From:	Warren Wallamulla
To:	IPCN Enquiries Mailbox
Subject:	ADDITIONAL material
Date:	Tuesday, 8 March 2022 1:34:35 PM
Attachments:	HH-2022-UNDERMINED-24.pdf HH-2022-How coal ends.docx HH-MIT-2022-THE RESPONSE.docx HH-2022-EXCESS mines-ines_2021_r4.pdf HH-HH-HH-2022-Tech to capture and reuse carbon is on the rise.docx

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1. After reading or scanning thru the 2 letters provided it seems that the NSW PLANNING Departments proposed "Approvable" stance may lack the "Credible expertise" of the UNSW professors,
The Comments may need to be "in-confidence",

The WAR in UKRAINE has placed an impact that includes Large Scale Nuclear Power station and a damaged one, and the Russian supply of OIL and GAS to EU. The actual COMPLIANCE with GHG emissions in EU and Germany may be lower than it should be. So they are now saying they will spend 220 billion to Transform.

This is COMPLEX so I have also referenced info from Uhdermined INC and MIT. in the response "File below".

Deep Trouble

2021

TRACKING GLOBAL COAL MINE PROPOSALS

Ryan Driskell Tate, Christine Shearer, and Andiswa Matikinca

ABOUT THE COVER

The cover photo shows the Bengalla coal mine in Australia. Photo by D. Sewell, licensed under CC by 2.0.

ABOUT GLOBAL ENERGY MONITOR

Global Energy Monitor (GEM) develops and shares information on energy projects in support of the worldwide movement for clean energy. Current projects include the Global Coal Mine Tracker, Global Coal Plant Tracker, Global Fossil Infrastructure Tracker, Global Steel Plant Tracker, Europe Gas Tracker, CoalWire newsletter, Global Gas Plant Tracker, Global Registry of Fossil Fuels, Latin America Energy Portal, and GEM.wiki. For more information, visit www.globalenergymonitor.org.

ABOUT OXPECKERS

The Oxpeckers Center for Investigative Environmental Journalism combines traditional reporting with data analysis and geo-mapping to track eco-offenses in Africa. They develop and share #MineAlert, a tool that maps data and documents South Africa's operating mines and applications for new mining projects. For more information, visit www.oxpeckers.org.

ABOUT THE GLOBAL COAL MINE TRACKER

The Global Coal Mine Tracker (GCMT) provides information on the world's major coal mines: every operating mine producing 5 million tonnes per annum (mtpa) or greater, and every proposed mine with a capacity of 1 mtpa or greater. The map and underlying data are updated bi-annually, in January and July. With each update, coverage is expanded to include smaller mines. By January 2022, GCMT will have cataloged every coal mine producing 1 mtpa or greater. Each mine included in the tracker is linked to a wiki page on GEM.wiki, which provides additional details.

AUTHORS

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FURTHER RESOURCES

For additional data on proposed and existing coal mines, see Summary Data of the Global Coal Mine Tracker (GCMT). For links to reports based on GCMT data, see Reports & Briefings. To obtain primary data from the GCMT, use the Data Request Form.

Deep Trouble

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SUMMARY / KEY FINDINGS

Coal producers need to halt all new mines and mine extensions and reduce output 11% each year through 2030 to stand any chance of limiting global warming to 1.5°C and achieving the targets of the Paris climate agreement. Yet rather than winding down production, coal operators continue to propose and build new mines.

This report provides the results of the first comprehensive global survey of coal mine proposals. Based on the survey, 2,277 million tonnes per annum (mtpa) of new coal mining capacity is currently under development, representing nearly 30% of 2019 global production levels (8,135 Mt). While three-fourths (1,663 mtpa) of proposed coal mine capacity is in the early stages of planning and thus vulnerable to cancellation, the remaining quarter (614 mtpa) of proposed mine capacity is already under construction. The prospect of a low-carbon transition puts these projects at risk of up to $91 billion USD in stranded assets. But if they proceed, without unprecedented cutbacks in global production over the next decade, proposed capacity could boost supply to over four times a 1.5°C-compliant pathway.

The survey, carried out by Global Energy Monitor, includes all active coal mine proposals with a capacity of 1 mtpa or more. Key findings include:

- **Coal rush from hundreds of proposed mines.** There are 432 new mine developments and expansion projects currently announced or under development worldwide, amounting to 2,277 mtpa of new capacity. Of this, 614 mtpa is under construction and 1,663 mtpa is in planning.
- **New developments breach a 1.5°C pathway.** Development of these new mines runs contrary to the IEA's new roadmap for net-zero emissions, which requires no new coal mines or mine extensions beyond 2021, and the findings of the UN and leading research organizations that coal production must decline 11% each year through 2030 to remain consistent with a pathway to 1.5°C. If all proposed coal mine capacity currently under development is realized, coal production in 2030 will be over four times the 1.5°C-compliant pathway.
- **China, Australia, India, and Russia make up over three-fourths of new mine developments.** New capacity development is strongest in China, Australia, India, and Russia. Together, the

countries represent 77% (1,750 mtpa) of global coal mine development: China has 452 mtpa of coal mine capacity under construction and another 157 mtpa in planning; Australia has 31 mtpa under construction and 435 mtpa in planning; India has 13 mtpa under construction and 363 mtpa in planning; and Russia has 59 mtpa under construction and 240 mtpa in planning.

- **Four Chinese provinces account for nearly a quarter of all the proposed coal mine capacity worldwide.** About 24% (544 mtpa) of the world's proposed mine capacity is located in four Chinese provinces and regions: Inner Mongolia (234 mtpa), Xinjiang (123 mtpa), Shaanxi (95 mtpa), and Shanxi (92 mtpa).

- **Most proposed projects are publicly financed.** The majority of proposed coal mines in China and India are sponsored by state-owned enterprises wholly or partially owned by the government, meaning taxpayer money continues to subsidize mine projects to fuel province and state economies.

- **Usual corporate suspects in the mix.** Despite slumps and slowdowns in market demand, the world's largest energy conglomerates such as Glencore, Mechel, and BHP still remain invested in new mines and mine expansions, though small and independent firms have shown the greatest appetites for new projects, especially in Australia and Russia.

- **Greenfield developments lead the way.** Nearly two-thirds of mine proposals are "greenfield" developments, signalling the industry's willingness to break ground on new mines that tend to lock-in more long-term production and more future emissions than existing mines. The remainder are "brownfield" developments that expand the capacity of existing operations or recommission idle mines.

- **Beware of mid-size operations.** While mega coal mine projects often attract intense global opposition from climate activists and pose a financial risk for investors, the industry is primarily reliant on mid-size operations with lower public profiles to boost supply. The median size for a new coal proposal is 3.5 mtpa.

- **Thermal coal is still king.** Although power generation from the world's coal plants has been on the decline since 2019, thermal coal operations still dominate, making up 71% of proposed mine capacity. However, in North America the numbers are reversed, with metallurgical coal for steel-making accounting for 70% of proposed capacity.

- **Greenhouse gas emissions from new mines comparable to U.S. emissions.** The emissions from coal mine projects now on the drawing board would total between 5,000 and 5,800 Mt of CO_2 equivalent (CO_2e) each year from combustion and methane leakage (for CO_2e100 and CO_2e20, respectively), comparable to the current annual CO_2 emissions of the United States (5,100 Mt).

- **Stranded asset risk.** Coal mines and related infrastructure such as ports and railways are capital-intensive projects that cost tens of millions of dollars per mtpa mined to open. Yet the prospect of a low-carbon transition and tighter emission policies put these projects at risk of shutting down early, representing up to $91 billion USD in stranded assets from coal mines alone.

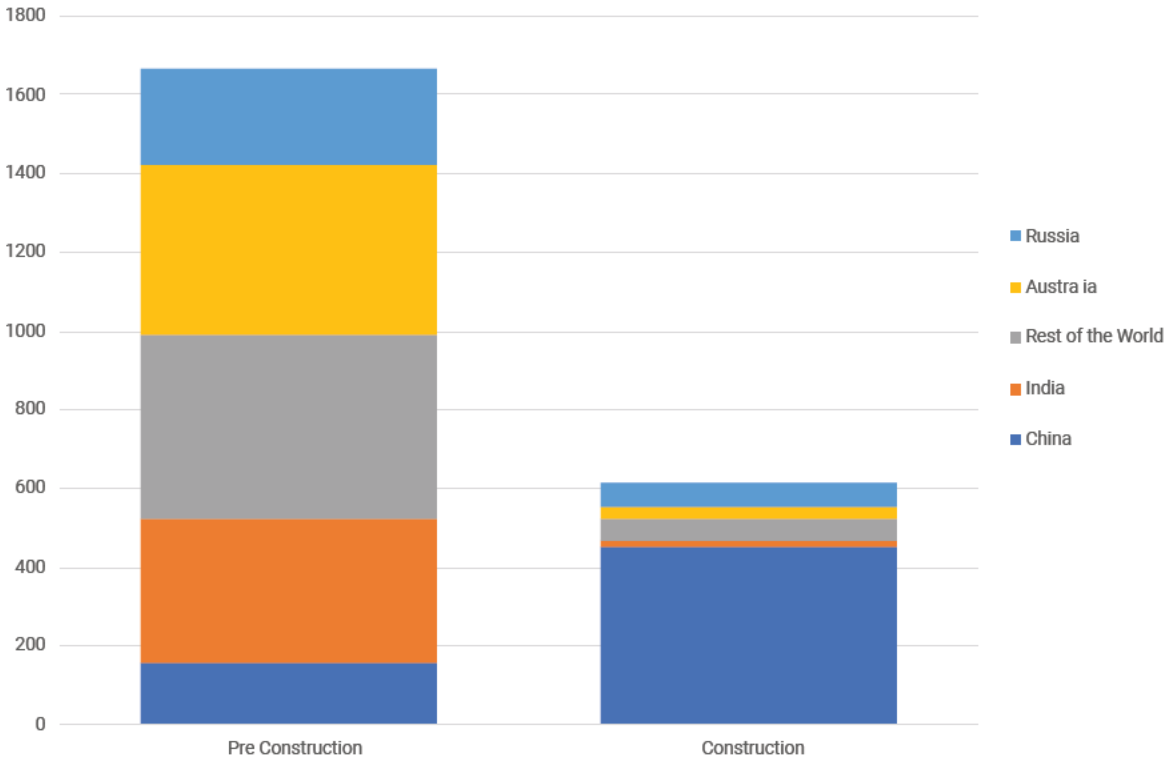
INTRODUCTION: STILL DIGGING

The coal industry faces a bust in its historic markets, but there's no end in sight in many parts of the world. Altogether, 2,277 million tonnes per annum (mtpa) of new coal mining capacity is on the drawing board, with one-quarter (614 mtpa) under construction and the remaining three-fourths in early stages of planning (1,663 mtpa) (see Appendix 1 for methodology).

The frenzy of new mine activity is strongest in China and India where state-owned enterprises (SOEs) with majority government ownership continue to invest in thermal coal mines and rely on subsidies to shield operations from external market pressures. Against market headwinds, even private coal companies in Australia and Russia remain committed to new projects, with small and independent firms showing a greater appetite for mine developments than multinationals. This is not to say the largest producers, like Glencore, BHP, or Mechel, have opted out. They remain invested in new operations as they hold out hopes for rebounds in seaborne markets or heightened demands for metallurgical coal.

The industry is pursuing a substantial number of greenfield developments, which comprise two-thirds (1,471 mtpa) of the 2,277 mtpa of proposed capacity. Despite economic slumps in coal markets, rebuffs from banks and insurers, and resistance from civil society groups, state and private operators remain bullish on new mines. The size of these projects seems to have created a Goldilocks effect: most are in the mid-range, neither very large nor very small, with a median capacity of 3.5 mtpa. At this size, they are less vulnerable to the intense public scrutiny typically associated with coal megaprojects, while also being shielded from near-term consolidation and

Figure 1: Coal mining capacity under development (mtpa)



Source: Global Coal Mine Tracker, Global Energy Monitor, January 2021

closure schemes, especially in China and India, where national governments have signalled plans to reduce the number of small mines in their portfolios.

But the future of new mine projects remains uncertain. Their viability is contingent on government policies related to the Paris climate agreement; in the event that governments impose tighter emission regulations, these operations face significant stranded asset risk. If planned coal mines open as intended, but are forced to lower production levels or shut down early, they represent up to $91 billion USD in stranded assets, based on the average capital costs to open a coal mine.[1]

The risk of stranded assets is particularly acute for the one-fourth (614 mtpa) of new mine developments currently undergoing construction, amounting to $27 billion USD in capital costs. The lion's share of these construction projects are located in China (452 mtpa), which has five times the number of construction projects than runner-ups Russia (59 mtpa) and Australia (31 mtpa) combined. The remaining three-fourths of new mines still in pre-construction planning (1,664 mtpa) are particularly vulnerable to the obstruction of mine financing and government approvals, meaning they may never open due to social and economic pressure to transition away from coal.

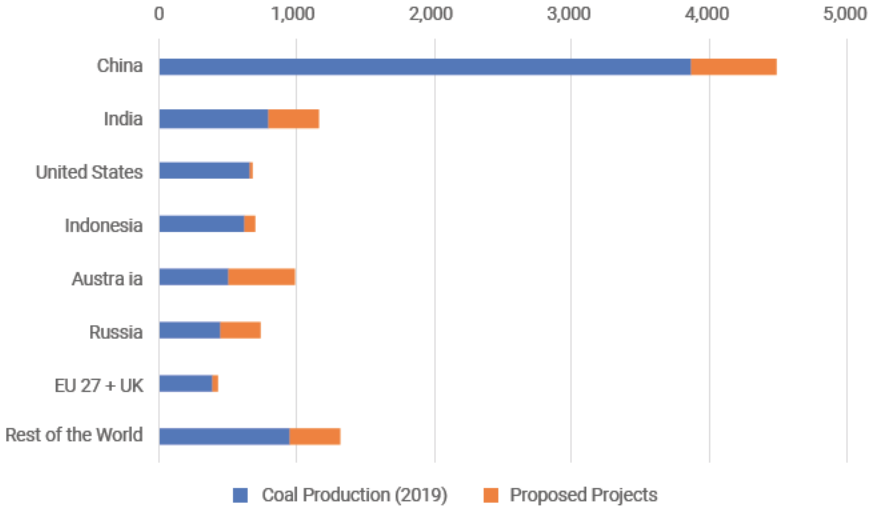
1. Assumes average capital costs of US$26 million per mtpa for surface mines and US$53 million per mtpa for underground mines in OECD nations (Harper 2008), and US$38 million per mtpa for surface mines and US$50 million per mtpa for underground mines in non-OECD nations (Dipu 2011).

GEOGRAPHIES OF PRODUCTION: WHERE ARE THE NEW MINES?

The world's 2,277 mtpa of proposed mine capacity is highly concentrated in a handful of heavy producers. At the national level, most proposed mine developments are clustered in China (609 mtpa), Australia (466 mtpa), India (376 mtpa), and Russia (299 mtpa). Together these countries make up 77% (1,750 mtpa) of all global mine development projects.

These new development projects perpetuate the broader trends in coal production over the last five years. In 2019, global production increased by an estimated 1.6% (Table 1), spurred by new developments in China, India, Australia, and Russia where coal production remains steady or rising. While early global estimates show the onset of the Covid-19 pandemic chipped away at global production levels in 2020, it was not enough to significantly reduce output in China, the largest producer, where production stagnated at 3,840 Mt. In fact, the Covid-19 pandemic provoked temporary mine shutdowns in many parts of

FIGURE 2: Proposed coal mines by country or region (mtpa)



Source: Production (BGR Energy Study 2019), Proposed Projects (Global Coal Mine Tracker, Global Energy Monitor, January 2021).

Table 1: Coal production by country or region, 2015–2019 (mtpa)

Country/Region	2015	2016	2017	2018	2019	Difference 2018–2019	Difference 2015–2019
China	3,563	3,408	3,520	3,680	3,850	4.6%	8.0%
India	704	723	737	780	777	–0.4%	10.5%
United States	814	661	703	686	641	–6.6%	–21.2%
Indonesia	462	456	461	558	616	10.4%	33.4%
Australia	501	503	492	502	504	0.3%	0.6%
Russia	373	386	409	434	437	0.7%	17.1%
EU27+UK	500	459	463	442	375	–15.3%	–25.1%
Rest of the world	840	876	893	924	935	1.2%	11.3%
Global	**7,756**	**7,471**	**7,678**	**8,007**	**8,135**	**1.6%**	**4.9%**

Source: BGR Energy Study 2019

the world, but did not halt the pace of mine approvals or construction in India or China.

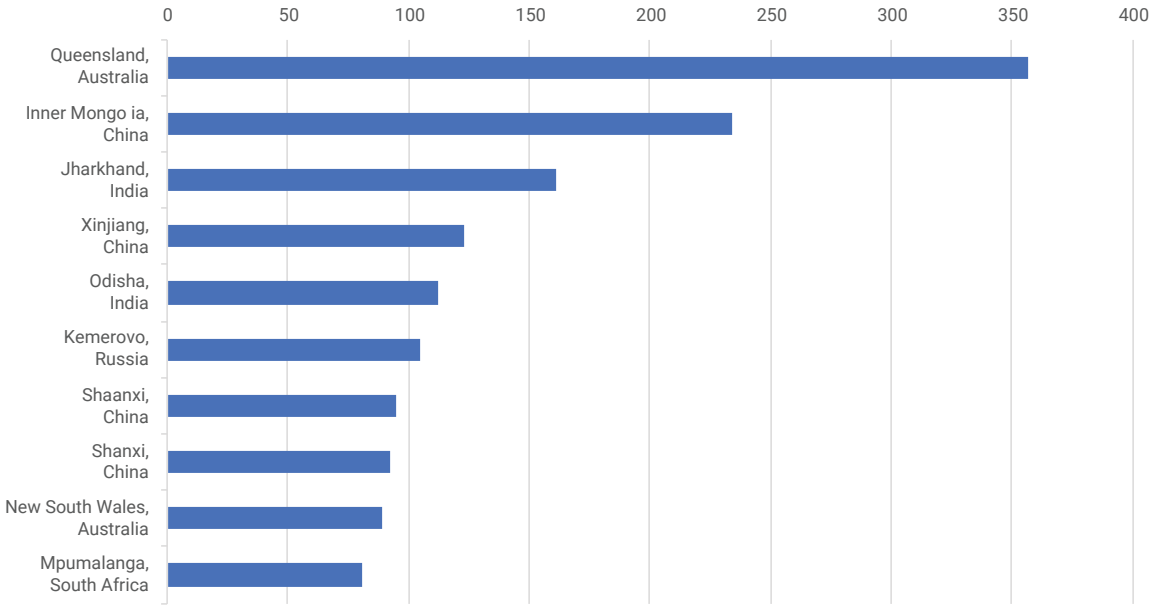
But the national view masks the origins and density of these projects. The fast-paced build out in China, which leads the world in new mine developments (609 mtpa), is driven by just four provinces: Inner Mongolia, Xinjiang, Shanxi, and Shaanxi Provinces amount to 89% (544 mt) of all the proposed capacity in China. What appears to be a coal boom in East Asia, or even China, is really a boom in a handful of China's coal-bearing provinces.

The same is true for new mine developments in Australia (466 mtpa), India (376 mtpa), and Russia (299 mtpa), where mining activity is heavily concentrated in traditional coal mining regions. The coalfields of Queensland, Australia have more coal under development than any state or province in the world (357 mtpa), bolstered by projects in the Bowen and Galilee Basins. Likewise, the bulk of India's proposals are located in just three states: Jharkhand (161 mtpa), Odisha (112 mtpa), and Chhattisgarh (40 mtpa), which together comprise 77% of all the coal development in South Asia. Similarly, over one-third (105 mtpa) of all mine projects in Russia are located in the coal-rich Kuznetsk Basin (Kuzbass) in Kemerovo Oblast.

But unlike China, where 74% of projects are already under construction, the vast majority of proposed mining capacity in Australia (94%), India (96%), and Russia (80%) are in pre-construction phases and have yet to undergo the build-out of mine infrastructure. Given their early stages of planning, these mines are particularly vulnerable to future status changes should investors, governments, or civil society groups avert financing or project approvals.

A second tier of mine developments in midsize producers, like South Africa (130 mtpa), Indonesia (70 mtpa), and Mozambique (54 mtpa), could significantly increase national output in those countries. South Africa accounts for 65% (130 mtpa) of proposed capacity in Africa and the Middle East. If all proposed mines went into operation, it would undergo a 51% increase in current production. Indonesia, the major driver of capacity growth in Southeast Asia, would undergo a 12% increase in production, with the province of East Kalimantan responsible for more than half of the region's new mine capacity (49 mtpa). The

FIGURE 3: Proposed coal mining capacity by states and provinces (mtpa)



Source: Global Coal Mine Tracker, Global Energy Monitor, January 2021

potential coal rush in Mozambique, from 10.3 mtpa to 64.3 mtpa, would represent the largest percent shift of national output worldwide, though some companies have already begun to renege on their plans.

While much of Western Europe is phasing out coal, Poland (32 mtpa) and Turkey (22 mtpa) continue to build new operations, accounting for 60% of the region's new mine development. Most new capacity remains under development in coal communities, such as Łódź (18 mtpa) and Lower Silesian (12 mtpa) in Poland, and Turkey's Black Sea province of Bartin (10 mtpa). As of 2020, 12% (56 mtpa) of the 453 mtpa proposed capacity in these regions is under construction, with the remaining 88% of capacity in pre-construction phases and subject to financial constraints or institutional and government restrictions in the coming years.

TAKING OWNERSHIP: WHO IS BUILDING NEW MINES?

There are 388 companies and state-owned enterprises invested in the development of coal mine projects around the world. A Top 10 list of companies building new mines is shown in Table 2. These operations are prorated by percent ownership in proposed mine projects. (A list of all companies can be found on the Global Coal Mine Tracker website.)

Virtually all mine development in India and China is by state-owned companies, with Coal India (243 mtpa) topping the list and China Datang (50 mtpa), NLC India (34 mtpa), and China Coal (32 mtpa) in the Top 10. This means public funding is effectively subsidizing new coal mines and related infrastructure development.

But private enterprises, including some of the world's largest multinationals, remain heavily invested in new mines and mine expansions, with Adani Group (67 mtpa) and Glencore (45 mtpa) invested in new developments worldwide and SibAnthracite Group (31 mtpa) continuing its build out in Russia.

