

# Thermal coal flat-lines in faltering economy, power from non-coal sources continues to grow

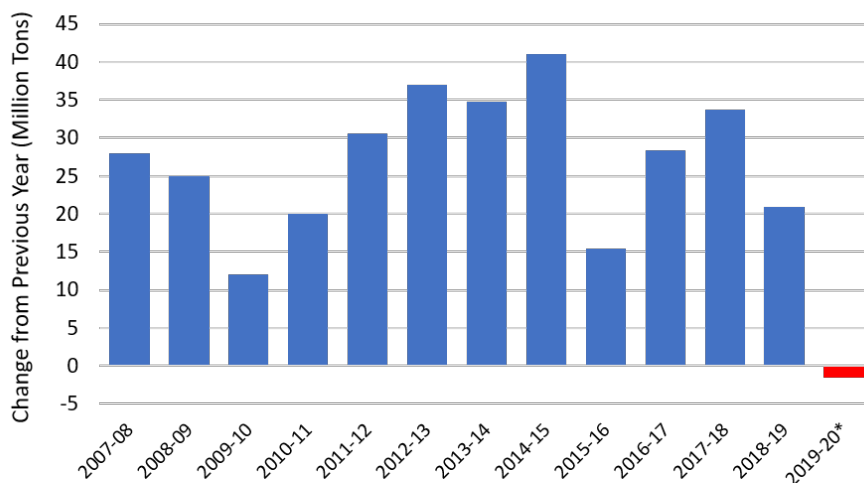
*Opportunity to fast-track ambitious clean energy transition, reduce air pollution and stimulate rural job growth*

In the space of just a few days, India's slowing economy has attracted the attention not only of the [domestic press](#), but of international media including the [Financial Times](#) and an Economist [special report](#), which noted that *"with alarming speed, India has gone from being the world's fastest-growing large economy to something more like a rumbling Indian railway train."*

A host of economic indicators have received attention, ranging from the official (World Bank and Indian government growth downgrades) through indices such as [Fitch Ratings](#) or LiveMint's [Macro Tracker](#), to the flippant but nonetheless informative (including the New York Times' story on underwear sales, or Nielsen's report of [declining toothpaste](#) purchases in rural India).

To this list may be added an economic heavyweight: thermal coal.

Figure 1. Annual Change in Coal Consumption by Power Sector



(Data: CEA) \*First 7 months of FY 2019-20, based on CEA coal statements to September and estimated coal consumption for October from POSOCO generation reports.

Having held up throughout the summer when other signs of a relative downturn were already apparent, the amount of thermal coal burned for power fell precipitously in September and October. So steep has been the decline that the annual increase in coal consumption by the power sector, which has averaged 6.3% or 27 million extra tons each year for the last 12 years, fell to zero not only for the financial year to date (Figure 1), but also for the full 12 months to 31 October 2019, compared to the previous year.

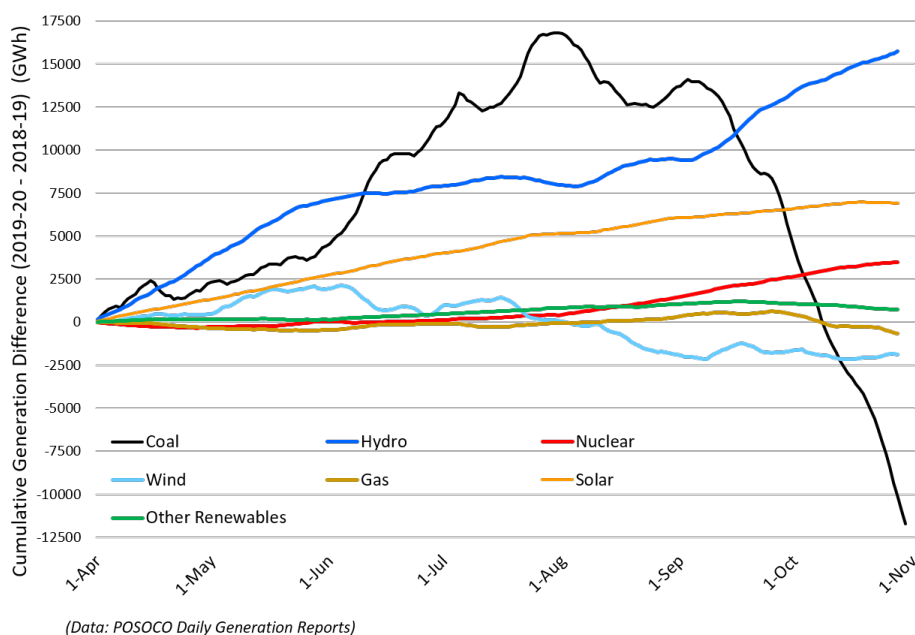
**When economies stumble, slackening electricity demand is a very common symptom.**

When economies stumble, slackening electricity demand is a very common symptom. In India's case, the current decline is quite specific to coal. This is most readily seen by comparing how power generation from different sources has changed across the course of this year relative to last.

Hydro, solar and nuclear have added substantially to their generation levels of the previous year and continue upwards. Wind started well but the monsoon period was disappointing, resulting in less cumulative generation than at the end of October in FY19. Gas, a minor player, also lagged slightly.

Collectively, power from all non-coal sources grew by about 24,000 GWh or 8.4%, to the end of October. (See Figure 2 showing the cumulative excess (+) or deficit (-) calculated daily from April 1, the start of FY20)

**Figure 2. Cumulative Generation - Difference between FY 2019-20 and FY 2018-19**



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The obvious exception is coal, which had made the largest contribution to extra energy as of late July, only to falter in August and collapse in September and October. As of the time of writing, coal had produced about 12,500 GWh less electricity than it had by the same date in FY19, roughly the amount, for perspective, consumed by Delhi and its 24 million residents in five months.

Given the scale and speed of coal's decline and its dominant generation role in India, it is noteworthy that overall electricity generation growth remains positive for the year so far, showing the continuing success of the Government of India's plans to diversify and decarbonise.

Three related points can be made about this abrupt fall. Firstly, it is not primarily the consequence of any shortage of coal, despite [claims to the contrary](#). Power plant stocks are now 8.5 million tons (66%) higher than at the end of October last year when generation was much higher, despite 29 plants having 'critically low' stocks (only three plants are in that position today). Not only have the Rail and Coal Ministries succeeded in increasing power plant stocks overall, they have evened out the distribution to reduce the number with only a few days' supply (even though these now include more high capacity plants).

**Coal's decline is not primarily the consequence of any shortage of coal, despite claims to the contrary.**

More to the point, the 77 plants that generated less energy in late October this year than they did a year ago had on average 7.8 *more* days of stock on hand (using October 28 as the day for comparison and only plants whose capacity was the same in both years).

Thus while specific individual plants clearly do have supply problems because of strikes, weather (e.g. Talcher STPS), the [Dipka mine flood](#), and others (such as Tuticorin JV TPS) are receiving less coal than a year ago, this is not typical. Nationally neither unmet energy nor unmet peak demand has increased. Warnings that a supply crunch threatens to [restrict India's economy by 2024](#) may or may not eventuate, but they are not today's reality. Rather, India's economy appears to be limiting the use of available coal.

The second point is that the duration of the thermal coal downturn cannot be accurately forecast. To the extent it is driven by India's economic conditions, it could be relatively brief if the economic optimists are correct (such as Gaurav Dalmia, interviewed at the University of Pennsylvania's [Wharton Business School](#)), or longer-lasting, if we rely on those who see more intractable and structural factors at play. The [Economist's](#) take is that higher growth will largely depend on whether India adopts appropriate economic reforms: *"With luck, in a few years' time, the present slump may be regarded as a useful catalyzing moment."*

The third observation is that the coal slump offers India an unusual opportunity. While not under pressure from burgeoning electricity demand growth, India could fortify its necessary energy transition plans, reduce the country's 1.2 million annual

air pollution-related deaths, and stimulate urgently needed rural job growth, all while enhancing India's energy security through greater domestic capacity.

This could include a revival of large-scale renewable infrastructure investment in preparation for sustained higher growth, while accelerating the [HVDC Green Corridors](#) and plans for the [Flexible Operation of Thermal Power Plants](#), as well as new projects built on the comprehensive and collaborative [Grid Integration](#) studies India has developed.

As India presses forward with its renewable energy transition, as and when higher economic growth does resume, it will be fueled by substantially cleaner energy than in the past.

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## About IEEFA

The Institute for Energy Economics and Financial Analysis conducts research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. [www.ieefa.org](http://www.ieefa.org)

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# Conflating Queensland's Coking and Thermal Coal Industries

## *Thermal Coal Adds Little to Queensland's State Budget*

### Executive Summary

Coking coal (also known as metallurgical coal) is used for steel manufacturing. Thermal coal is used to generate electricity.

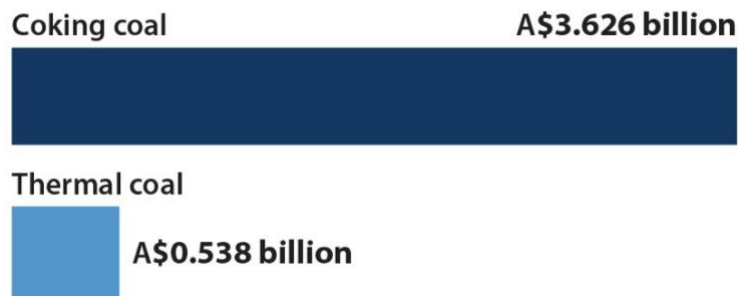
Coking coal and thermal coal are two completely different products of vastly different value to Queensland, supplying entirely different industries and with very different volume trajectories going forward.

According to IEEFA estimates for the calendar year of 2018 for Queensland coal exports:

Coking coal royalties are seven times more than thermal coal royalties in the Queensland budget, estimated at \$3,626m versus just \$538m from export thermal coal.

Coking coal contributes an overwhelming 87% of the coal royalties to the Queensland government. Standalone thermal coal mines generate less than 10% of Queensland coal royalties.

### Coking vs Thermal Coal Royalties to the Queensland Government



Sources: DFAT and IEEFA estimates for 2018 calendar year

Coking coal royalties averaged at \$23/tonne for coking coal vs. just A\$8/tonne for thermal coal.

Coking coal contributes 71% of total Queensland export coal volumes, but a much more significant 82% of the value of coal exports.

Given a progressive royalty rate for higher value products, coking coal export royalties reach 15% of value (in-excess of A\$150/t), whereas thermal coal export royalties are predominantly charged a 7% royalty rate. In calendar year 2018, thermal coal export royalties averaged just A\$8/t vs. \$23/t for coking coal.

**Coking coal is used for steel manufacturing and is far from technologically obsolete.** But there are alternatives to coking coal in supplying steel. One quarter of steel is made with scrap and electric arc furnaces, and at some point if the world is to achieve the Paris Agreement, coking coal emissions will need to be addressed.

Coking coal is valued at three times the price of thermal coal, far more able to carry the internalised cost of carbon emissions and is significantly less challenged by lower cost technology innovations.

**Coking coal is valued at three times the price of thermal coal.**

**Thermal coal is used to generate electricity and is rapidly approaching technological obsolescence.**

As a result, new thermal coal basins are un-bankable and of marginal viability.

Stranded asset risks for thermal coal, the associated supporting infrastructure investments and coal-fired power plants are rising. The urgency of dealing with the climate crisis is increasingly clear to financial institutions and financial regulators.

[To date, 112 globally significant financial institutions have introduced thermal coal policy restrictions.](#)

Adani has found it impossible to secure financial backers for its Carmichael thermal coal mine proposal in Queensland's Galilee Basin.

Given a three-year construction timeline and the proposed 7-year royalty holiday gifted by the Queensland government, the often-touted benefit of additional royalties from the Carmichael thermal coal mine proposal ignores that zero royalties are likely to be paid in the coming decade.

**Queensland Treasury forecasts point to speeding and red-light camera penalties being likely to contribute more to the Queensland budget than thermal coal in the next few years.**

A tonne of coking coal in Queensland pays four times the export royalties and is worth three times as much as low energy, high ash Carmichael thermal coal.

Queensland is the world leading supplier of coking coal for steel manufacture.

And coking coal, iron ore, and liquid natural gas (LNG) are Australia's three top mining and energy exports, rivalling tourism and education in their export value to Australia, highlighted by the Office of the Chief Economist (Figure 1).

In contrast, thermal coal use peaked globally back in 2014 and is set for terminal decline by 2050 if we are to limit global warming below dangerous levels (+1.5-2°C). The costs to Australia of extreme weather events and climate inaction are already A\$19bn annually and set to double.

Conflating coking coal with structurally challenged thermal coal tarnishes the overall resource sector’s social licence to operate. Global mining houses are being tarred defending the indefensible.

Forward looking mining houses like Rio Tinto planned their exit from thermal coal long ago. Andrew Forrest’s Fortescue Metals have ruled out entering the thermal coal mining sector in favour of investing in value-added opportunities in mining and new energy industries of the future, like hydrogen and lithium. BHP has now drawn the distinction with their no new thermal coal investments position.

