



There's No Second Life for Coal in Pakistan

Any Coal-to-Liquids and Coal-to-Gas Projects Would Need Unaffordable Subsidy Support

Executive Summary

The global experience of coal-to-liquids (CTL) and coal-to-gas (CTG) processes ought to be a warning that there is no bright future for such projects in Pakistan.

At the Climate Ambition Summit in December 2020, Pakistan's Prime Minister Imran Khan stated that Pakistan "will not have any more power based on coal." However, he also announced the intention to use Pakistan's domestic coal reserves to produce energy via coal-to-liquids and coal-to-gas processes. Coal-to-liquids is a process of turning coal into liquid fuels such as petrol and diesel. Coal-to-gas processes convert coal into gas for use in power generation, to supply gas consumers or as a feedstock for products such as fertilisers.

With the writing increasingly on the wall for coal-fired power amidst the continuing decline in the cost of wind and solar, it's also no surprise that the coal lobby in Pakistan is pushing for alternative uses for domestic coal. As a result, there is already a coal-to-liquids proposal in Pakistan for the production of diesel from domestic coal and a coal-to-gas proposal to produce fertilisers. Both are proposed to use Chinese technology and finance.

Such plans are immediately challenged by the relatively high cost of coal production in Pakistan, and the heavy reliance on yet-more debt dependence on China.

The Heavy Burden of Coal on Pakistan

In addition to the environmental impacts of coal power that are of increasing international concern, the technology – along with other thermal power sources – is placing an unsustainable financial burden on Pakistan's economy.

The addition of coal-fired power plants to date has contributed to Pakistan's increasing overcapacity problem. Power cuts in Pakistan are caused by a fragile transmission and distribution system rather than a lack of generation capacity. In fiscal year 2019-20, the overall utilisation of Pakistan's thermal power generation

Coal technology is placing an unsustainable financial burden on Pakistan's economy.

fleet dropped to an entirely unsustainable low of just 37% according to National Electric Power Regulatory Authority (NEPRA) data.

Overcapacity is an expensive burden on Pakistan power consumers as power plants receive capacity payments even when they are not being utilised, pushing up the average cost of electricity. Capacity payments to power generators are on course to reach Rs1.5 trillion (US\$9.4 billion) per annum by 2023. The expense of overcapacity is making the build-up of debt within Pakistan's power system (known as circular debt) even worse. The build-up of debt is to a large degree caused by subsidised power tariffs. It is expected that total circular debt across the power system will reach Rs2.8 trillion (US\$17.6 billion) by the end of June 2021.

The inevitable consequence of expensive power generation and unsustainable debt is a rise in consumer power tariffs. In March 2021 it was announced that power tariffs would have to rise Rs5.36 (34%) over the next two years, at the IMF's insistence, in order to help tackle the circular debt crisis. This followed a Rs1.95 (15%) increase in base tariff that was approved in February 2021.

Meanwhile, the IMF is working with the World Bank on plans to factor in climate change into negotiations over reducing nations' debt burdens via reduced fossil fuel emissions and investment in renewable energy.

The unaffordable nature of surplus coal-fired power built under the China-Pakistan Economic Corridor (CPEC) has also led the Pakistan government to seek debt relief from China. The request is likely to take the form of longer loan repayment terms in order to reduce capacity payments to the coal power generators.

Global Coal-to-Liquids and -Gas Experience: Implications for Pakistan

The Kemper coal-to-gas power project in the U.S. was meant to be the poster child for new, lower-carbon coal power technology. Instead, it became the classic case study highlighting the unviability of coal-to-gas for power with carbon capture.

The Kemper project attempted to gasify lignite coal that is similar to that found at Thar. It proved to be a highly expensive failure despite the significant federal government subsidy it received. Power consumers now have to pick up a US\$1 billion bill via increased tariffs.

Another key lesson from the Kemper debacle is the much-higher-than-anticipated water usage during the coal gasification process. Such very high water use makes the technology unviable in water-stressed places like Thar.

In Indonesia, PT Bukit Asam's (PTBA's) proposed coal-to-dimethyl ether (DME) project looks set to lose hundreds of millions of dollars on an annual basis according to a November 2020 IEEFA analysis, despite a much lower cost of coal production than Pakistan and being eligible for a subsidy in the form of a coal royalty exemption. These losses will be greater than the value of the LPG imports that the

DME is supposed to replace. An equivalent plant in Pakistan would be further challenged with a higher cost of coal feedstock.

Meanwhile, Sasol's world-leading position in coal-to-liquids is also based on subsidies – both historic and current. Thanks to these subsidies locking in its technology for the long term, Sasol has enjoyed a viable business model until recently. However, it is increasingly clear to Sasol that its current business model using coal as a feedstock is not fit for purpose going forward. Increasing global investor and stakeholder expectations on climate action, along with a declining outlook for oil demand are challenging Sasol's business model and this is being recognised by company management. The company is now targeting a replacement of coal feedstock with gas in the medium term and is strongly hinting at green hydrogen's role in its long term future.

Given the level of fossil fuel subsidies in Pakistan (which are currently contributing to the build-up of unsustainable debt within the power and gas systems), it's likely that any coal-to-liquids or -gas projects in Pakistan will be reliant on further subsidies. It's also likely – given experience in these technologies overseas – that these subsidies won't be enough to make such projects economically viable.

Now is *not* the time for Pakistan to be increasing fossil fuel dependence along with the subsidies needed to support their consumption.

Furthermore, the coal-to-liquids and -gas projects currently on the table for Pakistan involve Chinese companies/technology. As such they will also involve Chinese finance as well if they are to be funded at all. At a time when the Pakistan government is seeking debt relief from China on its CPEC coal projects to date, it is unadvisable to seek to increase that debt burden for technologies that are yet to be proven in the country, or globally.

**Now is *not* the time
for Pakistan to be
increasing fossil fuel
dependence.**

Further reliance on coal would also come as the European Union is preparing to implement a carbon border adjustment mechanism to protect its industries from being undercut by cheaper imports from nations that produce and manufacture using energy from coal and other fossil fuels. The UK and the U.S. are also considering similar mechanisms.

A 21st Century Alternative Is Available

Sasol's recognition that green hydrogen will play a part in the company's long term future is a key lesson for Pakistan. The production cost of green hydrogen is currently expected to drop 60% by 2030 and global investment in the technology accelerated sharply in 2020, and looks like doing so even more as 2021 unfolds.

The plunging cost of wind and solar power means that green hydrogen cost projections are falling faster than anyone expected. Likewise the capital cost of electrolyzers that use renewable electricity to split water to generate the green hydrogen are seeing an unprecedented acceleration in scale that will almost inevitably see dramatic capital cost reductions.

Going forward, green hydrogen will play a growing role in a wide range of applications including power generation, steel production, fertiliser production and marine transport fuel amongst others.

Global investment in new hydrogen technology accelerated during 2020, unincumbered by the COVID-19 pandemic. Saudi Arabia is planning a US\$5 billion investment in green hydrogen for export. By the beginning of 2021 over 200 industrial hydrogen projects had been announced, more than 30 countries had released hydrogen roadmaps, and governments have committed more than US\$70 billion in public funding. The total investment of all announced projects will be US\$300 billion through to 2030, should they all proceed. This sudden increase in global hydrogen investment will see the cost of green hydrogen production fall even faster than recently predicted.

Transportation of hydrogen over long distances is likely to take place in the form of ammonia – a key fertiliser feedstock. Pakistan is planning a coal-to-gas plant with the aim of producing fertiliser but in the future Pakistan could substitute ammonia as a feedstock for fertiliser production without the added expense of cracking it back into hydrogen. For fertilizer production, green ammonia produced with renewable energy will likely be cost competitive with fossil fuel-based ammonia produced in Europe by 2030 where the cost of carbon is no more than US\$50/tonne.

Pakistan would also have the option of co-firing ammonia in existing thermal power plants as a way of progressively reducing the carbon emissions of its electricity sector.

With global action on emissions reduction now accelerating, investment in zero emissions industries of the future is likely to better unlock global capital access for Pakistan in order to diversify from over-reliance on China.

Given energy security concerns, Pakistan could produce its own green hydrogen in the future using its abundant renewable energy resources. Hydrogen produced domestically could be used as a feedstock for fertiliser production, used for power generation, or blended into the gas grid to decarbonise the system and alleviate the gas shortages that Pakistan experiences on a regular basis.

Although green hydrogen is not cost competitive yet, the world now appears to be on the brink of a rapid cost deflation for new hydrogen technology of the type that has already been witnessed for wind and solar power, which are now the cheapest sources of new power generation in Pakistan.

If Pakistan continues with plans to build coal-to-gas and -liquids projects, it will be locking in 20th century technology whilst the rest of the world develops the energy and chemicals technology of the 21st century.

Contents

Executive Summary	1
Introduction	6
Status of Coal-Fired Power in Pakistan.....	6
Coal-to-Liquids and Coal-to-Gas in Pakistan	8
Case Study One: Sasol.....	10
Case Study Two: PTBA Coal Gasification, Indonesia	16
Case Study Three: Kemper Coal-To-Gas Power Plant.....	17
Implications for Pakistan	19
About the Author	23

Introduction

At the Climate Ambition Summit in December 2020, the speech made by Pakistan's Prime Minister Imran Khan drew perhaps the most attention of all. This was mostly down to what the Prime Minister stated about Pakistan's future coal plans, that Pakistan "will not have any more power based on coal".¹

It is not clear whether the statement means that existing coal projects that have not yet begun construction will be cancelled or that no new coal proposals will be added to the current development pipeline.

Either way, this is a highly significant statement for a nation that was until now intending to exploit its domestic coal reserves and reach 38,000 megawatts (MW) of coal-fired power by 2047. It seems that Pakistan's latest long term power plan – the Indicative Generation Capacity Expansion Plan 2047 (IGCEP 2047) – will need to be re-written. According to IGCEP – published in April 2020 – 27 gigawatts (GW) of new coal-fired power (all fuelled by domestic coal) was to be added between 2030 and 2047. It now seems this proposal has been dropped.

However, in his summit speech the Prime Minister also announced the intention to use Pakistan's domestic coal reserves to produce energy via coal-to-liquids and coal-to-gas processes. Coal-to-liquids is a process of turning coal into liquid fuels such as petrol and diesel. Coal-to-gas processes convert coal into gas for use in power generation, to supply gas consumers or as a feedstock for products such as fertilisers.

This report will present case studies from around the world highlighting why such a move into coal-to-liquids and -gas are likely to prove to be highly expensive burdens on Pakistan's economy.

A move into coal-to-liquids and coal-to-gas are likely to prove to be highly expensive burdens on Pakistan's economy.

Status of Coal-Fired Power in Pakistan

Even prior to the Prime Minister's December 2020 speech, the Pakistan government had turned its back on further power plant development fuelled by imported coal. With a weakened Rupee making coal imports even more expensive, power proposals intended to be fuelled by imports have either been converted to use domestic coal or cancelled. The 1,320MW Rahim Yar Khan coal-fired power proposal was cancelled in January 2019² whilst the China Datang project was

¹ Climate Ambition Summit 2020. [HE Imran Khan, Prime Minister of Pakistan.](#)

² Dawn. [Govt puts major CPEC power project on hold.](#) 14 January 2019.

scrapped in June 2020.³ According to the IGCEP 2047, power plants using imported coal will operate at just 14% utilisation by 2030 as imported coal-fired power is de-emphasised in the plan.⁴

The addition of coal-fired power plants to date fuelled both by imported and domestic coal under the China-Pakistan Economic Corridor (CPEC) program has contributed to Pakistan's increasing overcapacity problem. Power cuts in Pakistan are caused by a fragile transmission and distribution system rather than a lack of generation capacity.⁵ In the fiscal year 2019-20, the overall utilisation of Pakistan's thermal power generation fleet dropped to just 37% according to National Electric Power Regulatory Authority (NEPRA) data.

Overcapacity is an expensive burden on Pakistan power consumers as power plants receive capacity payments even when they are not being utilised, pushing up the average cost of electricity generation. Under existing contracts, capacity payments to power generators are on course to reach Rs1.5 trillion (US\$9.4 billion) per annum by 2023.⁶

The expense of overcapacity is making the build-up of debt within Pakistan's power system (known as circular debt) even worse. Power distribution companies sell power at rates lower than cost. That combined with poor bill collection rates and major distribution losses means the distributors are unable to sufficiently pay generators for power purchases. Power generators are then unable to pay their fossil fuel suppliers. It is expected that total circular debt across the power system will reach Rs2.8 trillion (US\$17.6 billion) by the end of June 2021.⁷

It is expected that total circular debt across the power system will reach Rs2.8 trillion (US\$17.6 billion) by end of June 2021.

A switch of focus from coal-fired power using imported coal to plants using domestic coal will make little or no difference to the cost burden given that tariffs for domestic coal-fired power are similar to those of plants consuming coal imports.⁸ The inevitable consequence of expensive power generation and unsustainable debt is a rise in consumer power tariffs. In March 2021 it was announced that power tariffs would have to rise Rs5.36 (34%) over the next two

³ Express Tribune. [PTI abandons K-Electric's coal project](#). 25 June 2020.

⁴ IEEFA. [Pakistan's new 27-year power plan risks locking in long-term overcapacity, leaving imported coal and LNG plants stranded](#). 3 September 2020.

⁵ Bloomberg. [Nation Plagued by Power Shortages Suddenly Has Too Much Electricity](#). 27 January 2021.

⁶ Business Recorder. [Capacity payment charges will soar to Rs1.5trn by 2023](#). 29 January 2021.

⁷ Dawn. [The galloping gap](#). 18 January 2021.

⁸ Express Tribune. [Thar coal – too little, too late](#). 10 January 2021.

years, at the IMF's insistence, in order to help tackle the circular debt crisis.⁹ This followed a Rs1.95 increase in base tariff was approved in February 2021.¹⁰

Meanwhile, the IMF is working with the World Bank on plans to factor in climate change into negotiations over reducing nations' debt burdens via reduced fossil fuel emissions.¹¹ IMF Managing Director Kristalina Georgieva has previously stated that discussions were taking place over the linking of debt relief with climate resilience and low-carbon energy technology investment.

The unaffordable nature of surplus coal-fired power built under CPEC has also led the Pakistan government to seek debt relief from China.¹² The request is likely to take the form of longer loan repayment terms in order to reduce capacity payments to the coal power generators.

The unaffordable nature of surplus coal-fired power built under CPEC has led the Pakistan government to seek debt relief from China.

Coal-to-Liquids and Coal-to-Gas in Pakistan

Given the issues caused by Pakistan's increased reliance on coal-fired power, the Prime Minister's statement that the country "will not have any more power based on coal" is not surprising. In addition to the environmental impacts of coal power that are of increasing international concern, the technology – along with other thermal power sources – is placing an unsustainable financial burden on Pakistan's economy.

With the writing on the wall for coal-fired power amidst the continuing decline in the cost of wind and solar, it's also no surprise that the coal lobby in Pakistan is pushing for alternative uses for domestic coal. As a result, there is already a coal-to-liquids proposal in Pakistan for the production of diesel from domestic coal using Chinese technology.¹³

According to a Chinese report, coal-to-diesel is feasible at a US\$50/barrel oil price.¹⁴ However, this analysis pre-dates 2020 and the COVID-19 crisis – an event likely to be seen as a turning point for the global oil industry going forward. Despite the worldwide economic slowdown, the energy transition continued at pace, not least in transport with the shift away from internal combustion engines and towards electric vehicles accelerating.¹⁵ Oil companies downgraded their forecast oil demand

⁹ Dawn. [Electricity tariff to go up by Rs5.36 per unit in two years](#). 16 March 2021.

¹⁰ Business Recorder. [Power tariffs: Good luck getting that](#). 15 February 2021.

¹¹ Reuters. [World Bank, IMF to consider climate change in debt reduction talks](#). 20 February 2021.

¹² Bloomberg. [Pakistan to Seek Debt Relief From China Belt and Road Loan](#). 9 February 2021.

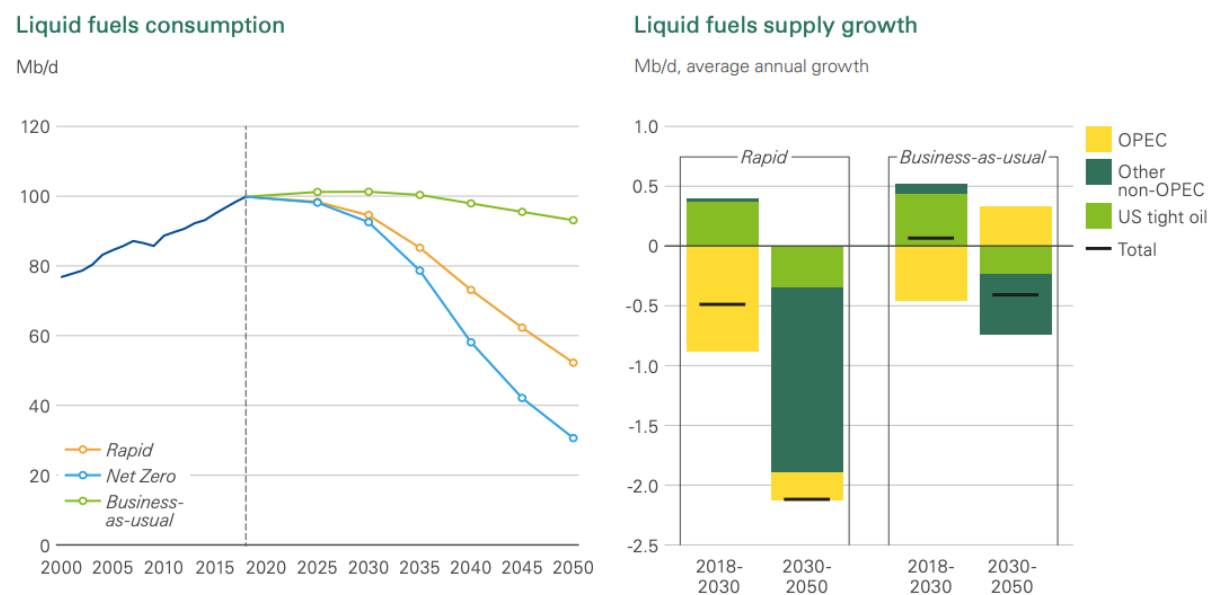
¹³ The News. [Pakistan will produce gas and diesel from Thar coal](#). 20 October 2020.

¹⁴ Express Tribune. [Thar: Potential for new power, fuel, urea projects](#). 16 December 2019.

¹⁵ Sydney Morning Herald. [GM's move the beginning of the end for petrol cars](#). 1 February 2021.

outlook during 2020 (Figure 1). Global coal-to-liquids leader Sasol is now planning for a US\$45/barrel oil price environment going forward (see below).

Figure 1: BP Energy Outlook 2020 Liquid Fuels Consumption and Supply Forecasts



Source: BP Energy Outlook 2020.

In addition, another Chinese analysis has reportedly found that the high cost of Pakistan's domestic coal would need to be about 50% lower for coal-to-diesel to be viable.¹⁶ In February 2021, Pakistan's power regulator approved a cost of Thar coal for power generation of almost US\$70/tonne.¹⁷ These figures place a large question mark over the commercial viability of Pakistan's coal-to-liquids plans, particularly in light of greatly diminished global investor interest in this high emissions technology as the world moves to embrace net zero emissions targets.

Gasification of coal from Pakistan's Thar coalfield has also been discussed for a number of years. The synthetic gas (syngas) produced by the coal-to-gas process can be converted into methanol, fertiliser, synthetic natural gas and chemical products. It can also supplement or replace liquified petroleum gas (LPG), replace diesel in modified engines or replace furnace oil in marine transport. Pakistan has a coal-to-gas proposal on the table using Chinese technology which would use Thar coal as feedstock to produce fertiliser.¹⁸

Pakistan's coal-to-gas and coal-to-liquids plans should be better informed by the experience of coal-to-gas and coal-to-liquids companies and projects overseas.

¹⁶ Express Tribune. [Thar coal – too little, too late](#). 10 January 2021.

¹⁷ NEPRA. [Decision of the Authority in the matter of Fuel Price Adjustment for Engro Powergen Thar \(Pvt.\) Ltd.](#) 26 February 2021.

¹⁸ The News. [Pakistan will produce gas and diesel from Thar coal](#). 20 October 2020.

Case Study One: Sasol

Any plan to develop a second life for domestic coal reserves via coal-to-liquids ought to be informed by the experience of Sasol of South Africa, a global leader in this field. Sasol uses coal as a feedstock to produce liquid fuels as well as chemicals. The company's coal-to-liquids plant at Secunda in South Africa is the largest in the world.

However, Sasol's leadership in coal-to-liquids has been historically shaped by unique factors and significant subsidies. Furthermore, the year 2020 has highlighted the vulnerability of the company's business model to long-term decline in fossil fuel demand as the energy transition accelerates.

2020: A Disastrous Year for Sasol

The global economic downturn that resulted from the COVID-19 pandemic exposed Sasol to lower oil prices, highlighting the risks the company faces in a lower oil price environment. The year has also seen major oil companies significantly reduce their outlooks for long term oil demand (Figure 1).¹⁹

For the year ended June 2020, Sasol reported a R91bn loss (US\$5.9bn) with the company heavily impacted by lower oil and chemical prices. Sasol recorded impairments of R111.6bn (US\$7.2bn) driven by its North American chemicals operations (US\$4.7bn). The integrated South African energy (coal-to-liquids) and chemicals operation recorded impairments of R35.2bn (US\$2.3bn) on lower oil prices, refining margins and chemicals prices. The long-term average crude oil price used in the impairment calculations was US\$60/barrel, down from an assumed US\$71/barrel in 2019.²⁰

The coronavirus-induced oil price collapse came at a time when Sasol's balance sheet was over-leveraged, significantly impacting liquidity. The company responded with cost cutting measures and stepped-up asset disposals.

In their June 2020 audit report, Sasol's auditors noted a "material uncertainty related to going concern", highlighting that "the Group's and Company's ability to meet its debt covenant requirements at 31 December 2020 and 30 June 2021 and repay debt as it becomes due is dependent on the timing and quantum of cash flows from operations, the ability to realise cash through a combination of asset disposals, or part thereof, and the successful raising of equity."²¹

Sasol's net debt to EBITDA ratio reached 4.3, breaching loan covenants. Sasol reached an agreement with lenders to increase the December 2020 covenant from 3.0 to 4.0.²² The company's credit rating was downgraded from investment grade to

¹⁹ Bloomberg. [BP Says the Era of Oil-Demand Growth is Over](#). 14 September 2020.

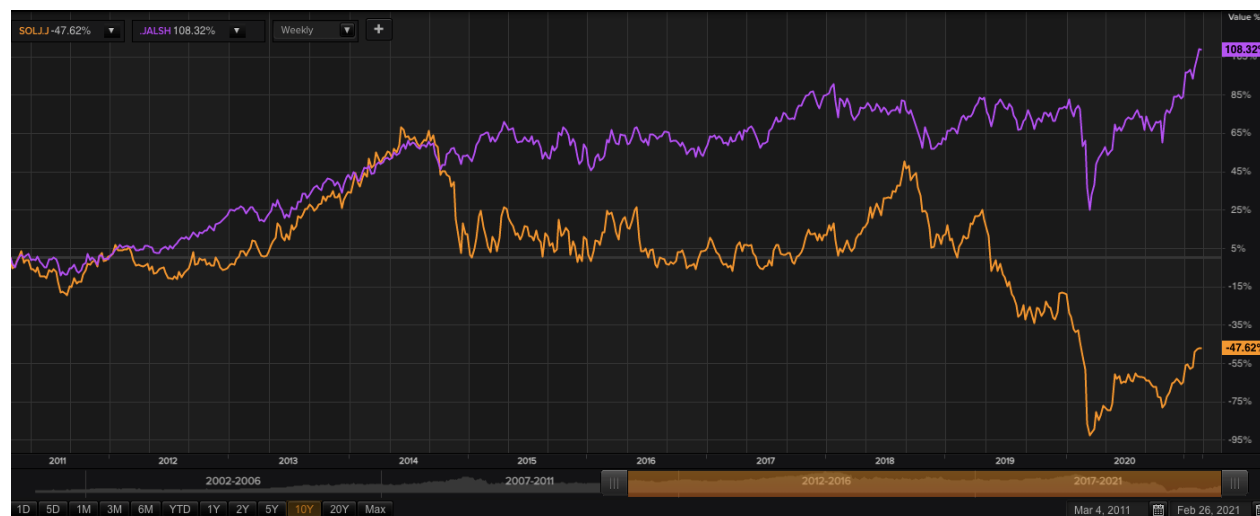
²⁰ Sasol. [Annual Financial Statements June 2020](#).

²¹ Ibid.

²² Sasol. [Integrated Report June 2020](#).

sub-investment grade (aka “junk”) in March 2020.²³

Figure 2: Sasol Share Price Performance (Orange) v Johannesburg Stock Exchange (Purple) Over 10 Years



Source: Refinitiv.

Unsurprisingly, Sasol’s share price took a significant hit in 2020 as oil prices collapsed. Figure 2 shows that Sasol was already under-performing the Johannesburg Stock Exchange as a whole prior to 2020 – the company has significantly underperformed the market over a ten-year period.

Despite using an oil price of US\$60 in its impairment calculations, the impacts of COVID-19 and growing concern over demand for oil mean Sasol is now planning for a US\$45 oil price environment.

Sasol’s interim results for 31 December 2020 showed that asset sales had helped reduce the company’s debt burden. Asset sales totalling US\$3.3 billion have been announced with more planned.

Reliance on Subsidies

From its inception, Sasol was propped up by subsidies. The company continues to receive subsidies today as well as benefitting from the technological lock-in resulting from subsidies received in the past.

Subsidies to Sasol arose from energy security concerns, heightened by trade embargoes imposed on South Africa during apartheid. Early support for Sasol included an import parity price and protection whenever the price of oil fell below a defined floor. In addition, oil companies operating in South Africa (Total, BP, Shell, etc) were required to offtake all of Sasol’s production. State compensation was

²³ Sasol. [Credit Rating](#).

transferred to the oil companies for the refining capacity they reduced to accommodate offtake from Sasol.²⁴

The pricing mechanism, based on an import parity price (which takes account of customs, freight and insurance costs), and is paid to producers of petroleum and synthetic fuels in South Africa, is known as the Basic Fuel Price (BFP). However, the BFP is typically higher than the actual cost of imports, thereby representing a transfer from consumers to liquid fuel producers. It has been calculated that this subsidy amounted to R12.65bn (US\$820m) between 2012 and 2019.²⁵

Sasol has also received a significant carbon tax break. In phase 1 of South Africa's carbon tax regime, which was applicable from June 2019 with an initial tax rate of R120/tonne (US\$7.80/tonne), the basic tax free allowance is 60% of emissions. However, Sasol is exempted from tax on 90% of its emissions giving it an effective carbon tax rate of just R12/tonne (US\$0.78/tonne). This has been calculated to be a tax break of over R6.5bn (US\$422m) in the first year of the tax alone.²⁶

Sasol has also received special treatment on air pollution. In 2015 Sasol applied for, and received, an exemption from meeting new sulphur dioxide pollution standards until 2020. Then in 2017 Sasol applied for another extension until 2025.²⁷ Sasol, along with Eskom – the state-owned power generator that is still highly reliant on coal – are responsible for the bulk of South Africa's very high level of sulphur dioxide emissions.

Sulphur dioxide is produced mainly from burning coal and can be addressed by the installation of flue-gas desulphurisation (FGD) units on existing plants – an investment that will cost Sasol billions of dollars. The delay in the necessary investment is a significant saving for Sasol.

In March 2020, the South African government weakened the new sulphur dioxide limits significantly. The relaxed limit of 1,000 milligrams per normal cubic metre is double that originally planned and is 28 times higher than the legal limit in China and 10 times higher than the legal limit in India for new installations²⁸ – two nations that have some of the worst air pollution crises in the world.

Despite the weakened emissions limits, Sasol's special treatment on air pollution may be about to come to an end. In March 2021, South Africa's environment minister made clear that both Sasol and Eskom must now comply with emissions limits even if it costs billions of dollars. Eskom has stated that the cost of installing

²⁴ Burton, J., Lott, T., & Rennkamp, B. (2018). *Sustaining carbon lock-in: Fossil fuel subsidies in South Africa*. In J. Skovgaard & H. van Asselt (Eds.), *The politics of fossil fuel subsidies and their reform* (1st ed.) (pp. 229–45). Cambridge University Press.

²⁵ IISD. *Understanding the Role of Subsidies in South Africa's Coal-Based Liquid Fuel Centre*. October 2020.

²⁶ Ibid.

²⁷ Reuters. *S. Africa's Sasol to apply for delay to 2020 air pollution deadline*. 1 June 2017.

²⁸ Bloomberg. *South Africa Loosens Pollution Limits Even As Virus Sets In*. 30 March 2020.

FGD units at just one coal power plant at Medupi would be around US\$2.7 billion.²⁹

Growing ESG Concerns

Back in 2017, Sasol made clear that new investments in coal- and gas-to-liquids projects were unappealing on both economic and environmental grounds due to volatile commodity markets, low returns and unacceptably high carbon emissions.³⁰ Sasol's Secunda complex, the largest coal-to-liquids plant in the world, is also the largest single-site carbon emitter in the world.³¹

Besides this, Sasol faces other significant ESG (Environment, Social, Governance) concerns including water use and air pollution. Sasol is one of the two biggest contributors to an air pollution problem in Mpumalanga province, South Africa, which is amongst the very worst in the world,³² enabled by Sasol's exception to already lax sulphur dioxide emission regulations.

Figure 3: Short and Long Term Pressures Identified by Sasol



Source: Sasol Integrated Report 2020.

Sasol has recognised that, “Globally there is an enhanced focus on sustainability, which Sasol supports, and we want to take a leadership role in South Africa’s transition to a lower-carbon economy”.³³ It has identified societal concern over carbon emissions and shifting investor expectations amongst its long term pressures (Figure 3).

²⁹ Bloomberg. Eskom, Sasol Face Government Demand to Meet Emissions Limits. 10 March 2021.

³⁰ Financial Times. Sasol goes cold on converting gas and coal to liquids. 26 September 2017.

³¹ Bloomberg. The World’s Biggest Emitter of Greenhouse Gases. 17 March 2020.

³² News24. Area in Mpumalanga is the second highest SO2 emissions hotspot in the world – new study. 19 August 2019.

³³ Sasol. Integrated Report June 2020.

The company is targeting a reduction in carbon emissions of at least 10% by 2030 via the increased use of gas as a feedstock in place of coal and utilisation of renewable energy. This low target is unlikely to placate investors that are increasingly concerned about carbon emissions.³⁴

Sasol came under pressure from some shareholders in November 2020 after its refusal to table a climate resolution at its 2020 AGM that would set out how the company aligns itself with the Paris Climate Agreement.³⁵ Following this Sasol agreed to table a climate resolution at its 2021 AGM.³⁶

Sasol will need to up its responsiveness to climate change going forward. In January 2021, the CEO of BlackRock – the world's largest asset manager – warned the leaders of carbon intensive companies to increase their efforts towards the net zero transition of risk being dumped by the investment giant.³⁷

“Future Sasol”

In response to the numerous and growing challenges that Sasol faces, the company is “preparing for a strategic reset – Future Sasol – to ensure a sustainable Group in an enduring low oil price environment and carbon-constrained world.”³⁸ The company is seeking to become sustainable in a US\$45/barrel oil price environment by 2025.

Sasol is seeking to become sustainable in a US\$45/barrel oil price environment by 2025.

Part of this reset involves reducing the role of coal in its operations as it seeks to use more gas as a feedstock in its attempt to reach its 2030 10% carbon emissions reduction target. How Sasol will secure the necessary gas supplies is unclear. The company's Pande and Temane gas fields in Mozambique are due to start tapering off production from 2023³⁹ and Sasol abandoned two gas exploration blocks off the Mozambique coast in 2020.⁴⁰ The company did make a final investment decision on a further Mozambique gas project in February 2021 to address near-term production declines at Pande and Temane.⁴¹ Sasol is also in the process of selling its 50% holding in the Rompco gas pipeline that links Pande and Temane to its operations in South Africa, as part of its debt reduction efforts.⁴²

³⁴ Business Day. [Green shoots or hot air? Sasol's decarbonisation plans come under scrutiny](#). 27 April 2021.

³⁵ Business Day. [Activists turn to global investors after Sasol rejects climate resolutions](#). 10 November 2020.

³⁶ Business Day. [Sasol to table climate-related resolution at its 2021 AGM](#). 11 November 2020.

³⁷ Australian Financial Review. [BlackRock issues ultimatum on net zero](#). 27 January 2021.

³⁸ Sasol. [Integrated Report June 2020](#).

³⁹ Engineering News. [Call for greater urgency as South Africa approaches gas 'supply cliff'](#). 4 November 2019.

⁴⁰ S&P Platts. [South Africa's Sasol abandons exploration blocks offshore Mozambique](#). 6 July 2020.

⁴¹ Sasol. [31 December 2020 Interim results presentation](#). 22 February 2021.

⁴² Bloomberg. [Sasol Agrees on Mozambique Gas Plant Sale in Latest Disposal](#). 21 December 2020.

Meanwhile, South African state-owned company PetroSA has announced the retrenchment of more than a third of its workforce. The company, which extracts offshore gas to produce liquid fuels at its Moss gas facility, faces dwindling gas supplies after the failure of expensive gas exploration efforts.⁴³ And Shell announced in its 2020 third quarter results presentation that it will no longer develop new greenfield gas-to-liquids (GTL) anymore⁴⁴, meaning its proposed Mozambique GTL project is now off the table.

Sasol has also stated it will cease coal mining investment and West African oil growth activities whilst investing in renewable energy. In April 2021, Sasol issued a Request for Proposals along with Air Liquide for 900MW of solar installations to power their South African operations.⁴⁵

Sasol regards the use of more gas as a feedstock as “a bridge to a low carbon future”⁴⁶. Given recent data on the full life-cycle greenhouse emissions of gas⁴⁷ – which are similar to that of coal – this is unlikely to placate any stakeholders who already believe Sasol’s 2030 emissions reduction target is too low. This demonstrates the difficulties that coal-to-liquids operations will face as concern about carbon emissions continue to increase. Sasol is due to reveal its emissions reduction plan out to 2050 during 2021. Green hydrogen technology seems set to play a part in Sasol’s emissions reduction path to 2050 – Sasol’s CEO has stated that the company will “play a leading role in the country’s hydrogen economy. Currently, we are underway with proof of concept green hydrogen initiatives and will leverage our Fischer Tropsch technology and know-how to succeed in this area.”⁴⁸

Sasol’s path towards future financial sustainability remains in question.

Sasol announced several new projects in April 2021 marking their first move towards a green hydrogen future.⁴⁹

⁴³ Business Day. [PetroSA plans to cut a third of its jobs](#). 21 January 2021.

⁴⁴ Shell. [Third Quarter Results](#). 29 October 2020.

⁴⁵ Sasol. [Sasol and Air Liquide to launch the renewable energy procurement programme for SA operations](#). 13 April 2021.

⁴⁶ Sasol. [Climate Change Report June 2020](#).

⁴⁷ Reuters. [Satellites reveal major new gas industry methane leaks](#). 26 June 2020.

⁴⁸ Sasol. [31 December 2020 interim results presentation transcript](#). 22 February 2021.

⁴⁹ Sasol. [Sasol and Sonatrach Raffineria Italiana partner to bid for regional hydrogen valley proposal](#). 23 April 2021.

With Sasol ceasing investment in coal mining and coal-to-liquids, a major question over the company's future will be how far it will be able to replace coal with gas as a feedstock and whether this will even be enough to satisfy global investors that are increasingly concerned about a clear pathway to zero carbon emissions. Sasol's path towards future financial sustainability remains in question despite the decades of subsidies that has supported it.

Case Study Two: PTBA Coal Gasification, Indonesia

Indonesia – the world's largest exporter of thermal coal – is currently seeking to boost coal demand via policies that stimulate investment in downstream coal processes to provide additional offtake of its significant coal reserves.

One of the most advanced proposals is state-owned Tambang Batubara Bukit Asam's (PTBA's) proposed US\$2 billion project in Sumatra for the construction of a coal gasification plant to produce methanol and subsequently dimethyl ether (DME). DME would then be used as a direct substitute for imported LPG. The project is to be supported by a government subsidy in the form of a newly legislated royalty relief for downstream coal projects.⁵⁰

Using coal as a feedstock to make DME has been explored but rarely scaled up in other countries with abundant coal resources outside of China. The technology for converting methanol into DME through dehydration involves coal first being converted into a syngas, with the hydrogen and carbon monoxide removed to form a liquid methanol. The water is then removed to form DME.

A November 2020 IEEFA analysis of the proposal found that the project would make substantial losses of US\$377 million annually, exceeding the savings made from lower LPG imports.⁵¹ The total cost per tonne of the DME plant would be US\$470, nearly twice the energy-adjusted current cost of LPG for consumers (DME has a lower energy content than LPG).

The economics of the proposal have been destroyed by the lower cost of LPG (Figure 4). A previous analysis on the economics of coal-to-DME in Indonesia was completed in 2018 when the price of LPG was US\$591/tonne. The November 2020 price of LPG was down to US\$365/tonne. In China, DME producer Lanhua's operations have been loss-making since the first half of 2019 following a decline in DME prices.

Mining costs per tonne are also higher in Pakistan relative to other coal producing nations.

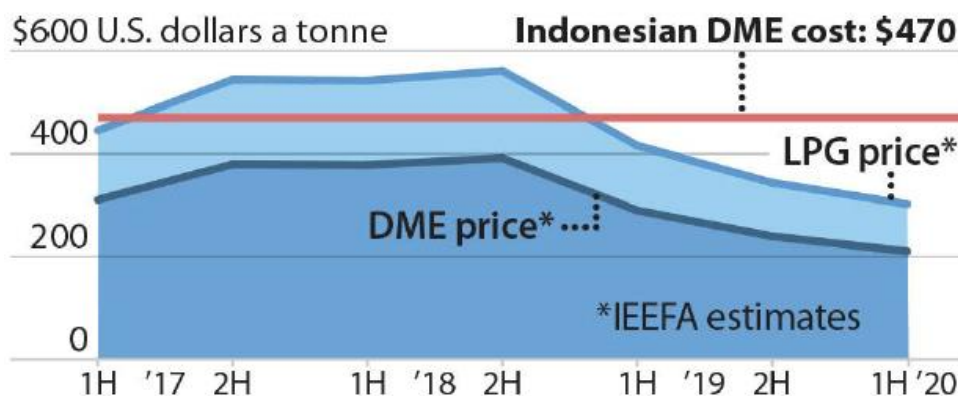
In addition, IEEFA's analysis of the proposal was based on a higher quality and lower cost of Indonesia coal (assumed US\$37/tonne) to be used as feedstock. The

⁵⁰ Reuters. [Indonesia to remove royalty payments for downstream coal](#). 22 February 2021.

⁵¹ IEEFA. [Proposed DME Project in Indonesia \(D\)oes Not \(M\)ake \(E\)conomic Sense](#). November 2020.

lignite mined at Thar is lower energy content meaning that an equivalent plant in Pakistan would need more coal to produce each tonne of DME. Mining costs per tonne are also higher in Pakistan relative to other coal producing nations. In February 2021, Pakistan's power regulator approved a cost of Thar coal for power generation of almost US\$70/tonne.⁵²

Figure 4: Indonesian Coal-to-DME Cost V's Indonesian and LPG and DME Prices



Source: Indexamundi. Graphic by IEEFA.

Despite support from a government subsidy, PTBA's Sumatran proposal to convert coal to DME via methanol looks set to make very large annual losses. Higher coal costs in Pakistan mean it's hard to believe that the economics of a similar project would make any more sense based on Thar coal.

Case Study Three: Kemper Coal-To-Gas Power Plant

As planned, the Kemper coal-to-gas power project in the U.S., owned by Mississippi Power – a subsidiary of Southern Co. – was meant to be the poster child for new, lower-carbon coal power technology. Instead, it became the classic case study highlighting the unfeasibility of coal-to-gas for power with carbon capture.⁵³

The Kemper project was envisaged as an integrated gasification combined cycle (IGCC) power plant that would use a gasifier to turn lignite coal into syngas. The IGCC process would then remove carbon dioxide and other impurities from the syngas for use or storage. After this, the remaining gas is largely hydrogen which can be combusted in a gas turbine to generate power. Southern Co. highlighted repeatedly that the carbon capture element of the Kemper project would make its carbon emissions comparable to a conventional gas-fired combined cycle power plant. Other by-products – including ammonia – were intended to be sold off as an

⁵² NEPRA. [Decision of the Authority in the matter of Fuel Price Adjustment for Engro Powergen Thar \(Pvt.\) Ltd.](#) 26 February 2021.

⁵³ IEEFA. [Holy Grail of Carbon Capture Continues to Elude Coal Industry.](#) November 2018.

additional source of revenue for the project.

The project was originally expected to cost US\$2.4 billion which is very expensive for a power plant of 830MW gross capacity. In fact, a series of significant technical issues resulted in the cost ballooning to US\$7.5 billion⁵⁴ – an extraordinarily high per-MW cost for a power plant.

Firstly, running the plants' coal gasification and carbon capture equipment consumed 250MW (30%) of the plant's gross output, resulting in its net output being at 530MW. In contrast, a typical natural-gas-fired plant consumes just 3-4% of its gross output to run internal plant equipment. In addition, technical issues with the coal gasifiers ran on for years meaning that, although the plant was producing power, it was being fuelled by conventional gas rather than by gas produced from coal.

Even if the gasifiers had worked, the plant would have been significantly less efficient than a conventional gas-fired power plant, whilst the operating and maintenance costs for the plant were 300% higher than anticipated. The result was that any power generated using gasified coal would have been much more expensive than that generated from conventional gas, wind or solar plants.

The huge amount of water needed to run the coal gasification process was another issue that only became apparent during construction and testing. The initial design included storage for 5 million gallons of water which proved to be inadequate. A temporary 1.7 million gallon storage capacity was later added and more permanent capacity was being considered before the project was abandoned (see below).

The project was due to receive hundreds of millions of dollars in the form of tax breaks but was not allowed to benefit from them due to missed development deadlines. However, Kemper did receive a \$245 million grant from the U.S. Department of Energy under a subsidy scheme meant to encourage the development of lower-emission coal power.⁵⁵

Power consumers will have to pay for US\$1 billion in costs for the plant via tariff hikes.

In June 2017 the coal gasification element of the project was abandoned, and it was announced that the plant would run on conventional natural gas instead (as it had been doing since 2014). The lignite mine that was supposed to supply feedstock to the plant was closed. In February 2018, the Mississippi Public Service Commission approved a settlement which limited the amount of capital costs that Mississippi Power could recover from its customers. However, power consumers will still have

⁵⁴ The Guardian. [How America's clean coal dream unravelled](#). 2 March 2018.

⁵⁵ Mississippi Center for Public Policy. [Two years since Kemper clean coal project ended](#). 17 July 2019.

to pay for US\$1 billion in costs for the plant via tariff hikes.⁵⁶

Implications for Pakistan

The experiences highlighted in the above case studies should be a warning that there is no bright future for coal-to-gas and -liquids projects in Pakistan.

The Kemper project attempted to gasify lignite coal that is similar to that found at Thar. It proved to be a highly expensive failure despite the significant federal government subsidy it received. Power consumers now have to pick up a US\$1 billion bill via increased tariffs.

Another key lesson from the Kemper debacle is the much-higher-than-anticipated water usage during the coal gasification process. Such very high water use makes the technology unviable in water-stressed places like Thar.

In Indonesia, PTBA's proposed coal-to-DME project looks set to lose significant sums on an annual basis despite being eligible for a subsidy in the form of a coal royalty exemption. An equivalent plant in Pakistan would be further challenged with a higher cost of coal feedstock.

Meanwhile, Sasol's world-leading position is also based on subsidies – both historic and current. Thanks to these subsidies that locked in its technology for the long term, Sasol has enjoyed a viable business model until recently. However, it is increasingly clear to Sasol that its current business model that uses coal as a feedstock is not fit for purpose going forward. Increasing investor and stakeholder expectations on climate action, along with a declining outlook for oil demand are challenging Sasol's business model and this is now being recognised by company management. The company is now targeting a replacement of coal feedstock with gas in the medium term and is strongly hinting at green hydrogen's role in its long term future.

Given the level of fossil fuel subsidies in Pakistan (which are currently contributing to the build-up of unsustainable debt within the power and gas systems), it's hard to believe that any coal-to-liquids or -gas projects in Pakistan won't be reliant on further subsidies. It's also hard to believe – given experience in these technologies overseas – that any subsidies will be enough to make such projects economically viable.

Now is not the time for Pakistan to be increasing fossil fuel dependence along with the subsidies needed to support their consumption.

Furthermore, the coal-to-liquids and -gas projects currently on the table for Pakistan involve Chinese companies/technology. As such, they will also involve Chinese finance as well if they are to be funded at all. At a time when the Pakistan government is seeking debt relief from China on its CPEC coal projects to date⁵⁷, it is

⁵⁶ Associated Press. [Utility faces federal investigation over failed power plant](#). 2 May 2019.

⁵⁷ Asia Times. [Chinese power loans fuelling a debt trap in Pakistan](#). 23 February 2021.

unadvisable that it would seek to increase that debt burden for technologies that are yet to be proven in the country.

A further reliance on coal would also come as the EU is preparing to implement a carbon border adjustment mechanism to protect its industries from being undercut by cheaper imports from nations that produce and manufacture using energy from coal and other fossil fuels. The U.K. and the U.S. are also considering similar mechanisms.

Hydrogen Technology Investment Is Accelerating

Sasol's recognition that green hydrogen will play a part in the company's long term future is a key lesson for Pakistan. The production cost of green hydrogen is currently expected to drop 60%⁵⁸ by 2030 and global investment in the technology accelerated sharply in 2020.

Green hydrogen does not involve fossil fuels. Instead, hydrogen is produced by electrolysis powered by renewable energy. The plunging cost of wind and solar power means that green hydrogen costs are falling faster than expected. Likewise, the capital cost of electrolyzers that use renewable electricity to split water to generate the green hydrogen are seeing an unprecedented acceleration in scale that will almost inevitably see dramatic capital cost reductions.

The plunging cost of wind and solar power means that green hydrogen costs are falling faster than expected.

Whereas just five years ago electrolyzers were just 1-2MW in capacity, January 2020 saw the first 10MW electrolyser commissioned, in Japan – a fivefold jump in scale. And in January 2021, the world's largest electrolyser was commissioned in Canada by Air Liquide at 20MW, a doubling in capacity in just one year. Statkraft of Norway had announced the first 50MW development, which was then trumped by a 100MW electrolyser announced by Vattenfall for development in Hamburg Germany, with a commissioning target of 2025 – flagging a fivefold upscaling in the next four years.

Going forward, hydrogen will play a growing role in a wide range of applications including power generation, steel production, fertiliser production, and transport fuel amongst others.

Global investment in new hydrogen technology accelerated during 2020, unincumbered by the COVID-19 pandemic. By the beginning of 2021, over 200 industrial hydrogen projects had been announced (Figure 5), more than 30

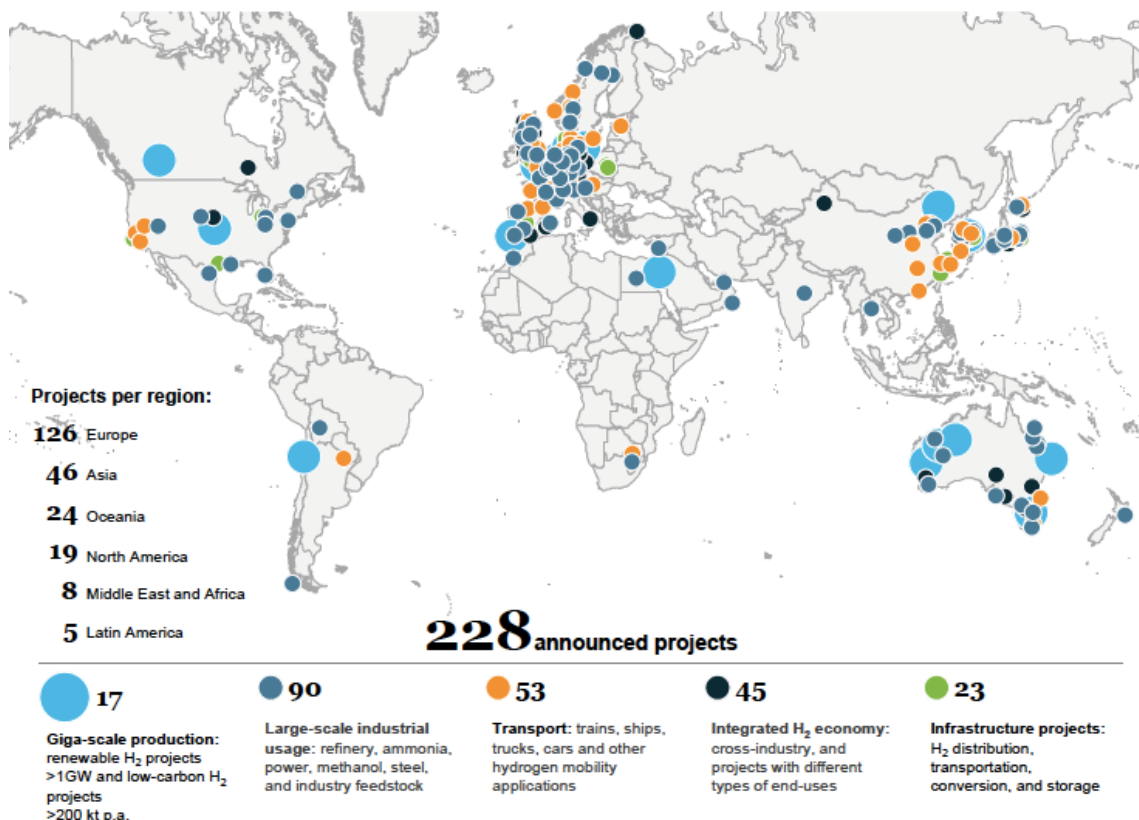
⁵⁸ McKinsey & Co., Hydrogen Council. [Hydrogen Insights](#). February 2021.

countries had released hydrogen roadmaps, and governments had committed more than US\$70 billion in public funding. The total investment of all announced projects will be US\$300 billion through to 2030, should they all proceed.⁵⁹ This sudden increase in global hydrogen investment will see the cost of green hydrogen production fall even faster than recently predicted.

Transportation of hydrogen over long distances is likely to take place in the form of ammonia which has a higher volumetric energy density than hydrogen, whilst ships that can transport ammonia are already commercially available. Today the great majority of ammonia is used as a feedstock for fertiliser production, with the rest used to produce chemicals.

Pakistan is planning a coal-to-gas plant with the aim of producing fertiliser but in the future, Pakistan could import ammonia as a feedstock for fertiliser production without the added expense of cracking it back into hydrogen. Saudi Arabia is planning a US\$5 billion investment in green hydrogen for export.⁶⁰

Figure 5: Global Hydrogen Projects Across the Value Chain



Source: McKinsey & Company.

⁵⁹ McKinsey & Co., Hydrogen Council. *Hydrogen Insights*. February 2021.

⁶⁰ Bloomberg. *Saudi Arabia's Bold Plan to Rule the \$700 Billion Hydrogen Market*. 7 March 2021.

For fertilizer production, green ammonia produced with renewable energy will likely be cost competitive with fossil fuel-based ammonia produced in Europe by 2030 where the cost of carbon is no more than US\$50/tonne.⁶¹ In February 2021, European carbon allowances were both auctioned and traded at a record high US\$49/tonne.⁶²

Pakistan would also have the option of co-firing ammonia in existing thermal power plants as a way of reducing the carbon emissions of its electricity sector.

Where energy security is a concern, Pakistan could produce its own green hydrogen in the future using its abundant renewable energy resources. Hydrogen produced domestically could be used as a feedstock for fertiliser production, used for power generation, or blended into the gas grid to decarbonise the system and alleviate the gas shortages that Pakistan experiences on a regular basis.

Although green hydrogen is not cost competitive yet, the world now appears to be on the brink of a rapid cost deflation for new hydrogen technology of the type that has already been witnessed for wind and solar power, which are now the cheapest sources of new power generation in Pakistan. If Pakistan continues with plans to build coal-to-gas and coal-to-liquids projects, it will be locking in 20th century technology whilst the rest of the world develops the energy and chemicals technology of the 21st century.

⁶¹ McKinsey & Co., Hydrogen Council. [Hydrogen Insights](#). February 2021.

⁶² S&P Platts. [EU carbon auction clears at record high price](#). 16 February 2021.

About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

About the Author

Simon Nicholas

Simon Nicholas is an energy finance analyst with IEEFA, based in Australia and covering the South Asia, Australian and African thermal coal and electricity markets. Simon holds an honours degree from Imperial College, London and is a Fellow of the Institute of Chartered Accountants of England and Wales. He has 16 years' experience working within the finance sector in both London and Sydney at ABN Amro, Macquarie Bank and Commonwealth Bank of Australia. snicholas@ieefa.org

This report is for information and educational purposes only. The Institute for Energy Economics and Financial Analysis ("IEEFA") does not provide tax, legal, investment, financial product or accounting advice. This report is not intended to provide, and should not be relied on for, tax, legal, investment, financial product or accounting advice. Nothing in this report is intended as investment or financial product advice, as an offer or solicitation of an offer to buy or sell, or as a recommendation, opinion, endorsement, or sponsorship of any financial product, class of financial products, security, company, or fund. IEEFA is not responsible for any investment or other decision made by you. You are responsible for your own investment research and investment decisions. This report is not meant as a general guide to investing, nor as a source of any specific or general recommendation or opinion in relation to any financial products. