BRIEFING

Coal-to-clean energy: assessing progress for a rapid and just transition

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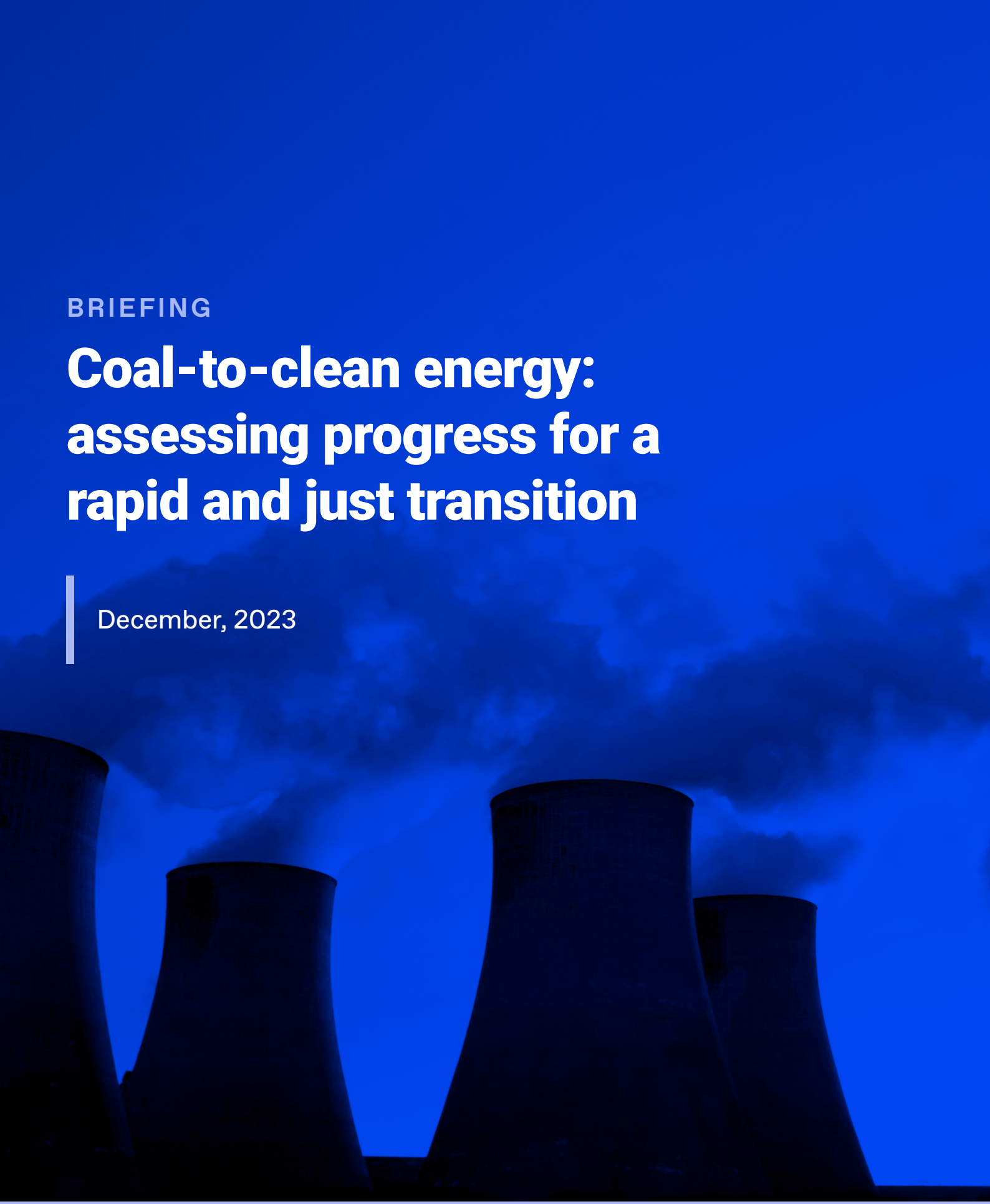

CARBON TRUST | Net Zero INTELLIGENCE UNIT

This briefing assesses global progress on the three enabling conditions for the coal-to-clean energy transition, addresses common misconceptions about the pace and nature of the transition, and offers workable recommendations for policymakers to help accelerate the pace of change.

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Executive summary

> **To continue driving progress on the coal-to-clean energy transition, we must build a pipeline of coal-fired power plants suitable for early retirement or repurposing from a social, energy security and financial perspective, while scaling up replacement renewable energy in parallel.**

To reach Net Zero by the middle of the century, a fundamental transformation in the global approach to coal is essential and urgent. This requires critical attention to three interlinked enabling conditions: **just transition, technology and innovation, and finance.** This briefing assesses international progress on these three key enabling conditions for the coal-to-clean energy transition and offers workable recommendations for policymakers to help accelerate the pace of change.

This briefing draws on the Carbon Trust's experience of working with governments and development organisations on the coal-to-clean energy transition across Asia and Africa, and analysis of primary and secondary sources. Across the three enabling conditions, we conclude:

1. **Policymakers must manage the tension between the urgency of the coal-to-clean transition from a climate perspective and the length of time it takes to properly plan for, manage and minimise potential socioeconomic impacts.**

A clear just transition vision and plan co-created with affected communities should be accepted as an essential precondition of a successful transition. It should then be used as driver of rapid, equitable change.