**Queensland needs to be strategic and develop those resources that have the highest value to the State.**

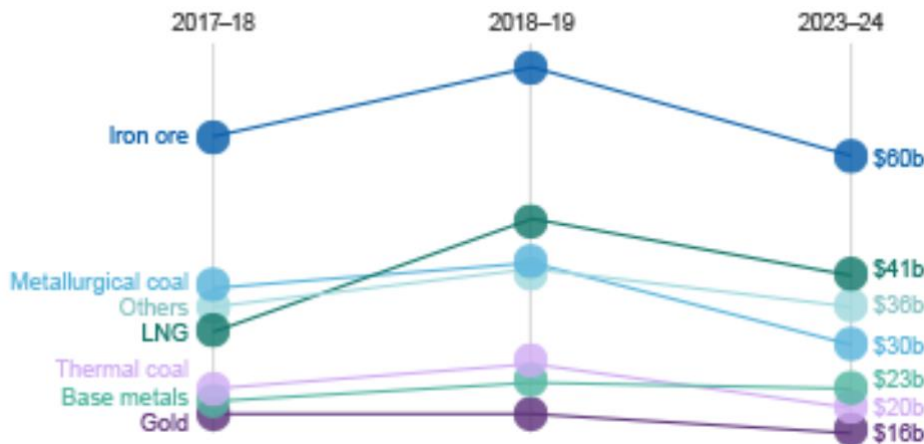
For IEEFA, the first step for Queensland would be a ‘no new thermal coal mine’ policy, highlighting the distinctly differing outlook of higher value-added coking coal for steel manufacturing vs. thermal coal. This would allow a sensible, bi-partisan debate and buy Queensland’s industry, community and workforce the time needed for an orderly transition over the coming decade.

**The first step for Queensland would be a ‘no new thermal coal mine’ policy.**

A ‘no new thermal coal mines’ policy would materially reduce the stigma and associated blame being felt by the state’s world-leading coking coal export sector, differentiating coking coal from the terminal decline prospects facing the thermal coal sector.

Expanding the extraction and use of thermal coal undermines the Paris Agreement, and is a policy objective of zero relevance to the outlook for Queensland’s coking coal, LNG or mining activities in rare earths, lithium and cobalt, all critical components of the supply chain for zero emissions industries of the future.

**Figure 1: Australia’s Top Resource and Energy Exports 2018-19 (A\$bn)**



Source: Australian Government’s Office of the Chief Economist, March 2019.



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## Section 1. Coking Coal Is Used to Manufacture Steel, Thermal Coal Is Used to Generate Electricity

Coking coal (also known as metallurgical coal) is used for steel manufacturing and is far from technologically obsolete.

Coking coal as a product holds a much higher value than thermal coal, with average export prices more than double those for thermal coal.

Thermal coal is used to generate electricity.

In a carbon constrained world, thermal coal is rapidly approaching technological obsolescence and struggling to compete with ever-lower cost, zero emissions renewable energy alternatives, as well as energy efficiency technologies, gas and hydro-electricity.

**Thermal coal is rapidly approaching technological obsolescence.**

Proponents of coal conflate coking coal and thermal coal. They are two completely different products of vastly different value to Queensland, supplying entirely different industries and with very different volume trajectories going forward (refer Appendix 1 for alternatives to coking coal).

### *Coking Coal for Manufacturing Steel*

Coking coal is predominantly used in steelmaking as a reductant (to convert iron oxide into metallic iron), as a carbon source to produce heat, and in the blast furnace to support the burden (preventing the iron ore and fluxes from collapsing into the liquid iron).

**Queensland is the world's largest supplier of seaborne coking coal globally, with a market share of almost 50%.<sup>1</sup>**

Queensland exports almost all of Australia's highest value hard coking coal. Queensland is also the major producer and exporter of two lower value coking coal grades:

1. Pulverised Coal Injection (PCI) coal which is used for its heat value and injected directly into blast furnaces, reducing the amount of higher quality, higher cost coking coal required.
2. Semi-soft coking coal (SSCC) used in the coke blend along with hard coking coal, resulting in a lower quality product with more impurities.

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<sup>1</sup> According to the Office of the Chief Economist, Australia has a 55% global market share in seaborne coking coal in 2018. Queensland exported 159Mt of coking coal in CY2018, 89% of Australia's total.

Alternatives to coking coal for the manufacture of steel are available. While structural timber is a commercially viable and proven alternative to steel in house frames and certain commercial building applications, and [aluminium](#) or [carbon fibre](#) can substitute for steel in cars, these alternatives have not yet been widely adopted globally.

Absent a sustained, high price on carbon emissions and further technological innovation (for example, commercialising the use of [zero emissions renewable energy](#) or [gas](#) generated hydrogen as a substitute for coking coal), current alternatives to coking coal in the manufacturing of new steel have not been widely adopted, and while this will change, it is not posing the same immediate disruption as wind, solar and storage is posing to thermal coal (See Annexure 1 – Alternatives to Coking Coal).

### *IEA Forecasts for Coking Coal*

Even if the world acts to successfully limit global temperature rises to 1.5-2°C, the International Energy Agency (IEA) acknowledges the limited scope for substitution to coking coal on current technologies, and as such forecasts that seaborne coking coal demand globally will only gradually decline.

**The IEA forecasts coking coal will decline a cumulative 17% by 2040, while thermal coal will show a much steeper 65% decline in the same period** (refer Figure 4.7).

The gradual decline in coking coal use primarily reflects the acceleration of scrap steel recycling in China using electric arc furnaces as their economic growth profile matures, along the lines of developments in North America and Europe in the last two decades.

In sum, while the demand profile of coking coal is negative, the lack of direct and commercially viable alternatives means that absent a very high global price on carbon emissions, Queensland's existing coking coal capacity has limited stranded asset risk over the coming decade or two.

### *Thermal Coal for Generating Electricity*

Thermal coal is used to generate electricity and therefore competes directly with a range of alternatives, from hydro-electricity, nuclear, gas/LNG, as well as renewable energy. A high price of coal and hence electricity will also drive the uptake of energy efficiency as an alternative.

In an increasingly carbon constrained world, thermal coal is rapidly approaching technological obsolescence and is struggling to compete with ever-lower cost, zero emissions renewable energy alternatives. As a result of this loss of competitiveness, and combined with the massive externality costs of coal mining and use (water and air pollution, problematic mine rehabilitation, fly-ash waste disposal post-use as well as the obvious carbon emissions), thermal coal is increasingly becoming unbankable.

**Greenfield thermal coal mine proposals are struggling with questions of viability**, particularly new basins, given the absence of prerequisite supporting water, electricity and transport infrastructure, combined with reduced capital access. This is the dilemma the Adani group is facing with its long delayed thermal coal Carmichael mine proposal for Queensland. Since 2017, India's domestic coal and domestic renewable energy projects are the preferred and low-cost source of new electricity supply, leaving Carmichael a stranded asset, unviable and unnecessary if the world is to remain a liveable planet.

### *IEA Forecasts for Thermal Coal*

The IEA very clearly states "unabated coal generation is incompatible with the long-term emissions requirements of the Sustainable Development Scenario (SDS)... Only 5% of global electricity generation is based on thermal coal by 2040."<sup>2</sup>

However, the IEA has also long assumed that carbon capture and storage (CCS) will be rapidly deployed in the thermal coal-fired power sector. This is despite the near global absence of a sufficiently strong carbon emissions price signal, leaving this forecast increasingly unrealised.

**The thermal coal industry has consistently campaigned against a price on carbon, despite this being a critical prerequisite for this industry's long-term survival.** The IEA concludes: "progress in CCS deployment and investment remains limited in practice and lags well behind the pace that would be needed in this scenario (the SDS)."

Likewise, the IEA continues to forecast that India will be the single largest source of global demand growth for thermal coal. IEEFA has long questioned the validity of this forecast in light of investment trends over the last three years (refer Section 8).

With global financial institutions increasingly committing to a thermal coal phaseout or outright lending ban (refer Section 7), capital flight from thermal coal is increasing at the same time as key coal import nations are rapidly shifting their energy targets towards renewable energy and LNG, replacing high polluting, high emissions imported coal.

**Capital flight from thermal coal is increasing.**

As one example, in April 2019 [South Korea](#) proposed a new 30-35% renewable energy target by 2040, up from the current 8%, as the latest iteration of their strategic shift away from thermal coal. This builds on the 28% increase in [South Korea's coal tax to US\\$40/t](#) (effective April 2019), and combines with a national emissions trading scheme which now prices carbon at US\$20/t, making imported coal less and less competitive.

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<sup>2</sup> IEA World Energy Outlook 2018, November 2018, page 232.

## Queensland Produces 96% of Australia’s Hard Coking Coal

In CY2018, Australia exported 385.8 million tonnes (Mt) of coal. Coking coal comprised 46% of this total at 178.2Mt, while thermal coal comprised 54% or 207.6Mt (Figure 1.1). An analysis of the exposure of coal exports by state shows a stark difference.

Queensland exported 58% of Australia’s total coal volumes while NSW exported the balance at 42%.

Queensland is predominantly a coking coal exporter, making up 71% of total state coal exports by volume and 83% by value (refer Figure 2.1). Queensland produces 96% of Australia’s high value hard coking coal, and a dominant 76% of Australia’s lower value semi-soft coking coal (SSCC) and pulverised coal injection (PCI).

### Thermal coal represents just 29% of Queensland’s coal export volumes (17% by value).

NSW exported 163.2Mt of coal in CY2018, but 88% of this was lower value thermal coal. Mirroring Queensland, NSW exports just 4% of Australia’s highest value hard coking coal, and 25% of Australia’s total SSCC & PCI volumes.

**Figure 1.1: Australia’s Coking vs. Thermal Coal Exports by State (CY2018)**

Exports CY2018 Millions of Tonnes	Australian Total	Qld Total	Qld Share	NSW Total	NSW Share
Hard coking coal	118.4	113.5	96%	4.8	4%
Coking coal (SSCC & PCI)	59.8	45.2	76%	14.7	25%
Coking coal (hard, SSCC & PCI)	178.2	158.7	89%	19.5	11%
Thermal coal	207.6	64.0	31%	143.7	69%
All coal exports	385.8	222.7	58%	163.2	42%
Coking coal as share of total volumes		71%		12%	

Source: DFAT STARS Database, based on ABS Cat No 5368.0, December 2018 data, Office of the Chief Economist, Department of Natural Resources and Mines Queensland, IEEFA calculations.

## Critical Headwinds Affecting Queensland’s Galilee Basin

While the Galilee Basin has long been touted as a potential source of new thermal coal exports for Queensland, this has ignored three critical headwinds:

1. The remote location of the Galilee Basin puts it 400km from a coal export port, without the prerequisite supporting water, electricity, roads and rail infrastructure.
2. Relative to the global seaborne thermal coal market, the Galilee Basin is high ash thermal, low energy (HALE) coal. Carmichael’s deposit has an energy content 15% below that of NSW’s Hunter Valley thermal coal, and double the ash content.

3. Global demand for thermal coal peaked back in 2014 and is set for terminal decline by 2050 if the world is to successfully limit global warming to +2°C or less. Flooding the world with more supply in a declining demand market is *not* in Australia's strategic interest and would only serve to lower the price of our existing thermal coal exports.

## Section 2: Queensland Government Coal Royalties

IEEFA estimates that royalties from coal exports due to the Queensland government in CY2018 include:

\$3,626m from coking coal for use in manufacturing steel.

\$538m from export thermal coal destined for use to generating electricity (as per Figure 2.1).

**Figure 2.1: Queensland Royalties – Coking vs. Thermal Coal (CY2018)**

	Price A\$/t	Volume Mt	Value A\$bn	Royalties A\$m
Coking coal	214	159	33.5	3,626
Thermal coal	111	64	7.1	538
<b>Total</b>	<b>n.a.</b>	<b>223</b>	<b>40.6</b>	<b>4,164</b>
Coking coal		71%	82%	87%
Thermal coal		29%	18%	13%
<b>Total</b>		<b>100%</b>	<b>100%</b>	<b>100%</b>

Source: DFAT STARS Database, based on ABS Cat No 5368.0, December 2018 data, Office of the Chief Economist, Department of Natural Resources and Mines Queensland, IEEFA calculations.

As discussed in Section 1, Queensland exported 223Mt of coal in CY2018. Some 71% of this total included coking coal exports for use in steel manufacturing. Thermal coal represents just 29% of Queensland’s total coal exports, by volume.

### **Coking coal is a much higher value product than thermal coal.**

Queensland coking coal export prices averaged an estimated A\$214/t in CY2018 in comparison to just A\$111/t for thermal coal – more than half the price.<sup>3</sup> The coking coal sector generated \$33.5bn of exports, or 82% of Queensland’s total coal, by value.

Queensland also has a strongly progressive royalty sharing policy. Above A\$150/t, coal royalties to the state are 15% of value, relative to just 7% on prices below A\$100/t (Figure 2.2).

### **In CY2018, Queensland thermal coal royalties averaged just A\$8/t versus A\$23/t for coking coal.**

<sup>3</sup> Calculated from the Office of the Chief Economist figures published in “Resources and Energy Quarterly”, March 2019.



In sum, coking coal exports contributed an estimated \$3,626m to the Queensland government in CY2018, 87% of the state’s total coal royalty take.

Given lower quality thermal coal is a by-product of many coking coal mines in Queensland, **the contribution to state royalties from standalone thermal coal mines is less than 10% of the state’s total.**

**Figure 2.2: Queensland Royalties**

Average price per tonne for period	
Up to and including \$100	7% of value
Over \$100 and up to and including \$150	First \$100 - 7% of value Balance - 12.5% of value
More than \$150	First \$100 - 7% of value Next \$50 - 12.5% of value Balance - 15% of value

Source: Queensland Government, accessed April 2019.

### *Combining Royalties from Coking Coal and Thermal Coal Muddies the Waters*

Conflating coking coal royalties and thermal coal royalties has significant strategic implications for Queensland.

Many environmental groups are campaigning for a ‘No New Coal Mine Policy’, given the mining and burning of coal is the largest single contributor to global carbon emissions.

If the coal industry was able to highlight the global importance of Queensland’s coking coal industry, and the lack of cost-effective, low emissions technology alternatives available,<sup>4</sup> much of the debate would rightly focus on the highest global climate priority – to rapidly phase out reliance on high emissions thermal coal used in generating electricity (refer Section 4).

<sup>4</sup> IEEFA’s expert witness report to the NSW Land & Environment Court of 2018 highlighted that the development of electric arc furnaces combined with rising recycling rates of steel scrap in China is a key threat to coking coal longer term. Also, cost-competitive alternatives to coking coal in the manufacturing of steel are emerging (primarily zero emissions hydrogen, incentivised in Europe by the rapidly rising carbon price (refer Section 6)). The IEA forecasts only a gradual, phased decline in global coking coal demand, rather than the precipitous and terminal decline in global thermal coal demand by 2050 if we are to retain a liveable planet (refer Section 4).

## *Global Finance is Exiting the Thermal Coal Sector*

The divergence of views on coking versus thermal coal is clearly evident in the growing number of [globally significant financial institutions](#) announcing thermal coal and coal-fired power plant lending and insurance restrictions and/or complete divestment (refer Section 7).

IEEFA also notes the global implications of Japan's Marubeni Corporation's new [climate policy](#) released in September 2018, announcing its decision to cease developing coal-fired power plants globally. Outside of China and India, Marubeni was the world's largest developer of new thermal coal-fired power plants during the last five years.

It is important to note that while Japanese trading houses are quickly exiting thermal coal mine ownership, they are generally choosing to retain their coking coal investments.

## *Carmichael Royalty Holiday: No Royalties to Queensland for a Decade*

It has been suggested that opening up lower quality thermal coal mining in the Galilee Basin will provide a much needed influx of thermal coal royalties for the Queensland government.

This statement ignores the significant and repeatedly downsized nature of the unfunded Adani Carmichael mine proposal, as well as the massive royalty subsidy demanded by Adani as the proposed first mover in the Galilee.

Given a three-year construction timeline and the proposed 7-year royalty holiday being negotiated with the Queensland government,<sup>5</sup> the often-touted benefit of additional royalties from the Carmichael thermal coal mine proposal ignores that few, if any, Galilee coal royalties are likely to be paid at all in the coming decade.

**Few, if any, Galilee coal royalties are likely to be paid in the coming decade.**

## *Coking Coal Royalties Nearly Seven Times More than Thermal Coal Royalties in the Queensland Budget*

Coking coal royalties contributed an estimated \$3,626m to the Queensland government in CY2018 versus just \$538m from export thermal coal.

Considering the **near 40% decline in global thermal coal prices since the start of 2019**, the likely near-term contribution of thermal coal royalties to the

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<sup>5</sup> While the Queensland Government is yet to sign the proposed seven-year royalty deferral, this is a massive capital subsidy, worth up to A\$125m annually at Carmichael's intermediate product coal export target of 27Mtpa.

Queensland government is set to diminish. In the long term, Queensland's thermal coal royalty contributions will be very significantly challenged by the likely progressive decline in import demand.

The IEA forecasts seaborne thermal coal markets will shrink two-thirds by 2040 if the world is to successfully and collectively deliver on the Paris Agreement.

In light of the likely steady decline in demand for coal globally, Queensland Treasurer Jackie Trad recently acknowledged the risks in Queensland's over-reliance on coal royalties, noting in the Mid-Year Fiscal and Economic Review: "What we do need to do is focus on the diversification factor, we need to focus on advanced manufacturing... encouraging new industries particularly in innovation into Queensland."<sup>6</sup>

Unlike NSW, Queensland has time to build this economic transition.

Queensland government revenues in 2018/19 are [forecast](#) at \$59bn. Beyond GST receipts, payroll tax is forecast to be the top contributor at \$4.1bn. This is followed by coking coal royalties at \$3.7bn. Thermal coal royalties are estimated at \$560m.

**Queensland Treasury forecasts point to speeding and red-light camera penalties as likely to contribute more to the Queensland budget than thermal coal in the next few years.<sup>7</sup>**

### *The Mining Industry's Reputation is Being Tied to Thermal Coal but Rio Tinto's Actions Highlight a Split is Coming*

Back in 2013, the Australian Coal Association (ACA) lobby group was [reported](#) as being taken over by the Minerals Council of Australia (MCA). In retrospect, this now looks to have been more of a reverse takeover of the MCA by the ACA.

In IEEFA's view, the dominant focus of the MCA in recent years has been: lobbying to undermine and then dismantle Australia's world leading carbon emissions price; advocating for non-existent "clean coal"; calling for yet-more taxpayer funded subsidies for coal carbon capture and storage (CCS); more recently, calling for even more Australian taxpayer capital subsidies to underwrite an otherwise unbankable investment in slightly lower emissions but high-cost new coal-fired power generation (marketed as "High Energy, Low Emissions" (HELE) coal-fired power plants); and finally, advocating against renewable energy policies.

IEEFA takes issue with the largely tax-haven based structured fossil fuel industry (both in Australia and globally) spending far more on political donations, lobbying and advertising on issues such as these, than on actual investment in research and development which sits at a fraction of a single percent of coal industry revenues.

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<sup>6</sup> Brisbane Times, "[Queensland's debt bill to hit more than \\$83 billion in three years](#)", 13 December 2018.

<sup>7</sup> ABC News, "[Queensland fines revenue on track to nudge half-a-billion dollars, figures reveal](#)", 20 March 2019.

**The MCA's activities are intent on prolonging the extraction and use of thermal coal**, policy objectives that are of zero relevance to the outlook for coking coal, iron ore, or any other Australian mining activities.

The MCA appears largely absent when it comes to advocating for the development of mining and downstream Australian processing relating to industries of the future.

A recent survey by the [Queensland Resources Council](#) (QRC) highlighted that the constant support for thermal coal has eroded the entire Queensland mining industry's social licence to operate, including that of the valuable coking coal sector.

While Australia's current political discourse focuses on the merits and need for thermal coal, most people in Australia would be surprised to learn that **West Australia is already a world leader in lithium (#1 globally), rare earths (#2 globally), cobalt (#3) and nickel (#4)** - all critical minerals needed for accelerating deployment of batteries, electric vehicles and renewable energy, the massive growth industries of the future.

IEEFA views the climate denialism of the MCA as a direct contradiction to major mining groups who are aligning with the global Paris Climate Agreement.

In December 2017, [BHP](#) acknowledged material differences of opinion and practice by the World Coal Association, the US Chamber of Commerce and the MCA over energy and climate policy. In April 2018, BHP finalised its exit from the [World Coal Association](#) citing the lobby group's stance on energy and climate change. BHP said it would remain, for now, a key funder of the MCA after the MCA committed to being technology neutral, and following the exit of its CEO in [September 2017](#).

In May 2019, BHP [announced](#) it will no longer invest in thermal coal.

In April 2019, [Rio Tinto](#) confirmed it was actively reviewing its association memberships after extensive stakeholder engagements on the issue of energy and climate policy. Rio Tinto is now [requiring its lobbyists to be consistent with the Paris targets](#), to be technology neutral, and to advocate against public coal subsidies.

Rio Tinto was the first global mining conglomerate to exit coal mining, progressively selling out of Mongolia, Mozambique and Australia, a process completed in 2018.

We also note Australian company Fortescue Metals have [ruled out entering the coal mining sector](#) in favour of investing in value-added opportunities in mining and new energy industries of the future, like [hydrogen](#) and [lithium ion](#).

The Queensland Resources Council as well as Queensland's state branch of the Construction, Forestry, Maritime, Mining and Energy Union (CFMMEU) are well aware of this technology transition, and it was an important message that saw the CFMMEU's Bob Carnegie prioritise climate change over the Galilee in his [comments](#) of May 2019.

Both could better invest in highlighting the high value and necessary role of coking coal as a completely different industry sector to thermal coal.

## *Acknowledging the Difference Between Thermal and Coking Coal for Better Public Discourse in Queensland*

All coal is not the same; coking coal is used widely, despite the alternatives available. Coking coal's higher value (three times higher than thermal coal) allows more optionality with respect to the eventual emergence of a carbon price or value to coal CCS.

Thermal coal is already in terminal decline and is the single biggest target globally of the scientific and environmental communities focussed on reducing emissions to divert the climate crisis.

Acknowledging the critical difference between coking coal for steel manufacturing and thermal coal for power generation, and the very different demand outlooks for each, might allow a more positive public discourse that looks to the real and sustainable opportunities for Queensland's resource industry as a whole.

For instance, renewable energy is another key natural and sustainable resource of regional Queensland, both for domestic use and longer term for export.

The political and community discourse about how to deal with the growing cost to all Queenslanders of more frequent, more extreme weather events would be far less divisive if the resources sector and their lobbyists acknowledged both the real risks and opportunities relating to the climate crisis.

**Renewable energy is another key natural and sustainable resource of regional Queensland.**

For IEEFA, the first step in this would be a 'no new thermal coal mine' policy. This would allow a sensible, bi-partisan debate and buy the industry, community and workforce the time needed for an orderly transition over the coming decade.

A 'no new thermal coal mines' policy could materially reduce the stigma and associated blame being felt by the state's world-leading coking coal export sector, differentiating coking coal from the terminal decline prospects facing the thermal coal sector.

**For the world to limit global temperature rise to 1.5-2°C, thermal coal mining and the associated coal-fired power plants must cease entirely by 2050.**

Global investors managing US\$32 trillion of assets have made this a clear priority for all companies they invest in. Use of coking coal must reduce over time, but its future is nowhere near as dire as thermal coal, and its higher value use gives it a far greater capacity to viably internalise the real cost of its carbon emissions.

### *Case Study: Olive Downs Coking vs. MacMines Thermal Coal*

In May 2019, there have been four distinct but (to IEEFA) related announcements:

1. Pembroke Resources received Queensland Government approval for their 15Mtpa Olive Downs coking coal export mine proposal in the Bowen Basin.<sup>i</sup>
2. Macmines of China announced it was abandoning its 38Mtpa China Stone HALE thermal coal export proposal in the Galilee Basin.<sup>ii</sup>
3. BHP's CFO Peter Beaven announced the company's plans to maximise the value of its last two thermal coal mines in the Hunter Valley in NSW, as the world inevitably moves away from high emissions thermal coal for power generation.<sup>iii</sup>
4. China's National Development and Reform Commission announced the world's largest renewable energy tender at 20.8GW, and awarded with zero subsidy, marking in dramatic fashion China's bid to reach renewable grid parity with coal-fired power by 2020 (three years ahead of its schedule for solar).<sup>iv</sup>

<sup>i</sup> Pembroke Resources, "[Olive Downs Coking Coal Project Receives Approval](#)", 14 May 2019.

<sup>ii</sup> ABC, "[Mega mine next to Adani quietly put on hold, thousands of promised jobs in doubt](#)", 23 May 2019.

<sup>iii</sup> The AFR, "[BHP dark on thermal coal's future](#)", 22 May 2019.

<sup>iv</sup> Bloomberg News, "[China Unveils First Batch of Solar, Wind Farms That Won't Be Supported by Subsidies](#)", 22 May 2019.

### *Kickstarting Olive Downs Coking Coal*

The relatively fast approval of the 15Mtpa Olive Downs coking coal mine near Moranbah in Queensland's Bowen Basin was achieved in part because there were no objections lodged against the proposal on environmental grounds.

This illustrates the key distinction of coking vs. thermal coal.

The IEA clearly flags that unabated thermal coal use must cease by 2050 if the world is to collectively deliver on the Paris Agreement. This alone is insufficient to deliver the necessary limit to global warming but is the single most important step. Coking coal use for steel manufacturing will continue for decades to come. Coking coal is worth three times the value of the low energy high ash thermal coal in the Galilee Basin.

The economics of the Olive Downs coking coal mine are greatly enhanced, and the project risks materially diminished, by the ability of this project to leverage existing road, rail, water, power and port infrastructure, along with the fully qualified workforce in the region, rather than having to build a new commercial airport to facilitate fly-in, fly-out workers, with all the associated family stress this brings.