Notably, several small and medium size firms, especially in Australia, have elbowed their way into the Top 10. This includes heavy investments from Mineralogy (106 mtpa), through its subsidiaries Waratah Coal and Central Queensland Coal, as well as Valiant Resources (48 mtpa), a small independent firm pursuing an ambitious coking project in Queensland. VostokCoal (35 mtpa), an independent Russian firm, rounds out the top tier of the list.

TABLE 2: Coal Mine Developments by Company (mtpa)

Company	Proposed Mine Capacity (mtpa)
Coal India	243
Mineralogy	106
Adani Group	67
China Datang	50
Valiant Resources	48
Glencore	45
VostokCoal	35
NLC India	34
China Coal	32
SibAnthracite Group	31

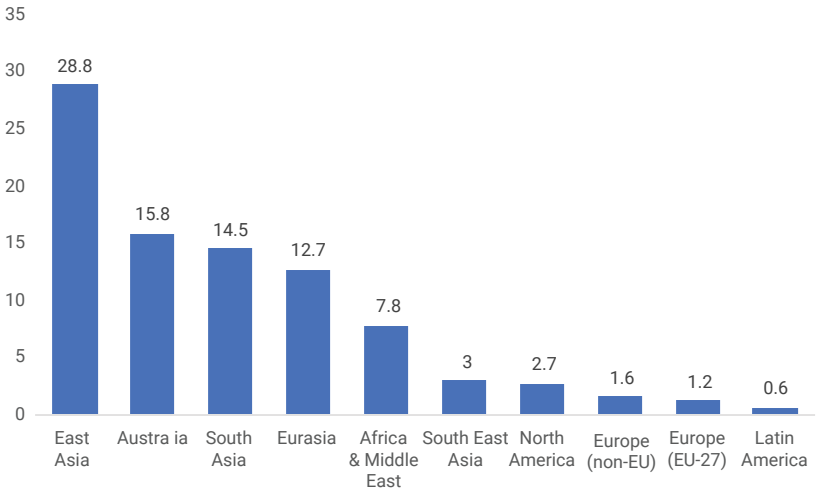
Source: Global Coal Mine Tracker, Global Energy Monitor, January 2021

STRANDED ASSET RISK

The capital expenditures necessary to bring all 432 mine projects into operation is $91 billion USD, based on the average capital costs to open a coal mine. If planned coal mines open as intended, but are forced to lower production levels or shut down early, they represent a significant stranded asset risk (see Appendix 1 for methodology).

That risk is most acute for the coal projects already under development with sunken costs. With one-fourth (614 mtpa) of new projects under construction, $27 billion USD in capital expenditures has likely been fixed in place, and vulnerable to closure or late-stage cancellations from the transition away from coal. The remaining three-fourths of coal projects (1,663 mtpa) are early phase developments and open to prospective cancellation owing to low-carbon transition and tighter emission policies. But if they continue to proceed, those operations put $63 billion USD in capital costs at stranded asset risk.

Figure 4: Estimated Capital Cost of Projects Under Development (Billion USD)



Source: Global Energy Monitor

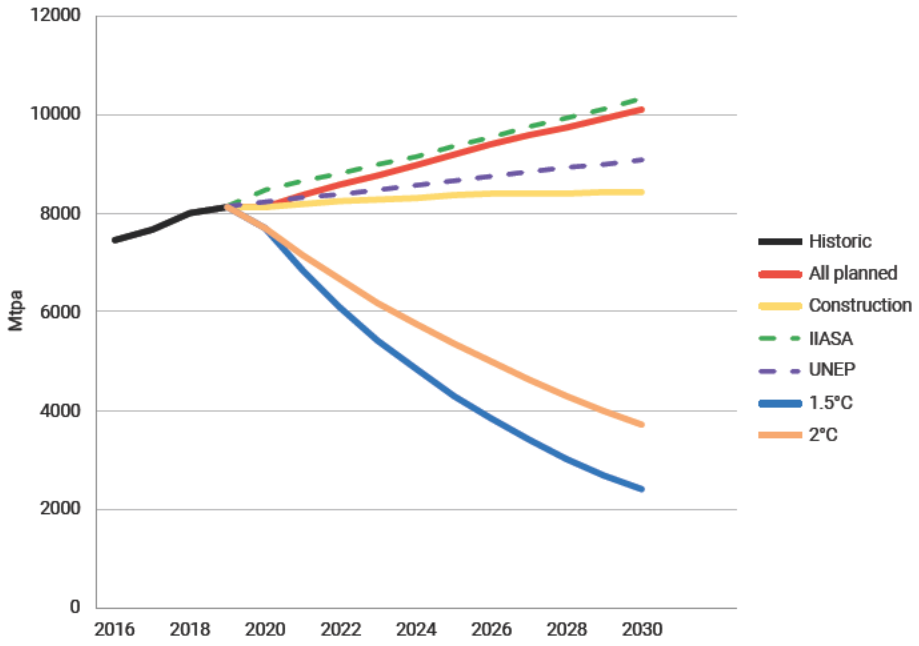
UNDERMINING PARIS CLIMATE AGREEMENT

Despite political, social, and economic pressures on the coal industry, the world is not on course to phase out coal fast enough to avert the worst impacts of global climate change. The metric of a "production gap," first developed by the United Nations Environment Program (UNEP) and several partners in 2019, shed light on the discrepancy between planned fossil fuel production and the reductions in production required to meet the Paris climate agreement. Estimating future coal mining production, the 2020 Production Gap report found that by 2030, coal-producing countries would mine about three to four times more coal than what is compatible with Paris climate goals. In contrast, the report estimated that coal production will need to decline 11% annually in order to maintain a pathway to hold warming to 1.5°C, and 7% annually to hold warming "well below" 2°C.

The estimates of the Production Gap Report relied on the best available data at the time: national energy strategies and outlooks of the eight largest coal-producing countries accounting for over 60% of global production, used to create a global estimate of future production. GEM's Global Coal Mine Tracker has extended that analysis by providing asset-level data on every announced, explored, permitted, and under-construction coal mine in the world with a proposed capacity of 1 mtpa or greater. By surveying current mine proposals, GEM is able to offer an estimate of future coal mining production based on project-level data for all countries.

Figure 5 shows two projections for future coal mining production: 1) if all 2,277 mtpa of proposed coal mining capacity opens evenly through 2030 (averaging 227.7 mtpa, red line) and 2) if only the 614 mtpa of capacity currently under construction opens evenly through 2030 (averaging 61.4 mtpa, yellow line). The proposed capacity has been added to 2019 production (8,135 Mt), minus production at mines planned for closure or likely to exhaust their recoverable reserves before 2030 (totaling 306.1 mtpa). These projections

Figure 5: Proposed increases in coal mining capacity are not compatible with the Paris climate agreement



Sources: Historic (BGR Energy Study 2019), All planned and Construction (Global Coal Mine Tracker, January 2021), IIASA (Kholod et al. 2020), UNEP, 1.5C and 2C targets (2020 Production Gap report)

are comparable to the UNEP's global forecast (dashed purple line) as well as "business as usual" coal production scenarios by climate and energy models (IAASA, grey dashed line), and show that projections of future production are not far off from actual coal mine proposals (see Appendix 2). The orange and blue lines represent the 7% and 11% annual reduction in coal mining from 2020 to 2030 that the UNEP has called for to keep warming "well below" 2°C, in line with the Paris climate agreement.

If all proposed coal mining capacity is realized, coal production in 2030 will be over four times the 1.5°C-compliant pathway, and nearly three times the 2°C-compliant pathway, as the proposals raise production to 10,106 Mt by 2030, while the UNEP reduction requires production be limited to between 2,400 and 3,600 Mt by 2030. Even if new capacity is limited to what is currently under construction and all other planned capacity is cancelled, coal production in 2030 will still be 8,443 Mt, over three times the 1.5°C-compliant pathway and over two times the 2°C-compliant pathway.

Importantly, every year of increased production means steeper cuts are needed to meet the required decline in coal production. Even if future coal mining production is limited to what is currently under construction (yellow line), coal production would need to be cut 35 to 50% by 2025 and 55 to 70% by 2030 to meet the Paris-compatible pathways, after which holding warming to well below 2°C may be out of reach. The IEA's new roadmap for net-zero emissions by 2050, which limits global warming to 1.5°C, requires no new coal mines or mine extensions beyond 2021. Thus any new coal mine opened by the industry needs to be accompanied by a much greater number of mine closures to keep Paris goals within reach.

Lock-in of future emissions

The Special Report on 1.5°C by the UN's Intergovernmental Panel on Climate Change estimates that CO_2 emissions from coal use needs to fall 50 to 80% by 2030 to keep warming well below 2°C. If proposed new mines open as intended, the CO_2 emissions from combustion will be equivalent to 4,639 Mt a year, a 14% increase over global CO_2 emissions in 2020 (34,100 Mt), barring declines elsewhere. In addition, the mines will leak an estimated 13.5 Mt of methane each year from broken coal seams and surrounding rock strata, based on coal mine depth and the gas content of the coal seam.

Combined, the annual greenhouse gas emissions from proposed coal mines will be between 5,000 and 5,800 Mt of CO_2-equivalent (CO_2e) each year (for CO_2e100 and CO_2e20, respectively), comparable to the annual CO_2 emissions of the United States (5,100 Mt). The build out of new mines, therefore, raises serious concerns about meeting the Paris climate agreement.

MINE BY DESIGN: A PROFILE OF OPERATIONS

While the age of coal sputters to an end in much of the world, two-thirds of mine proposals are "greenfield" developments (298 mines), signalling the industry's willingness to break ground on new mines that lock-in future production and emissions. The remainder of operations consist of expansions to existing mines (122 mines) and recommissions of idled mines (7 mines). The trend is apparent worldwide: among the largest producers, only Russia has more expansions on the books than greenfield projects. Given the uncertainty of greenfield developments, which require top-to-bottom permitting and financing, these projects pose stranded asset risks. Yet the industry's push for greenfield mines demonstrates bullishness in the face of mounting odds. These mine projects are split equally between surface and underground operations (185 each), with 62 projects using mixed methods.

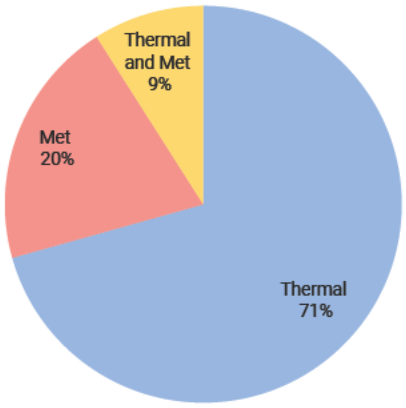
While there are prominent cases of resistance to new greenfield mines, such as the mega Carmichael Mine (60 mtpa) in Australia, many new mines—especially expansions—fly under the radar. This year, two Canadian mine expansion projects (Vista mine expansion and Castle Mountain project) "slipped through the cracks" of federal environmental assessment until civil society raised alarms with the Minister of Environment and Climate Change. In traditional coal communities like Russia's Kuzbass, Poland's Lower Silesia, and China's Shaanxi Province, new mines received even less scrutiny. In the U.S., the Longview coal mine in West Virginia, for instance, has escaped widespread opposition, even though the proposed Appalachia mine, owned by foreign investors and intended for export to Asia, will contribute 4 million short tons a year to U.S. production.

The median capacity for a new mine is 3.5 mtpa, a relatively mid-size that has allowed many proposals to evade the public scrutiny associated with coal mega projects, while still contributing significantly to new production and emissions. It has helped insulate them from potential consolidation and closure, especially in China and India where national governments have signalled plans to reduce the number of small mines in their portfolios (typically those producing well below 1 mtpa).

Thermal coal dominates, but metallurgical coal prominent in proposed mines

Coal-fired power generation has been on the decline since 2019, but thermal coal mines, intended for power plants, still dominate development plans. Where coal type is known, thermal coal accounts for 71% of planned capacity, while metallurgical coal for steelmaking accounts for 20% and mixed for 9%, showing that thermal continues to carry sway (Figure 6). About 216 projects are thermal coal operations, amounting to 1,276 mtpa, with an additional 21 projects providing both thermal and metallurgical coal to industrial consumers amounting to 163 mtpa. In addition, about 117 bituminous coal mines of undefined grade and consumer amounts to 473 mtpa of proposed coal mining capacity.

Figure 6: Planned coal mining capacity by type



Source: Global Coal Mine Tracker, Global Energy Monitor, January 2021

There are 78 metallurgical coal projects proposed worldwide for steel-making and mixed industrial consumers, whose production has held steady since 2018. The overwhelming share of metallurgical projects are located in Australia (164 mtpa) and Russia (97 mtpa) and North America (75 mtpa), which all rely heavily on exports to the Asia-Pacific region. Australia, the world's largest exporter of metallurgical coal, initially anticipated high demands in 2020 from traditional consumers in China, but found their tankers lined up outside ports after Beijing imposed tariffs on Australian imports amid a growing trade war. Russia, the world's fifth largest exporter of metallurgical coal, has kept a keen eye on the region's metallurgical market, and has since hustled for a larger share of the pie. Moscow moved in early in 2021 to fill the gap in China once occupied by Australia.

WAYUU RESISTANCE AT CERREJON

On the northernmost tip of Guajira Peninsula, near the Venezuelan border, indigenous communities and workers remain locked in a standoff with the international mining industry. The heavyweights of the coal business—BHP, Anglo American, and Glencore—own the Cerrejón coal mine, the largest open pit coal mine in Latin America. For three decades, the indigenous Wayuu people of northern Colombia have fought to protect their ancestral lands and community from the mine's impacts including noxious pollution and excessive water use. Human Rights Watch, in a 2017 report to the United Nations, described the Wayuu as wracked by "humanitarian crisis . . . caused by extremely limited access to food and water compounded with high levels of poverty and equally limited access to basic services."

In 2020, Wayuu community leaders appealed to the United Nations to intervene in their struggle. They claimed that the Cerrejon mine violated water rights and caused poor air quality that exacerbated the risks of Covid-19. By September, an UN Special Rapporteur on human rights and the environment called for a halt to mine operations "until it can be shown to be safe." The recommendation landed at an opportune time. A month earlier, in August, coal miners at Cerrejon walked off the job and ground production to a halt. While the union, Sintracarbon, demanded better pay and benefits, the major bone of contention in labor negotiations was 1,250 job losses and a new work shift that miners said jeopardized their wellbeing—a so-called "shift of death." By December, the strike came to an unceremonious end, with a new three-year contract, shortly after Cerrejon announced a preliminary agreement with the Wayuu (which indingeous community leaders adamantly denied).

The controversies that erupted over Cerrejon in 2020 and again in early 2021, when workers blocked railway lines, remain largely unresolved and demonstrate the stakes of local conflict in the midst of global coal transitions. The construction of new mines poses continued threats to local and Indigenous communities and environmentally sensitive bioregions. Just as the Wangan and Jagalingou Nation fight the Carmichael mine in Australia, and indigenous villagers in India resist the expansion of the Parsa East mine, and communities around the world mobilize to fight the build out of new mines in the years ahead.

CHINA

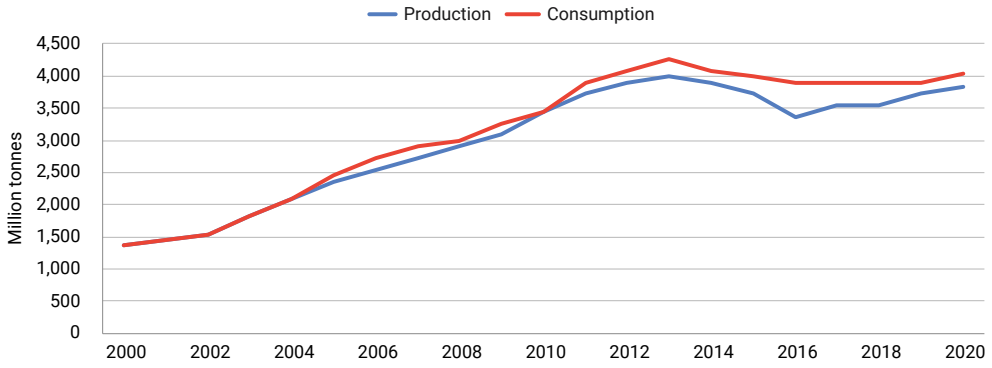
China leads the world in proposed coal mining capacity, with 452 mtpa under construction and another 157 mtpa in planning, for a total of 609 mtpa of capacity under development. Coal production has been on the rise in China since 2017, but the pressure for new mines accelerated after the Covid-19 pandemic, as provinces used new coal projects to stimulate local economies in the wake of the economic slowdown. This effort has been highly concentrated: About 90% (544 mtpa) of China's proposed coal mining capacity is located in just four Chinese provinces and regions, namely Inner Mongolia (234 mtpa), Xinjiang (123 mtpa), Shaanxi (95 mtpa), and Shanxi (92 mtpa). While the central government recently pledged that China will aim to reach net zero carbon emissions by 2060, coal-dependent provinces and companies are pushing to expand the country's coal mining capacity.

The coal mine build-out represents a marked shift from where the country appeared to be heading in 2015. That year the central government issued a policy for coal "decapacity", signaling its potential to wind down the country's growing coal use. The policy involved the closure of smaller mines, consolidation and integration of mine operations, and the creation of a fund for worker transition. The policy also included a three-year ban on raising coal mining capacity through 2018, meaning no new coal mines could be opened unless an equivalent amount of capacity was closed. Government efforts to improve the energy structure and tackle pollution saw coal consumption consistently fall between 2014 and 2016, after peaking at 4,264 Mt in 2013.

However, by 2016 the country's economy was beginning to slow, leading the central government to introduce a large stimulus spending package, with emphasis on coal-intensive heavy industry. In addition, the transfer of coal power permitting authority from the central government to the provinces in late 2014 led to a frenzy of new coal plant construction. By 2017, China's coal consumption and production was back on the rise (Figure 7), reaching 3,840 mtpa of production and 4,040 mtpa of consumption in 2020. Of coal consumed in 2020, about 55% was for power generation, 20% for iron and steelmaking, and the remaining quarter for industrial uses such as cement and chemical production.

To meet the increase in coal consumption, China's National Energy Administration (NEA) approved 64.1 mtpa of new coal mining capacity in 2018, followed by 195.7 mtpa in 2019. Based on GEM analysis, most of the mines appeared to have begun construction before the permits were granted, meaning the permits were applied retro-actively to coal mines that had been operating illegally. In 2020, the NEA approved 22 mining projects totaling 42.6 mtpa of

Figure 7: China coal consumption and production



Source: China National Bureau of Statistics, 2000–2020

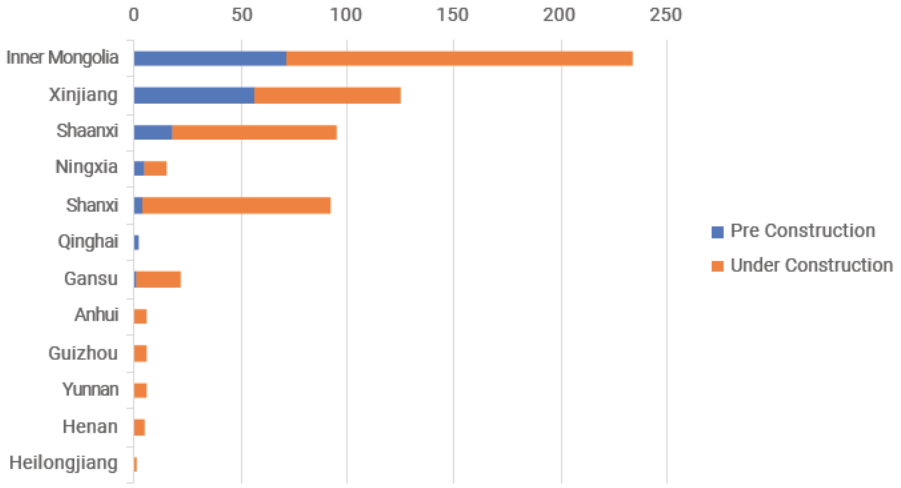
coal mining capacity, and another six projects totaling 15.3 mtpa in January 2021. Of these 28 coal mining projects permitted, 26 are located in just one region: Xinjiang.

In January 2021, an unprecedented report by China's powerful Central Environment Inspection Group criticized the NEA for lax enforcement of the country's restrictions on coal development, including coal mining. According to the report, inspection of three provinces found that 121 coal mines were exceeding production quotas by as much as 30%. The NEA is required to submit a "rectification plan" which should provide the first indication of whether the central government plans to clamp down on illegal coal mining.

In March 2021, the China Coal Association announced the country will limit its annual coal output to around 4,100 mtpa, and limit the commodity's use to 4,200 mtpa by the end of the country's 14th Five-Year-Plan period (2021–25). Compared to 2020, the cap would allow annual coal consumption to grow by 160 mtpa, and coal production to grow by 260 mtpa—significantly lower than the 609 mtpa of coal mining capacity that China has in planning unless 350 mtpa of annual capacity is closed. Any additional new coal mining capacity will require equivalent closures to meet the China Coal Association's coal production cap.

In April 2021, President Xi announced at the Climate Leaders' Summit that the country will "strictly limit the increase in coal consumption over the 14th Five-Year Plan period and phase it down in the 15th Five-Year Plan period." The announcement suggests the country's coal consumption—and thus its CO_2 emissions—should peak by 2025, and phase down through 2030. While a welcome acceleration in the country's previous target of peaking CO_2 "before 2030", China's planned increase in coal production through 2025 is still in stark contrast to the immediate 11% annual declines in coal production that the UN and leading research organizations have called for to meet the Paris climate agreement.

