-based occupations and/or entering renewables occupations. **Labour and social protection measures** need to be put in place to provide temporary relief to workers in transition and their families as well as protect communities from higher energy costs and other energy transition costs.
- For employees nearing the pension age, a pension package could be considered to avoid high early retirement costs and ease the transition for affected families (IESR, 2022).

  (See analysis above in the employment focus)

- To ensure a just and equitable outcome of the transition for all, the government should create accessible forums and procedures for genuine stakeholder consultation before and during the transition. For an inclusive and just transition existing **governance structures** should integrate just transition considerations into all other policy domains and processes. This needs to happen not only at the national but also at the subnational levels to guide and help govern the transition at a local level.
- Constitutionalising a just transition can act as an accelerator for the implementation of the just energy transition. Incorporating justice into national development planning can lead to a shift in sub-national development priorities, allowing regional governments to take action.

- Technical and financial support to encourage Research & Development in targeted sectors – e.g. through small and medium sized enterprises as well as state-owned enterprises as carriers of the low-carbon economy – can encourage **economic diversification**. In particular, local institutions should be supported to plan and guide the strategic diversification of their local economies.
- Provinces that are highly dependent on the coal industry need enhanced support in planning and diversifying their revenues streams over time to avoid a sudden decrease in economic welfare as revenues from coal value chain activities decline.

Institutional capacity can include resources within Government ministries, state-owned entities such as PLN, as well as sub-national public resources that provide governance and administrative support

Key institutional capacity needs to facilitate a JETP-aligned power sector transition

- Dedicated working groups should put in place **environmental and social safeguards** to plan the remediation and rehabilitation of past fossil-fuel sites. And adding additional institutional capacity dedicated to the monitoring and enforcement of environmental and social regulations can help minimise further damages from the clean build-up of grids and new renewables (e.g. with a focus on land use, critical minerals mining, affected communities).
- The 'JET framework' developed by the JETP secretariat's Just Working Group could be applied beyond so-called 'JETP projects' and serve as general guidance for the government on environmental and social safeguards.

- General expansion of (low-carbon) **infrastructure** is needed to help strengthen communities' resilience during the energy and social transition (e.g. transportation, education, healthcare). Strategic planning for repurposing existing industrial or other infrastructure can help minimise resource use as well as offering new economic activities to local workers whose jobs may otherwise be at risk.
- The JETP targets should be mainstreamed across **existing resources for system planning**. All long-term strategies for energy sector planning should align with the ambition of the JETP. To accelerate the transition and remove bottlenecks, permitting and licensing systems for new technology should be put in place or updated, and fast-tracked.

- Comprehensive **policy implementation** is key to achieve a successful transition.
- Government departments need to be prepared to make analytical and legal resources available to introduce or revise regulations and continuously monitor their impact.
- Plans for a just transition can only materialise if all relevant departments and levels within government endorse and enforce regulation. For example, de-risking renewables and creating a central body responsible for allocating PPAs is a crucial enabler of the transition, which will require engagement from several department, including those responsible for energy, planning, permitting and finance across different levels of government.

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NewClimate – Institute for Climate Policy and Global Sustainability gGmbH

Cologne Office

Waidmarkt 11a
50676 Cologne, Germany

Berlin Office

Schönhauser Allee 10-11
10119 Berlin, Germany

Phone: +49 221 999 83 300
Email: info@newclimate.org
Website: www.newclimate.org

Institute for Essential Services Reform (IESR)

Jl. Tebet Timur Raya No.48b
RT.9/RW.5
Jakarta Selatan 12810
Indonesia

Phone: +62 21 2232 3069
Email: iesr@iesr.or.id
Website: https://iesr.or.id/