Olive Downs will produce up to 15Mtpa of coking coal. At the current price of US\$200/t, and using the spot USD/AUD exchange rate of 0.69, this gives revenue of A\$290/t. Total annual revenues would be over \$4bn, generating A\$618m annual royalties (A\$41/t) to the Queensland government at the current spot hard coking coal price.

A high value coking coal mine close to the coast generates exceptionally high revenues and leverages existing infrastructure. This makes commercial and political sense.

In contrast, there is the Adani Carmichael project proposal.

At 10Mtpa, Carmichael's HALE thermal coal would sell at the current spot price of US\$50/t, or A\$72/t, giving annual revenues of A\$725m. Coal royalties would be A\$5/t (7%), or \$50m annually - if there is no seven-year royalty holiday.

**In sum, Olive Downs coking coal mine on 50% more volume delivers six times more revenue annually than Adani's thermal coal mine.** This is a high value product compared to a low value product.

The royalties per tonne are eight times higher at current spot prices for coking vs. thermal coal (A\$40/t vs. A\$5/t), acknowledging the estimated discount for HALE thermal coal in the Galilee.

**The total royalties of Olive Downs of up to A\$618m are more than twelve times that generated by Adani's stage I Carmichael proposal of A\$50m.**

Olive Downs will employ up to 1,000 staff at 15Mtpa generating A\$4bn of revenue. Adani Carmichael mine at 10Mtpa will have revenues of \$725m. If Adani is employing 10,000 staff to generate a sixth of the revenue of Olive Downs, the proposal is clearly unviable. The operational staff of Carmichael are likely to be half of Olive Downs, say 500, and not the 1,464 testified by Adani's economic expert in court in 2014, given the project has been downsized many times since then.

### *Abandoning China Stone's HALE Thermal Coal*

The decision to abandon the 38Mtpa China Stone HALE thermal coal proposal after a decade of investigation reflects the changing strategic landscape in China, the world's largest producer, consumer and importer of coal.

Macmines has clearly reassessed the outlook for thermal coal exports to China.

Given China's coal use peaked back in 2014, China is now looking to rapidly deploy well over US\$60bn annually in domestic renewable energy infrastructure projects at or below the cost of coal-fired power plants. Further, China is looking to deliver on

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its commitment to its people to progressively reduce air pollution, and its global commitment to ratchet up its efforts to meet the Paris Agreement.

### *BHP's Thermal Coal Exit*

The BHP announcement to progressively exit thermal coal mining is a clear independent assessment of the inevitable technology and policy driven changes underway. The assessment by one of the world's largest mining companies follows the same assessment and conclusion by RIO Tinto (which entered this decade one of the world's largest coal mining firms, and which now owns no coal mines, coking or thermal). Likewise, South32 has announced it will exit thermal coal mining globally.

There is a third global force at play. The world's largest financial institutions are announcing policies to cease lending, investing and insuring thermal coal mining and coal-fired power plants. To date, [112 global financial institutions](#) are exiting coal. (Refer Section 7.)

### *China Is Set to Reach Renewable Grid Parity by 2020*

In May 2019 China's National Development and Reform Commission (NDRC) – the country's top economic planning agency – approved the first 224 wind and solar projects under its new zero-subsidy policy. Of a total 20.8GW, this subsidy-free list encompasses 56 onshore wind farms and 168 solar arrays across 16 provinces.<sup>8</sup> China has long targeted subsidy free wind power by 2020, but while total installed solar costs have been coming down in recent years, China's solar was no-where near cost competitive with coal-fired power generation – until 2019.

America has seen renewable energy costs below thermal power generation since 2017, but that is with a 30% investment tax credit subsidy. India saw renewables move 20% below domestic coal fired power generation costs in 2017 (with a dramatic 50% decline in both wind and solar costs in a single year due to the introduction of transparent reverse auction tenders).

With domestic wind and solar in China now set to be delivered at grid parity by 2020 – even absent a cost of carbon emissions – the outlook for thermal coal has dimmed even faster than most thought possible.

Economics, finance, climate and energy policy considerations all highlight that thermal coal is strategically challenged. It is time to prioritise the limited global carbon budget to make room for high quality energy sources like coking coal, and join China, India, Japan and America in accelerating the deployment of low cost sustainable renewable energy generation.

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<sup>8</sup> Recharge News, "[China approves first 21GW of subsidy-free renewables](#)", 22 May 2019.



### Section 3. Coal Quality Issues

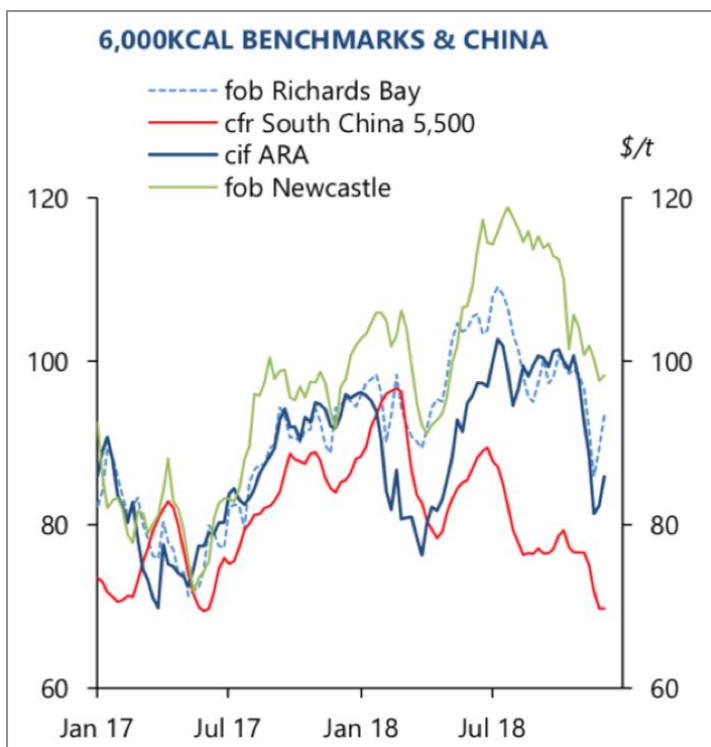
#### *The Galilee Thermal Coal Is of Inferior Quality*

The Newcastle benchmark 6,000kcal 12-14% ash content thermal coal export price ended the 2018 year at US\$100t/free on board (fob) - Figure 3.1. This was a dramatic improvement, double the 2016 lows of US\$50/t. As of end of March 2019, this price has fallen back to below US\$90/t.

The Newcastle 6,000kcal net as received (NAR) benchmark coal is a higher energy product than Indonesian export coal which has a 4,000-5,500kcal range, 10-30% below this top grade.

Coal quality is measured in terms of a number of attributes. After energy content, ash content is the second most important determinant of pricing. Indonesian thermal coal has an average ash content of 5-6%, half the Australian top benchmark.

**Figure 3.1: 6,000kcal Newcastle Benchmark Thermal Coal Price (US\$/t)**



Source: Argus Consulting, December 2018.<sup>9</sup>

Coal promoters often talk about Australian thermal coal being higher quality than domestic inland thermal coal in India, which is generally very low energy and high ash content. While the statement is correct, in IEEFA’s view it is also entirely misleading.

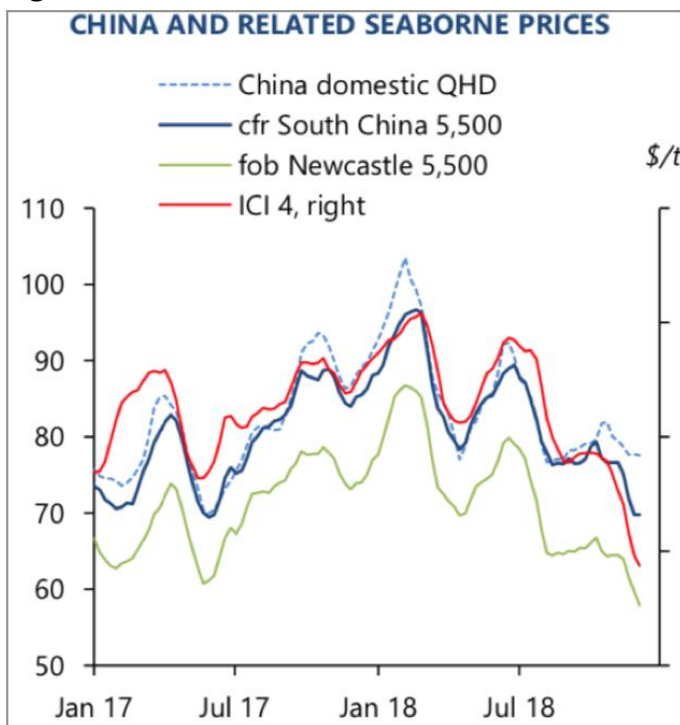
<sup>9</sup> Argus Consulting Services, “Thermal Coal Outlook 2019”, 7 December 2018.

Indian coal is located inland and is largely unconnected to any distant coal ports. As such, the vast majority of Indian coal power plants are entirely unable to use imported coal, even if they could afford the significant premium price (mine-mouth coal in India wholesales for ~US\$20/t). Further, the inland Indian coal plants are designed and engineered to use low energy, high ash thermal coal.

*Low Grade Thermal Coal (5,500 kcal) at a 2018 Low*

An important divergence emerged in the seaborne thermal coal market during 2018. The price discount of lower quality 5,500kcal coal to 6,000kcal coal reached a record differential. This was also evident in European coal pricing and has continued into 2019.

**Figure 3.2: 5,500kcal Newcastle Benchmark Thermal Coal Price (US\$/t)**



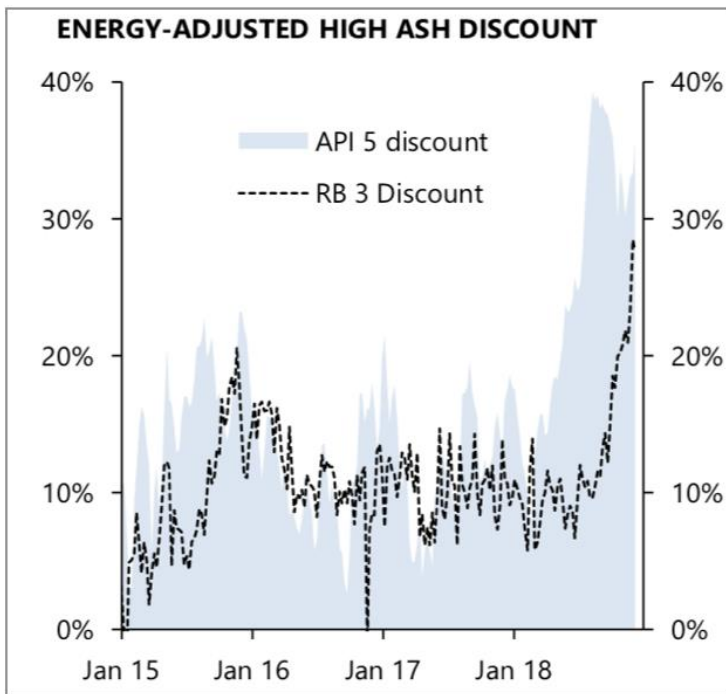
Source: Argus Consulting, December 2018.

The Newcastle benchmark for 5,500kcal coal with 20% ash declined over 2018 and exited the year at US\$57/t (See Figure 3.2, in green), a 43% discount to the 6,000kcal benchmark. As at end March 2019, this price was US\$56/t, a discount of 38%.

IEEFA views this as reflective of the ongoing push to deal with critically dangerous air pollution and lower emissions. China joined Japan, Taiwan and South Korea in paying a record high price for lower ash, higher energy coal (See Figure 3.3).

Argus has normalised coal pricing to calculate that on an equivalent energy content basis, high ash coal is now trading at a 30% discount to equivalent energy content coal of lower ash. This is treble the discount that applied in previous years.

**Figure 3.3: The High Ash Coal Price Discount Hit an Unprecedented High**



Source: Argus Consulting, December 2018.

IEEFA concludes that, unwashed, the Carmichael 4,950kcal, 26% ash raw thermal coal would sell internationally at a likely 50% discount to the 6,000kcal Newcastle benchmark price (using the end-March 2019 price of US\$90/t) – Figure 3.4.

**Figure 3.4: Carmichael’s High Ash Coal Price Discount likely 50%**

	US\$/t	Ash	
Newcastle Benchmark (12-14% ash)	6,000	\$90.00	13%
Newcastle Benchmark	5,500	\$56.00	20%
Price discount (%)	-8%	-37.8%	
Carmichael Coal	4,950		26%
Discount vs 5,500kcal	-10.0%		
Implied Carmichael Price (US\$/t)	\$40.52		
Discount 5,500kcal vs 6,000kcal	-37.8%		
Energy discount vs 5,500kcal	-10.0%		
Discount 26% vs 20% ash	-7.2%		
<b>Total Discount</b>	<b>-55.0%</b>		

Source: Platts, IEEFA calculations as at March 2019.