2. **To deliver an energy system fit for growing energy demand, coal-dependent countries should seize untapped renewable energy potential. Ramping up renewable energy penetration within power and heat systems is only one element of the technology and innovation needed.**

Renewable energy penetration must be complemented by improvements to grid infrastructure and transmission system upgrades, as well as electricity storage capacity to ensure a reliable supply. This is also true of heat networks, which are critical sources of energy for countries with colder climates. During the transition period, new technologies such as synchronous condensers, can help to provide dispatchable power.

3. **There is no 'right' way to fund coal retirement. Financing is likely to continue to be bespoke to a plant's characteristics, finances, and legal structures.**

Therefore, identifying the right assets to fund and retire or repurpose is essential. At this early stage in the transition, all sources of funding for coal retirement should remain on the table to provide maximum flexibility within the market. Governments of coal dependent nations should be provided with the necessary support and access to finance, whether that be multilateral funding through initiatives such as the Just Energy Transition Partnerships (JETPs), or concessional funding from multilateral development banks (MDBs) or philanthropic institutions.

The unprecedented pace and scale of the coal-to-clean transition necessitates system-wide shifts in policy, community engagement processes, energy infrastructure and financial support, as well as asset-level financial agreements that ensure early retirement of coal assets makes both financial and local socioeconomic sense. This twin system-level and asset-level approach is crucial to accelerating the pace of change necessary for a coal-to-clean energy transition.

Introduction

This briefing assesses international progress on the three key enabling conditions for the coal-to-clean energy transition. It makes recommendations for policymakers drawing on the Carbon Trust's experience across Asia and Africa.

Coal-fired power plants are the single biggest source of greenhouse gas emissions, producing a fifth of global annual emissions.[1] To reach Net Zero by the middle of the century, a fundamental transformation in the global approach to coal is essential and urgent. However, despite growing recognition of this need at the international political level over the past two years, limited progress has been made on either ending the development of new coal or the early retirement or repurposing of existing coal-fired power plants.[2]

In particular, China, which is responsible for over half of the world's coal-related emissions, has demonstrated limited progress on phasing out coal, despite high-level commitments to reducing coal consumption.[3] In 2022, the construction of new coal power plants in China was six times greater than the rest of the world combined.[4] In many other countries, including India and the US, clear targets and a coordinated policy approach to coal phase-out are lacking, despite national-level commitments to Net Zero. International initiatives are yet to demonstrate a significant impact on coal emissions. In their short life, the Just Energy Transition Partnerships (JETPs) launched to support South Africa, India, Indonesia, Vietnam, and Senegal, have come under significant scrutiny for their slow progress, lack of transparency, reliance on loan-based financing, and limited focus on the 'just' element of their mandate.

From a climate and environmental perspective, the need for an urgent coal phase-out is clear, but social and economic factors are also at play

To achieve the International Energy Agency's Net Zero Emissions by 2050 Scenario, all unabated coal-fired power generation needs to end by 2040.[5] In addition to greenhouse gas emissions, coal-fired power generation is also a major contributor to local environmental problems such as harmful air pollution, biodiversity depletion and acid rain.

However, other considerations, in addition to environmental ones, need to be factored into the coal-to-clean transition. No energy source exists in a socioeconomic vacuum, especially coal, which is deeply rooted in the economic security and development pathways of many countries, particularly in the Global

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[1] It's critical to tackle coal emissions – Analysis - IEA Accessed November 2023

[2] In April 2021, the G7 committed to accelerating the phase out of domestic unabated coal power and ending financing of new unabated coal in emerging economies. At COP26 in December 2021, over 80 countries signed a declaration committing to phase out coal and end the development of new coal assets, with the final agreement committing all 197 UNFCCC members to a coal "phase down". The Powering Past Coal Alliance, an international coalition which commits its members to phasing out existing coal-fired power plants and ending the development of new coal assets, has also attracted the membership of 48 nation states to date.

[3] President Xi has pledged that China will reduce coal consumption in the 2026-30 period.

[4] CREA_GEM_China coal power overdrive in 2022 (energyandcleanair.org) Accessed November 2023

[5] Net Zero by 2050 – Analysis - IEA Accessed November 2023

South. Coal has been a core part of critical national infrastructure for many developed countries and remains so in many countries with high energy needs. The UK and many European countries have taken decades to gradually disentangle coal from their energy systems. However, the coal transition now requires unprecedented speed. The relatively 'slow' pace of the transition must therefore be understood in the context of widespread dependency on coal for social, economic and energy security.