FIGURE 8: Coal Mine Proposals in China's Provinces (mtpa)



Source: Global Coal Mine Tracker, Global Energy Monitor, January 2021

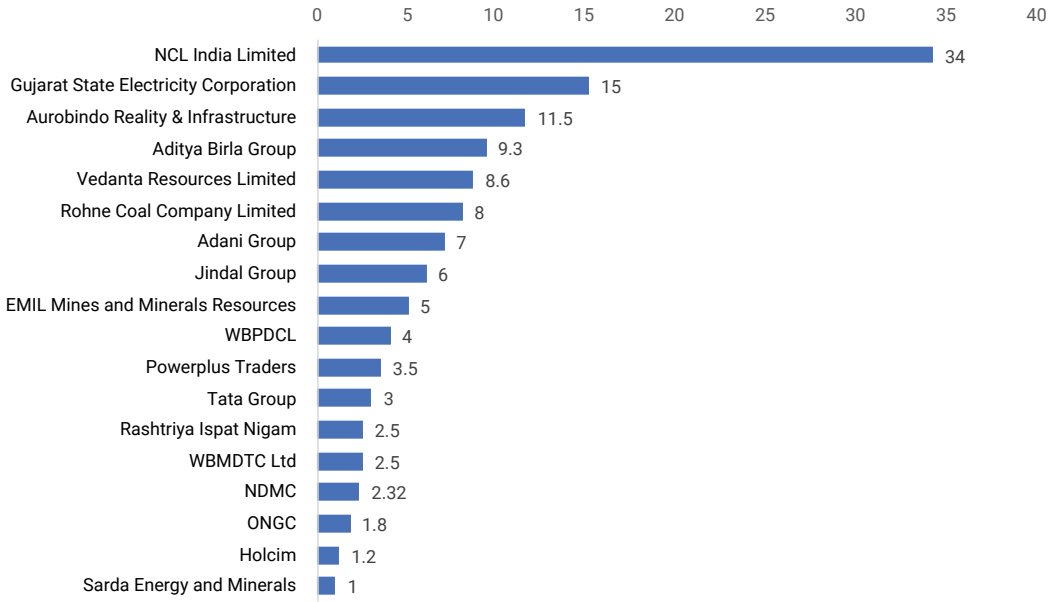
INDIA

India ranks third in the world for proposed mine capacity, with 363 mtpa in planning and 13 mtpa under construction. The country has had a long-standing goal of replacing its coal imports, totaling 250 Mt in 2019, with domestic coal output. To accomplish this, the government has directed state-owned enterprise (SOE) Coal India Ltd (CIL) to increase its coal production, despite studies finding that 70% of CIL's active mines currently operate at a financial loss due to low labor productivity. Even with the push, proposed coal mines by SOEs have fallen short of national targets, which coincides with the Indian government's unusual move in 2020 of inviting foreign interests to mine its coal.

In 2020, the government directed CIL to replace 100 mtpa of imports with domestic coal in the fiscal year 2020–21 and cease imports altogether by producing 1,000 mtpa in 2023–24. As of 2020, CIL currently accounts for 80% of India's domestic production and in 2019–20 produced 602 mtpa. Based on GEM analysis, 66% (250 mtpa) of India's proposed mine capacity is currently controlled by CIL. On its own, 9 mtpa currently under construction by CIL is insufficient to meet the government's target of replacing 100 mtpa in imports next year, nor is the full build-out of all CIL's proposed capacity (250 mtpa) enough to guarantee production of 1,000 mtpa by 2024. To close the gap, India will have to rely on its record stockpile of 132 Mt set aside during the Covid-19 pandemic. This past year, CIL implemented several haphazard measures to boost supply, such as recommissioning smaller mines, some after 20 years of closure, even as 46 active mines remain idle or on care-and-maintenance and 13 are producing less than a nominal 10,000 tonnes per year.

But to really meet its domestic coal targets, the national government has signaled its willingness to break from its reliance on CIL to boost national production. Over the last few years, private contractors have begun to operate a larger share of CIL mines and the national government has moved to ease the tendering process. Currently, 57.8 mtpa of proposed mine capacity is under development by non-CIL government and state-owned enterprises, including NCL India Limited (34 mtpa), Gujarat State Electricity Corporation (15 mtpa), and the state of West Bengal

FIGURE 9: India mine proposals by private and non-CIL state producers (mtpa)



Source: Global Coal Mine Tracker, Global Energy Monitor, January 2021

(6.5 mtpa). An additional 68.4 mtpa of new capacity is planned by private companies, including Aurobindo Reality and Infrastructure (11.5 mtpa), Aditya Birla Group (9.3 mtpa), Vedanta Resources Limited (8.6 mtpa), Rohne Coal Company (8 mtpa), and Adani Group (7 mtpa).

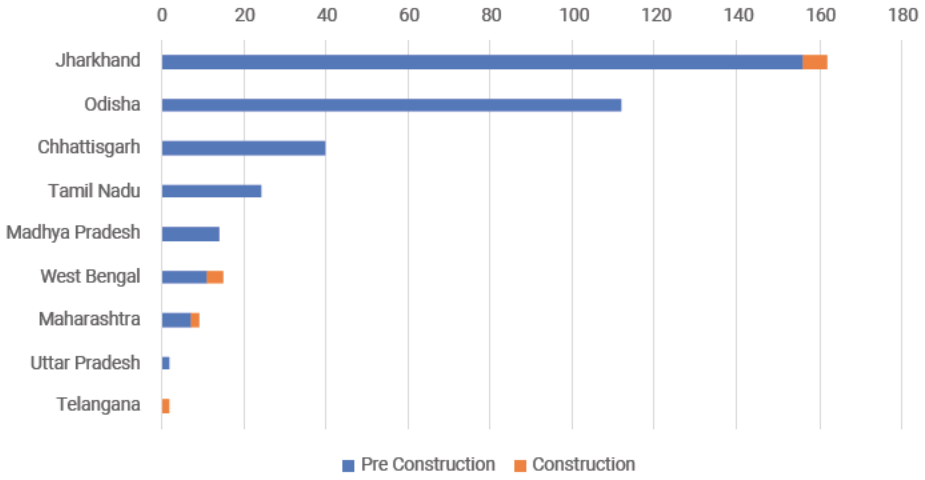
In June 2020, India for the first time opened public coal blocks for auction to private companies with direct foreign investment. The move largely backfired after the coal blocks struggled to secure bidders. While 40 coal blocks were initially announced for sale, the government later revised them to 38, of which only 23 received qualifying bids and only 19 were allocated to a winning bidder before the end of the year. In all, the initial plan put 186 mtpa of productive capacity up for sale, but only one quarter (51 mtpa) was allocated, and none of it to foreign buyers. In addition, allocations went to the smallest coal blocks with the least risk, with a median capacity of just 1.2 mtpa. When four large blocks were reauctioned in the opening months of 2021, only one received a bidder.

Undeterred, the national government announced in March 2021 that it would put an additional 67 coal blocks up for sale, the most of any previous auction. Those auctions will take place from June to July 2021, even as the country comes under growing pressure to set a net-zero emissions target and CIL moves to diversify its portfolio into renewables.

All told, 52 coal mines over 1 mtpa remain under development in India with 33 still on the books after allocations from previous tranches, while an additional 54 mines are at risk of being shelved from ongoing delays. Yet most mine projects remain early phase developments that face uncertain timelines and futures. As of 2020, 38 proposed mines have been announced or in exploration, 10 fully permitted but yet to break ground, and 4 mine projects currently under construction.

As in much of the world, India's mining proposals are highly concentrated, with 83% (313 mtpa) of the nation's planned capacity located in just three states: Jharkhand (161 mtpa), Odisha (112 mtpa), and Chhattisgarh (40 mtpa). The single largest project in the country, the Siarmal Open Cast mine in Sundergarh, Odisha could produce 50 mtpa at peak capacity, with an operational life of 38 years, making it the second largest proposed coal mine in the world after Australia's Carmichael Project (60 mtpa).

Figure 10. Coal Mine Development by Indian States (mtpa)



Source: Global Coal Mine Tracker, Global Energy Monitor, January 2021

AUSTRALIA

Australia is second only to China in the number of coal mine proposals under development, with 435 mtpa in planning and 31 mtpa undergoing construction. While the economic volatility of the Covid-19 pandemic led to a host of cost reductions and investment deferrals in 2020, Australian operators continue to justify new mine projects based on consumer demands in the Asia Pacific. Australia now accounts for 20% of the world's proposed coal mine capacity with all 52 proposals clustered in the coal-rich basins of Queensland and New South Wales.

As the world's largest coal exporter, Australia is reliant on seaborne trade with the Asia Pacific region. But this dependency became a challenge in 2020, when thermal coal prices fell to their lowest level in fourteen years. According to the office of Australia's chief economist, one-third of the nation's mines supplying seaborne thermal coal markets have now become "uneconomic." Despite this finding, our survey shows 213 mtpa of thermal coal projects remain in development, with an additional 75 mtpa of mixed thermal-metallurgical projects. By far, the Carmichael coal mine has provoked the greatest international controversy, given its size (60 mtpa), the weak finances of its Indian parent company Adani Group, and its potential, through the provision of new rail infrastructure, to open the door to several shelved mega coal mining projects in the region, such as Kevin's Corner and the Alpha Coal Project. Yet much of the thermal development in Australia is taking place at a smaller scale (with a median size of 5 mtpa) and currently no stand alone thermal coal project has yet to begin construction.

In fact, all of Australia's thermal mine proposals are early phase developments and thus vulnerable to cancellation, especially with foreign governments moving to cut emissions and reduce demand. Among Australia's biggest importers, Japan plans to eliminate as much as 90 percent of its older coal-fired plants by 2030; India intends to phase out coal imports by 2024; China recently announced plans to limit coal consumption and achieve carbon neutrality by 2060; and South Korea and Taiwan have announced net-zero targets for mid-century. If these policies come to fruition, Australia's current mine thermal projects (245 mtpa) could become stranded assets. The only potential driver for thermal coal projects remains Vietnam, where thermal imports are expected to grow this decade.

The outlook for metallurgical coal markets remains just as uncertain. In 2019, Australia was responsible for 55 percent of the world's supply of coking coal, but export earnings fell in 2020. Australian operators have since curtailed production and announced temporary closures of coking mines, such as the Middlemout mine and Metropolitan mine. The investments in metallurgical mine projects have begun to slow, but 164 mtpa remains under development. A great deal of new activity is led by smaller firms, such as Mineralogy (106 mtpa), Valiant Resources (48 mtpa), Whitehaven (21 mtpa), and Pembroke (15 mpta), though larger multinationals like Glencore (16 mtpa), BHP (7 mtpa), and Peabody (7 mtpa) have stayed in the mix.

China, the biggest consumer of Australia's metallurgical exports (27%), effectively ended trade last year after a diplomatic dispute over the origins of Covid-19. The office of Australia's chief economist has yet to factor these restrictions into long-term forecasts. As a result, the geopolitical row may put greater downward pressure on Australia's metallurgical mines than anticipated, especially with Russia eager to expand its footprint in the Asia Pacific. On the other hand, Australia's second biggest consumer, India (21%), intends to increase its consumption of metallurgical coal for steel making. India has limited domestic reserves of coking coals and struggled to extract those reserves safely. According to our analysis, India has only 2.6 mtpa of metallurgical coal in development, so even as India's national government intends to phase out coal imports, the country will likely remain reliant on seaborne markets for coking coal into the foreseeable future, providing a potential lifeline to Australian mine projects. Japan (17%) and South Korea (13%) have similarly left the door open for Australia's

metallurgical coal mines, even as they restrict thermal coal projects in climate-related policies. Yet the growing interest in hydrogen, as an alternative to coking coal in steel making, could undermine those plans.

NORTH AMERICA

North America has 26 mine projects in development, amounting to 72 mtpa of new capacity. Most are early phase developments with just two mines under construction (Murray River Coal Mine and Blue Creek Coal Mine) totalling 10 mtpa. While the region is responsible for a small share of proposed global mine capacity (3%), its operators are at the forefront of a global shift toward metallurgical coal, which accounts for 70% (50 mtpa) of the region's current proposals. The preference for metallurgical coal reflects the continued slump in thermal coal markets that has weakened production in both the U.S., the world's third largest coal producer, and Canada, the thirteenth largest, over the last decade. Whether metallurgical coal proves to be a saving grace for large North American producers depends on demand in the Asia Pacific region.

In 2019, U.S. coal production fell to its lowest levels since the 1978 miner's strike. The slump has been long in the making, compounding a decade-long collapse in domestic coal use for power generation and lower demand in Europe. The number of U.S. coal mines shrank by half from 2008 to 2019, with major bankruptcies rocking the industry throughout the 2010s. During the Covid-19 pandemic production fell even further, with several mines announcing temporary closures after positive cases of coronavirus and once sturdy operators filing for bankruptcy. The country's largest coal mine, North Antelope Rochelle, experienced a $1.42 billion write down by its owner Peabody in August. By the end of 2020, production reached its lowest levels since the 1960s, though it is expected to rebound slightly in 2021.

Thermal coal producers have been the hardest hit. Peabody and Arch Resources have even put their heads together about building a joint venture to manage thermal coal assets to weather the collapse. To protect themselves, U.S. operators are also increasing their investments in new metallurgical mines, such as the Blue Creek mine in Alabama and Leer South mine in West Virginia. In the U.S., not since 1961 have coking coal plants and other industrial users consumed more coal than electric utilities. Currently the coal industry only supplies 47 mtpa to coking and industrial consumers.

Similarly, Canadian operators have readily embraced a revival of metallurgical production, which is not affected by shifts in power generation. As of 2020, 90% (34 mtpa) of Canada's proposed coal mines are metallurgical projects, most located in British Columbia where the coalfields are rich in coking coal. Canada is the fourth largest exporter of coal meeting consumer demands in South Korea, Japan, and India. If these new metallurgical projects were to go into operation, they could effectively double the size of Canada's metallurgical coal export economy. The operations, though, are early phase developments by mostly small-to-midsize firms. Vancouver-based Teck Resources, the largest metallurgical coal producer in North America, recently shelved its metallurgical coal Quinette Project, and has no active proposals, just life of mine extensions, signaling some hesitancy from large producers about scaling-up too quickly.

RUSSIA

Russia, the sixth largest producer in the world, has proposed 58 coal projects, amounting to 299 mtpa of new capacity. The new development signifies business-as-usual for Moscow's coal strategy, which remains bullish on coal demand, both domestically and abroad. Over the last decade, Russia has commissioned 300 mtpa of new coal mining capacity, while the Ministry of Energy continues to push

for a series of ambitious coal plans. There is already 59 mtpa of new coal mine capacity currently undergoing construction, even as Russia's current production (440 mtpa) exceeds the ambitious production targets originally set for 2030. This past year, Moscow revised its coal production targets upward with a $83 billion USD coal development program intended to reach 550 mtpa (on the low end) and 670 mtpa (on the high end) by 2035—a 25 to 50% increase over current production levels.

Mines currently under development are enough to meet these ambitious targets. A large share of total proposals (148 mtpa) comes from greenfield developments. The VostokCoal company, for instance, is currently developing a 30 mtpa coal mine on the northeastern tip of the Arctic Peninsula. The mine is one of several that VostokCoal has licensed in the region, even after the government fined the company $9.1 million USD for environmental violations. Another major greenfield project is Coalstar's Beisky-Zapadniy coal mine, with a proposed capacity of 20 mtpa, in Khakassia. In addition to these greenfield developments, over half of current proposals consist of mine expansions, with the industry making a major play in metallurgical coal markets. Tuva Energy Industry Corporation, for instance, has proposed a 13 mtpa expansion of the Elegest coal mine, which would make it Russia's largest coking coal mine, and steel-producer Mechel has planned to expand the Sibirginsky coal mine by 17.5 mtpa.

Russia's near-term goal is to outcompete Australia and Indonesia, its chief rivals in the seaborne market. The Ministry of Energy anticipates an increase in the global coal trade over the next 15 years and expects China, South Korea, India, Pakistan, and Japan to drive global consumption. This prioritization of coal exports to Asia is part of Russia's larger "de-dollarization" strategy to reduce the threat of U.S. sanctions. To better reach the Asia-Pacific, Russia has pushed for new export infrastructures, particularly in the Far East and Arctic Basin. The coal infrastructure projects currently underway include the modernization of the Baikal–Amur Mainline (BAM) and Trans-Siberian Railway (Transsib). These coal projects remain critical since 60% of the country's production and 75% of its exports originate in the landlocked Kuzbass. Our survey found 35% of new mine capacity (105 mtpa) remains concentrated in the Kuzbass, but in a sign of national plans to reach export terminals, almost half of new development activity is spread across other mining regions, including Krasnoyarsk Krai, (45 mtpa), Khakassia (32 mtpa), Tuva (27 mtpa) Amur Oblast (20 mtpa), and Sakha (17 mtpa).

The optimism of the Ministry of Energy aligns with Russia's private sector forecasts, but Russia's own Ministry of Economic Development (MED) harbors doubts. In 2020, MED argued that "the industry will not be developing in the foreseeable future," anticipating that the slump in global consumption combined with a series of climate-related policies in Asia will tighten the outlook for exports, putting Russia in a situation similar to Australia. But the opening of new mines certainly remains possible. Russia underwent a similar expansion over the last two decades (about half of Russia's currently operating mines are less than twenty years old) and an ongoing trade conflict between China and Australia has now handed Russia a bigger share of the seaborne market in 2021. All the while, Russia's commitments to reduce greenhouse gas emissions under the Paris Agreement are not particularly ambitious, suggesting Moscow's coal-heavy energy strategy could still carry forward.

SOUTH AFRICA

South Africa's coal production and consumption is ranked seventh in the world, with reported production at 258 Mt in 2019. The nation's industry has been historically dominated by global giants like Anglo American, Sasol Mining, BHP Billiton Energy Coal South Africa (Becsa) and Xstrata (Glencore). But a number of companies, including Anglo American, Glencore, and South32, which spun out of BHP Billiton in 2015, have exited in recent years or are in the process of exiting in the near future. The decision to exit South Africa's

coal sector has not entirely slowed production with a number of small and medium-scale firms, including Seriti Resources and Exxaro, filling the void.

Still, over the last decade net investments in South Africa's coal sector has declined by R2-billion. In 2019, South Africa's Integrated Resource Plan laid out intentions to diversify the country's power mix by 2030. But the industry's fall in investments is also attributable to a funding environment shifting away from new coal projects. The pressures from environmental lobbying and recent litigation have set a precedent for future investments, requiring projects to complete climate impact assessments before receiving a license. On top of that, the altered customer base for coal exports, especially in India, which is the largest importer of South African coal, has reduced the industry's long-term prospects. The country's other major importers—South Korea, Pakistan, and Vietnam—have varying intentions to swap fossil fuels for renewables.

Yet even with the decline in net investments, the country's coal reserves are projected to last for the next fifty years. South Africa has 30 proposed coal mines with a projected output of 129.5 mtpa. Of these 30 proposed projects, 21 are based in the Mpumalanga province, which is currently close to being mined out and already accounts for 83% of South Africa's coal production. Seven of the remaining nine projects are located in Limpopo, which are said to contain about 70% of the country's remaining coal resources, and are seen as a point of interest for future development projects. KwaZulu-Natal and Gauteng have one proposed coal mine each.

The continued build-out in Mpumalanga comes after a 2019 Greenpeace study ranked it the world's largest power plant emission hotspot and second in the world for sulfur dioxide (SO2) emissions. The province is home to twelve of the country's coal-fired power stations run by the state-owned energy company Eskom. According to Eskom, 25% of South Africa's marketable coal is exported internationally and 53% of the remaining coal used for domestic electricity production.

The country's economy remains heavily dependent on coal for 70% of its power generation. South Africa currently has 18 coal-fired power plants and two of the proposed coal mines set to supply 6.3 mtpa to existing coal power stations in Mpumalanga: the 2,352 MW Arnot power station and 3,600 MW Matla power station. Three of the proposed coal mines are set to supply 22 mtpa to three proposed power stations. All of these proposals, the 1,200 MW Thabametsi coal plant outside Lephalale in Limpopo, and the 300 MW Khanyisa coal plant and the 4,800 MW Kusile Power Station in Witbank, have been heavily contested. The environmental approval for Thabametsi was set aside in November 2020 by a High Court judge due to the minister of Environmental Affairs' failure to take into account the climate change impacts of this proposed coal-fired power station, while NGOs say the environmental authorization granted to Khanyisa expired in 2020.

EUROPE

Coal production has plummeted in Europe with several countries adopting coal phase-out plans and mine operators facing declining demand from power companies due to competition from renewables and gas. In 2019, EU coal-fired power generation fell to a historic low, and was exceeded by renewable power generation for the first time. Even before the onset of the Covid-19 crisis, the region's production dropped 15% to 373 Mt in 2019 (Table 1). Only modest recoveries are expected in 2021, and not enough to reverse downward trends. But coal has proven difficult to dislodge in Central and Eastern Europe. As of 2020, the region has 15 coal mine projects, amounting to 87 mtpa of new mine capacity, although all are early phase developments with none under construction.

While new proposals are split evenly across the EU (45 mtpa) and non-EU (42 mtpa), Central and Eastern Europe accounts for 94% of new mine developments. Only the UK's Woodhouse Colliery (3 mtpa) is located in Western Europe. By contrast, Turkey has four new mine proposals (22 mtpa) and Poland has three

(32 mtpa). Kazakhstan (16 mtpa) and Serbia (15 mtpa) have two each. The new mine capacity in Romania (5 mtpa), Serbia (15 mtpa), Czech Republic (9 mtpa), and North Macedonia (3 mtpa) all hinge on a single project.

Most of these proposals are sited in traditional mining regions, such as Poland's Łódź (18 mtpa) and Lower Silesian (12 mtpa), and Turkey's Black Sea province of Bartin (10 mtpa). In 2020, these same regions were particularly hard hit by the Covid-19 crisis, with coal miners and their families in Poland's Lower Silesian making up 16% of the nation's positive cases over the summer. While some mines halted production temporarily, many others continued to operate as essential businesses.

In 2020, the Polish government halted coal imports to protect domestic state-owned producers. Poland employs more than half of Europe's coal workforce and its plan to extend the life of existing mines has heightened tensions with the European Union, with the majority of EU countries planning to phase out coal by 2030. The Turow mine extension on the Czech border could cost Poland access to the EU's "Just Transition Fund", which requires nations to submit plans for mine closures. In September 2020, state-owned enterprise Polska Grupa Gornicza (PGG) announced plans to close all of its mines by 2049, following a strike of 200 coal miners in Silesia. The late date shows the troubling gap between Poland and EU timelines for a coal phaseout.

In Eurasia, the second-largest producer in the region Kazakhstan is planning to increase production at existing mines and promote future growth, as detailed in its Roadmap for the Development of the Coal Industry 2019–2021. Currently, 16 mtpa are under development, although Kazakhstan continues to struggle to make inroads with export markets given the high transportation costs from its remote operations.

SOUTH AND SOUTHEAST ASIA

South and Southeast Asia make up 21% (483 mtpa) of proposed coal mining capacity on the globe. Proposed capacity in Southeast Asia is dominated by Indonesia, with 21 mtpa under construction and another 49 mtpa in planning, followed by the Philippines, with 8 mtpa in planning. Outside India, proposed capacity in South Asia is led by Bangladesh, with 19 mtpa of coal mining capacity in planning

Coal production in Indonesia has grown by a third (154 mtpa) since 2015, from 462 mtpa to 616 mtpa (Table 1). During that time its coal exports grew by a quarter (90 mtpa), from 360 mtpa in 2015 to 450 mtpa in 2019. The remaining increase in coal production has helped fuel a 40% rise in both domestic coal consumption and domestic coal-fired capacity, with the nation's coal-fired power capacity increasing from 17.2 GW in 2015 to 27.4 GW in 2020.

The quick ramp-up of coal power has been part of a national plan to mine and use domestic coal, making the country now the world's largest thermal coal exporter. The development has been highly concentrated, with 70% of planned new mine capacity (49 mtpa) coming from East Kalimantan alone. While the Indonesian government has consistently scaled back the amount of coal plants in its future energy plans, leading to over 30 GW of coal plant cancellations, the country still has 10.7 GW of coal power under construction, second only to China (88.1 GW) and India (36.6 GW).

Combined with 21 mtpa of annual coal mining capacity under construction, Indonesia is poised to continue growing its domestic coal output. The same cannot be said of the Philippines and Bangladesh, where coal mining plans may well be cancelled as plans for new domestic coal plants collapse.

In the Philippines, coal mining production has nearly doubled since 2015, from 8.2 mtpa to 15.3 mtpa. Over the same period, the country also doubled its coal-fired capacity from 5.0 to 10.3 GW. Yet the growth in domestic production is not enough to cover the country's growing coal consumption, with 27.7 mtpa imported in 2019. In addition, the Philippines also

exported 5 mtpa of coal in 2018 and 10 mtpa in 2019, mainly to China.

Coal mining capacity under development in the Philippines consists of a proposed doubling of the Semirara Molave Coal Project, from an annual production of 8 to 16 mtpa. According to the mine's Project Description for Scoping, about a quarter of the increased capacity would go to fuel a proposed expansion of the Calaca coal-fired power station in the province of Batangas.

In October 2020 the Philippine Department of Energy declared a moratorium on new coal plants that were not already in the permitting pipeline. In November 2020, plans for the Calaca expansion were called off, with Meralco president Rogelio Singson saying the cancellation was the result of the DOE's moratorium on new coal plants. It is unclear if the coal mine will also be cancelled, or will seek out new customers.

Following India, Bangladesh leads proposed coal mining capacity in South Asia, with 19 mtpa in planning. The proposed mining capacity is part of a government push to expand domestic coal power capacity in the country: Bangladesh's 2016 Master Plan "Revisited" projected coal power growing from 0.5 GW in 2018 to 25.5 GW by 2040.

Yet many of the coal projects have struggled to get off the ground, with only five coal plants totaling 4.7 GW currently under construction, and operating coal power capacity rising to just 1.2 GW as of 2020. Public opposition to building large coal power complexes and mines in the densely-populated country has been fierce: two people died protesting the Phulbari coal plant and mind, while twelve people died protesting the S. Alam coal plant.

Facing strong public opposition and delays, the Bangladesh Energy Ministry finalized plans in November 2020 to cancel all coal plants not currently under construction. The exact details are expected in late 2021, when the government outlines its next power sector master plan. In canceling the coal plants, government officials cited difficulties in securing domestic coal as a primary reason for transitioning away from the fuel.

The main proposals for coal mines in Bangladesh are the 16 mtpa Phulbari coal mine and the 3 mtpa Dighipara coal mine. Given that both proposals are to feed domestic coal plants, they may well be cancelled once the government finalizes a move away from coal power.

AFRICA

Africa is home to 9% (198 mtpa) of proposed coal mine capacity on the globe, although two-thirds (130 mtpa) is located in South Africa alone. The remaining capacity is primarily located in Mozambique, with 54 mtpa of annual new coal mining capacity planned, followed by Botswana (6 mtpa planned), Zimbabwe (4 mtpa under construction), Tanzania (4 mtpa planned), and Niger (1 mtpa planned). Most of these proposals are intended for coal exports, and in fact the proposals that are for domestic use are the most uncertain and likely to be cancelled.

The potential coal rush in Mozambique, with 54 mtpa of capacity proposed on top of an annual production of 10.3 Mt in 2020, would represent the largest percent shift of national output worldwide. Planned coal-mining capacity in Mozambique is dominated by metallurgical coal operations for international steelmaking, specifically:

- the proposed 17 mtpa Revuboè coal mine sponsored by Japanese and Korean steelmakers, including Nippon Steel and POSCO
- a 15 mtpa expansion of the Benga coal mine by International Coal Ventures Limited (ICVL), majority-owned by the Steel Authority of India Limited (SAIL)
- the proposed 12 mtpa Zambeze coal mine by ICVL
- a 4 mtpa expansion of the Moatize coal mine by Brazilian steelmaker Vale.

In Botswana, proposed coal mining capacity is divided between proposals for domestic coal power use and coal exports. The proposed 1.2 mtpa Mmamabula coal mine was originally intended for a number of planned coal plants that have languished due to lack of funding, making the mine's future uncertain. Owners of the Morupule coal mine have proposed a 3 mtpa expansion to fuel the 600 MW Morupule B coal plant, a plant that has suffered multiple breakdowns due to poor construction and whose long-planned expansion to 1,200 MW looks increasingly unlikely. Finally, there is a proposed 2 mtpa expansion of the Masama coal mine, which primarily exports coal to South Africa.

The planned coal mining capacity in Tanzania and Niger are for proposed coal plants that have been stalled for a decade, specifically the 4 mtpa Ngaka coal mine for the Ngaka coal plant, and the proposed 1 mtpa Salkadamna coal mine for the Salkadamna coal plant. Given the long delays for these coal plants, the prospect for the companion coal mine projects look unlikely, unless other buyers are found.

LATIN AMERICA

Latin America makes up just 0.7% (16 mtpa) of proposed global coal mining capacity. The majority of proposed capacity is located in Colombia (3 mtpa under construction and another 7 mtpa planned), followed by Brazil with 5 mtpa of capacity planned and Venezuela with 1 mtpa planned.

Notably, all proposed coal mining capacity in Colombia is sponsored by Yildirim Holding of Turkey. The coal mines would fuel the 3 GW of new coal-fired power projects in Turkey that the company is pursuing. Most of the coal mined in the country is exported abroad while locals deal with the effects, including water and soil pollution, displacement, and anti-union repression and murder by paramilitary groups in the early 2000s.

In Brazil, the 5 mtpa Guaíba mine is sponsored by Copelmi Mineração, the country's largest private coal mining company. If approved, it would be the largest open-pit coal mine in Brazil. In February 2020, a Brazilian federal judge suspended the environmental licensing process for the mine, citing Copelmi's failure to consider the mine's impact on the nearby indigenous community of Aldeia TeKoá Guajayvi.

In Venezuela, proposed capacity consists solely of the planned 1 mtpa Las Lajitas mine. Coal from the mine would primarily be sold to Venezuela's Dutch-owned Lomas de Niquel slag-to-nickel project, with the remainder to be exported internationally.

APPENDIX 1: METHODOLOGY

The Global Coal Mine Tracker surveyed every announced, explored, permitted, and under-construction coal mine in the world with a proposed capacity of 1 mtpa or greater. A proposal is considered active if it has shown activity during the previous two years. In this report, a project listed as "pre-construction" has yet to build mine infrastructure—that includes projects that have been announced, explored, or permitted but yet to begin construction. A project listed as "construction" has begun to build mine infrastructure, but yet to begin commercial operation.

The 2,277 mtpa of proposed capacity represents plans to scale-up existing coal mining operations, either through building new mines (greenfield developments) or expanding the capacity of existing mines (brownfield developments). For brownfield developments, our methodology makes a distinction between mine extensions and mine expansions. A mine extension seeks to prolong the life of a mine, but not increase its capacity. By contrast, a mine expansion intends to increase the designed capacity of an operation and scale-up production. For instance, a mine producing 3 mtpa, with plans to expand to 5 mtpa has a proposed expansion of 2 mtpa, with only 2 mtpa tallied in the 2,277 mtpa of proposed capacity. After operation, coal mines may produce less coal than their designed capacity.

On stranded assets, GEM's analysis is based on a global average for capital costs of surface and underground mines in Australia (Harper 2008) and India (Dipu 2011). These averages are then applied to OECD and non-OECD countries, respectively, per ton of proposed coal mine capacity by mine type. Capital costs are estimated at $26 million USD per mtpa for surface mines and $53 million USD per mtpa for underground mines in OECD nations (Harper 2008), and $38 million USD per mtpa for surface mines and $50 million USD per mtpa for underground mines in non-OECD nations (Dipu 2011). Capital costs cover the funds needed to open the mine, but not the operating costs needed to keep the mine running.

For more information, see the Methodology page of the Global Coal Mine Tracker.

APPENDIX 2: PROJECTIONS

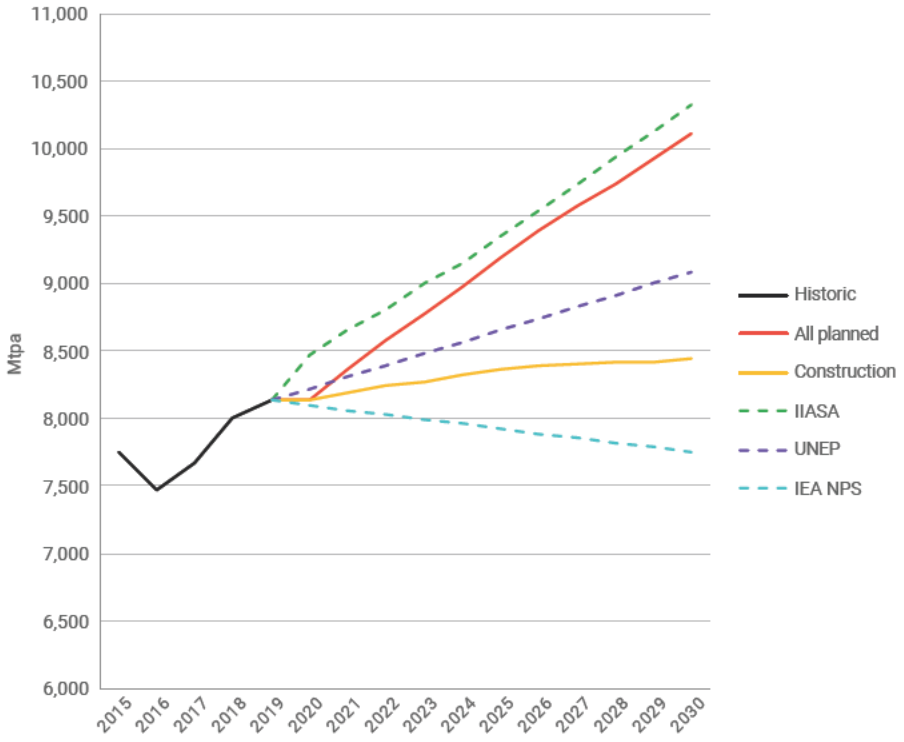
This report offers two projections for future coal mining production: 1) if all 2,277 mtpa of proposed coal mining capacity comes online evenly through 2030 (averaging 227.7 mtpa) and 2) if only the 614 mtpa of capacity currently under construction comes online evenly through 2030 (averaging 61.4 mtpa). The annual increase in capacity is added to 2019 production (8,135 Mt), which is assumed to remain constant through 2030, minus 306.1 mtpa of operating coal mining capacity planned for closure or expected to exhaust their proven reserves before 2030. Constant levels of coal production are assumed—minus actual depletion of coal reserves—given the myriad of factors that make fluctuations in future coal mine production levels difficult to predict, such as coal prices, corporate restructuring, changes in national energy plans, and climate-related policies.

We then compared our projections to other global forecasts derived from national energy plans as well as estimates of future production from climate and energy models, known as integrated assessment models (IAMs). Our projection for all proposed coal mining capacity online (red solid line) runs about 200 mtpa below the SSP2-Baseline scenarios produced by six Integrated Assessment Models (AIM/CGE, GCAM4, IMAGE, MESSAGE-GLOBIOM, REMIND-MAGPIE, and WITCH-GLOBIOM) (IAASA, green dotted lines). This projection can be seen as a highly optimistic scenario for the coal mining industry, in which all proposed coal mining capacity is realized over the decade.

UNEP's projection for future coal mining production in the 2020 Production Gap report (dashed purple line) falls just between our projection for all proposed

capacity coming online (red solid line) and only capacity under construction coming online (solid yellow line). UNEP's projection is based on the national energy strategies and outlooks of the eight largest coal-producing countries (over 60% of global production), used to derive an estimate of future global production. Compared to the GCMT, the UNEP projection would be equivalent to all capacity under construction coming online by 2030, as well as 40% (650 mtpa) of capacity in pre-construction planning.

Finally, the IEA NPS scenario (dashed blue lines) shows the reductions in coal mining production expected if countries follow through on their announced climate policy initiatives, as estimated by the International Energy Agency (IEA). It is far below our projection for coal mining under construction (yellow solid line), and shows any planned increase in coal mining capacity is inconsistent with countries' stated climate policies, much less the ambitious temperature target of the Paris climate agreement.



Sources: Historic (BGR Energy Study 2019), All planned and Construction (Global Coal Mine Tracker, January 2021), IIASA (Kholod et al. 2020), UNEP, IEA NPS (2020 Production Gap report)

APPENDIX 3

Coal Mine Development Projects by Country (mtpa)

Country	Pre Construction	Construction	Total
Australia	435	31	466
Bangladesh	19	0	19
Botswana	6	0	6
Brazil	5	0	5
Cambodia	1	0	1
Canada	33	6	39
China	157	452	609
Colombia	7	3	10
Czech Republic	9	0	9
India	363	13	376
Indonesia	49	21	70
Kazakhstan	16	0	16
Laos	2	0	2
Mongolia	22	0	22
Mozambique	54	0	54
Niger	1	0	1
North Macedonia	3	0	3
Pakistan	8	0	8
Philippines	8	0	8
Poland	32	0	32
Romania	5	0	5
Russia	240	59	299
Serbia	15	0	15
South Africa	111	19	130
Tanzania	4	0	4
Turkey	22	0	22
United Kingdom	3	0	3
United States	29	4	33
Uzbekistan	5	4	9
Venezuela	1	0	1
Zimbabwe	0	4	4
Total	**1663**	**614**	**2277**

APPENDIX 4

Number of Coal Mine Development Projects by Country

Country	Proposed Mine Projects
Australia	52
Bangladesh	2
Botswana	3
Brazil	1
Cambodia	1
Canada	13
China	140
Colombia	3
Czech Republic	1
India	52
Indonesia	11
Kazakhstan	2
Laos	1
Mongolia	4
Mozambique	6
Niger	1
North Macedonia	1
Pakistan	1
Philippines	1
Poland	3
Romania	1
Russia	58
Serbia	2
South Africa	29
Tanzania	1
Turkey	4
United Kingdom	1
United States	13
Uzbekistan	3
Venezuela	1
Zimbabwe	1
Total*	**413**

*Note: 413 projects is a total of unique projects, not including 19 multi-stage expansion proposals, which totals 432 active projects.

How coal ends: We already have the tools to make it clean

Australia plans to join allies in personally sanctioning Putin and says expulsion of Russian diplomats a ‘live option’

Sydney pub gave free booze to gamblers

The ‘sudden' retreat from coal in Australia has been a long time coming.

© Andrew Meares Will Scott Morrison's government stay true to its free market ideals?

It is attracting national attention right now because the closure date of our largest coal plant has been brought forward by its owners, Origin Energy, from seven years to 3½, and because Mike Cannon-Brookes has gone public with his startling proposal to kill off AGL's entire coal fleet.

But there have been many informed voices warning that coal would wane for years. More importantly, they have been calling for a plan to manage coal's retreat to ensure that its sudden departure did not leave gaps in the energy supply that would spike prices or dislocating shocks to communities that depend on coal mining and power generation around the country.

Such plans have been carefully drawn up, published and debated, only to be ignored by federal governments who have dismissed the suggestion that the fuel that powered the nation and helped make it rich would soon become redundant.

According to Professor Frank Jotzo, director of the Centre for Climate Economics and Policy at Australian National University, though it is now clear that coal is already in retreat, it is not too late to adopt a plan to manage its demise in Australia.

Such a carefully managed withdrawal may no longer change the speed at which the old coal plants are replaced - the market is taking care of that already - but it would ensure the transition was smoother and therefore cheaper. And it would make transition easier on the communities who will soon lose jobs in coal mining and generation.

Back in 2015, Jotzo and his colleague Salim Mazouz wrote a paper in which they identified the trend that is now causing the power companies to close their coal plants - for most of the day their coal power is unable to compete on price with renewables.

The solution they sketched out in their paper Brown coal exit: a market mechanism for regulated closure of highly emissions intensive power stations, was fairly simple.

Having accepted that the coal plants would go due to market forces and should go due to their terrible impact on emissions, the federal government would collaborate with the plants' owners to see them out faster. A levy would be placed on power sales to create a pool which would be distributed to the plant owners for payments to close their plants at set dates.

Given that crucial data about the plants' operations were held by the private sector, the government would create a competitive bidding process to determine which plant would close and at what payment level.

After plants made bids, the energy regulator would choose a winner. With a schedule for the network's closure drawn up years in advance, federal and state governments working with unions and civil society groups would then be free to draft plans to ensure that the energy supply remained predictable and work forces hit by the closures had time to prepare.

The paper was well-received in energy policy circles, mentioned in Labor policy documents for the 2016 election, only to then fade from public view.

The economic and environmental forces acting against coal didn't change, though, and in 2018 Jotzo published a second paper on the theme, Coal Transitions in Australia.

By then coal provided about 60 per cent of Australia's power, down from 80 per cent at the turn of century, and 10 coal-fired power plants had closed in the previous decade.

The surviving 18 plants had an average age of 30 years, and the average age of the plants in the fleet at their point of closure was 40. Given increasing costs of running ageing plants, falling costs of renewables and intensifying international pressure to reduce emissions, Jotzo and his co-authors saw it as clear that there was no private sector urge to spend the billion or so dollars it would cost to extend the life of the plants, let alone the billions to build a new one, especially as the cost of renewables continued to plummet.

They laid out two scenarios for the death of the fleet. Under the more rapid scenario the fleet would be reduced to less than one-third of its then capacity before 2030, and by 2035 only one plant would remain.

At the time, Jotzo says today, that prediction was dismissed out of hand by many in the industry. As it turns out, Jotzo was right about the trend, or at least he has been so far.

And in a survey by the Australian Energy Market Operator, the industry's regulator, it is also now the scenario that stakeholders believe to be most likely.

Video: Eraring coal-fired plant earmarked to close in 2025 (ABC NEWS)

Given that Jotzo's predictions of a rapid coal retreat have been proven correct, does it matter that the government did not intervene with a plan to manage it?

Well, yes, says Jotzo.

He believes that if the exit was planned there would have been more investment in wind and solar and firming technology to replace coal sooner, and more certainty for the market and the affected communities.

"Both the Victorian and the federal government rushing in with local economic stimulus programs, and retraining programs and so forth," says Jotzo. "All of it was done in terrible haste. They were reasonably successful considering just how quickly it was all put together, but this can obviously be done a lot better and a lot more cost-effectively as well."

The planned retreat model is not unprecedented. Germany managed to shut down its vast network of black coal mines in the Ruhr Valley without retrenching work forces and with retraining and new job opportunities in place.

Working under a slogan that can be loosely translated to "No Miner Left Underground", the government adopted a similar convening role as the one Jotzo proposes. It worked with industry and unions to schedule closures, transferring workers who wanted to remain in the industry from one to the next while offering healthy severance packages to older employees who sought early retirement and retraining packages to younger miners.

One of the men who has led this transition was Michael Mersmann, director of global affairs with German mining union IG BCE.

Asked if Australia might manage a similar feat, Mersmann told the *Sydney Morning Herald* and *The Age* that he thought not, so fractured is the relationship between the unions and generators and the federal government.

"In your country you are rather heading towards a conflict, not a consensus. What we are trying to do here is have softer negotiations and find a solution at an earlier point."

It is also clear, though, that the feral politics of climate change have poisoned the well in this country in a way that has not happened in Europe.

Warrick Jordan, a coordinator of the Hunter Jobs Alliance, which is seeking to help prepare for a transition from coal in NSW, says he has noticed a significant difference in attitudes among the community to this week's announcement of the closure of Eraring and the announcement in 2015 that the neighbouring Liddell plant would close by 2022.

There is a clear sense, he says, that the Eraring closure is being driven by changed economic circumstances. When the Liddell closure was announced, many believed that AGL had somehow "internalised" green propaganda.

The end result might be the same, he says, but changes caused by economic rather than environmental decisions seem to be more easily accepted.

But he agrees with Jotzo that the certainties delivered by a transition plan would help.

Communities faced with the loss of coal power and associated mines and heavy industry fare best when they are replaced with a complex mix of high-end industry and technology, which takes time and funding, he says.

"There's a reason we are punching-on with Uzbekistan and Burkina Faso to come in at number 87 in the economic complexity index," Jordan remarks drily.

What he is referring to is an international measure of how complex the economies of different regions and countries are. More complex economies demand greater knowledge and education standards and suggest a higher level of economic development.

Japan is ranked as number one followed by Switzerland and South Korea. As Jordan correctly recalls, Australia is ranked 87, beneath Uganda but ahead of Burkina Faso. Uzbekistan has pulled ahead to number 80.

The index shows that Australia is a nation with first-world living standards but a third-world economic mix.

Jordan believes that Australia will fare far better in future if the void left by coal is filled with a mesh of high-end manufacturing and tech industries, something better achieved with a national plan.

Each year for over a decade the International Energy Agency has failed to predict the speed at which solar would fall in cost and enter the global energy mix, often by a factor of 50 per cent or more.

Over time the IEA annual predictions became a running joke in energy analysis circles, says Jotzo, at least until last year, when the organisation finally conceded that solar was now the cheapest energy source in history.

It's not yet clear what impact cheap clean fuel will have on global economies, nor how exactly we should manage the transition.

That's where a plan comes in.

Undermined Inc

underminedlakes@gmail.com

Save Our Thirlmere Lakes and Creeks

President: David Eden Phone: +61 2 4659 6682

220 New Jerusalem Road, Oakdale NSW 2570 Australia

Atmospheric carbon dioxide concentration 411 ppm

SUBMISSION TO INDEPENDENT PLANNING COMMISSION - TAHMOOR

As President of Undermined Inc, a community action group with 70 members, I address damage caused by longwall coal mining in Wollondilly Shire. Undermined campaigns for remediation, repair and restoration of local creeks, rivers and lakes impacted by mining. Of particular concern is the water loss in the five Thirlmere Lakes coinciding with the closest approach of longwall coalmining by Tahmoor Colliery in the years 1997 to 2001.