## Section 4. Scenarios Foretell Thermal Coal’s Structural Decline

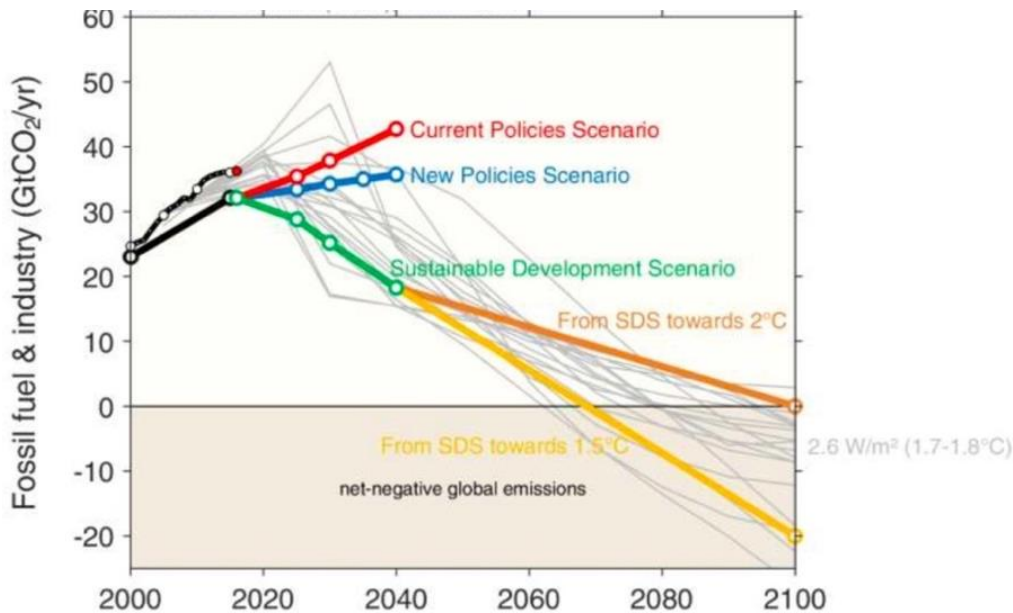
Each year, the International Energy Agency (IEA) releases the [World Energy Outlook \(WEO\)](#) which, among other things, [models](#) global energy demand using various scenarios. The scenarios are not predictions, rather tools to assess risks. The scenarios respond to global [Paris Agreement](#) targets aimed at keeping temperature rises to 1.5- 2°C.

Should the world successfully limit climate change to well below 2°C of warming, fossil fuel extraction must rapidly decrease towards zero net emissions, starting immediately. Thermal coal is the most negatively exposed commodity in this scenario.

All countries must instead accelerate reliance on sustainable, affordable and renewable non-fossil sources of energy to avoid catastrophic climate change.

IEEFA sees the IEA’s Sustainable Development Scenario (SDS) as the most likely reflection of the world’s energy future. Global financial institutions exiting coal are generally committing<sup>10</sup> to the IEA’s SDS or an even more ambitious transformation as outlined in the Beyond 2°C Scenario when they set Paris Agreement compliant targets.

**Figure 4.1: Possible Carbon Emissions Pathways Reflecting IEA Scenarios**



Source: Glen Peters, IEA WEO 2017, SS database (IIASA)P.<sup>11</sup>

<sup>10</sup> See IEEFA, [Over 100 Global Financial Institutions Are Exiting Coal, With More to Come Every Two Weeks a Bank, Insurer or Lender Announces New Restrictions on Coal](#), 27 February 2019.

<sup>11</sup> Centre for International Climate Research (CICERO), [Beyond Carbon Budgets and Back to Emissions Scenarios](#), Glen Peters, September 2018.

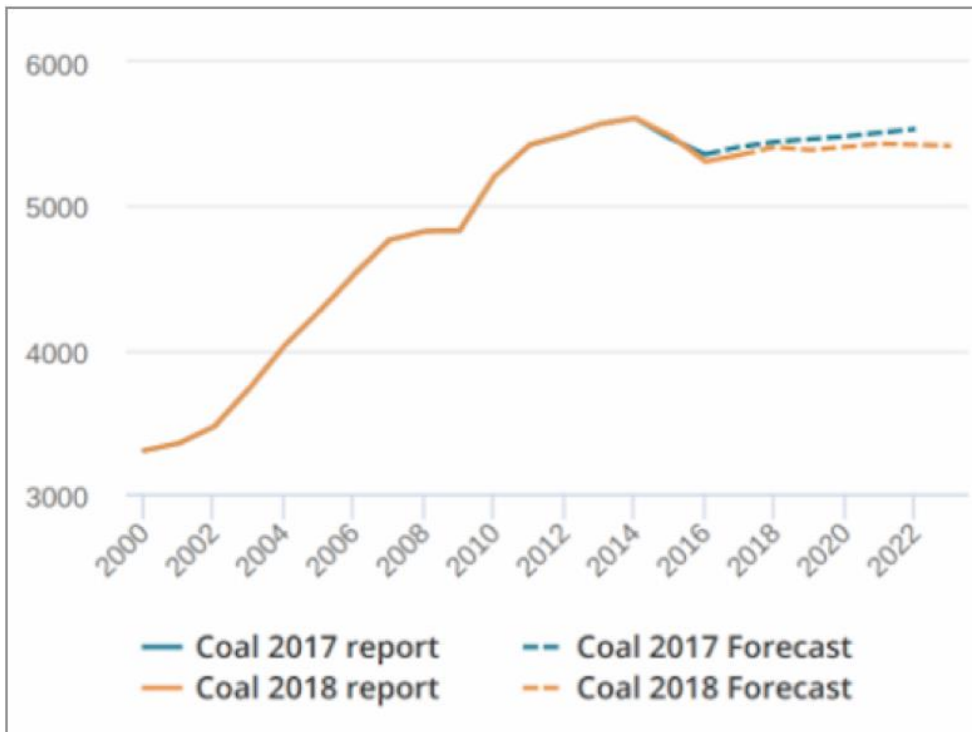
The Sustainable Development Scenario (SDS) presents a realistic, desirable scenario whereby nations work together to successfully limit climate change by transforming the energy market. Under the SDS, the planet’s ‘carbon budget’ will be exhausted as early as 2023 under a 1.5°C target and by 2040 under a 2°C objective. The SDS projects a significant decline in thermal coal demand, with global trade plummeting 65% by 2040.

The SDS falls short of meeting the Paris Agreement’s target with any certainty, given the presumption that coal carbon capture and storage (CCS) is commercialised at scale by 2030. IEEFA sees this as an improbable assumption absent a high price on carbon emissions.

### Reviewing IEA’s Thermal Coal Forecasts to 2040

The IEA acknowledges that global coal use likely peaked five years back in 2014 while modelling a stagnant near-term outlook to 2022 (See Figure 4.2). The global seaborne thermal coal market is a sub-section of the global coal market. The IEA also estimates seaborne thermal coal exports to have likely peaked in 2015.

**Figure 4.2: IEA Global Coal Demand Actual and Estimates 2018 vs. 2017 (Mtce)**



Source: OECD/IEA.

Despite coal’s peak back in 2014, coal lobbyists distract from the big picture by claiming Southeast and South Asia will provide significant thermal coal demand into the future.

In IEEFA's view, Southeast Asia represents a small fraction of the global seaborne thermal coal market. The idea that this region will remain isolated from the global energy transition and an untouched growth market to the benefit of Australian thermal coal exporters is a highly optimistic or even false hope.

For instance, in May 2019 Thailand announced a new energy plan to 2037 halving the role of imported thermal coal to just a 12% share.

IEEFA notes the global seaborne thermal coal market is not likely to reverse the inevitable technology, cost and policy driven direction of a slow, steady and ultimately terminal decline in volumes by 2050.

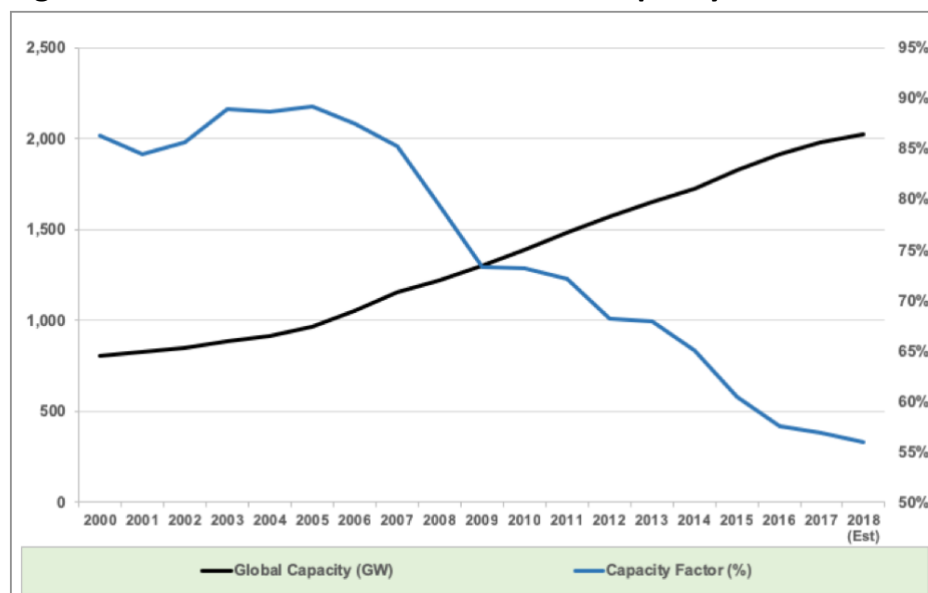
IEEFA makes this point relatively categorically given the rate of decline in the cost of renewable energy and on the premise the world collectively makes further efforts to implement the Paris Agreement, and absent the long touted but increasingly unlikely development of yet-to-be-funded commercially viable CCS for coal-fired power plants.

Rather than sinking more capital into expanding redundant thermal coal capacity, Queensland would be better placed optimising coking coal ventures in existing coal basins with established infrastructure already in place, while also investing in new low emissions industries of the future. This would best transition the Queensland, and ultimately Australian economy and limit our collective exposure to stranded assets.

**Queensland would be better placed optimising coking coal ventures.**

### *A Decade-long Global Over-investment in New Coal*

Coal supporters often justify a positive outlook for thermal coal by referencing the continued commissioning of new coal-fired power plants globally over the last decade – a trend detailed in Figure 4.3.

**Figure 4.3: Global Coal-fired Power Plant Capacity and Utilisation Rate**

Source: Global Coal Plant Tracker, BP Statistics, IEEFA estimates & calculations.

This outlook however only tells the optimistic half of the story, with the narrative missing several key globally entrenched developments:

**As coal plant capacity has risen, coal plant utilisation has declined.**

Coal consumption is *not* linked to increased thermal coal-fired power plant capacity but to the *use* of a coal plant. An idle new coal plant does not use *any* coal; it simply represents a stranded asset. The capacity utilisation rate of the global thermal coal-fired power plant fleet hit a new record low in 2018, exceeding the record low set in 2017, and in fact every year this past decade. (See Figure 3.4. RHS is in blue).

**Many coal lobbyists often cite new thermal coal plant development pipelines while failing to mention the rate of coal plant retirements.**

Global coal-fired power plant retirements are accelerating and by 2022 are forecast to exceed new plant completions.<sup>12</sup> In January 2019 Germany announced it would close 12 GW of thermal coal plants by 2022 as part of its accelerated 100% coal phaseout of its remaining 42 GW by 2038.<sup>13</sup> Global coal closures over 2015-2018 were 32 GW p.a., a 50% increase vs. the previous four years – Figure 4.4.

**The global thermal coal plant pipeline has shrunk by two-thirds.**

The pipeline has shrunk by a cumulative US\$1 trillion or 744 GW in a small

<sup>12</sup> Carbon Brief, Global Coal Plant Tracker, “Guest post: ‘Peak coal’ is getting closer, latest figures show”, July 2018.

<sup>13</sup> Financial Times, “Germany plans to phase out coal-fired power stations by 2038”, 28 January 2019.

timeframe (the 30 months to July 2018). Stranded asset losses are rapidly rising as renewable energy competition gets increasingly competitive.

**New thermal coal plant FID proposals are slowing.**

The IEA identifies 2017 as having a record low level of new thermal coal-fired power plant proposals moving to final investment decision (FID), due to investors reassessing coal’s future (Refer Figure 4.5).

**Thermal coal-fired power plants are becoming, on average, more efficient.**

Thermal plants are generating 0.5-1.0% p.a. more electricity per tonne of coal used.

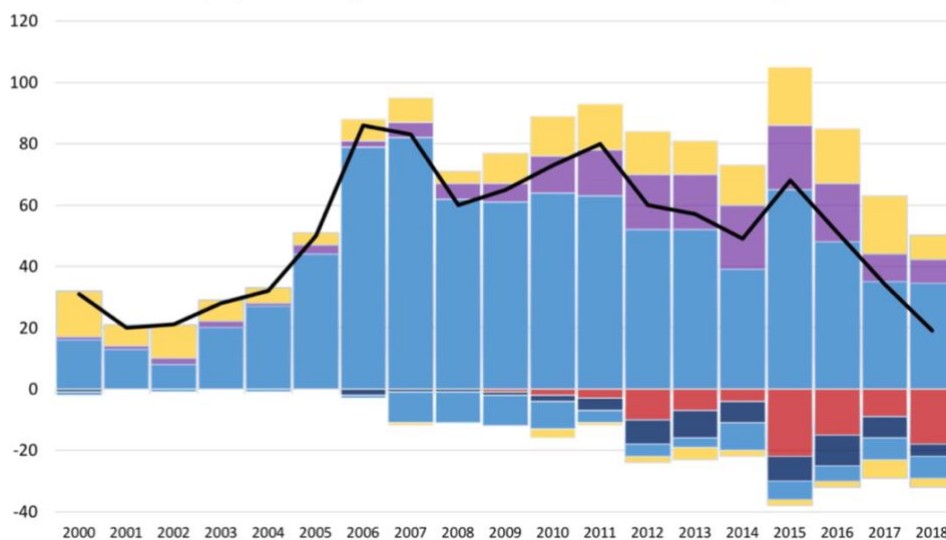
IEEFA notes there has been a decade-long over-investment in new coal-fired power generation capacity, in excess of demand. By 2020, IEEFA expects global coal plant capacity to reach a peak, and steadily decline thereafter, with thermal coal having already peaked back in 2014.

The commercial viability of the global coal power fleet on aggregate is technically challenged by collapsing utilisation rates which are sitting near 55%, suggesting plants sit idle, on average, every second day. This is a long way below the optimal 75-85% assumption erroneously factored into optimistic and wrong past projections.

**Figure 4.4: Net Global Coal-fired Power Plant Capacity Expansion**

**Figure 3: Coal power capacity additions (above 0 GW) and retirements (below 0 GW) between 2000 and 2018 (colored columns) and the global net change (black line) (gigawatts).**

China = blue, India = purple, Other = yellow, USA = red, EU = dark blue, Net change = black line



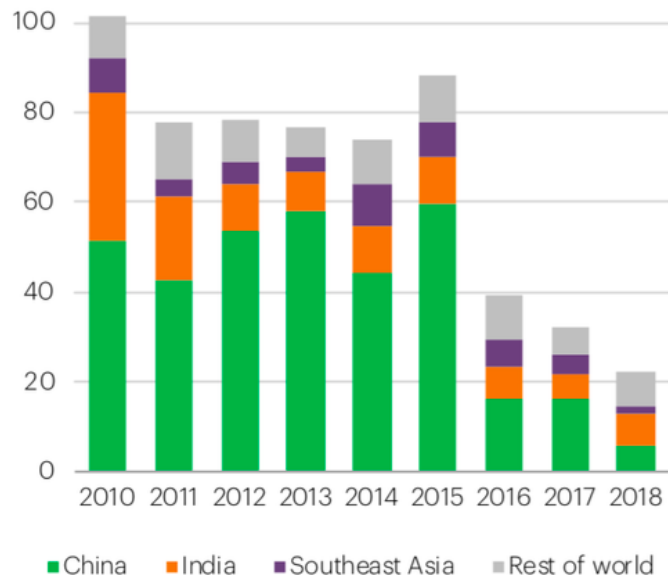
Source: Global Coal Plant Tracker, March 2019.

Investors have responded by dramatically curtailing coal-fired power plant expansion plans (Figure 4.5).



The momentum away from thermal coal is building.

**Figure 4.5: IEA Global Coal Power Plants Reaching FID Sign-off (GW)**



Source: IEA World Energy Investment, based on McCoy Power Reports 2019.

As per the IEA, if the world takes an SDS path consistent with limiting average warming to 2°C, global coal demand will more than halve by 2040 (-57%). The consequences for thermal coal would be even more dire, dropping in the realms of 61%<sup>14</sup> (Figure 4.6).

**Figure 4.6: IEA Global Coal 2014-17 vs. Forecast 2040: NPS vs. SDS (Mtce)**

	2014	2015	2016	2017	NPS 2040	NPS Chg vs 2017	SDS 2040	SDS Chg vs 2017
Total Coal (Mtce)	5,680	5,531	5,225	5,360	5,441	1.5%	2,282	-57.4%
Coking Coal (Mtce)	1,016	994	956	960	806	-16.0%	579	-39.7%
Thermal Coal (Mtce)	4,374	4,254	3,979	4,134	4,412	6.7%	1,609	-61.1%
Coking Coal % of total Vol.	17.9%	18.0%	18.3%					

Source: IEA WEO 2017 page 644-645, WEO 2018 pages 520-521, IEEFA calculations.

Under the SDS, which is a possible 2°C outcome, traded seaborne demand declines 65.1% against 2017 levels (Figure 4.7).

<sup>14</sup> As measured in millions of tonnes of coal equivalent (Mtce), an adjustment to standardise coal use by energy content.

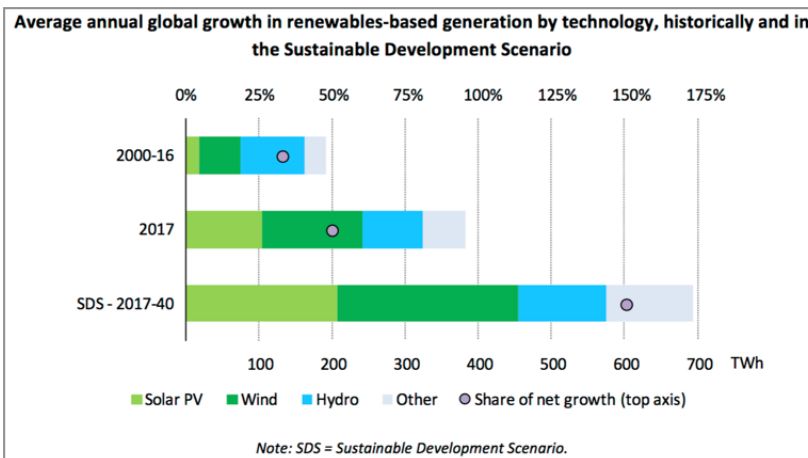
**Figure 4.7: IEA Global Seaborne Coal 2014-17 vs. 2040: NPS vs. SDS (Mtce)**

Mtce	2014	2015	2016	2017	NPS 2025	NPS 2040	NPS Chg vs 2017	SDS 2040	SDS Chg vs 2017
Thermal	801	761	756	805	736	760	-5.6%	281	-65.1%
Coking	284	293	292	302	320	346	14.6%	250	-17.2%

Source: IEA WEO 2016 page 206, WEO 2017 page 207, COAL 2017, NPS pg 134, WEO 2018 p. 218.

The SDS models electricity generation from zero emissions technologies more than doubling through to 2040 relative to the record high set in 2017 (Figure 4.8).

**Figure 4.8: The IEA SDS Forecasts Renewable Energy Will Supply 150% of Net Growth in Electricity Demand Globally Over 2017-2040**



Source: IEA WEO2018.

India is already talking about quadrupling renewable energy installs annually in the next two years relative to the record high installs recorded in 2017/18.

Similar to the IEA, IEEFA sees **India’s shift to the lowest cost sources of electricity generation, wind and solar, as indicative of the likely shift across the greater Asian market over the coming decade.**

Whether motivated by any or all of the reasons for this including energy security, economics, financial flows and/or policies to deal with rising fossil fuel pollution and other pressures, this trend is accelerating.

The implications are clear – the demand for seaborne thermal coal is past its peak and potentially entering terminal decline.<sup>15</sup>

<sup>15</sup> IEEFA, “Past their peak, NSW coal export volumes head toward terminal decline as markets transition”, November 2018.

## Section 5. Commitment to Paris Agreement

Australia is a legal signatory to the Paris Agreement and are committed as part of a global effort to limit temperature rise to 1.5-2°C above pre-industrial era levels.

Climate change experts like Professor Will Steffen have long testified in court and in the public domain<sup>16</sup> as to the challenges of delivering on this target while fossil fuels continue to burn:

*"There is no way you will meet any of these targets if you continue to increase emissions and I think that's a clear and very robust outcome of applying a carbon budget approach to the Paris targets... So step number 1, if you're really serious about the Paris targets, is no new fossil fuel developments. I mean, it doesn't take an Einstein to work that out that you cannot reduce emissions by increasing them."*

Opening a new thermal coal mine is clearly moving in diametrically the opposite direction to Australia's Paris Agreement commitments.

Australia is likely to come under increasing international pressure to do more to reduce carbon emissions going forward. This will include calls for action to reduce Australia's major global role in the export of fossil fuels to other countries.

### Sovereign Risk?

Coal lobbyists occasionally give the unsubstantiated opinion that banning new thermal coal developments would have a material adverse impact on Australia's global financial standing. In IEEFA's view, this "Sovereign Risk" argument is a hollow claim that has no standing.

At a time when our key global trading partners have already been discussing climate risks for many decades, any modernisation of the government approval process that takes into account the growing global financial market consensus on the need for a high price on carbon and the clear and rapid exit from the use of unabated coal within the 2030-2050 timeframe will be accepted as belated and entirely justified.

Back in 2017, the US\$6.3 trillion asset manager BlackRock's global head of infrastructure, Jim Barry, made it very clear:<sup>17</sup>

*"It's been amusing sitting back and watching Australia from afar because in effect it's been denying gravity... Coal is dead. That's not to say all the coal plants are going to shut tomorrow. But anyone who's looking to take beyond a 10-year view on coal is gambling very significantly."*

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<sup>16</sup> The Climate Council, "Unburnable Carbon: Why we need to leave fossil fuels in the ground", 2015.

<sup>17</sup> The Australian Financial Review, "BlackRock says coal is dead as it eyes renewable power splurge", 26 May 2017.

IEEFA would elaborate and say that allowing the re-opening and modification of the Dartbrook Mine actually raises a sovereign risk for Australia.

Australia is a signatory to the Paris Agreement, a global treaty ratified and entered into back in November 2016 with almost universal agreement.

Should Australia continue to approve the development of new coal mines, this clearly marks Australia as a hypocrite, a country that signs global treaties with no intent of adhering to them. It would identify Australia as heading in the wrong direction at a canter, out of step with the rest of the world. That is the definition of "Sovereign Risk".

IEEFA speaks with global financial institutions on a very regular basis and not once has any of the world's largest investors, corporates or banks ever suggested the controversial discussion over new thermal coal mines would have any impact on Australia's credit rating.

Banning the development of an entirely new coal mines is entirely consistent with both the majority of Australians views on the subject, and also increasingly consistent with the stance of global financial institutions.

## Section 6: Carbon Risk

The severe, multiple climate risks to Queensland’s critically important agriculture and tourism sectors and overall community costs of increasingly frequent extreme weather events are each significant enough to warrant the precautionary stance of leaving untapped low quality thermal coal/carbon reserves in the ground. Multiple economic experts have reported on this risk at length.<sup>18</sup>

The pricing of European Union’s Emissions Allowance Units (EAU) gives one guide to the cost of carbon and methane emissions. EAU’s are currently trading at a record €27/t (Figure 6.1).

**Figure 6.1: European Union’s Emissions Allowance Units (€/t)**



Source: <https://markets.businessinsider.com/commodities/co2-emissionsrechte>, 16 April 2019.

IEEFA would reference the [Rocky Hill decision](#) by Justice Preston as saying carbon emissions from a coal mine of scope 1,2 & 3 all count, as they are all released into the shared atmosphere, regardless of which country they are released from. It is therefore in Australia’s interest to utilise the little remaining carbon budget for highest value energy production.

While Australia’s current political landscape currently creates a policy disconnect between its international treaty obligations and its domestic climate policy, the financial, legal, and fiscal risks and costs of this have been well articulated by the Reserve Bank of Australia (RBA), the Australian Prudential Regulation Authority (APRA) and in our [legal system](#).

<sup>18</sup> The Australia Institute, “[Great Barrier Bleached: Coral bleaching, the Great Barrier Reef and potential impacts on tourism](#)”, June 2016.

## Section 7. Global Divestment from Coal-fired Power

### *Financial Institutions Pivot Away from Thermal Coal*

There is an ongoing and accelerating global shift away from financing thermal coal and coal-fired power plants, matched with the rapid cost declines of renewables technology and the very clear message of the United Nation's Intergovernmental Panel on Climate Change (UN IPCC) highlighting the need to virtually cease global coal use by 2050.

Global investors managing US\$32 trillion released a policy statement in December 2018 calling for a global price on carbon and an accelerated coal phase-out:

“Expert analysis shows that to meet the Paris Agreement goals of limiting the increase in global temperatures by 2°C, while striving to limit the increase to 1.5°C, a coal phase-out is needed by 2030, in the OECD countries and in the European Union; by 2040, in China; and by 2050, in the rest of the world.”<sup>19</sup>

The [Bank of England](#) has repeatedly highlighted the magnitude of climate change risks, including in April 2019 quantifying stranded asset losses at an estimated US\$20 trillion.

Australian banks have all moved to recognise the global financial risks of climate change, making strong commitments to reduce funding for thermal coal mining and coal-fired power plants.