The social, economic and energy security offered by coal rests on shaky foundations

Coal assets and the communities that depend on them are at risk of being 'stranded' as lower cost, alternative technologies, such as wind and solar power, replace coal. Analysis shows that by 2025, for 78% of global coal plants, it will be cheaper to *build* alternative energy generation than to continue *operating* coal plants.[6]

The coal supply chain directly supports 6.3 million jobs globally, and coal-fired power generation directly supports an additional two million jobs.[7] Coal-related jobs often have unhealthy, dangerous, working conditions, but compensation, benefits and employment protection are often considerably more favourable than alternative jobs of a similar skill level.[8] The coal-to-clean energy transition offers an opportunity to create decent, secure jobs in new sectors and boost economic diversification, however a hasty, poorly managed transition risks a potential loss of livelihoods.

From an energy security perspective, coal is the bedrock of many economies and is deeply rooted in energy system infrastructure. Coal still supplies just over a third of global electricity generation.[9] However, the energy security offered by coal is not without risks. Reliance on imported coal to fuel power stations creates a trade dependency exposed to spikes in international fuel prices and geopolitical tensions, as seen with gas following Russia's invasion of Ukraine. Low carbon electricity generation offers an opportunity to increase sustainable energy security.

However, despite the opportunities of the coal-to-clean energy transition, managed early retirement of coal plants is extremely challenging. Favourable tariffs, long-term power-purchase agreements and direct subsidies insulate coal-fired power plants from market pressures, meaning finance is required to retire or repurpose them early. This requires a complex disentangling of each plant from its roots in livelihoods, energy security, and asset-level financial agreements.

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[6] https://rmi.org/insight/how-to-retire-early. Accessed November 2023

[7] World Energy Employment Report (windows.net). Accessed November 2023. The coal supply chain also indirectly supports millions more jobs through complementary activities in adjacent economic sectors.

[8] Global Perspective on Coal Jobs and Managing Labor Transition out of Coal: Key Issues and Policy Responses (worldbank.org) Accessed November 2023

[9] Coal - IEA Accessed November 2023

Accelerating the coal-to-clean energy transition requires critical attention to three system-level enabling conditions

The complexity of the coal-to-clean energy transition necessitates engagement at both the *system-level* to create the right enabling environment for socioeconomically positive change and at the *asset-level* to establish appropriate financial mechanisms for early retirement or repurposing of individual plants. To deliver this, policymakers must pay critical attention to three enabling conditions:

A just transition

Coal is deeply rooted in socioeconomic systems. A Just Transition is required to mitigate potential risks and unlock benefits to society.

Technology and innovation

A focus on existing and new energy technologies as well as innovation within the energy system is needed to ensure energy security and to smooth the transition.

Finance

Financing is crucial to retire coal plants before the end of their useful economic lives and provide adequate funding to those affected.

Without integrated policy frameworks that focus on these three enabling conditions, retirement of individual coal assets is unlikely to be financially viable, socio-economically responsible, or in sync with local or national renewable energy infrastructure developments.

1. A just transition

Best practice frameworks for ensuring a fair and equitable coal-to-clean energy transition are emerging. Ensuring positive socioeconomic outcomes however, will require time, planning and direct finance.

While the global energy transition is urgent and transitions away from coal assets need to be rapid, it is imperative to achieve this while addressing the risk of potentially negative socioeconomic implications, particularly for workers and local communities.

Coal supply and power generation directly supports over eight million jobs globally, and many times that through indirect employment.[10] In some heavily coal-dependent regions, such as Mpumalanga in South Africa, the sector accounts for 5-8% of the total local labour force.[11]

Transitioning to cleaner sources of energy has many potential benefits for society. Investing in renewables can create decent jobs, support local economic diversification, address existing social inequalities, and help to alleviate the health impacts, poor air quality and local environmental degradation associated with coal. However, unlocking these potential benefits and distributing them equally requires careful planning and management. The high stakes of a poorly managed transition are evidenced by the ongoing impacts of the coal transition in countries like the UK, where the phase-out of coal industries contributed to regional inequality.

In an ideal world, a *just transition*[12] would mitigate potential risks and capture the significant potential benefits of the coal-to-clean energy transition to *society* as well as the climate. While it is not realistic to expect the concerns of all impacted stakeholders to be addressed, and for benefits and costs to be distributed perfectly equitably, planning can help to address the risks and maximise opportunities. The process should be guided by a shared vision of what a successful transition looks like, co-created with the affected communities, and supported through finance ring-fenced specifically for this purpose.

Best practice frameworks for ensuring a fair and equitable coal-to-clean transition are emerging

The concept of a just transition has been increasingly used in academic and policy discourse to understand the socioeconomic implications of the low carbon transition. Academic studies on previous coal transitions have emerged, as well as assessments of the impacts of coal transitions at a hyper-local scale.[13] Building on these, best practice frameworks that set out practices common to transitions that have unlocked some successes and lessons from less-successful ones are being developed and

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[10] Global Perspective on Coal Jobs and Managing Labor Transition out of Coal: Key Issues and Policy Responses (worldbank.org) and World Energy Employment Report (windows.net) Both accessed November 2023

[11] Coal in Net Zero Transitions – Analysis - IEA Accessed November 2023

[12] The Carbon Trust uses the ILO's definition of a Just Transition as 'a process that prioritises local, socioeconomic opportunities and decent livelihoods, and minimises risks to affected groups, including through inclusive, transparent, social dialogue, robust governance, and support for impacted workers and communities.'

[13] See for example, Research_Series_Paper_15_TTCaseStudies.pdf (nesc.ie) and CoalDependentCommunities_Report.pdf (justtransitioninitiative.org) Both accessed November 2023

applied to support decision-making around coal transitions. The 'Just Transition Planning Framework' (JTPF) developed by the Carbon Trust is a practical framework that can be used in the retirement of coal-fired power plants across multiple regional contexts.[14] The JTPF is built around three core principles[15] and provides learnings and practical tools for policymakers and other key stakeholders across three pillars of planning for a just transition:

1. **Governance:** guidance on establishing dedicated institutions, structures, and funding processes to drive and be accountable for the just transition. For instance, this could include technical advisory groups to provide strategic direction and expert guidance and/or stakeholder forums and social dialogue processes.
2. **Livelihoods:** guidance on and tools to assess impacts on direct, indirect and induced employment. It features practical ways of mitigating risks to livelihoods and steps for examining how workers might transfer into new livelihoods, and options for other forms of support where possible. For instance, this could include a jobs and livelihoods impact assessment that considers worker ages and retirement plans to inform closure programmes and minimise redundancies.
3. **Community and environment:** tools to assess social, economic, and environmental risk to the wider community. It also includes guidance around mitigating these risks, investing in diversifying and strengthening the local economy, investing in sociocultural projects, and prioritising regional revitalisation. For instance, this could include community ownership of renewable energy projects to help provide tangible benefits to the community and help to maintain a sense of cohesion.

Some countries have created strong just transition plans to inform the implementation of coal-to-clean programmes. The 'Just Transition Framework'[16] created by the South African Presidential Climate Commission (PCC) is a strong example of the value of community and worker involvement and good governance in planning. The Framework is the result of a series of dialogues conducted by the PCC in 2021. The Commission started with a baseline assessment of research into just transitions. It followed this up with policy dialogues and stakeholder consultations to test different policies, support measures, ideas and approaches for the development of the framework. The Framework has now been accepted by the government and will be used to inform just transition implementation in South Africa.

A just transition requires a bottom-up and a top-down approach, but there is often a disconnect between engagement at the local level, and national and multilateral initiatives

Planning for and executing a just transition often requires dedicated finance and a strong political steer through 'top-down' national policymaking. This should go hand-in-hand with 'bottom-up' engagements

[14] Supporting a rapid just and equitable transition away from coal (windows.net).

[15] 1) Recognition of inequalities, 2) transparent, accountable and inclusive processes, and 3) equitable distribution of costs and benefits

[16] Just Transition Framework (climatecommission.org.za) Accessed November 2023.

with local stakeholders who are most impacted by a transition. However, at present there is often a disconnect between engagement at the local level and national or multilateral initiatives.

For example, before and during the decommissioning of Australia's Hazelwood coal-fired power plant in 2017, local stakeholder engagements were limited, if not, non-existent. Upon closure, there was no support from the asset owner, and limited support from the government. It was not until the Australian government faced political backlash that a generous support package was developed. This featured an engagement programme between local authorities, trade unions, community groups and local businesses to shape the forms of support. The eventual approach taken is now looked to as a 'best practice' example of combining both a top-down and bottom-up approach to secure future employment opportunities through training programmes and investments in local economic diversification.[17] Such hyper-local instances demonstrate that with appropriate planning and resourcing from national and/or state governments, the closure of coal-fired power plants can be managed in a way that minimises negative impacts on workers and local communities.

It is critical to address the disconnect between local and national-level planning. Successful local transitions are often dependent on national, and even international, support and finance.[18] Just transition policies and processes should not be seen as an 'add-on' to climate policies, but as holding meaningful influence over their implementation, which, to be effective, require financing. Investments in economic diversification, community revitalisation and reskilling should be made as early as possible to maximise benefits and enhance resilience.

Recommendations

Policymakers must manage the tension between the urgency of the transition and the length of time it takes to properly plan for, manage and minimise potential socioeconomic impacts

- **A just transition is a critical analytical concept. It is not an endpoint or something to be 'achieved'. Rather, it is a means of identifying solutions to potential socioeconomic challenges associated with the move to a Net Zero economy.** The importance of a just transition as a key enabler of the coal-to-clean transition cannot be understated. For example, without clear commitments to engage impacted stakeholders, and effectively manage the socioeconomic impacts of the transition, there is a risk a transition could be delayed due to local dissent or political fallout.
- **A clear just transition vision and plan, co-created with affected communities, should be considered an essential precondition of a successful coal-to-clean transition.** The plan should integrate sufficient, targeted support measures for those impacted and be tailored to local contexts. Just transition planning frameworks can be useful tools to ensure commonalities of 'successful' coal transitions (and lessons from less successful ones) are incorporated into

[17] Research_Series_Paper_15_TTCaseStudies.pdf (nesc.ie) and wiseman_campbell_green_prospects_for_a_just_transition_away_from_coal-fired_power_generation_in_australia_ccep_wp1708.pdf (anu.edu.au) Both accessed November 2023

[18] In the Ruhr Valley in Germany, for example, there are strong linkages between top-down financing and industrial policies and bottom-up community level engagement and planning which have helped to guide the transition towards socially positive outcomes.

plans at both a national and multilateral level. A just transition plan should ensure robust governance processes are implemented at a local level with consistency and a commitment to continuous learning.

- **Policy coherence across multiple sectors is vital. This is because transitioning from coal to cleaner energy sources does not necessarily lead to replacement jobs, and job creation alone won't guarantee just outcomes.** Not only are there often differences in the numbers of jobs between outgoing and incoming industries, the skill sets, timing, and nature of the jobs can differ. For instance, large scale solar or wind projects do not require as many low skilled workers as coal assets, especially outside of the construction phase. Policy coherence across multiple government ministries and investment in other local industries, such as agriculture, services and others, can help create further job opportunities.

- **The most effective just transition policies and processes engage top-down and bottom-up initiatives.** Representatives of local communities should be given meaningful roles in the co-creation of just transitions plans. At the asset-level, coal plants should be prioritised for retirement, with consideration for projected impacts on local communities. These bottom-up initiatives should be complemented by national level plans, including early investments in local jobs, skills and industries**.** These may include direct government investment in new industries, such as clean hydrogen, as well as policy signals, such as setting targets or roadmaps to help direct private finance to these emerging industries. This will help to build the local workforce's resilience to the transition and keep wealth creation local. Similarly, investments in social and cultural projects can build resilience within communities through enhanced social cohesion.

- **As countries navigate the coal-to-clean transition, there should be international forums to share learnings and technical support on effective just transition planning and processes.** Recent initiatives – such as the JETP Convening for Exchange and Learning event held between South Africa, Indonesia and Vietnam in June 2023 – are essential processes to ensure dialogue and the exchange of effective practices.

2. Technology and innovation

A direct transition from coal to renewables would secure a cheap, abundant source of reliable energy. However, a focus on technology and innovation is required to capitalise on untapped renewable energy potential and smooth the transition.

A transition away from coal requires a replacement energy source to be readily accessible at an affordable cost. For instance, coal transitions in developed economies, such as the UK and Germany, have relied primarily on an abundant supply of imported natural gas. Today, renewable energy technologies, such as wind and solar power, are the cheapest sources of electricity. This is due both to innovation and the significant rise in gas prices following Russia's invasion of Ukraine. The Coal-to-Clean Carbon Price Index shows that, in 2022, transitioning from existing coal to existing gas cost on average $\$235/tCO_2$. A 'leapfrog' transition, direct to new renewables, costs $-\$62/tCO_2$ on average.[19]

To unlock this replacement energy source and ensure a smooth energy transition, scale up of existing renewables, energy storage and grid infrastructure technologies is vital. The transition will also require a focus on innovation within the energy system to reduce the overall amount of greenhouse gas emissions released by coal power. This may include repurposing coal-fired power plants for flexible operation, particularly for younger coal-fired power plants which may be more suitable for flexible operation than early retirement.

Many coal-dependent countries have huge, untapped potential for renewable energy capacity

Indonesia, for instance, has 2,898 GW of solar photovoltaic (PV) potential. Vietnam has 353 GW of wind potential and 844 GW of solar PV potential. For each country, this compares to less than 100 GW of coal power across both current and planned plants.[20] This renewable energy capacity could therefore deliver significant energy security in line with sustainable development goals.

For most economies, the coal transition requires a direct switch to these clean sources of electricity. This would avoid exposure to price volatility of fossil fuels, and creating further assets which would go on to become stranded.[21] Most coal-dependent economies can achieve energy security by capitalising on the untapped potential for cheap, abundant renewable energy, as well as supporting grid network development and energy storage.

A transition from coal to renewables will also bring benefits in terms of public health and cost savings. Although some countries, such as South Africa, have emphasised the need to preserve coal in parallel with increasing renewables capacity, this approach underestimates the significant costs to the economy brought by continued coal power, particularly in the form of increased health costs. Analysis shows that if current plans for decommissioning of coal plants in the 2030s and 2040s in South Africa are not accelerated, there would be 32,000 excess deaths from poor air pollution and an economic cost of

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[19] Fuel switching 2.0: Coal to Clean Electricity — TransitionZero Accessed November 2023

[20] Carbon Trust readiness assessments for Indonesia and Vietnam, part of the Coal Asset Transition Accelerator programme.

[21] Making the Leap: The need for Just Energy Transition Partnerships to support leapfrogging fossil gas to a clean renewable energy future (iisd.org) Accessed November 2023

R721.00 billion.[22] The full socioeconomic cost of maintaining coal should therefore be weighed up against the relatively lower cost of renewables.

To meet growing energy demand, scale-up of wind and solar energy will need to be complemented by improved energy storage and grid infrastructure

The concern that renewable energy supply will not be able to meet peaks in energy demand has led many governments to question the viability of retiring coal-fired power plants. Historic under-investment in electricity systems in some countries, such as South Africa, has led to significant shortages of energy supply and therefore concern that retiring coal power would exacerbate existing problems.[23] In some other coal-dependent economies, such as Vietnam, there is significant *over*capacity within the energy system, coupled with vast renewable energy potential. In both instances, however, increasing the penetration of renewable energy within the electricity system will require careful management of the grid and new infrastructure to ensure a reliable supply.

While caution around energy security is justified, the retirement of plants without significant negative impacts on energy security can be achieved through a robust plan. This should include renewable deployment, energy storage, electricity grid network development and grid balancing.

The inherently variable nature of wind and solar energy supply will require improved energy storage infrastructure, transmission systems and grid infrastructure to manage peaks in energy demand, particularly in the context of growing energy needs. Countries with a high share of renewables generation, such as the UK, are developing solutions to the challenges of variable generation. These include batteries and deployment of network management equipment, such as synchronous condensers to remaining thermal power assets. Maturing these solutions will enable countries transitioning directly from coal to renewables to maintain or even strengthen their grid management capabilities while reducing their energy costs.

The priority should always be early retirement, but flexible operation, or the introduction of carbon capture infrastructure may be considered for a limited number of younger coal-fired power plants as part of a pragmatic, just transition plan

An important goal of the coal-to-clean transition is to lower total greenhouse gas emissions by reducing the overall amount of energy produced by coal. A viable option for achieving this is to repurpose existing coal-fired power plants (CFPPs) by ending or limiting continuous baseload energy production. Instead, they can remain available for 'backup' energy production at times of high demand. This can be achieved by improving the ability of the CFPP to cycle on and off, operate at lower minimum stable loads, and ramp quickly (up and down) to follow unpredictable changes in demand. Repurposing CFPPs this way will likely only require minor equipment upgrades, but would necessitate more active management of on-site staff.[24] Repurposing CFPPs, particularly those that are very young and therefore potentially less

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[22] Health impacts of delaying coal power plant decommissioning in South Africa (energyandcleanair.org)

[23] South Africa's Just Energy Transition Investment Plan (JET IP) 2023-2027 | The Presidency Accessed November 2023

[24] Coal in Net Zero Transitions – Analysis - IEA Accessed November 2023

suited to retirement, can help to smooth the transition by limiting the effects of coal retirement on asset owners, investors, communities, and energy systems.

For a small proportion of particularly young CFPPs, retrofitting with carbon capture and storage infrastructure could facilitate immediate reductions in emissions. To be compatible with Net Zero, capture rates would need to be very high – around 99% – according to analysis from the International Energy Agency. The cost per MWh of CCUS-abated coal power should therefore be weighed up against the comparatively low cost per MWh of wind and solar PV. However, as with repurposing options, there is a need to assess the costs to the total system. For instance, CCUS-abated coal power could bring grid balancing benefits in a limited number of contexts.

Another retrofit option, co-firing with ammonia, should be de-prioritised as an emissions reduction strategy for CFPPs. This is due to the increase in levels of nitrogen oxide (NO_x) emissions associated with ammonia-blended firing and the relatively high costs of retrofitting plants in this way.

Small modular nuclear reactors could provide a stable, long-term source of power, but cost feasibility and safety concerns would need to be addressed

One potential option for ensuring synchronous baseload energy production without the need for coal power is the replacement of coal plants with small modular nuclear reactors (SMRs).[25] SMRs are an emerging technology, but they could deliver a number of benefits. These include preserving the use of some parts of coal plant infrastructure, such as cooling towers and grid connections, as well as providing a stable, long-term source of power. Due to their modular design, SMRs can also be manufactured and then installed on site, helping to deliver cost and construction efficiencies. However, replacement of coal with SMRs is unlikely to be appropriate in all circumstances. Legal requirements often stipulate that nuclear reactors need to be located far away from densely populated areas, and appropriate safeguarding through robust regulations and infrastructure will be required. SMRs should therefore be explored for their potential to replace coal plants, but the technology is not yet cost competitive with other options without significant government support and subsidies.

Recommendations

Ramping up renewable energy penetration within power and heat systems is only one element of the technology and innovation needed.

- **Policymakers should consider the full cost of maintaining current coal assets when evaluating the transition from coal to renewables. This should include health impacts, mining and/or transport subsidies, as well as ongoing maintenance and upgrade costs.** An accurate understanding of the costs of replacement renewable energy sources, will enable the most effective route to affordable energy security. It will also reduce or avoid exposure to volatile fossil fuel prices.
- **To deliver an electricity system fit for growing energy demand, coal-dependent countries should make use of their domestic, untapped renewable energy potential.** Vietnam, for

[25] As proposed by the Repower initiative from Quantified Carbon: Repower

instance, has already made huge strides in offshore wind deployment. It has now commissioned more wind power than any other country in Southeast Asia.

- **Ramping up renewable energy penetration within the electricity system is only one element of the technology and innovation needed.** It must be complemented by improvements to grid infrastructure, transmission system upgrades, utilising novel approaches for renewables to provide balancing services, as well as building electricity storage capacity to ensure a reliable supply. During the transition period, tried-and-tested technologies such as synchronous condensers, can help to balance transitioning grids.
- **Repurposing coal-fired power plants to support grid rebalancing, and retrofitting a select group of coal-fired power plants with carbon capture infrastructure, could help to bring about immediate reductions in emissions from coal power and smooth the transition for communities, investors, and energy systems.** However, these options should never be the default option and should only be considered as a part of a pragmatic coal-to-clean transition plan which prioritises the retirement of coal-fired power plants wherever possible.

3. Finance

New funding routes for the early phase-out of coal-fired power plants are emerging, however, scaling and replicating them is challenging. Every financial package needs to be carefully tailored to local requirements and plant characteristics.

As renewable energy sources become cheaper, the economics of coal-fired power generation are changing. However, the rate of change is not fast enough. Despite substantially lower operating expenditures compared to coal and other fossil-fuel-powered generation, renewable technologies are still expensive at scale due to the capital expenditure required for infrastructure.

In addition, due to favourable tariffs, direct subsidies and long-term power purchase agreements, most coal-fired power generation remains insulated from market pressures. This extends the life of coal plants and could increase risks in the future, once market structures change and protections are removed. This could lead to stranded assets, and hasty, poorly managed closures.[26]

There are fundamental questions at the heart of coal retirement financing. How should the value of a plant be quantified? What would be a 'fair' return for coal plant owners? How should local needs and perspectives be factored in to make any transitions 'just'? Governments, financers, and philanthropies need to explore ways to ensure an accelerated shift away from coal-fired power generation makes financial and socioeconomic sense.

To retire coal plants before the end of their useful economic lives and provide adequate funding to those affected, financing is needed. Without this, there would be forgone profits for the plant owners and increased risk for lenders. If phasing out coal is not properly financed and managed it would also leave workers and local communities at risk of both energy and economic insecurity.

How best to finance coal retirement is a complex and critical consideration for enabling the accelerated phase-out of coal generation

In simple terms, retiring a coal plant earlier than its useful economic life can be achieved either by removing the need for future revenue streams by reducing the plant's operating costs and/or by securing new future revenue streams by making investments into renewable generation capacity. Any financing mechanism must also be able to cover the socio-economic costs of phasing out a plant. Funding routes and mechanisms can broadly be grouped into three categories:

1. **Debt financing:** This funding route targets the cost of capital of coal plants. Combinations of private, public, and concessional (blended) finance can be used to reduce the cost of capital and therefore debt of the plant, reducing their financing costs and the need for future revenue streams to pay off debts. Debt financing routes are usually extensions of loan tenors or renegotiations of existing debt on more favourable terms.

2. **Acquisition**: This funding route changes the ownership structure of the plant through a buy-out, again with the aim of reducing the debts of the assets and therefore its remaining operating life. An acquisition can also be coupled with investments in replacement renewable energy capacity, creating new future revenue streams.

[26] https://rmi.org/insight/how-to-retire-early. Accessed November 2023

3. **Government intervention:** This funding route involves government incentivisation of the retirement of coal assets through financial incentives and the removal of coal subsidies or targeted schemes, such as through reverse auctions (where coal asset owners bid for government support). This funding route can be conducted without private financial market intervention.

The viability of each financing mechanism is dependent on the circumstances of individual plants

For some coal plants, early retirement bundled with investment in renewable energy is a viable option and could even generate enterprise value for plant owners.[27] It is likely that older, fully depreciated plants, with no outstanding debt, will be unable to raise new debt and attract any investment. For these plants, focussing on building replacement capacity may be enough to wind them down and manage them off the system with limited intervention. Conversely, newer assets with long operating lives (often 40+ years) may be too expensive to retire and replace. For these plants, repurposing or retrofitting to reduce emissions may be the more financially viable option. Prioritising which assets to target for each financial mechanism is critical.[28]

At this early stage, all sources of funding for coal retirement should remain on the table

Multi-lateral Development Banks (MDBs) have pioneered funding for the early retirement of coal plants. Many of these, such as the Asian Development Bank (ADB) and the Inter-American Development Bank (IDB), have both the capital and the ambition needed to make significant contributions to the design and the source of funds. This can be in the form of concessional finance (finance that is below market rate) provided through Special Purpose Vehicles or Managed Transition Vehicles to fund a debt refinancing or straight acquisition. However, there will be limits to the amount of funding these MDBs can provide, and the current models only work by crowding-in other sources of private finance.

A good example of MDB financing is the ADB's Energy Transition Mechanism (ETM). The ETM was launched in 2021 with a pilot pre-feasibility project focusing on Indonesia, Vietnam, and the Philippines. It had a clear objective to expedite the retirement of coal-fired power plants and replace them with low-carbon energy sources. The initiative explored different funding models, including debt-refinancing and acquisition. The most notable progress has been made in Indonesia, where ADB signed a memorandum of understanding with Cirebon Electric Power (an independent power producer) to retire a 660 MW coal-fired power plant.

A second key source of finance is likely to be private financers and investors. These take the form of banks, private equity firms, and pension funds. However, the risk appetite of these funders is likely to be much lower than MDBs. Therefore, if the market in question already has a high base rate of interest or

[27] Opinion: Retiring coal plants early could benefit investors and communities (ampproject.org) Accessed November 2023

[28] There have been a number of strategic initiatives and projects to identify how best to do this, including the Asian Development Bank's (ABD) Energy Transition Mechanism (ETM) in Vietnam, Indonesia, the Philippines, Pakistan and Kazakhstan, and The Climate Investment Fund's (CIF) Accelerating Coal Transition (ACT) programme to replace coal generating capacity with renewables in South Africa, India, Indonesia and the Philippines.

systemic issues with uncollected receivables across the energy sector (as has been observed with Pakistan's circular debt problem), incentivising additional investment could be challenging.[29]

Governments are likely to play a role in funding the accelerated transition of some coal assets, however, this could be constrained by challenging public perceptions of using tax-payer revenues to "bail out" coal assets. International initiatives could also be utilised as a funding source, whether that be the European Just Transition Mechanism, the Just Transition Transaction, a proposed scheme to set South Africa on track for a low-carbon future, or the Just Energy Transition Partnerships (JETPs) recently initiated with South Africa, Indonesia, and Vietnam.

Germany is taking a proactive role in phasing out coal. In 2020 the German government approved a draft law to phase out coal by 2038 through the use of compensation schemes.[30] Compensation schemes offer coal plant owners the option of bidding into a reverse auction to receive compensation to realise partial capital recovery for their early closure. The mechanism is innovative in its use of a timeline of reducing incentives which encourage earlier closures and therefore help to minimise the cost of closures to the government and taxpayers. Any plants operational after the last auction will be forced to close without compensation. The first five auctions led to the retirement of more than 40% of Germany's hard coal and small lignite resources, a total of 10 GW of installed capacity, at a total cost to the federal budget of around €700 million.

Finally, monetising carbon reductions could be a key source of funds for the transition. Carbon pricing and voluntary carbon markets could be critical in closing the gap between what an asset owner views as an acceptable price and what investors are prepared to pay. Carbon tariffs, such as the EU's Carbon Border Adjustment Mechanism (CBAM), could drive domestic carbon pricing models in countries where the EU is a key export market. This would make coal less competitive and increase the risk-level of future revenues of coal-fired power plants. Voluntary carbon markets could provide an intervention at the asset level to raise additional revenue to aid in either debt refinancing or the acquisition of assets identified for early retirement. However, care must be taken to ensure that all credits represent real, additional emissions reductions, are not double counted in the host country's NDC ambition, and do not inadvertently inflate the value of the power plant. This will require the introduction of safeguards, including conservative baseline setting.

Chile provides a good example of this approach. ENGIE Energía Chile, a subsidiary of the ENGIE Group, secured a $125 million financial package from IDB to build and operate a 151MW wind farm in Calama. The financial package is structured by monetising the emissions avoided by the early closure of ENGIE's coal-fired power plants. This deal follows commitments between ENGIE and the Chilean government to phase out coal plants in Tocopilla, which has resulted in the closure of four units, two in 2019 (170 MW) and two in 2021 (270 MW). This is one of the most innovative examples globally to date of blended finance being combined with the monetisation of avoided emissions.

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[29] https://sdpi.org/the-vicious-cycle-of-circular-debt-in-energy-sector-/blogs_detail#:~:text=Circular%20debt%2C%20a%20term%20that,operational%20inefficiencies%20of%20the%20sector. Accessed November 2023

[30] Germany: Law on Phasing-Out Coal-Powered Energy by 2038 Enters into Force | Library of Congress (loc.gov) Accessed November 2023

Recommendations

There is no 'right' way to fund the accelerated retirement of coal-fired power generation. Financing is likely to continue to be bespoke to a plant's characteristics, finances, and legal structures

- **In challenging markets more government intervention, as well as multilateral and philanthropic funding, will be required to stimulate coal-to-clean transition financing and investment in renewable energy.** The effectiveness of different financial mechanisms for coal retirement will be dependent on the state and maturity of the market, the local economy, and the energy sector as a whole. Some markets with high interest rates and a challenging investment environment are likely to struggle to attract foreign investors. In these markets, more government intervention and potentially multilateral and philanthropic funding will be required to stimulate change and investment in renewable energy.
- **Identifying local requirements and understanding local perspectives is critical to delivering the best funding route.** These need to be properly understood and a transition needs to be properly funded for those worse affected. Alternative sources of energy and employment will need to be explored and funded if an equitable transition away from coal is to be pursued.
- **The development and build out of renewables should still be a key priority for governments and decision-makers.** Any build out should be properly planned and managed to ensure equitable outcomes. Grid stability will be critical, as explored in the section above, but the funding for upgrading existing grid infrastructure and new renewable energy capacity should be prioritised over funding accelerated coal phase-out in most scenarios.
- **Younger assets should be the target for any coal transition mechanisms and financing.** It is only assets that are likely to stay on the system for long periods without intervention that should be explored as targets for accelerated retirement and financing. Older assets can be replaced with new renewable capacity, which can be planned and managed by policy makers and system operators. Plants should still be assessed against planned system level changes and on a case-by-case basis before any coal transition financing mechanism can be considered.
- **The role of international players, such as multilateral development banks, will be important in getting the ball rolling on coal financing and demonstrating proof of concept.** They will also be a vital source of initial finance at competitive rates of interest.