The proposal to extend the life of Tahmoor Colliery by another 12 years to 2034 will dewater the natural environment where ever mine subsidence fractures rock to depth. Methane and carbon dioxide emissions from the mine and subsequent burning of coal and coke for steelmaking are unacceptable because they add to the effects of climate change. These effects are of such a scale and significance that the proposal is unacceptable in terms of New South Wales planning legislation.

The effect of climate warming is now unendurable. The 1.15 Celsius rise in temperature (averaged worldwide over one year in 2020) demonstrates it is not possible to continue making the problem worse hoping, we will be able to deal with climate change next year. 2020 was the fourth hottest year on record averaged across Australia, 1.15 C above average. Penrith experienced 48.9 C in January 2020. A desire to limit temperature rise to 1.5 C may be a tolerated in the Northern Hemisphere where people cope now with freezing winters, but the effects of climate change in Summer in Australia have already resulted in drought, extremely hot temperatures and bushfires.

Undermined submits we have to start slowing our emissions of carbon dioxide and methane now. Undermined submitted slides showing the Black Summer bushfires and referred to how our wildlife like possums try to survive bushfire by climbing higher and higher up trees. Australians are not like possums. We have experienced 1.15 C temperature rise. We understand the problem. We ask for a resolution that will sustain our children's children.

Undermined Inc (Undermined) submitted 18 pages of scientific information to Department of Planning, Industry and Environment dated 2020 April 18 with a logical argument for the refusal of the second amended TSCP SSD 8445. We refer the IPC to the data and references in the original Second Amendment Submission of Undermined. As the NSW DPIE assessed the project as approvable with conditions, the Undermined oral submission to the IPC on 2021 February 15 **opposed approval** of the Tahmoor Project, stating that adding **conditions will not limit damage** to the environment and self regulation will again be inadequate to prevent environmental damage.

SIMEC uses words like “adaptive management” and the Department of Planning, Industry and Environment recommend conditions like its first: “the Applicant must implement all reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment”. The DPIE **conditions offered to this IPC are too general to be enforceable**. Such unenforceable conditions give an impression that the community could be looked after, but fail to convince people who visit Bargo River and Redbank Creek.

Conditions requiring monitoring and adaptive management are not capable of properly reducing or mitigating areas of uncertainty in respect of the present Tahmoor South Application.

When weighed against the objectives of the EP&A Act and Environmental Sustainable Development principles, the impacts associated with the Project are not manageable. The risks of adverse impacts on the environment are high and likely to be irreversible. The significant uncertainty in predicted impacts of the Tahmoor South Project warrant our conclusion that a refusal of the Application is in the public interest.

To assist this IPC, Undermined has engaged the **Environmental Defenders Office (EDO)** to set out the legal framework under which the Tahmoor Project can be refused. Undermined has engaged the EDO to submit that framework and their advice to the IPC on our behalf.

The EDO has engaged **independent scientific experts** on behalf of Undermined to advise on geology, geomorphology and **hydrology** (Dr Philip Pells) and to advise on **green steelmaking** using less and eventually negligible coal (Mr Tony Wood and Associate Professor John Pye). David Eden referred to his experience designing air pollution collection hoods to go over electric arc smelters at Comm Steel in Newcastle in 1972. In 1972, the electricity used in Newcastle was generated by burning coal, so the steel

making would in modern parlance be described as “blue”. With renewable power now so abundant and becoming cheaper, it would be “green” burning no coal or coke. Undermined notes that in Mr Eden’s example of alternative greener methods of making steel in 1972, the electric arc furnaces were on a smaller scale than the largest blast furnaces in the world. Such green electric arc furnaces have been used since at least 1918 for specialty steel making and scrap steel recycling.

Undermined has used the **information and scientific methodology** used by the **research teams assembled and paid by the NSW Government** through DPIE (OEH and EES) to investigate the drying of Thirlmere Lakes. This is in part because Undermined has neither the time nor resources to organise the research required. Undermined awaits the research findings due in 2021 approximately mid-year. We append to our IPC submission the DPIE (EES) Interim Results of 3 February 2021 because they document and explain the seriousness of climate drying.

Undermined submits that predictions of surface and underground hydrology by SIMEC and its consultants who have not done similar research nor used similar technology (scintillation counters, stable isotope tracing), are **too uncertain to be relied upon**. Undermined submits the Tahmoor Project should not be approved because the **uncertainty** in the SIMEC predictions are **too great**. Undermined Inc submits the second amended SIMEC Project should be refused because the mine design is not informed by the best scientific methodology (coordinated by OEH and EES and used by independent researchers to understand the hydrology of the Thirlmere Lakes area), and because the mining proposal has been finalised before the Thirlmere Lakes investigation is completed.

The three reasons **drying, GHG emissions** and **unacceptable risk** described in the oral Undermined submission of 2021 February 15 are revisited here in more detail is to demonstrate the **public interest** can only be satisfied by the IPC refusing the Tahmoor application.

On the grounds of **drying**, the SIMEC mine design maximises extraction of the valuable coal resource overwhelmingly balanced by unacceptable surface subsidence, water loss, landscape scale surface drying, loss of heritage and cultural significance and loss of biodiversity.

Undermined offers the IPC a **scientific solution** to the problem of resolving the wishes of SIMEC and its workers and ensuring public interests are preserved. Perhaps little good has come from our Covid 19 pandemic.

Denying that it was a pandemic in other countries resulted in human death and slowed economic activity. Decision making informed by science has worked better in Australia and NZ, saving lives as well as economies.

This Independent Planning Commission can apply scientifically informed thinking like that used by ecologists dealing with biodiversity problems and by epidemiologists dealing with pandemics, to the equally complex ecology and climate problems Tahmoor Coal presents. Both ecology and pandemic problems have many variables and inter-relationships and are difficult to resolve.

Because you as Commissioners understand ecology and planning problems, we at Undermined believe you will use science and logic in this Tahmoor Project to arrive at a well considered, sustainable decision. Undermined asks the IPC to rely on science to find a safe, balanced way of protecting the environment.

Green House Gas Emissions (GHGE): Scope 1 and 2 Green House Gas emissions of 28 million tonnes from this project will not be captured or offset unless this IPC requires that capture. Professor Penny Sackett presented the issue of climate change to the IPC on 2021 February 17.

There will be an **unacceptable risk increase** if the project were to be approved: climate change has already decreased rainfall in eastern Australia by 31.7 mm per decade since 1970 (reference Bureau Of Meteorology, page 18 of 2020 submission) and based on recent experience, climate change will continue to increase the frequency of unacceptably hot weather, record high temperatures, bushfires, drought and extreme rainfall events (floods).

More than 1 billion tonnes of GHGEs approved by IPC since Rocky Hill

As Mike Foley observed in the Sydney Morning Herald on 3 January 2021:

> *"Coal and gas projects which could release more than 1 billion tonnes of greenhouse gases have been given the green light by the NSW government in the two years since a Land and Environment Court ruling which overturned the government's Rocky Hill coal mine approval in part because of climate impacts."*[1]

[1] https://www.smh.com.au/national/nsw/a-billion-tonnes-in-mining-emissions-approved-despite-landmark-case-20201230-p56qu6.html

One billion tonnes in mining emissions approved despite landmark case

Mike Foley
January 3, 2021

The Sydney Morning Herald

"Coal and gas projects which could release more than 1 billion tonnes of greenhouse gases have been given the green light by the NSW government in the two years since a Land and Environment Court ruling which overturned the government's Rocky Hill coal mine approval in part because of climate impacts."

Clear message from the Land and Environment Court has been ignored by multiple NSW IPC panels

A ruling by the New South Wales Land and Environment Court in February 2019 to refuse consent to the proposed Rocky Hill coal mine was hailed as a landmark in the fight to limit dangerous climate change. The judgment rested heavily on expert scientific testimony, especially with regard to the carbon budget concept, taking both direct and indirect (or downstream) emissions into account with regard to their impact on both the local environment and global climate change. Justice Preston found that:

> *"The Project's cumulative greenhouse gas emissions will contribute to the global total of GHG concentrations in the atmosphere. The global total of GHG concentrations will affect the climate system and cause climate change impacts. The Project's cumulative GHG emissions are therefore likely to contribute to the future changes to the climate system and the impacts of climate change."*

In summing up his Judgement, Justice Preston said of GHGEs:

> *"Wrong time because the GHG emissions of the coal mine and its coal product will increase global total concentrations of GHGs at a time when what is now urgently needed, in order to meet generally agreed climate targets, is a rapid and deep decrease in GHG emissions."*

This case however, did not set a formal legal precedent requiring decision makers in NSW to follow the same logic when determining new coal and gas projects. Indeed, since the Rocky Hill decision, five significant new coal mine projects and a new coal seam gas project have been approved in NSW by the NSW IPC with a cumulative total of Scope 1,2 and 3 GHG emissions of **1,184 Mt CO2-e**. These projects are: United Wambo, Rix's Creek South, Vickery Coal Project, Russell Vale, Maxwell Underground and the Narrabri Gas Project.

Clear messages from eminent scientists have been ignored by multiple NSW IPC panels

Professor Will Steffen, United Wambo assessment (May 2019)

"The absolutely clear, scientifically indisputable fact is that if the global average temperature rise is to be limited to "well below 2 degrees C" (the Paris Agreement), then expansion of the fossil fuel industry must end immediately …"

"The question I raise here is the fundamental question of whether the IPC should make a merit-based decision to approve the project taking into account the overall objective of avoiding dangerous climate change as articulated by the Paris Agreement, in particular, the temperature targets."[2]

Professor Will Steffen, Vickery Extension Project (30 June 2020)

"Meeting the carbon budget consistent with the Paris accord climate targets therefore means that not only must currently operating mines and gas wells be closed before their economic lifetime is completed (obvious from point 54 above – 780 is much larger than the assumed budget of 300), but also that no approved (but not yet operating) and no proposed fossil fuel projects, based on existing reserves, can be implemented. ***This analysis applies to the Vickery Extension Project.****"*[3]

Professor Penny Sackett, Narrabri Gas Project (21 August 2020)

"In my scientific view, there is nothing in the development application or its assessment by the NSW DPIE that would indicate the benefits of the Narrabri Gas Project are substantial enough that – on balance – they could outweigh the high-risk devastating consequences associated with continued expansion of fossil fuel production. Consequently, I reject the proposition that the Narrabri Gas Project represents Ecologically Sustainable Development."[4]

93.8 Mt of additional GHGE if Tahmoor South were to be approved

If Tahmoor South is approved by the NSW IPC, up to an additional 93.8 Mt GHGE would be added to the atmosphere.

Page 125 of the DPIE AR finds that over the life of the Project, the maximum estimated total GHGE (unabated scenario) would total 93.8 Mt CO2-e, including approximately:

- 26.7 Mt CO_2 of Scope 1
- 1.24 Mt CO_2 of Scope 2
- 65.8 Mt CO_2 of Scope 3

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[2] Prof Will Steffen, submission to IPC for EDO NSW acting on behalf of Hunter Environment Lobby Inc, to respond to the United Wambo, https://www.ipcn.nsw.gov.au/resources/pac/media/files/pac/projects/2018/11/united-wambo-open-cut-coal-mine-project-ssd-7142/independent-experts-engaged-by-edo-on-behalf-of-hunter-environment-lobby/190503-final-combined-report--will-steffen.pdf

[3] Prof Will Steffen, submission to IPC on Vickery Extension Project, 30 June 2020, https://www.ipcn.nsw.gov.au/resources/pac/media/files/pac/projects/2020/03/vickery-extension-project/comments/expert-submissions-provided-on-behalf-of-edo-nsw/200714-w-steffen-expert-advice.pdf

[4] Prof Penny Sackett, Expert Report on the Greenhouse Gas and Climate Implications of the Narrabri Gas Project (SSD-6456), Response to Additional Material, Professor Penny D Sackett, Honorary Professor, Climate Change Institute, The Australian National University, Advice Provided: 21 August 2020

SCOPE 1 EMISSIONS

32nd largest producer of Scope 1 emissions in Australia

The Tahmoor South Coal Project – if approved – would be approximately the 32nd largest producer of Scope 1 emissions in Australia.

Australian Government
Clean Energy Regulator

Corporate emissions and energy data 2018–19

Tahmoor South Coal Project – if approved – will be the **32nd largest producer of Scope 1 emissions** in Australia

Data as at 28/02/2020

	Organisation Name	Identifying Details	Total Scope 1 Emissions (t CO2-e)
26	QUEENSLAND ALUMINA LIMITED	98 009 725 044	3,192,846
27	EXXONMOBIL AUSTRALIA PTY LTD	48 091 561 198	2,890,748
28	CEMENT AUSTRALIA HOLDINGS PTY LTD	99 001 085 561	2,771,507
29	PEABODY AUSTRALIA HOLDCO PTY LTD	61 154 820 130	2,656,851
30	VIRGIN AUSTRALIA HOLDINGS LIMITED	54 100 686 226	2,597,936
31	SHELL ENERGY HOLDINGS AUSTRALIA LIMITED	69 054 260 776	2,317,273
32	TAHMOOR SOUTH COAL PROJECT	97 076 663 968	2,220,000
33	YANCOAL AUSTRALIA LIMITED	82 111 859 119	2,190,524
34	ADELAIDE BRIGHTON LTD.	15 007 596 018	2,156,481
35	CENTENNIAL COAL COMPANY LIMITED	30 003 714 538	2,024,212
36	QGC MIDSTREAM INVESTMENTS PTY LTD	77 130 857 215	1,786,152
37	ORICA LIMITED	24 004 145 868	1,754,798
38	INCITEC PIVOT LIMITED	42 004 080 264	1,711,015
39	FORTESCUE METALS GROUP LTD	57 002 594 872	1,699,122
40	CK WILLIAM AUSTRALIA HOLDINGS PTY LTD	14 613 690 243	1,636,581

2.22 Mt in the wrong direction

Meeting NSW's 2030 GHG target will require an annual new *reduction* of about 2.4 Mt CO2-e per annum. Approval of Tahmoor South will *increase* annual emissions in NSW by up to 2.22 Mt CO2-e per annum.

In a 2020 submission to the NSW IPC on the Narrabri Gas Project, former Chief Scientist of Australia Professor Penny Sackett stated that meeting NSW's own 2030 GHG target *"will require an annual new reduction of about 2.4 MtCO2-e per year, year on year".*[5]

Since the NSW IPC was established in March 2018, NSW IPC panels have approved new coal and gas projects in NSW that are expected to emit on average about 1.69 Mt of GHGEs per annum **in Scope 1 emissions alone**. If Tahmoor South is approved - without imposing a condition to offset Scope 1 emissions which cannot be mitigated or avoided - then new Scope 1 emissions in NSW will likely more than double, from 1.69 Mt CO2~e of GHGEs per annum to about 3.91 CO2~e Mt per annum.

Scope 1 GHGE - largest of any coal project determined by NSW IPC

Tahmoor South's annual Scope 1 GHG emissions would be the largest of any coal project determined by the NSW IPC to date.

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[5] Expert Report on the Greenhouse Gas and Climate Implications of the Narrabri Gas Project (SSD-6456), Professor Penny D Sackett, Honorary Professor, Climate Change Institute, The Australian National University, Advice Provided: 3 August 2020, pg 24

TABLE 1: Significance of Tahmoor South Scope 1 emissions relative to other new coal and gas projects approved in NSW since the March 2018 creation of the NSW IPC

Project	**Determination**	**Date**	**Total Scope 1 GHGEs** (Mt CO2~e)	**Scope 1 GHGEs per annum** (M t CO2~e)
Maxwell Underground Project	**Approved**	22/12/20	9.9	0.38
Russell Vale	**Approved**	8/12/20	1.4	0.28
Narrabri Gas Project	**Approved**	30/09/20	15.5	0.62
Vickery Coal Project (new mine)	**Approved**	12/08/20	3.1	0.124
Rix's Creek South Mine (expansion)	**Approved**	12/10/19	0.8	0.04
United Wambo (new mine)	**Approved**	29/08/19	5.8	0.25
Total Scope 1 GHGEs approved since Rocky Hill			**36.5**	**1.69**
Tahmoor South			***26.7***	***2.22***
Note: *Approval of Tahmoor South - with no GHGE offsets - would more than double annual average Scope 1 emissions in NSW from new coal and gas projects (approved since IPC created in March 2018) from 1.69 Mt to 3.91 Mt per annum.*				

GHGE offsets: NSW law and policy

What does NSW law and policy say about conditioning GHGE offsets for new coal and gas projects?

In the Maxwell Underground Statement of Reasons, the Commission noted: *"that no applicable law or policy mandates the imposition of an offsetting requirement"*. Whilst this is technically correct, it is also simultaneously correct that applicable law and policy in NSW specifically *allows* the imposition of an offsetting requirement. The IPC Narrabri panel imposed an offset condition and the Dendrobium IPC panel signaled it was willing to require offsets however, as it determined to refuse consent, this did not occur (see Table 2 below for a summary of recent IPC decisions and statements on GHGE offsets).

Justice Pain affirmed the power of a consent authority to impose offsets for GHGE in her 2011 judgement - Hunter Environment Lobby Inc v Minister for Planning [2011] NSWLEC 221:

> *"It was common ground between the experts that scope 1 emissions are a direct consequence of the carrying out of the activities authorised by the project approval, and are the emissions over which the proponent has potentially greatest control. A condition requiring the offsetting of emissions directly attributable to the operation of the project, in order to address direct potential or actual adverse impacts on the environment, is related to*

the purpose of assessing and approving a significant extension of a coal mine both in terms of time and rate of extraction of the resource. I am satisfied that a condition requiring Ulan to offset the scope 1 emissions of the project would be within the scope and purpose of the power conferred first on the Minister and now on the Court under s 75J."[6]

The Land and Environment Court's Rocky Hill judgement explained what the proactive options are for proponents:

> *"In the climate change context … an applicant for development consent could commit to reducing the GHG emissions of the development by deploying emission reduction technologies, such as carbon capture and storage, or offsetting the GHG emissions of the development by increasing the removal of GHGs in the atmosphere by establishing sinks, such as by reafforestation or afforestation of land." (Pt 530)*

Precedents for GHGE offsets – NSW IPC determinations

What are the precedents for GHGE offsets from earlier NSW IPC determinations and what is the logic behind these discretionary decisions?

It is difficult to discern any particular logic running as a thread through the several NSW IPC handling of this issue.

The Maxwell Underground Project was allowed 9.9 Mt of Scope 1 emissions with zero GHG offsets required. Wollongong Coal was allowed 1.4 Mt of Scope 1 emissions for its Russell Vale Project but was then told that it must not *exceed* this amount. Narrabri Gas was allowed 15.5 Mt of Scope 1 emissions with zero GHG offsets required, however if emissions *additional* to the 15.5 Mt of Scope 1 emissions occur, then Santos was told that these additional emissions must be offset.

In the Maxwell Underground determination, the Commission decided that offsetting is "an impractical means of minimising GHG emissions and of limited utility". Meanwhile the Dendrobium panel decided that "the project could be conditioned in a manner to ensure methane emissions are flared or that offsets are provided accordingly which in the Commission's view could address the objectives of the CCPF." To underscore the utility of offsets, the Dendrobium panel made the observation - in their 5 February 2020 SoR - that South32 / Illawarra Coal "is yet to install flaring infrastructure in any of the mine's current five mining areas".

The Maxwell Underground panel justified inaction on this issue by suggesting that offsetting is "impractical" and of "limited utility, given that only approximately 6% of the Project's anticipated GHG emissions will be Scope 1 or 2 emissions capable of being offset by the Applicant". Less than two months later – as stated above - the Dendrobium panel found the opposite was true, suggesting offsets were appropriate for Scope 1 or 2 emissions representing 7% – 9% of anticipated GHG emissions. It must be noted that Tahmoor South's Scope 1 and 2 emissions represent almost 30% of anticipated GHG emissions for this Project.

In summary, neither law nor policy mandates any specific approach, therefore it is up to each panel to determine what it will do.

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[6] https://www.caselaw.nsw.gov.au/decision/54a6364d3004de94513d9150

Table 2: NSW IPC decisions on conditioning Scope 1 GHGEs

Project	Total Scope 1 GHG Mt CO2~e	NSW IPC's position on offsetting GHGEs which cannot be avoided or mitigated
Narrabri Gas	15.5 Mt	**No requirement imposed to offset Scope 1 GHGEs which are not mitigated or avoided by Santos BUT GHGEs *additional* to the volume predicted are required to be offset.** "Scope 1 and Scope 2 emissions can be minimized through conditions that require any *exceedance* of the predicted emissions to be fully offset so that the Project delivers its expected emissions advantage from using CSG for electricity generation as compared to coal."
Russell Vale	1.4 Mt	**No requirement imposed to offset Scope 1 GHGEs which are not mitigated or avoided by Wollongong Coal BUT GHGEs *additional* to the volume predicted are not allowed.** "Condition B9(d)(ii) imposed by the Commission requires the Applicant to ensure the Project does not exceed the predicted Scope 1 and 2 GHG emissions." To achieve this outcome, Wollongong Coal is required to prepare an Air Quality and Greenhouse Gas Management Plan which describes what they will do to ensure they don't *exceed* predicted Scope 1 and 2 GHGEs. Condition B10 requires them to implement these measures.
Maxwell Underground	9.9 Mt	**No requirement imposed to offset Scope 1 GHGEs which are not mitigated or avoided by Malabar Coal. Offsets considered to be "impractical" with no specific law or policy in NSW requiring they be imposed.** "Submissions were made to the Commission urging the imposition of a condition requiring the offsetting of GHG emissions (see paragraph 154 above). The Commission notes that no applicable law or policy mandates the imposition of an offsetting requirement. In the particular circumstances of the Project, the Commission considers offsetting to be an impractical means of minimising GHG emissions and of limited utility, given that only approximately 6% of the Project's anticipated GHG emissions will be Scope 1 or 2 emissions capable of being offset by the Applicant." [Point 184, pg 32]

Dendrobium	17 – 22 Mt	**The IPC finds that offsets *could* have been imposed on Scope 1 emissions caused by South32's development if the mine had been approved.** Regarding existing Scope 1 emissions at the current mine, the IPC noted that South32 / Illawarra Coal "is yet to install flaring infrastructure in any of the mine's current five mining areas". "The CCPF [Climate Change Policy Framework] is not directive as to whether a mining project must or must not be refused by reason of GHGE. The Commission considers that in order to reduce emissions, the project could be conditioned in a manner to ensure methane emissions are flared or that offsets are provided accordingly which in the Commission's view could address the objectives of the CCPF." (Pt 304 of the SoR)
Tahmoor South	26.7 Mt	**The NSW IPC has an opportunity to require that SIMEC offset 100% of GHGEs which cannot be avoided or mitigated.** NSW DPIE say that "Tahmoor Coal proposes to minimise its Scope 1 and 2 GHGEs by around 26.5% through either flaring or using the methane gas for power generation."

Comparative information provided to NSW IPC by NSW DPIE is incorrect

Page xvi of NSW DIE's Assessment Report claims that Scope 1 and 2 greenhouse gas emissions (GHGE) over the life of the Project represents approximately 0.65% of total NSW emissions and 0.2% of total Australian emissions. Both numbers are wrong.

Page 125 of the DPIE AR finds that over the life of the Project, the maximum estimated total GHGE (unabated scenario) would total 93.8 Mt CO2-e, including approximately:

- 26.7 Mt CO_2 of Scope 1 (with an annual average of 2.22 Mt CO_2);
- 1.24 Mt CO_2 of Scope 2 (with an annual average of 0.1 Mt CO_2); and
- 65.8 Mt CO_2 of Scope 3 (with an annual average of 7.81 Mt CO_2).

Percentage of Scope 1 and Scope 2 NSW GHG inventory almost triple that claimed by NSW DPIE

Total emissions for New South Wales in 2018 were 131.7 Mt CO2-e.[7]

2.32 Mt of Scope 1 and Scope 2 emissions annually represents 1.76% of the 131.7 Mt CO2-e 2018 NSW GHG inventory (the latest year for which information is available), almost triple the 0.65% claimed by NSW DPIE.

Tahmoor South GHGEs as a percentage of the Australian GHG inventory are more than double the amount claimed by NSW DPIE

Australian emissions for the year to March 2019 were 538.9 Mt CO2-e.[8]

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[7] https://www.industry.gov.au/sites/default/files/2020-05/nga-state-and-territory-greenhouse-gas-inventories-2018.pdf

[8] https://www.environment.gov.au/system/files/resources/6686d48f-3f9c-448d-a1b7-7e410fe4f376/files/nggi-quarterly-update-mar-2019.pdf

2.32 Mt of Scope 1 and Scope 2 emissions annually represents 0.43% of the 538.9 Mt CO2-e 2019 Australian GHG inventory, more than double the amount claimed by NSW DPIE.

Contradictory information from DPIE regarding proposed mitigation of Scope 1 and Scope 2 emissions

NSW DPIE's Final Assessment Report (FAR) for this project clearly states that at best, Tahmoor South hopes to reduce Scope 1 and 2 GHGEs by around 26.5%. During the Public Hearing however, a claim was made that a reduction of Scope 1 emissions of *"something in order of … 80 per cent"* may be achieved. The 80% claim does not appear to be supported by information in NSW DPIE's FAR.

The first thing to notice about the 26.5% claim is that even if this is achieved, a 26.5% reduction would amount to 7.4 Mt GHGEs, meaning that Scope 1 and Scope 2 GHGEs would still be just over 20 Mt GHGE in total. 20 Mt represents a significantly larger Scope 1 and 2 footprint than any other coal mine assessed and approved since the NSW IPC was created (United Wambo 6.6 Mt CO2-e, Rix's Creek 1 Mt CO2-e, Vickery Coal 3.9 Mt CO2-e, Russell Vale 1.5 Mt CO2-e, Glendell expansion 0.2 Mt CO2-e and Maxwell Underground 11 Mt CO2-e).

NSW DPIE has presented quite a muddled picture of precisely what is proposed by SIMEC regarding the mitigation of Scope 1 and Scope 2 emissions. Our submission is that the NSW IPC should require NSW DPIE to clarify contradictory statements claiming that emissions may be reduced by 26.5% or perhaps 80%. NSW DPIE should also provide an update to the Commission on the track record of the proponent to date on site regarding mitigation of Scope 1 and Scope 2 emissions. At the end of the day, the only effective strategy to drive maximum mitigation of Scope 1 and Scope 2 GHGEs is to require the proponent to offset 100% of GHGEs that they are unable to avoid or mitigate.

Claims made in the DPIE FAR

At page xvi of NSW DPIE's FAR, it is claimed that "Tahmoor Coal proposes to minimise its Scope 1 and 2 GHGEs by around 26.5% through either flaring or using the methane gas for power generation."

At page 125 of the same report, NSW DPIE provide a little more context:

> *"Under the 'abated' scenario, around 35% of the methane gas would be captured and either flared or used for power generation. This would reduce Scope 1 and 2 emissions by around 26.5%. However, Tahmoor Coal has advised that the concentration of methane within captured gas is not always suitable for beneficial re-use and therefore flaring and power generation is subject to variability. Additionally, gas management infrastructure on the site is operated by a third party and is therefore subject to commercial contractual considerations."*

Answer to NSW IPC panels question in Public Hearing

On the final day of the Public Hearing, Professor Mackay put the following question to Mike Young, NSW DPIE:

> *"The Public Hearing has heard a number of presentations and submissions about greenhouse gas, and in relation to greenhouse gas emissions, the presentation from Mr Floro from the EDO proposed that if the Commission were of a mind to approve the application - and that would be despite all the other concerns that the EDO expressed - then they were of the view that the Scope 1,2 and 3 greenhouse gas emissions should be fully offset. Could the Department please comment on the merits of requiring any offsets for greenhouse gas emissions please?"*

Having stated in the FAR that *"Tahmoor Coal proposes to minimise its Scope 1 and 2 GHGEs by around 26.5%",* NSW DPIE proceeded to claim to the Commission at the Public Hearing that

should it be approved, a system would be in place to *"capture 99 per cent of the gas drainage or the gas that is emitted from the mine in the form of methane, and to either flare or use that for power generation."* Mr Young then suggested that his understanding is *"that that abatement or that minimisation is substantial and that the abated versus unabated, you're talking about something in order of an 80 per cent reduction in overall greenhouse equivalent or CO2-equivalent tonnages emitted by the mine, so they're not trivial undertakings."*[9]

DRYING AND BIODIVERSITY

Undermined quotes from the **Long-term changes to water levels in Thirlmere Lakes – drivers and consequences** paper by Samira Schädler and Richard T. Kingsford (Centre for Ecosystem Science, School of Biological, Earth & Environmental Science, University of NSW, NSW 2052, Australia) as their scientific study links biodiversity, heritage and the drying of Thirlmere Lakes.

"These serious declines in water levels in the three Thirlmere Lakes were not climate related and are best explained by anthropogenic impacts. There are two potential explanations for the draining of Thirlmere Lakes, which may have acted synergistically: either there was considerable pumping of groundwater or longwall coal mining disrupted the groundwater aquifers, causing diversion of groundwater resources."

Undermined submits the IPC should refuse the TSCP Application because if it were to proceed, the mistakes and environmental damage of the past would continue, making it even harder and more expensive to rectify in the future.

Submitted by

Undermined Inc

David Eden, President

2021 February 24

[9] NSW IPC transcript, Day 3, P-67

Tech to capture and reuse carbon is on the rise. But can it help the world reach its climate goals?

If the latest IPCC report has told us anything, it's that it's time to confront climate change right now. And while reducing the amount of fossil fuels we use is absolutely crucial, there's no doubt that some of the carbon dioxide in our atmosphere will have to be sucked out one way or another. That's where carbon capture and sequestration come in.

© Pixabay Emissions can be reused for all sorts of purposes—from building concrete blocks to fertilizing crops.

Carbon capture and sequestration, often dubbed CCS, is the process by which CO2 can be sucked out of sources like power plant smokestacks or, in some cases, even the atmosphere through Direct Air Capture. Then, the carbon is locked away permanently, often underground, through sequestration.

However, there's another potential route for capturing carbon dioxide: reusing it for another product. And in a world where circular economies based on reusing as much material as possible are necessary, many are exploring a second life for greenhouse gas emissions.

"Carbon capture is definitely one way that we can remove CO2 from the atmosphere," says Daniel Sanchez, assistant cooperative extension specialist in the department of environmental science, policy, and management at UC Berkeley. "We can do a lot more with it, though. We can reduce emissions and we can recycle emissions."

But there are still lots of questions as to how carbon dioxide can be reused—and if it's actually worth it for the climate.

Carbon capture and utilization, explained

Back in 2017, a group of researchers found that to stay under a 2-degree-Celsius rise above pre-industrial temperatures by 2050, the world would need to avoid emitting around 800 gigatons of carbon for the next three decades. Even with emissions reductions, a chunk of about 120 to 160 gigatons of CO2 will need to be sequestered until 2050, and more so after.

However, there's not a lot of economic incentive to bury loads and loads of carbon deep beneath the land or sea. Enter carbon capture and utilization (CCU), which turns those castoff gases into sellable products.

There are several ways in which captured carbon could be marketed and repurposed, beginning with direct use, or non-conversion. This is a method in which carbon dioxide isn't chemically altered. Some common forms of direct use are by piping the gas into greenhouses, concentrating it as fertilizers, and turning it into a solvent for decaffeination or dry cleaning.

But the most common way for carbon dioxide to be reutilized through non-conversion is through enhanced oil recovery. Enhanced oil recovery (EOR) is the process by which carbon dioxide is injected into an existing oil field to, through increased pressure, force out even more petroleum. (The world produces 500,000 barrels of oil every day with this method, according to one 2018 analysis.) Theoretically, if some of the carbon dioxide stays beneath the ground and the rest is recaptured and injected into the process again, the oil could be "carbon-negative." Of course, burning oil still releases carbon dioxide into the atmosphere, so the balance is dependent on where the gas comes from in the EOR process, and who gets credit for the storage.

[Related: Volcanoes could be our fiery allies in the fight against carbon emissions]

Beyond just using carbon dioxide as is, the emissions can be converted into products like methane, methanol, gasoline, plastic polymers, cement, and concrete. In some cases, the carbon captured in these products can be kept out of the atmosphere for, theoretically, up to centuries.

But no matter how captured carbon is utilized, those emissions will likely make it one day back into the atmosphere—which has led to lots of debate on if, and how, these technologies should be wielded against climate change.

The debate over using CCU against climate change

Last month, a study published in the journal OnEarth broke down the life cycle of emissions and readiness of the technology of dozens of different CCU pathways to

determine if any could potentially meet the global goals of halving carbon emissions by 2030 and reaching net-zero by 2050. After considering where the carbon dioxide came from (atmospheric, biogenic or naturally sourced from plants, fossil fuels, or a combination of biogenic and fossil fuels) and what it became (direct use, fuels and chemicals, mineral carbonates and construction materials, or enhanced hydrocarbon recovery), only a handful of methods met the 2030 Paris Agreement conditions. Just one would work with the 2050 benchmark.

What the researchers found is that the technologies that aligned with the 2030 goals are using carbon dioxide from a biogas plant to enrich agricultural greenhouses, biogenic carbon dioxide to make construction materials, flue gas captured directly for, again, make construction materials, and basic oxygen furnace gas to produce urea, which can be used in fertilizer and commercial products. EOR, meanwhile, only reaches Paris goals under the very specific circumstances that CO2 is used directly and that no more than two barrels of oil are produced per ton of injected carbon.

"There are only very few of these CCU routes that are compatible in 2030, or because they're not ready on time," says Kleijne de Kleijne, author of the study and PhD student at the Radboud University Nijmegen in the Netherlands. "They're still in a low level of technological maturity."

Move over to the Paris Agreement's vision for 2050, and only one type of CCU makes the cut: construction blocks using a purified stream of biogenic CO2. "Because CO2 is not stored permanently in fuels or chemicals, these products can only be strictly Paris-compatible when the CO2 is of biogenic or atmospheric origin and zero emissions are associated with the capture and conversion processes," the authors write.

But the Paris goals are incredibly tough to meet, says Sanchez. Considering how hard it will be in general for the world to keep climate change below a 1.5-degrees-Celsius rise, and how far off track we currently are, the bar is extremely high.

"[CCU] can substitute for other fossil intensive alternatives. It can help us reduce emissions, but it does not remove carbon from the atmosphere," says Sanchez. "It keeps the carbon in the economy." Without long-term storage, he notes, it's pretty much impossible to get down to zero emissions.

[Related: 4 sustainability experts on how they'd spend Elon Musk's $100 million climate commitment]

There are two other major arguments for powering through on CCU. One is that by recycling the carbon dioxide for uses that we'd typically turn to fossil fuels for, we are keeping more fossil fuels buried deep beneath the ground and out of the atmosphere.

Considering how many industries are having a hard time decarbonizing quickly, it seems all the more important to find ways to keep the economy alive without all the environmental degradation of digging up more fossil fuels. One study in the journal

Nature last year showed that to have even a 50-50 chance of meeting Paris Agreement goals, 58 percent of oil, 59 percent of fossil gas, and 89 percent of coal around the planet needs to stay in the ground. "Further investment in fossil fuel extraction is not compatible [with mitigating climate change], as shown by this research," coauthor and University College London energy systems researcher Steve Pye told PopSci in September.

The second reason is that even if we were able to convert the world's power to nearly net-zero overnight, we'd still likely be depending on carbon capture and sequestration to draw existing carbon out of the atmosphere to keep the climate in check (the current atmospheric CO2 levels are 419.03 parts per million, compared to pre-industrial levels of around 260 to 270 parts per million). In some cases, CCU can be used as a stepping stone to more permanent carbon sequestration technologies.

"There's a really interesting and kind of more nuanced conversation to be had around [CCU]," Sanchez says. "Maybe the net all of the positive emissions and all the negative emissions need to be less than or equal to zero. But not every single [technology] needs to equal zero."

Capturing CO_2 from the air

There has also been considerable interest recently in using CCS technologies to remove CO_2 from the atmosphere. One option is bioenergy with CCS (BECCS), where biomass (like wood or grasses) removes CO_2 from the air through photosynthesis. The biomass is then harvested and burned in a power plant to produce energy, with the CO_2 being captured and stored. This creates what is called "negative emissions" because it takes CO_2 from the atmosphere and stores it. Another negative emission option is called direct air capture (DAC), where CO_2 is removed from the air using a chemical process. However, the concentration of CO_2 in the air is about 300 times less than in the smokestacks of power plants or industrial plants, making it much less efficient to capture. Because of this, DAC is quite expensive today.

What Can Be Done About Climate Change

It is not too late to take action on climate change.

The Science

Given what we know about the threats that climate change poses to humans, we must take swift action. As a global community, we need to soon level off—and then decrease—the amount of carbon dioxide (CO_2) and other greenhouse gases in the atmosphere. The faster we do this, the less damage we will cause to our world and our way of life.

Stopping the Rise in CO2

The fastest way to address the buildup of CO_2 in the atmosphere is to stop adding more. Many vital parts of our economy emit huge amounts of greenhouse gases: the way we generate electricity and heat for our buildings and industry; the oil we burn to power our cars, trucks and planes; the refrigerants we use to preserve our food and cool our buildings; and the intensive manufacturing processes for making concrete and steel.

And yet there are many ways to reduce the CO_2 from these sectors. We can replace high-emitting fuels like coal, oil and gas with nearly "carbon-free" alternatives, such as solar power, wind power, or nuclear power. We can capture the CO_2 from fossil fuel power and manufacturing plants and store it underground. We can also update our buildings and infrastructure, so that it takes less energy to build and use them.

We can add to these efforts by trying to remove some of the CO_2 that is already in the atmosphere: for instance, by reforesting the Earth, by changing our farming practices to store more carbon in the soil, or through "direct air capture" technology. However, these methods will likely not be able to remove CO_2 quicker than we are now adding it to the atmosphere. We must begin with stopping our runaway greenhouse gas emissions.

If, by 2030, we cut our carbon emissions in about half – and, by 2050, we don't emit any more carbon emissions than the planet can absorb each year – scientists predict that we can avoid the worst threats of climate change.

Summarized from the Intergovernmental Panel on Climate Change (IPCC)

Special Report, Global Warming of 1.5°C (https://www.ipcc.ch/sr15/)

Adapting to Change

Because human activity has already added such a large amount of greenhouse gases to the atmosphere, the world is now experiencing the early effects of climate change. We need to prepare for and adapt to these changes, so that we can protect human health, water and food supplies, our cities and towns, and natural habitats. A new field of work has emerged to reinforce coastlines to shield them from rising oceans, grow new crops to match regions' changing climates, protect our infrastructure from wildfires and hurricanes, and plan for shifting supplies of water and food.

Today, these tasks are still manageable. If we get ahead of the regional changes we know are coming, and if we put the needs of the poorest and most vulnerable first, very few parts of the world will be irreparably damaged by the climate change we have already caused.

But unless we also actively cut our greenhouse gas emissions, unchecked climate change could eventually put safe and just adaptation beyond our reach. This possibility has led some scientists to study more extreme and controversial options, like geoengineering; for example, there are proposals that would try to artificially cool the Earth to counter some of the effects of climate change. Urgent action is needed to avoid the need for these riskier options.

Driving Solutions

Great progress can and must be achieved with the low-carbon technologies we have today. And all of us can help speed the pace at which these technologies take root and spread. Individuals can change their behavior and advocate for ambitious new policies. Corporations can drive change across whole industries. Governments can enact laws to make it easier and cheaper to cut greenhouse gas emissions, and to help communities prepare for new challenges. And intergovernmental agreements such as the Paris Agreement have already created a strong framework for international cooperation and aggressive action, if governments around the world step up their commitments.

At the same time, the world does not have a true alternative to fossil fuels that can meet all our current energy needs, let alone meet an increased demand in the future. We severely lack the suite of solutions to address climate change at an economic and social cost that we can agree to bear.

A tremendous amount of work is taking place at MIT and other scientific and engineering institutions around the world to develop these options, in collaboration with the industries and communities that can deploy and scale them. But to quicken the pace of technological breakthroughs, policymakers need to set the stage now for game-changing advances in multiple fields of science, technology, and policy. To take on the hardest challenges in reducing our emissions, in removing CO_2 from the atmosphere, and in adapting to a changing climate, we urgently need new tools.

Seizing the Opportunity

The MIT community fundamentally agrees that climate change presents grave risks that demand society's urgent attention. The challenge requires an aggressive and pragmatic plan to achieve a net zero carbon global energy system, the sooner the better, for all of humankind.

If academia, business, government, and citizens act together toward this common goal, we *can* create a pollution-free energy system; form a prosperous, adaptable and resilient society; keep human, animal, and plant life flourishing; and create a better world for ourselves and generations to come.

There is room and reason for each of us to be part of the solution. I urge everyone to join us in rising to this historic challenge.

L. Rafael Reif

President, MIT

What We Know About Climate Change

The Earth's climate is changing faster today than ever before in the history of our species – and human actions are the main reason why.

The Science

In the late 1800s, humans started burning large amounts of fossil fuels—coal, oil and natural gas—for heat, to power machines, and to generate electricity. These fuels helped us make significant technological, social, and economic progress and elevated standards of living around the world. As we've burned more and more fossil fuels over two centuries, we have added large amounts of carbon dioxide (CO_2) and other heat-trapping greenhouse gases to our atmosphere.

Greenhouse gases prevent some heat from escaping the Earth out into space, and while this is a natural phenomenon, human behavior has now added so much greenhouse gas that our atmosphere is keeping in too much heat. In fact, ice core data shows us that there is now more CO_2 in our atmosphere than at any point in at least the

past 800,000 years. Because of this, our planet is almost 1.8°F hotter than it was in the 1880s.

As the levels of CO_2 continue to rise, the planet is still getting hotter—and because CO_2 stays in the atmosphere for such a long time, some of the CO_2 we emit now will still be trapping extra heat on Earth for many hundreds of years.

This is especially worrisome because many parts of the world are still industrializing, and the global need for energy is growing.

For these facts, the evidence is overwhelming.

Take a look at the 25 warmest years that have ever been measured [since 1880]. If you're 32 years old or more, you've been alive for every single one of them. Even if you're only 20, you've been alive for the great majority of them. We, this generation of people, are living on the warmest planet that has ever been measured in the instrumental record.

Prof. Susan Solomon

who proved that gases called CFCs were creating the ozone hole in Antarctica. She is the Lee and Geraldine Martin Professor of Environmental Studies and Chemistry, MIT Department of Earth, Atmospheric and Planetary Sciences

The Risks

If this warming goes on unchecked, we leave ourselves open to severe risks. Scientists predict that it is highly likely that the rainfall patterns we all need for clean, fresh water will change, drying up in some places while causing floods in others. There is also significant evidence that, as a result of climate change, wildfires will worsen, destroying lives and property; that sea levels will rise, flooding many large cities; that hurricanes will become stronger; that the oceans will grow more acidic and hold

less oxygen, threatening sea life and the people who rely on it for food; and that many people around the world would need to move to escape floods, famines or droughts, particularly in the poorest countries with the least capacity to adapt to a changing climate.

In communities across United States and around the world, people are already experiencing the early effects of this climate change.

It Is Not Too Late

Because of the amount of CO_2 we have already added to the atmosphere, some warming has already occurred and some further warming is now unavoidable. In fact, even if we stopped all greenhouse gas emissions today, the planet will maintain this extra warmth for some time, given how long these gases stay in our atmosphere and given the extra heat that has been taken up by the oceans.

But if we act swiftly, it is not too late to prevent much more severe changes to the Earth's climate.

MIT and many of the world's leading companies, organizations, and institutions are making a tremendous effort to meet this challenge, and there are options for what can be done. We can, as a species, learn to better adapt to the unavoidable effects of the warming that human behavior has already caused. And we can make choices that will stop adding CO_2 to our atmosphere, and work on ways to remove some of what we've already emitted.

With a worldwide effort to control our CO_2 emissions, we, our children, and our planet can avoid the threats that await us on a hotter Earth.

POSTMARCH 1, 2022

Ukraine's invasion underscores Europe's deep

reliance on Russian fossil fuels

Russian president Vladimir Putin's decision to send troops into Ukraine spooked energy markets this week, amid fears that the escalating conflict and ensuing sanctions could disrupt global fossil-fuel supplies.

Russia is one of the world's largest producers of petroleum, natural gas, and coal, so any actions that curtail exports could have global ripple effects, pushing up prices and slowing economic growth. Western Europe is particularly vulnerable because it's heavily dependent on Russia's fossil fuels, despite determined efforts to switch to cleaner energy sources in recent years.

Oil, natural gas, coal, and other fossil fuels accounted for more than 70% of total energy consumption within the European Union, according to a report last year from the European Commission. Russia supplied more than 41% of the natural gas, nearly

27% of the crude oil and liquids separated from natural gas, and about 47% of the coal.

Even Germany, Europe's largest economy, which has invested heavily in renewable energy sources, is still deeply reliant on fossil fuels, particularly for heating and transportation. Non-fossil-fuel sources meet only 16% and 7.5% of those needs, respectively.

In response to Putin's actions, German chancellor Olaf Scholz announced plans to halt development of the Nord Stream 2 pipeline, designed to carry natural gas between Russia and the northern part of that nation.

In addition, the European Union and United States imposed a variety of sanctions that included tight restrictions on some state-owned financial institutions and Russian elites. US president Joe Biden pledged to take more severe actions against Russia "if it continues its aggression."

He stressed that the administration was taking deliberate steps to ensure that the conflict doesn't push up energy costs for US consumers.

Read the full article at: https://www.technologyreview.com/2022/02/23/1046429/how-the-ukraine-invasion-could-accelerate-europes-clean-energy-shift/

4 MARCH 2022 EXPERT COMMENTARY- CSIRO AUSTRALIA

Flood risks under climate change

Senior hydrologist Dr Francis Chiew says:

"Our climate and streamflow are highly variable, with many different drivers of this variability including the El Nino and La Nina cycle. The effects of climate change will be superimposed on this natural variability. We can attribute the contribution of climate change on some extreme events with confidence, including the role in heat extremes on land and in the ocean.

"However, due to the complex drivers of extreme rainfall and floods, and the highly variable nature of rainfall, we are less confident about attributing the relative contributions of different factors right now. That analysis will take a few months. We know that under a warmer climate, flood risk in general is likely to increase.

"Floods are the costliest natural disasters in Australia, averaging $8.8 billion per year. Cascading societal impacts are evident in Queensland and NSW, such as deaths, injuries, mental stress, thousands of houses damaged, thousands of people evacuated, major infrastructure damage and service disruption, limited food and fuel, and contaminated drinking water."

Senior climate researchers Dr Michael Grose and Kevin Hennessy say:

"The IPCC Sixth Assessment Report (Working Group I and Working Group 2) indicates that the frequency and intensity of extreme rainfall has already increased over most land regions, and extreme rainfall will generally become more intense under a warmer climate. This will increase flood risk in cities, in built-up urban areas, and in small catchments, where extreme rainfall over hours to a day can quickly become flash floods.

"It's more complex in rural areas and for larger river basins, which are driven by multi-day rainfall events and by the preceding catchment conditions. For example, in southern Australia, the change in flood risk will be the net result of contrasting effects of increases in extreme rainfall and generally drier catchments under climate change. Nevertheless, the IPCC report gives medium confidence that risks from river flood will increase with climate change."

Adaptation progress

Senior climate researcher Kevin Hennessy says:

"The federal government has a National Climate Resilience and Adaptation Strategy, all states and territories have climate adaptation plans, most local councils have climate adaptation plans, and the private sector is developing introduction of climate risk and disclosure regimes. However, recent fires and floods highlight those regional vulnerabilities remain large, so more needs to be done to improve our resilience.

"The IPCC Working Group 2 report found that adaptation progress is uneven. Barriers include lack of consistent policy direction, competing objectives, different risk perceptions and values, knowledge constraints, inconsistent information, fear of litigation, up-front costs, and lack of engagement, trust and resources.

"The good news is that a range of incremental and transformative adaptation options and pathways is available. Key enablers include shifting from reactive to anticipatory planning, integration and coordination across levels of government and sectors, inclusive and collaborative institutional arrangements, government leadership, policy alignment, nationally consistent and accessible information, decision-support tools, along with adaptation funding and finance.

"Local 'adaptation champions' and tailored engagement processes can enhance learning. Knowledge brokers, information portals and alliances can help communities, governments and businesses to better access and use climate change information.

"Recent initiatives like the Australian Climate Service, the National Recovery and Resilience Agency and Future Drought Fund, are positive steps to helping address risks from floods, fires, droughts, heatwaves and other hazards. These are important because of the cascading and aggregated impacts from multiple hazards on ecosystems, people, infrastructure, services and supply chains."

Environmental impacts of flooding

Senior environmental scientist Dr Klaus Joehnk discusses challenges caused by flooding:

“Large floods are a threat to water supply and safe drinking water, straining water treatment plant operation by increased sediment load and potential contaminants.

“Potential sewage treatment plant overflow as well as the inundated sewer system will increase pathogen concentration in the water masses. (See a recent article in Drinking water can be a dangerous cocktail for people in flood areas (theconversation.com))

“Like in the floods after bushfires, the large-scale erosion will lead to increased sediment loads in the flood waters carrying with it increased concentrations of nutrients but also other contaminants such as metals.

“Shoreline vegetation will be smothered with sediments, increased turbidity reduces underwater light climate and thus impacts plant photosynthesis. This large pool of sediment load flowing into coastal systems will have similar negative impacts, increased turbidity, sediment deposition across a larger coastal area and increased nutrient concentrations. Those plumes can be easily tracked by satellite imagery.

“While terrestrial animals might be negatively impacted, fish and other aquatic animals may benefit from the increased connectivity of flood inundated areas.

“Inundation of large, vegetated areas always bear the risk of blackwater forming, that is high levels of dissolved organic carbon in water associated with decreased oxygen and potential hypoxic conditions killing fish. This is not so much of a problem in a well-connected system where fish can avoid low oxygen zones.”

Senior ecologist Dr Tanya Doody discusses benefits of flooding:

“Floods are important to reconnect creeks and wetlands that come off main river channels, to supply fresh water to top up or fill wetlands, which in turn supports flora and fauna in the vicinity. Floods can often initiate breeding of various fauna such as fish, frogs and birds. More frogs, for example, then provide a food source for reptiles and other larger fauna.

“Floods and flooding rains are also critical in areas with soil salinisation as water can flush the salts to deeper areas of the soil profile and provide fresh water sources for the surrounding vegetation. Most vegetation is not especially tolerant to salt and will become unhealthy without periods of freshwater availability. Likewise, any additional water that becomes available to vegetation, especially trees will provide benefits in reducing water stress and growth of new leaves to improve canopy vigour.

“Vegetation debris accumulates on the soil under trees and bushes and floods are required to push this food source into water bodies where microorganisms digest the debris and make the nutrients available to other organisms in the water via the food web. So small fish eat microorganisms, and large fish eat microorganisms, small fish and other food sources such as tadpoles.

“Many understory plants and bushes require water/floods to germinate. This is especially important for species that provide food sources for Indigenous communities such as Nardoo (*Marsilea drummondii*) which is used to make a form of bread. Many plant species provide critical food and medicinal resources for indigenous communities.”

Requested Information

> *Noting the Commission's enquiries, the Department requests that you provide an updated cost benefit analysis (CBA) to account for the Project's total Scope 1 and Scope 2 greenhouse gas emissions. The analysis should be updated to include allocation of the Project's Scope 1 and Scope 2 greenhouse gas emission costs to NSW and Australia, and then be apportioned to NSW.*
>
> *A comparison of low, central and high carbon price scenarios should also be included along with clarification of how each value is formulated, to be provided as background context to the carbon price estimates used.*

In accordance with the DPE's request, the CBA in the Economic Assessment has been updated (Table 1) to incorporate updated Project Scope 1 and 2 GHG emissions provided by Jacobs (2021a and 2021b)[4,5] that include post-operations GHG emissions (i.e. after 2044). All other assumptions adopted in the Economic Assessment (e.g. capital and operating costs, product coal production, coal prices) remain unchanged.

Furthermore, as requested by the DPE, Table 1 provides an alternative estimate of the externality cost of Project Scope 1 and 2 GHG emissions to NSW by adjusting the overall externality cost of Project Scope 1 and 2 GHG emissions based on NSW's share of Australia's population.

Table 1 also considers the same central, low and high price scenarios adopted in the Economic Assessment:

- Central price scenario is based on the prices of EU ETS futures, as published by EEX (2020), whereby prices from December 2029 onwards (the date for which the latest futures prices were available) are assumed to increase by 1.7 per cent in real terms (consistent with historic trends) to A$70.88/t $CO_{2\text{-}e}$ in 2064;
- Low price scenario relies on carbon prices derived from the US EPA Social Cost of Carbon (DPE 2018), which are assumed to increase to A$48.4/t $CO_{2\text{-}e}$ by 2064; and
- High price scenario relies on carbon prices derived from the Australian Treasury Clean Energy Future Policy Scenario, in accordance with the NSW Government's 'Greenhouse Gas Emissions Valuation Workbook' (DPE 2018) whereby prices are assumed to increase to A$253.4/t $CO_{2\text{-}e}$ by 2064.[6]

Table 1: Alternative Project emissions valuation ($2020)

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Table 1: Alternative Project emissions valuation ($2020)

Price Assumption	Adjusted by NSW's Share of Global GDP		Adjusted by NSW's Share of Australia's Population	
	Externality Cost of Greenhouse Gas Emissions to NSW (NPV)	Net Benefit to NSW (NPV)	Externality Cost of Greenhouse Gas Emissions to NSW (NPV)	Net Benefit to NSW (NPV)
Central price scenario European Union Emissions Trading System	$1.3M	$598M	$138M	$462M
High price scenario Australian Treasury Clean Energy Future Policy Scenario	$2.5M	$597M	$258M	$341M
Low price scenario US EPA Social Cost of Carbon	$0.9M	$598M	$93M	$506M

Note: As of June 2021, NSW' share of the Australian population was 31.82 per cent (https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population/latest-release#states-and-territories; accessed 21 Jan 2022).

[4] *https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-10269%212021053 1T065545.008%20GMT*

[5] *https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-10269%212021122 3T010055.714%20GMT*

[6] *We note that the relevant workbook is no longer accessible on the Department's website. Greenhouse Gas Emissions Valuation Workbook.xlsm; http://planspolicies.planning.nsw.gov.au/index.pl?action= view_job&job_id=7312; accessed on 28 February 2020.*

The revised net benefit to NSW as a result of the Project remains positive in all circumstances.

Sincerely,

Stephen C. Beare

Dr Stephen Beare
Director

THE RESPONSE ::

1. The UNSW Professors (5) submission opposed the "Extention" of the Coal Mine.
2. The war in Ukraine has caused the EU to "Review" its supply of Gas from Russia.
3. This has led to a Construction Start for a Gas Pipeline from Norway to Poland.
4. The German Govt has announced a proposed $220 billion transformation of German economy.(MARCH 2022)
5. Poland has announced in 2021 that it plans to phase-out Coal by 2049.

6. The proposed "Re-routing" of the Narrabri section of the Inland Rail Project should confirm that is NOT IMPACTING planned Long-wall Mining for the planned Coal Mine Project.

7. If the NSW GOVT want to achieve a net zero emissions by 2050, then a "Viable Off-set" method would be needed. (NSW Govt has been criticised by environment groups on allowing excessive "Land Clearing")

8. **So "funding the mitigation" such as increasing "Trees and vegetation" or "Seaweed" and closing Coal Fired Power Stations. And using a "Low Emissions" technology for making steel. (perhaps it is "better to Mitigate the GHG risks in AUSTRALIA for all the EXPORTED COAL ??? than expecting users in Asia or Europe to Mitigate the burning of Fossil Fuel)**

9. *This is COMPLEX, and the "APPROVAL" of the WHITE HAVEN COAL MINE EXTENTION may be "Questioned" as the UNSW Sustainability Professors have signed a submission to NOT APPROVE the proposed extention.*

10. *The approval "assumes that all the mitigation is achieved Locally?" (Clean Coal?) or accept the "Refusal" and convert to "GREEN HYDROGEN" use and exporting it (instead of COAL?).*

11. There is NSW Treasurer, claiming he has a $100 Billion Renewable Energy Plan in Hunter Valley,(but as the EU is facing GAS SUPPLIES from Russia being CUT OFF and Oil increasing to $ 300 per Barrel ?) So is the "GREEN POWER" in the HUNTER VALLEY "believe-able" ?

12. **The German proposal to Transform its economy to a Low Emissions Economy – (* In part by reducing its dependence on Russian products). Includes reducing dependency on Nuclear Power, and closing coal mines, making electric cars, and decarbonisation of industry.**

13. *So a "Recovery of the Threatened with extinction NSW KOALA POPULATION" could include the Pilligia Koala Colony that was circa 5,000 to 10,000 but in circa 2019 had dropped to circa 50 koala.*

14. And the Recovery of Native Fauna funded by a "Green infrastructure Fund" potentially from the " extraction of COAL" and "whatever".

15. This is termed “Carbon Capture and Utilization” verse the CCS models of storing Carbon in Off-shore Wells.

16. The “Background info” from MIT provides the following.

What Can Be Done About Climate Change

It is not too late to take action on climate change.

The Science

Given what we know about the threats that climate change poses to humans, we must take swift action. As a global community, we need to soon level off—and then decrease—the amount of carbon dioxide (CO_2) and other greenhouse gases in the atmosphere. The faster we do this, the less damage we will cause to our world and our way of life.

Stopping the Rise in CO2

The fastest way to address the buildup of CO_2 in the atmosphere is to stop adding more. Many vital parts of our economy emit huge amounts of greenhouse gases: the way we generate electricity and heat for our buildings and industry; the oil we burn to power our cars, trucks and planes; the refrigerants we use to preserve our food and cool our buildings; and the intensive manufacturing processes for making concrete and steel.

And yet there are many ways to reduce the CO_2 from these sectors. We can replace high-emitting fuels like coal, oil and gas with nearly “carbon-free” alternatives, such as solar power, wind power, or nuclear power. We can capture the CO_2 from fossil fuel power and manufacturing plants and store it underground. We can also update our buildings and infrastructure, so that it takes less energy to build and use them.

We can add to these efforts by trying to remove some of the CO_2 that is already in the atmosphere: for instance, by reforesting the Earth, by changing our farming practices to store more carbon in the soil, or through "direct air capture" technology. However, these methods will likely not be able to remove CO_2 quicker than we are now adding it to the atmosphere. We must begin with stopping our runaway greenhouse gas emissions.

If, by 2030, we cut our carbon emissions in about half – and, by 2050, we don't emit any more carbon emissions than the planet can absorb each year – scientists predict that we can avoid the worst threats of climate change.

Summarized from the Intergovernmental Panel on Climate Change (IPCC)

Special Report, Global Warming of 1.5°C (https://www.ipcc.ch/sr15/)

Adapting to Change

Because human activity has already added such a large amount of greenhouse gases to the atmosphere, the world is now experiencing the early effects of climate change. We need to prepare for and adapt to these changes, so that we can protect human health, water and food supplies, our cities and towns, and natural habitats. A new field of work has emerged to reinforce coastlines to shield them from rising oceans, grow new crops to match regions' changing climates, protect our infrastructure from wildfires and hurricanes, and plan for shifting supplies of water and food.

Today, these tasks are still manageable. If we get ahead of the regional changes we know are coming, and if we put the needs of the poorest and most vulnerable first, very few parts of the world will be irreparably damaged by the climate change we have already caused.

But unless we also actively cut our greenhouse gas emissions, unchecked climate change could eventually put safe and just adaptation beyond our reach. This possibility has led some scientists to study more extreme and controversial options,

like geoengineering; for example, there are proposals that would try to artificially cool the Earth to counter some of the effects of climate change. Urgent action is needed to avoid the need for these riskier options.

Driving Solutions

Great progress can and must be achieved with the low-carbon technologies we have today. And all of us can help speed the pace at which these technologies take root and spread. Individuals can change their behavior and advocate for ambitious new policies. Corporations can drive change across whole industries. Governments can enact laws to make it easier and cheaper to cut greenhouse gas emissions, and to help communities prepare for new challenges. And intergovernmental agreements such as the Paris Agreement have already created a strong framework for international cooperation and aggressive action, if governments around the world step up their commitments.

At the same time, the world does not have a true alternative to fossil fuels that can meet all our current energy needs, let alone meet an increased demand in the future. We severely lack the suite of solutions to address climate change at an economic and social cost that we can agree to bear.

A tremendous amount of work is taking place at MIT and other scientific and engineering institutions around the world to develop these options, in collaboration with the industries and communities that can deploy and scale them. But to quicken the pace of technological breakthroughs, policymakers need to set the stage now for game-changing advances in multiple fields of science, technology, and policy. To take on the hardest challenges in reducing our emissions, in removing CO_2 from the atmosphere, and in adapting to a changing climate, we urgently need new tools.

Seizing the Opportunity

The MIT community fundamentally agrees that climate change presents grave risks that demand society's urgent attention. The challenge requires an aggressive and pragmatic plan to achieve a net zero carbon global energy system, the sooner the better, for all of humankind.

If academia, business, government, and citizens act together toward this common goal, we *can* create a pollution-free energy system; form a prosperous, adaptable and

resilient society; keep human, animal, and plant life flourishing; and create a better world for ourselves and generations to come.

There is room and reason for each of us to be part of the solution. I urge everyone to join us in rising to this historic challenge.

L. Rafael Reif

President, MIT

THE AUSTRALIAN STOCK MARKET "Commentator".

© Provided by The Motley Fool Three coal miners smiling while underground© Provided by The Motley Fool Three coal miners smiling while underground

A message from our CIO, Scott Phillips: *"G'day Fools. If you're like us, you're dismayed by the events taking place in Ukraine. It is an unnecessary humanitarian tragedy. Times like these remind us that*

money is important, but other things are far more valuable. And yet the financial markets remain open, shares are trading, and our readers and members are looking to us for guidance. So, we'll do our best to continue to serve you, while also hoping for a swift and peaceful end to war in Ukraine."

—

ASX coal shares are flying high on investors' radars as the price of fossil fuels is rocketing.

In today's action alone, the **S&P/ASX 200 Energy Index** (ASX: XEJ) is up 4.8% while the broader **S&P/ASX 200 Index** (ASX: XJO) is down 0.8%.

And some of the top ASX 200 coal shares are leading the charge higher for the Energy Index.

The **Whitehaven Coal Ltd** (ASX: WHC) share price, for example, is up 4.5%, while **New Hope Corporation Limited** (ASX: NHC) shares have gained 5.6% today.

Meanwhile, rival ASX 200 coal share, **Yancoal Australia Ltd** (ASX: YAL), has enjoyed a 6.6% boost to its share price in intraday trading.

What's boosting ASX coal shares today?

While many factors determine a coal company's share price (management, balance sheet, quality of assets, etc.), the price of the coal they dig from the ground is a major factor.

And coal prices have climbed rapidly recently alongside oil and gas, offering strong tailwinds to ASX coal shares.

Energy prices were already trending higher late last year as the world's pandemic reopening picked up pace. This saw a sharp increase in the demand for energy for both travel and

manufacturing outpacing any additional supply growth coming online.

But fossil fuel prices have really taken off in the last month as Russia first massed troops on Ukraine's border and then launched an all-out assault.

Now Western nations are getting serious about imposing sanctions on Russian oil, gas and coal exports.

That's critical here because Russia is the second largest oil exporter and third largest coal exporter in the world. The prospect of removing that much supply, or even a significant slice of it, has sent crude oil prices to 13-year highs today and coal surging to another all-time high of some US$420 per tonne.

Aussie coal to the rescue?

Somewhat ironically for an industry that's taken so much flack for the 'dirty energy' it provides, nations the world over are turning to Australia to potentially help fill any void left by a ban on Russian coal.

As *The Australian* reports, despite Poland relying on Russia for 90% of its coal needs, "the country's government has led the European charge to impose sanctions".

Poland is among the countries that may be getting a lifeline in the form of additional shipments supplied by ASX coal shares. "Industry sources say officials also sought information on whether coal supplies could be made available to customers in South Korea and Japan."

According to Resources Minister Keith Pitt (quoted by *The Australian*) the Aussie government is "facilitating access to Australian thermal coal producers to interested parties as they seek

alternative supplies from Russia. Australian producers have indicated they are willing to help our friends and allies if they can."

But ramping up coal mining isn't as simple as turning up the tap.

With most ASX coal shares already producing near their production peak, it will take some time before capacity can be significantly ramped up. Which could see the price of coal remain elevated.

How have these ASX coal shares been tracking?

All 3 of the ASX coal shares mentioned above have trounced the benchmark index of late.

Over the past month alone, the New Hope share price is up 24.5%, Whitehaven shares have leapt 46% and the Yancoal share price has rocketed an eye-popping 71.5%.

To put that into context, the ASX 200 is down 1.4% over the past month.

CSIRO AUSTRALIA – REPORTS ON CARBON SEQUESTRATION – landuse.

Download the report

- Potential for Australian land-sector carbon sequestration and implications for land use, food, water and biodiversity PDF (2 MB)
- Potential for Australian land-sector carbon sequestration and implications for land use, food, water and biodiversity DOCX (20 MB)

FutureFeed

FutureFeed has been developed in a collaboration between CSIRO, MLA and James Cook University. It is a cost effective seaweed feed additive which uses a variety of Australian seaweed to significantly reduce cattle methane emissions and energy saved would be directed to live weight gain. Laboratory research showed that adding dried

seaweed to a cow's diet can reduce the amount of methane it produces by at least 99 per cent and improve production of animals (both dairy and feedlot).

Savanna management

The savanna zone in total comprises 15 percent of the Australian continent. The Emissions Avoidance methods are making real differences to fire management in northern Australia with associated co-benefits for remote livelihoods and protection of biodiversity and infrastructure. Carbon offsets are being produced as a result of these activities and helping Australia reduce its emission liabilities, and overall improving the economic efficiency of meeting our emissions reduction targets.

FutureFeed

FutureFeed will result in a reduction of GHG (methane) emissions from cattle and higher farm productivity (because less feed will be converted to methane). Although it is yet to be commercially adopted, if 10 per cent of Australia's feedlot and dairy cattle were fed this product, Australia's GHG emissions would be reduced by 3 million tons.

The net present value (NPV) for Savanna management and Futurefeed is estimated to be $166.6 million (2017-18 dollars), with a benefit-cost ratio (BCR) of 40.6.

The Reported "HIGHER PRICE" for Australian Coal could "assist in funding agricultural Carbon Emissions Projects. Eg. Re-generative Farming or FutureFeed for Livestock.

❖ Policy gaps on climate impact of fossil fuels, NSW planning authorities concede

Michael Mazengarb 20 January 2022 5

NSW planning authorities concede uncertainty surronds how to best apply the state's climate targets to individual fossil fuel projects. (Photo Credit: Canva).

The NSW planning department has made a candid admission that significant uncertainty surrounds how to apply the state's high-level climate targets to individual fossil fuel developments, while recommending that an expansion of an existing coal mine could proceed.

NSW planning authorities are currently considering an application from Whitehaven Coal to expand the Narrabri Underground coal mine into a third stage. The expansion would extend the life of the mine – which has the capacity to produce 11 million tonnes of coal each year – by a further 13 years, until 2044.

In a blunt admission of the difficulties in assessing the potential climate change ramifications of such a coal mine expansion, the NSW planning department has conceded that it lacks clear policies to enable the climate change impacts of individual fossil fuel projects to be assessed against the state's emissions reduction targets.

The concession was made in a referral to the NSW Independent Planning Commission, published on Wednesday, along with a detailed assessment report prepared by the department, which outlines department's views that the coal mine's expansion is "approvable".

While the department noted the state government has put in place a range of high-level goals for the state's climate change efforts, such as a target to reach net zero emissions by 2050 and to cut emissions by 50 per cent

by 2030, it was not clear how these policies could be applied to the planning assessment of individual projects.

“There are still a range of uncertainties about the specific application of the various policies to individual [state significant development] applications under the [Environmental Planning and Assessment Act],” the report states.

“There is no clear methodology to assess the relative scale (or associated consequences) of emissions in a consistent manner, nor are there any definitions of different levels of emissions.”

“There are no performance criteria or limits provided (e.g. maximum annual or total emissions) for any development types (e.g. coal mines, power stations, or industrial facilities), nor is there any clear timeline to measure any ratcheting down (e.g. a plan for staged reductions in fugitive emissions).”

The report also highlights the difficulties in assessing potential mitigation or offset measures that may be imposed as a condition of a project development approval.

“In the absence of specific policy on impacts, standards, mitigation or offsets, the Department has assessed the Project’s GHG emissions in a holistic way with reference and comparison to other recent project consents,” the department’s report says.

Advocacy group Lock the Gate Alliance spokesperson Georgina Woods said the concession by the NSW planning department highlighted the need for the state government to properly consider the climate change impacts of new coal projects and slammed the department’s suggestion that the coal mine expansion could be approved, despite the clear policy gap.

“Whitehaven’s Narrabri Underground expansion would mean this coal mine is responsible for the highest volume of direct and indirect carbon emissions of any coal project determined by the Independent Planning

Commission to date. This is clearly unacceptable at a time when the world desperately needs to reduce greenhouse gas pollution and avoid worsening the climate crisis," Woods said.

"The department's decision to recommend approval to this huge new source of greenhouse pollution is particularly infuriating because, for the first time, the department actually sought advice about the project's carbon emissions."

"The department's admission that New South Wales has no coherent policy about how to prevent and manage the greenhouse emissions of the state's coal mines is damning, but that policy failure should not mean this damaging project gets waved through," Woods added.

Prospective fossil fuel projects have faced increased pressure to account for their potential climate change impacts, particularly through the NSW planning process.

In a landmark decision of the NSW Land and Environment Court, potential climate change impacts were found to be a relevant factor in a decision to refuse development consent for the Rocky Hill coal mine.

In his decision, Chief Judge of the Land and Environment Court, Brian Preston, cited the 'dire consequences' of the proposed coal mine and recognised the demonstrated need for "a rapid and deep decrease in greenhouse gas emissions."

Following that decision, the NSW Independent Planning Commission refused to issue development consent for the Bylong Coal Mine, citing the project's potential to negatively impact the state's environmental, heritage and agricultural values.

Michael Mazengarb

Michael Mazengarb is a journalist with RenewEconomy, based in Sydney. Before joining RenewEconomy, Michael worked in the renewable energy sector for more than a decade

Fugitive methane emissions from coal mines

Why methane emissions?

Methane is a key component of natural gas and an important energy source, however it is also a potent greenhouse gas.

Methane gas is formed underground during a natural process where organic plant materials are converted into coal. The gas is stored within coal seams and surrounding rock strata and can be released during natural erosion, faulting or mining operations. Reducing methane emissions from NSW coal mines will result in a substantial reduction in the sector's greenhouse gas emissions.

In 2015 approximately 15 million tonnes of CO_2 was emitted from coal mining as fugitive emissions[1]. This accounted for 11 per cent of the state's total greenhouse gas emissions.

Project: Greenhouse Gas Abatement Facility Demonstration

The challenge:

Investigate new technologies to reduce the methane emissions that can escape from coal mining.

The action:

Coal Innovation NSW funded the trial of a Ventilation Air Methane Regenerative After Burner (VAM-RAB) technology.

Grant amount:

Up to $2.2 million (EOI Round 2009).

The project:

Centennial Mandalong Pty Ltd received funding to trial a new technology called a Ventilation Air Methane Regenerative After Burner (VAM-RAB).

This technology oxidises almost all the methane (>99%) in a combustion chamber heated to approximately 1000º Celsius. At this temperature the methane is converted to water and carbon dioxide (CO_2), which has a significantly lower Global Warming Potential (GWP) than methane. A key feature of the technology is its ability to be self-sustaining as it doesn't need additional energy to maintain the temperature in the combustion chamber.

A demonstration plant was constructed at Mandalong mine to test the technology. Initial heat-up trials in 2014 revealed issues with the plant requiring an extensive remedial works to recommission the plant. However, the heating trials remained unsuccessful, as the required temperatures were not reached.

In early 2019, the project ceased by agreement of all parties, with a commitment to work with the Commonwealth and industry to navigate a pathway to the commercial deployment of VAM abatement technologies. The project highlighted the safety issues involved in abating VAM. Subsequently, a separate, Commonwealth funded project was able to achieve a safe design installation of VAM abatement technologies at an active mine site.

VAMRAB pilot plant at Mandalong (courtesy of CINSW)

Project: Ventilation air methane catalytic mitigator

The challenge:

Investigate novel technologies to reduce ventilation air methane (VAM) emissions from coal mining operations.

The action:

Coal Innovation NSW funded the development and site trial of a novel pilot VAM catalytic mitigator.

Grant amount:

Up to $1.5 million (EOI Round 2018).

The project:

This project involves undertaking the further development of a novel technology that aims to reduce the greenhouse gas emissions (GHG) from underground coal mining. Approximately 50-85 per cent of coal mining methane, a potent GHG, is emitted to the atmosphere through mine ventilation air, depending on mine site specifications. Ventilation air methane is very challenging for the coal industry to mitigate or use as an energy source because the air volume is large, and the methane resource is dilute and variable in concentration. CSIRO has previously successfully trialled a novel VAM mitigator (VAMMIT) at the Appin coal mine in southern NSW and is using the current funding to improve the performance and safety of this technology.

This project aims to reduce the operating temperature of the VAMMIT to much safer levels by incorporating two layers of catalysts inside the refractory bed of the existing VAMMIT unit at Appin mine. The project is ongoing, and the unit is intended to be commissioned and trialled with VAM to demonstrate its performance.

QBE dumps thermal coal due to global warming

2 April 2019

On Saturday, Australia's biggest coal underwriter (insurer) took the positive step of committing to phase out its entire thermal coal business by 1 January 2030.

QBE also ruled out providing insurance to any new thermal coal mine, power plant or transport network from 1 July 2019, and pledged to dump coal company shares from its direct investment portfolio. It has defined coal companies as those making over 30% of revenue from coal, or generating over 30% of electricity from coal.

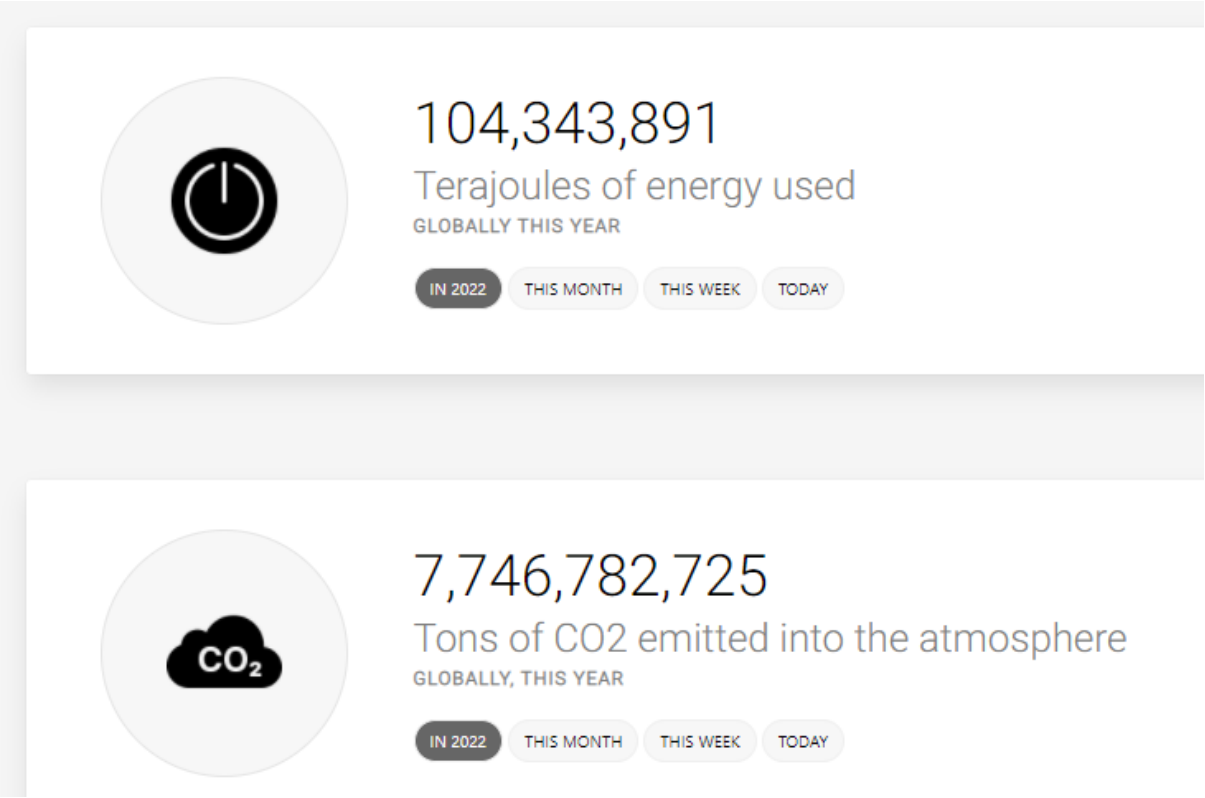
QBE has confirmed that this move covers all classes of insurance and facultative reinsurance except for statutory and/or compulsory insurance such as workers compensation.

The decision makes QBE the 11th major global insurer to restrict its coal underwriting, and the first based outside of Europe.

QBE's new Energy Policy makes clear the insurer is taking this step in an attempt to align itself with the Paris Agreement. Coal is the largest single contributor to global warming, which is fueling the worsening storms, bushfires, floods and heatwaves threatening lives and the profits of insurers worldwide.

QBE's announcement came in the midst of a long-running campaign by customers, shareholders and the wider public, coordinated by Market Forces, calling on QBE to end its investment in and underwriting of fossil fuel companies and projects.

❖ THE WORLD COUNT



- **This seems to be a massive "reduction of emissions" task to "capture the amount above" .**
- *So increasing the "Mitigation and Carbon Sequestration in NSW would help.*

❖ **THE CONVERSATION –** Published: September 26, 2019

Professor Jeremy Moss, UNSW

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- But Australia is also the world's largest exporter of coal and liquified natural gas. And by providing fossil fuel subsidies and exploration rights, the Australia federal government encourages its major mining companies to export more. This situation is now profoundly hostile to action on climate change.
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- ***Read more: Australia's energy exports increase global greenhouse emissions, not decrease them***
-
- The emissions produced from the fossil fuels extracted by Australia's major gas, coal and oil producing companies – our "carbon majors" – such as BHP, Glencore and Yancoal, are now larger than all Australia's domestic emissions.
-

❖ **THE CONVERSATION – 2018**

– Coal does not have an Economic future in Australia.

Renewables are stealing the march over coal in Australia, and the international outlook is for lower coal demand. Today the international Coal Transitions project released its findings, based on global coal scenarios and detailed case studies by teams in China, India, South Africa, Australia, Poland and Germany.

Our research on Australian coal transition – based on contributions by researchers at the Australian National University and the University of Melbourne – looks into the prospects for coal use in Australia and for exports, and the experiences with local transition in the case of the Hazelwood power station closure.

Read more: Hazelwood closure: what it means for electricity prices and blackouts

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Coal exports

Coal production in Australia is likely to be on a long term declining trajectory. Almost all coking coal (coal used for making steel) mined in Australia is exported, as is around 70% of steam coal (for electricity generation). Australia supplies about a fifth of the global steam coal trade.

A question mark hangs over the future of steam coal exports. Economic, technological and policy developments in other countries all point to likely falling coal use over time. The international coal transitions synthesis report expects that global coal consumption will go into reverse by the early 2020s.

In most industrialising countries, there are big concerns about local air pollution, and renewable power alternatives are becoming cost-competitive with coal. Add to that the pressure to meet Paris emissions targets.

China and India, on which much of the hopes of Australia's coal export industry are pinned, mine coal themselves. When overall coal use in these countries falls, imports may be curbed, if only because of pressures to prop up domestic coal mining.

Coal in Australia's power sector

Most coal used in Australia is for power generation. We are at the start of a fundamental change in the system, where coal power will be replaced by renewables, with energy storage and flexible demand-side response to firm up the system.

Read more:* *Want energy storage? Here are 22,000 sites for pumped hydro across Australia

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This change now reflects market economics. New wind farms and solar parks can now provide energy at much lower cost than any new fossil fuel powered generators. A new coal fired power plant would need subsidies, take a long time to build, and suffer exposure to future carbon policy.

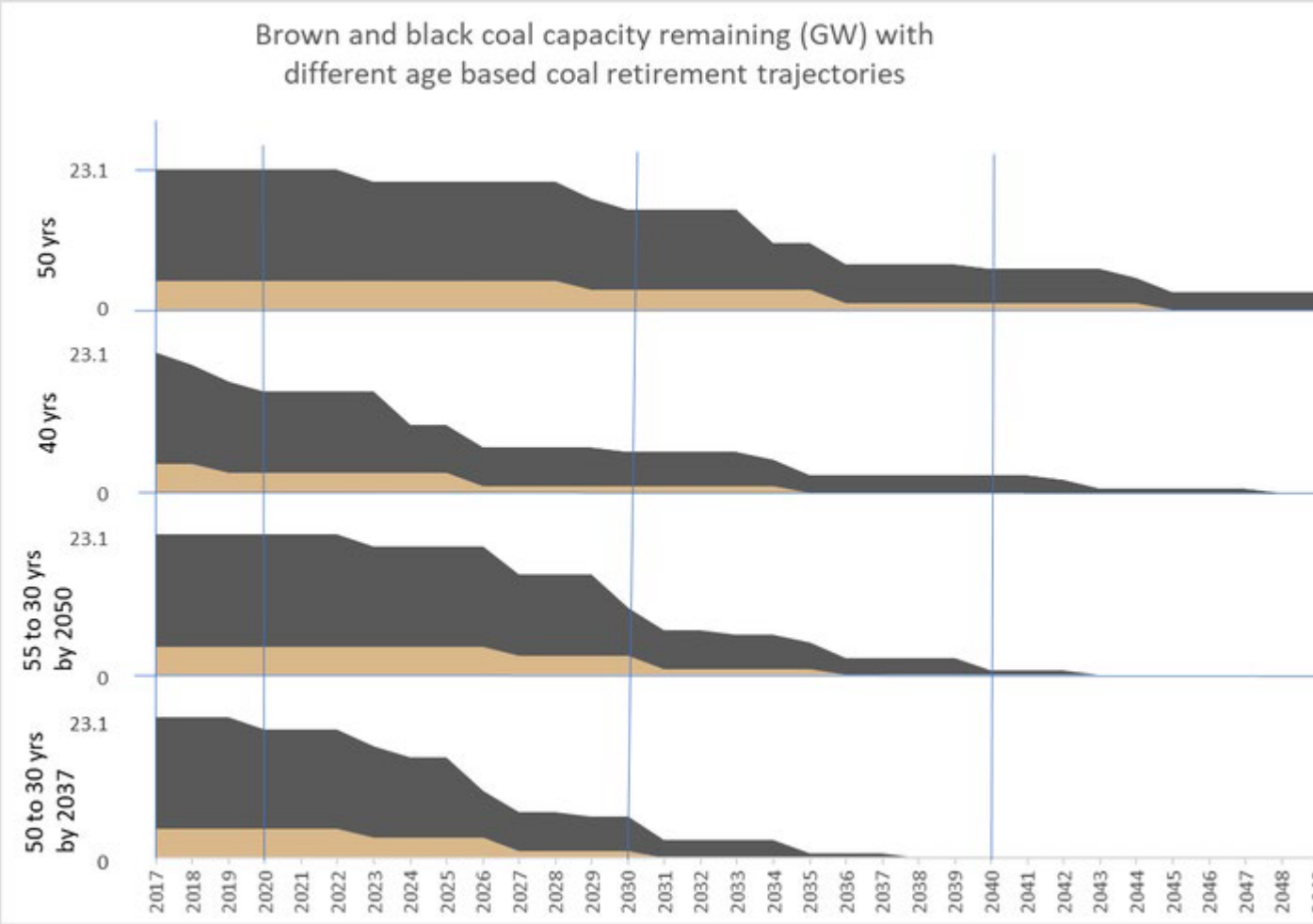
The competition is now between renewables and existing coal fired power stations. Wind and solar power cost next to nothing to run once built, so they are dispatched first on the grid and tend to bring wholesale market prices down. In turn, the economics of coal power plants deteriorates. They will not be able to sell as much power, and get lower prices on average for every megawatt-hour of electricity produced. New wind and solar is now

contracted at prices close to the operating cost of some existing coal plants, and renewables costs are falling further.

Coal plants will be less and less profitable. They will tend to be shut down earlier, typically when major repairs or overhauls are due. Major refurbishments will tend to become unattractive. And the system does not need coal plants to run reliably. A combination of regionally dispersed renewables, pumped hydro and battery storage, gas plants and demand response will do the job.

It is difficult to predict just when coal plants will shut down. The following graphic illustrates the difference between a flat 50-year retirement pattern (as used for example by the Australian Energy Market Operator), with plants retiring at 40 years of age, in line with the average retirement age of plants over the past decade, and two illustrative scenarios that capture the fact that coal plants will come under increasing economic pressure.

In our “moderate” scenario, remaining coal plants retire at 55 years in 2017 and progressively retire younger until they exit at age 30 by 2050. In our “faster” scenario, plants exit at 50 years now, then progressively younger until they exit at age 30 by 2030.



Coal closure scenarios from Coal Transitions Australia report.

Even more rapid closure scenarios are plausible if the cost of renewables and storage continue on their recent trends. We do not present them here, instead opting for relatively conservative assumptions.

The pace of closure makes a big difference to emissions. In the "moderate" scenario, cumulative emissions from coal use are around 2.6 gigatonnes of carbon dioxide ($GtCO_2$) during 2020-50, and in the "faster" scenario around 1.8 $GtCO_2$.

As a reference point, a "2 degree compatible" emissions budget for Australia proposed by Australia's Climate Change Authority has a total national emissions budget of around 5.8 $GtCO_2$ from 2020-50. Our "moderate" scenario has coal emissions take up around 44% of that cumulative emissions budget, while the "faster" scenario takes up around 32%. By comparison, coal currently makes up around 30% of Australia's annual net emissions.

It is no longer true that reducing emissions in the electricity sector necessarily means higher prices. These days, and in the future, having policy to guide the replacement of ageing coal capacity with cheap renewables is a win-win for consumers and the environment.

We had better get ready

We better put our efforts in preparing for the transition, rather than trying to stem the tide. That includes a meaningful policy treatment of carbon emissions, and mechanisms to allow more predictable exit pathways. The relatively sudden closures of the Hazelwood power station is an example of how not to manage the transition.

Wholesale prices jumped up because the replacement investment takes time, and governments scrambled to provide support to the local community after the fact.

We can do much better. Australia is well placed for a future built on renewable energy. The change can be painful if it's not well managed, but the future looks bright.

Read more:* *Australia is not on track to reach 2030 Paris target (but the potential is there)

IPCC adaptation report

'a damning indictment of failed global leadership on climate'

28 February 2022

Climate and Environment

UN scientists on Monday delivered a stark warning about the impact of climate change on people and the planet, saying that ecosystem collapse, species extinction, deadly heatwaves and floods are among the "dangerous and widespread disruptions" the world will face over the next two decades due to global warming.

"This report is a dire warning about the consequences of inaction," said Hoesung Lee, Chair of the Intergovernmental Panel on Climate Change (IPCC).

"It shows that climate change is a grave and mounting threat to our wellbeing and a healthy planet. Our actions today will shape how people adapt and nature responds to increasing climate risks," he said, adding: "Half measures are no longer an option."

According to the report, **human-induced climate change is causing dangerous and widespread disruption in nature and affecting billions of lives all over the world**,

despite efforts to reduce the risks, with people and ecosystems least able to cope being hardest hit.

This is the second in a series of three reports from the the UN's top climate scientists and its launch comes just over 100 days since the UN climate action summit in Glasgow, COP26, agreed to step up action to limit global warming to 1.5°C and stave off the worst effects of climate change.

UN Secretary-General António Guterres called the first report, issued last August, a "code red for humanity", and said that "If we combine forces now, we can avert climate catastrophe."

Criminal abdication of leadership

Mr. Guterres said the world's biggest polluters are guilty of arson of our only home.

In the face of such dire evidence, it is essential to meet the goal of limiting global temperature rise to 1.5 degrees, and the science shows that will require the world to cut emissions by 45 percent by 2030 and achieve net zero emissions by 2050.

"But according to current commitments, global emissions are set to increase almost 14 per cent over the current decade. That spells catastrophe. It will destroy any chance of keeping 1.5 alive," said the UN chief.

One of the report's core truths is that coal and other fossil fuels are choking humanity, the Secretary-General explained, **calling on all G20 governments to live up to their agreements to stop funding coal abroad**, and the must now urgently do the same at home and dismantle their coal fleets.

Moreover, he said that oil and gas giants – and their underwriters – are also on notice. "You cannot claim to be green while your plans and projects undermine the 2050 net-zero target and ignore the major emissions cuts that must occur this decade. People see through this smokescreen."

Instead of slowing down the decarbonization of the global economy, now is the time to accelerate the energy transition to a renewable energy future, he said declaring fossil fuels **a "dead end for our planet, for humanity, and yes, for economies,"** and calling for developed countries, Multilateral Development Banks, private financiers and others to form coalitions to help major emerging economies end the use of coal