Westpac ruled out financing new thermal coal basins in April 2017.

Commonwealth Bank (CBA) reported in August 2018, as part of its 2017/18 financial results, substantial progress in measuring, reporting and acting on their commitment, with a substantial decarbonisation shift well underway. This includes “carbon foot-printing” its equity portfolio of Colonial First State, one of Australia's largest fund managers. CBA has also shifted its lending programs towards funding low emissions technologies. Direct exposure to coal mining was down 7% year on year (yoy) to \$270m and coal infrastructure was down 30% yoy to \$1,000m, while lending to renewable energy was +32% year-on-year to \$3,700m.

In contrast, [Macquarie Group](#) has flown under the radar to-date and made no public commitment to exit coal. Yet, Macquarie has made renewable infrastructure investing one of its four global pillars of growth. Landmark [renewable energy](#) and [storage](#) deals across Europe and Asia show the momentum of global infrastructure investing towards decarbonisation.

Global coal divestment has also been progressing, with financial institutions pivoting to boost lending to renewable energy infrastructure and other low emissions alternatives.

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<sup>19</sup> IGCC, “[Briefing Paper on the 2018 Global Investor Statement to Governments on Climate Change](#)”, December 2018.

Today, 112 globally significant financial institutions have divested from thermal coal, including 45% of the top 40 global banks and 23 globally significant insurers.

Since the beginning of 2018, 41 coal restriction policies have been announced, with 28 being new and 11 building on earlier coal-related commitments, including:

February 2018 – **Generali of Italy** announced it would cease coal investments.

March 2018 – **BBVA of Spain** committed to US\$100bn of renewables lending by 2025 as well as ceasing financing any new coal mines and coal-fired power stations or extensions to existing ones.

April 2018 – **HSBC** committed to stop financing new coal-fired power stations in all countries except for Indonesia, Bangladesh and Vietnam.

June 2018 – the world's third largest reinsurer **Hannover Re** (US\$64bn AUM) introduced a 25% coal revenue maximum for its investment universe.

July 2018 – **Swiss Re** announced it would no longer provide insurance or reinsurance to businesses with more than 30% exposure to thermal coal.

August 2018 – **Munich Re**, the world's second largest reinsurer, committed to cease offering insurance for new coal-fired power plants and mines in industrialised countries. In addition, Munich Re will no longer invest in shares and bonds of firms that generate more than 30% of their sales in the coal sector.

September 2018 – the Chairman of **Standard Chartered** José Viñals announced the bank's coal exit strategy entitled "Here for good means saying no to coal: Why we're stopping our financing of new coal-fired power plants".

September 2018 – the Netherlands' **ING Bank** announced it would assess its US\$600bn lending book against alignment with a less than 2.0°C global temperature change, consistent with Paris. The bank previously announced a phase-out of lending to coal and expects to have zero coal exposure by 2025.<sup>20</sup>

September 2018 – **Standard Bank of South Africa** announced a withdrawal from new coal power plant financing.

October 2018 – the **World Bank** exited underwriting of the Kosovo coal power plant, its last coal finance proposal. The **International Finance Corporation** then announced it would shift its indirect partner financing away from coal. And the **Asia Development Bank** (ADB) acknowledged coal plants were becoming unviable investments.

November 2018 – the biggest public life insurer in Norway, the US\$85bn **Storebrand ASA** announced a progress coal exit to be completed by 2026.<sup>21</sup>

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<sup>20</sup> Financial Times, "ING will steer portfolio towards 2°C goal to help combat climate change", 16 September 2018.

<sup>21</sup> Bloomberg, "An \$85Bn Asset Manager Is Planning a Total Exit From Coal", 30 November 2018.

November 2018 – Spain's **Banco Santander** announced its coal exclusion policy.

November 2018 – Generali of Italy (US\$581bn AUM) limited its coal insurance, having divested from coal in February 2018.

December 2018 – The **European Bank for Reconstruction and Development** (EBRD) announced its even tighter policies under its Energy Strategy away from coal in "The Switch from Coal".

December 2018 – **Citi**, the #1 U.S. banker of coal power in 2017, updated its coal policy excluding project financing of new coal-fired power plants.

January 2019 – **Export Development Canada** revealed its new Climate Change Policy: "No new financing for coal power plants, thermal coal mines or dedicated thermal coal-related infrastructure – regardless of geographic location."

January 2019 – **Barclays Bank** UK expanded on its April 2018 exclusion of project finance for coal mining to also exclude coal plants.

January 2019 – **Varma of Finland** announced cessation from investing in coal.

January 2019 – **Nedbank** of South Africa withdrew financing for two major coal-fired power plant projects in South Africa. February 2019 saw **FirstRand Bank** withdrew from funding commitments for two coal-fired power plant projects in South Africa.

February 2019 – **VIG of Austria** ceased coal insurance.

March 2019 – **MAPFRE** of Spain and **UNIQA** of Austria excluded coal insurance.

March 2019 – **State Development & Investment Corporation** is the first leading Chinese financial institution to completely exit the coal industry.

March 2019 – **BNP Paribas Asset Management** (€537bn AuM) announced a new coal exclusion policy.

March 2019 – **UBS** of Switzerland expands its progressive exit from thermal coal.

March 2019 – **QBE Insurance** announces its progressive exit from coal.

April 2019 – **DBS, UOB** and **OCBC of Singapore** all announced they will cease coal-fired power plant financing.

While initial measures vary in effectiveness, IEEFA has found the trend is for financial institutions to ratchet up the strength of policies once they are in place. With environmental and reputational concerns certainly driving factors for capital fleeing coal, investors are also increasingly aware of dire coal forecasts.



## *Japan, Australia's Biggest Export Customer, is Pivoting*

The progressive coal-fired power divestment announcements from Japan (Australia's largest coal export destination) since 2018 have been staggering.

New thermal coal exits were announced by [Dai-ichi Life](#) in [May 2018](#) and [Nippon Life](#) in [July 2018](#). Japanese banks have also changed their lending standards to exclude all lending to out-dated coal-fired power plant technologies, as reported in October 2018 for [Sumitomo Mitsui Banking Corporation](#). IEEFA has [written](#) extensively about this emerging trend, particularly with respect to Marubeni Corp.<sup>22</sup>

In September 2018 [Marubeni Corp](#) announced a radical pivot, one reinforced by the opinion piece by [Prime Minister of Japan Shinzo Abe](#) acknowledging the rise of extreme weather events and the need to act decisively to deal with global warming, noting "climate change can be life-threatening to all generations".

More recently, several of Marubeni's fellow sōgō shōsha ([Mitsubishi Corp](#),<sup>23</sup> [Mitsui & Co.](#),<sup>24</sup> [ITOCHU](#) and [Sojitz](#)) have also divested their thermal coal mine holdings.

In December 2018 saw another domestic coal-fired power proposal had been cancelled – [JFE Steel and Chugoku Electric Power's](#) 1GW project near Tokyo.<sup>25</sup>

In January 2019 [Tokyo Gas](#) decided not to push ahead with the proposed but long delayed 2GW Chiba imported coal-fired power plant.<sup>26</sup> In a separate development, a proposed 112MW Able Company plant in Iwaki which was to be fuelled by coal with up to 30% biomass has been revised to operate as a biomass-only plant. The change represents Japan's ninth proposed coal unit cancellation or modification since 2012.

In January 2019 [Tokyo Electric Power Company](#) (TEPCO) announced Japan would begin construction of its first commercial offshore wind plant.<sup>27</sup> TEPCO's aim is to fund 2-3GW of wind as part of its strategic pivot from thermal and nuclear power.

In March 2019 Japan's [Environment Minister Yoshiaki Harada](#) said that in principle it will not sanction construction of new large coal-fired power plants nor boilers to existing facilities in line with Japan's international pledges to tackle global warming.

March 2019 also saw Kansai Electric announce a 6GW renewables target for 2030.

In May 2019, Japan's largest bank, [Mitsubishi UFJ Financial Group](#) established quantitative targets for restricting coal project financing, and a potential halving of its existing coal loan book. [Mizuho Financial Group](#) respond with a similar policy.

For more details on Japan, please refer to IEEFA's recent [briefing note](#).<sup>28</sup>

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<sup>22</sup> IEEFA, "Marubeni's Coal Problem: A Japanese Multinational's Power Business at Risk", Jul 2018.

<sup>23</sup> Reuters, "Mitsubishi exits thermal coal sector, sells stakes in Australia mines", 18 Dec 2018.

<sup>24</sup> Reuters, "Japan's Mitsui may sell stake in Australia thermal coal mine", 31 October 2018.

<sup>25</sup> Bloomberg, "JFE Steel, Chugoku Electric Scrap Coal-Fired Power Plant Plans", 27 Dec 2018.

<sup>26</sup> Reuters, "Japan's Idemitsu, Kyushu Elec, Tokyo Gas scrap coal power plant plan", 31 Jan 2019.

<sup>27</sup> TEPCO, "TEPCO's First Commercial Offshore Wind Facility to Launch Jan 2019", 27 Nov 2018.

<sup>28</sup> IEEFA, "Japan's Pivot from Thermal Coal to Renewables is Building", 29 March 2019.

## Section 8. India’s Sustained Pivot to Renewables

Under Prime Minister Narendra Modi, India has accelerated its national pivot to lower cost, zero emissions renewable energy. October 2018 saw Modi reconfirm India’s 2030 target to generate 40% of its total electricity from non-fossil fuels.

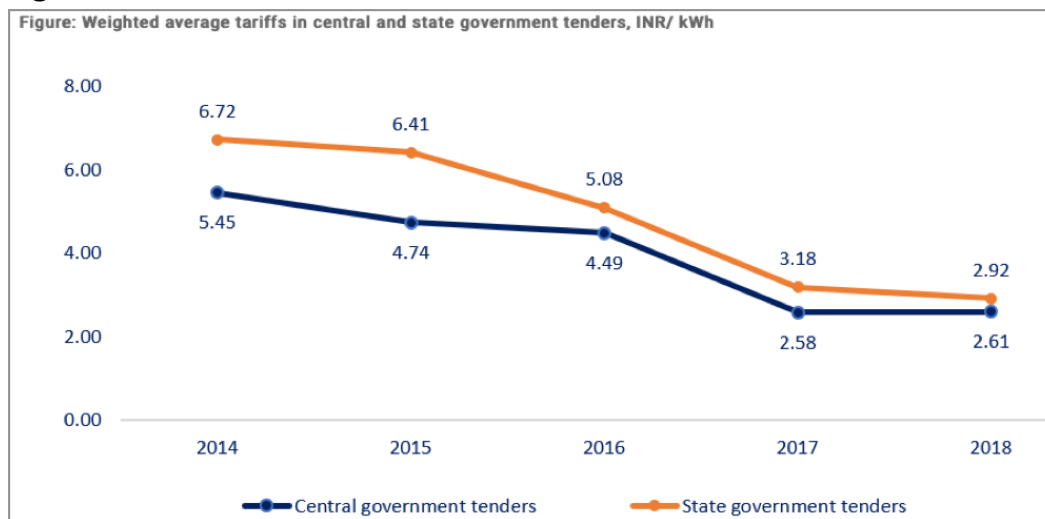
India’s Power Minister R. K. Singh has repeatedly talked up opportunities for India to lift the development of renewables to a massive 40GW annually, triple the current run-rate. In January 2019 R. K. Singh yet again lifted the level of renewables ambition, sounding out a call for India to target the installation of 500GW of renewables by 2028.<sup>29</sup>

The Indian Coal and Railways Minister Piyush Goyal has repeatedly stated his target for India to cease thermal coal imports, recognising the threat to India’s energy security of India’s excessive and unsustainable reliance on fossil fuel imports.

India’s progress has been astonishing. With wind and solar tariffs regularly being tendered for Rs2.40-3.00/kilowatt hour (kWh) and averaging Rs2.61-2.92/kWh in 2018 (Figure 8.1), existing domestic thermal power is struggling to compete.

NTPC, India’s largest power generator, had an average 2018/19 (year-to-date to December 2018) tariff of Rs3.47/kWh for existing domestic coal-fired power, up 6% year-on-year. Non-mine mouth coal requires tariffs of Rs4.00-5.00/kWh and new imported coal-fired power generation requires a tariff of Rs5.00-6.00/kWh.

**Figure 8.1: Solar Tariff Declines Continue to Drive Indian Deflation**



Source: Bridge to India, January 2019.

In September 2018 Gujarat completed a 500MW solar tender at a record low of Rs2.44/kWh with zero indexation for 25 years. As import duties roll off in 2020, this trend is set to accelerate, given global solar module prices fell by over 30% over

<sup>29</sup> ETEnergyWorld, “India to bid out 500 GW renewable energy capacity by 2028”, 7 January 2019.

2018. New thermal coal cannot compete with the current deflationary tariffs that are contractually set to decline in real terms every year for the next 25 years.

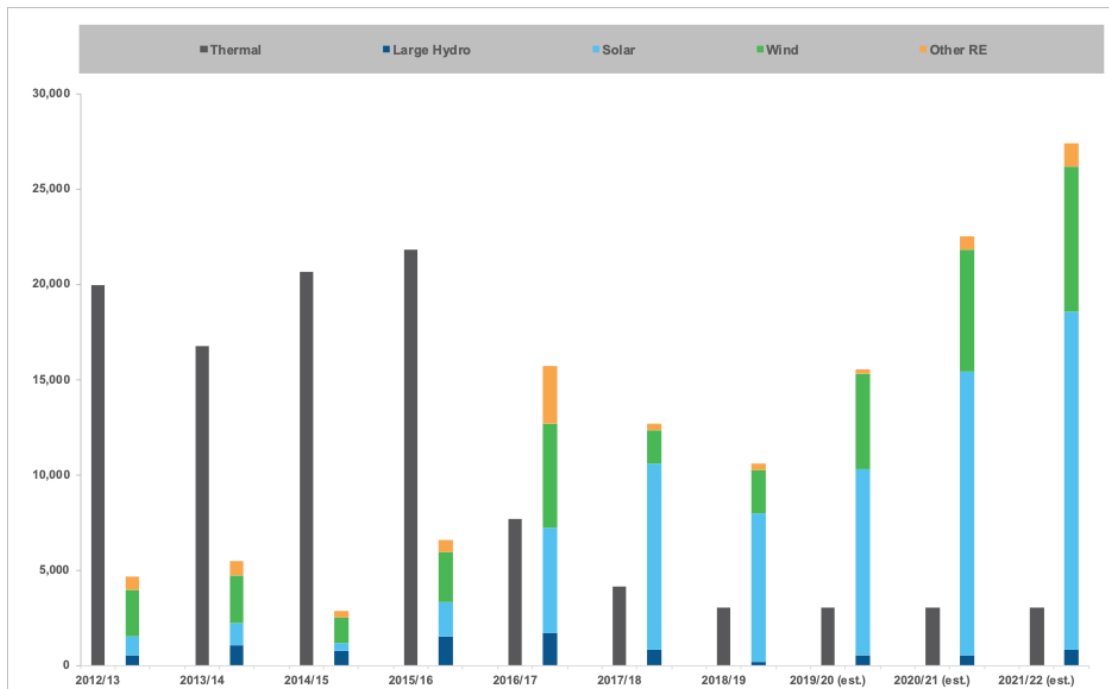
Major private integrated power firm [Tata Power](#) has suspended all new coal-fired power plant developments. They instead are preferring to acquire [financially distressed existing power plants](#) which are selling at 40% of the face-value of debt, valuing completed projects at 30% of total investment value. CEO Praveer Sinha announced a [US\\$5bn renewable energy investment plan](#) in May 2018.

NPTC Ltd has likewise commenced a pivot into renewables with a plan to facilitate or build upwards of 10-20GW over the coming decade. NTPC has also announced it has [cancelled 10GW of proposed new coal power plants to-date in 2018](#).

The Adani Group has expanded into renewable energy, floating its renewables business (Adani Green) on the Bombay Stock Exchange in June 2018. With 3GW of renewables in operation and another 3GW in planning, it is a top corporate investor in Indian renewables. In Australia, Adani announced a 1,500MW solar investment program.

As a result, India’s renewable energy installs have doubled to 12GW in 2018/19, while thermal power installs (net of closures) have [dropped 80% to just 3GW annually](#) vs. the 20GW annual installs evidenced up to 2015/16 (Figure 8.2). IEEFA forecasts a more than doubling of renewable energy installs by 2021/22, on the back of open tenders of 35GW plus finalised auctions of 25GW as of April 2019, with a two-year build timeframe.

**Figure 8.2: Indian Thermal and Renewable Power Capacity Adds (MW)**



Source: Central Electricity Authority, MNRE, IEEFA estimates.

IEEFA references this to highlight the severity of the problem of stranded asset risk for fossil fuel projects in India. India is grappling with upwards of US\$100bn of non-performing loans to the thermal power sector alone as a result of under-estimating the rate of technology change and renewable energy deflation.

## Annexure I. Alternatives to Coking Coal

Coking coal is often viewed as having few alternatives.

However, increased European Emission Allowance (EUA) prices on carbon pollution and advances in recycling of scrap steel are driving technology innovation which is combining to challenge this perspective.

The metals industry has long researched new technologies to reduce or even eventually eliminate carbon emissions in steel manufacturing. Back in 2010 the World Steel Association (WorldSteel) reported the steel industry had reduced the average energy consumption of coking coal by 50% over the 30 years to 2004.<sup>30</sup>

New technologies and processes can progressively replace the current reliance on coking coal to manufacture steel. A few specific examples include:

1. HYBRIT is the brand for a Swedish development project to “make fossil free steel” from iron ore and hydrogen, removing entirely the need for coking coal and carbon emissions (refer below).
2. FINEX is a brand developed by South Korea's POSCO that allows for the use of lower quality thermal coal in substitution for coking coal in steel manufacturing.
3. Electric arc furnaces promote steel recycling in lieu of coking coal and iron ore.
4. Rio Tinto has moved to develop carbon-free aluminium.
5. [Outokumpu](#) of Finland has developed 90% recycled stainless steel.
6. Lend Lease has been using timber composites to replace structural steel in buildings.

### *HYBRIT – Towards Fossil-Free Steel*

In 2016, Swedish steel maker SSAB AB, Europe's largest iron ore producer LKAB, and one of the largest European utilities Vattenfall, came together in a joint venture named HYBRIT with the objective:<sup>31</sup>

*“A joint venture project that endeavours to revolutionize steel-making. HYBRIT aims to replace coking coal, traditionally needed for ore-based steel making, with hydrogen. The result will be unique: the world's first fossil-free steel-making technology, with virtually no carbon footprint.”*

In February 2018 Steelmaker SSAB announced a venture to build a pilot plant, to be operational by 2020.<sup>32</sup> In May 2018 HYBRIT estimated a production cost 20-30%

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<sup>30</sup> “Challenges & opportunities for the steel industry in moving towards green growth”, OECD, Anthony de Carvalho Green Growth Workshop, 4 March 2010.

<sup>31</sup> “HYBRIT – Towards fossil-free steel”, SSAB, LKAB & Vattenfall corporate website accessed 19 June 2018.

<sup>32</sup> Reuters, “[Swedish steel plant to run on hydrogen](#)”, Lefteris Karagiannopoulos, 1 February 2018.

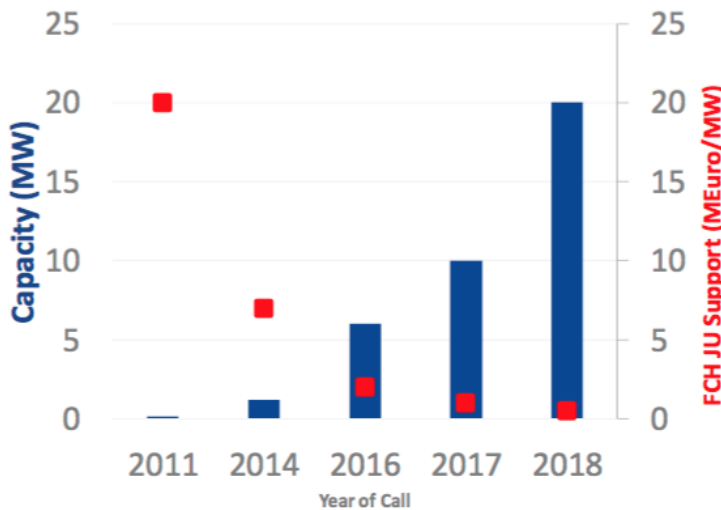
higher than conventional steel, a premium that requires a sustained high price of carbon emissions and falling renewables costs, both of which are now on track in the EU.<sup>33</sup>

*Emissions Free Hydrogen*

A critical pre-requisite for coking coal free HYBRIT technology is the commercialisation of cost effective, low or zero-emissions hydrogen. Significant investment is underway globally in this pursuit. In 2016 four European industry majors consisting of the voestalpine group, Siemens, VERBUND and the Austrian Power Grid commenced construction of a 6MW pilot plant for the production of zero emissions hydrogen, with commissioning due 2019. This was reported as the largest project of its type to-date.<sup>34</sup>

Figure A.1 details the acceleration of hydrogen electrolyzer demonstration projects globally into 2018 and the rapid decline in subsidy requirements (in red, RHS).

**Figure A.1: Hydrogen Electrolyzer Demonstration Projects Accelerate**  
**Electrolyser Demo Projects**



Source: FCH Fuel Cells and Hydrogen Joint Undertaking.<sup>35</sup>

<sup>33</sup> “Company debuts world’s first fossil-free steel-making technology” Digital Journal, Karen Graham, 14 May 2018, and “Swedish steel boss:’ Our pilot plant will only emit water vapour”, Euractiv, Frederic Simon, 11 May 2018.

<sup>34</sup> “Construction starts at the world’s largest hydrogen pilot plant”, Joint Press Release by Siemens, voestalpine and VERBUND, 16 April 2018.

<sup>35</sup> “FCH JU – Key to sustainable energy and transport... making fuel cells and hydrogen an everyday reality”, Fuel Cells and Hydrogen Joint Undertaking, European Commission, February 2018, ISBN 978-92-9246-324-3 doi:10.2843/167095.

Siemens AG of Germany has long studied the ability to use renewables to create and store hydrogen<sup>36</sup> and in February 2018 commenced construction of a 1.25MW Proton exchange membrane electrolyzer demonstration plant in Adelaide to produce hydrogen from electricity and potentially onsite from solar electricity. Siemens concluded:<sup>37</sup>

*“This is about using inexpensive or free energy, which would otherwise be spilled to produce a clean form of stored energy that has many value streams – 100% pure hydrogen, with the only by-product being 100% pure oxygen.”*

Further accelerating the development of zero emissions hydrogen, Alstom of France in 2018 launched the world's first hydrogen fuel cell powered regional train.<sup>38</sup> World leading firms are moving to commercialise zero emissions alternatives to fossil fuels as financial institutions increasingly restrict coal finance and increase financial supply to zero emissions alternatives.<sup>39</sup>

Federal Labor in January 2019 announced plans for a A\$1bn investment in [hydrogen](#) as a key potential Australian export industry leader of the future, backing up the conclusions of Alan Finkel's [Hydrogen RoadMap](#).

### *Electric Arc Furnaces*

In response to continued pollution pressures, China continues to introduce a suite of policy measures to remove outdated capacity across a number of industries, including steel. During its thirteenth Five Year Plan 2016-2020,<sup>40</sup> China targeted the removal of 100-150Mtpa of old, highly polluting steel manufacturing capacity, equivalent to one-tenth of China's total.

2017 saw 50Mtpa of new electric arc furnaces approved which will see electricity and scrap steel replace coking coal and iron ore. As this process continues, China's coking coal and iron ore demand is forecast to progressively decline over the coming two decades.<sup>41, 42</sup>

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<sup>36</sup> Siemens, “[Siemens Supports South Australia's Hydrogen Roadmap](#)”, Press Release, 8 September 2017.

<sup>37</sup> Siemens, “[Australia's First Hydrogen Demonstration Park with Siemens Technology to be Built in Adelaide](#)”, Press Release, 21 February 2018.

<sup>38</sup> Alstom, “[Alstom's hydrogen fuel cell train wins 2018 GreenTec Mobility Award](#)”, Press Release, 4 May 2018.

<sup>39</sup> Mitsubishi UFJ Financial Group, Inc. (MUFG), “[MUFG Adopts Environmental Policy Statement, Human Rights Policy Statement, and Environmental and Social Policy Framework](#)”, 15 May 2018.

<sup>40</sup> NDRC, “[The 13th Five-Year Plan For Economic And Social Development Of The People's Republic Of China \(2016–2020\)](#)”, accessed 18 June 2018.

<sup>41</sup> U.S. Energy Information Administration, “[Increased recycling may reduce metals sector energy use in China](#)”, Paul Otis, 28 October 2015.

<sup>42</sup> McKinsey & Co, “[The growing importance of steel scrap in China](#)”, Steven Vercammen, Avetik Chalabyan, Oliver Ramsbottom, Junjie Ma & Charlie Tsai, March 2017.

A 2017 German Power-to-Steel study<sup>43</sup> evaluating the combination of renewable energy produced hydrogen and electric arc furnaces concluded:

*“It is possible to reduce CO2 emissions by up to 95% through the integration of renewable energy into the currently coal-based steel industry by using alternative technologies. Both the possibility to integrate renewable power and CO2 reduction is mainly achieved by an increase or complete discontinuation of coal.”*

**The IEA report notes that global use of coking coal peaked back in 2014**, and regardless of the success of Paris Agreement, the coking industry expects the gradual ongoing decline to continue through to 2040 (Figure 4.6).

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<sup>43</sup> Alexander Otto et al Energies, “Power-to-Steel: Reducing CO2 through the Integration of Renewable Energy and Hydrogen into the German Steel Industry” 2017, 10, 451; doi:10.3390/en10040451.



## About IEEFA

The Institute for Energy Economics and Financial Analysis conducts research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. [www.ieefa.org](http://www.ieefa.org)

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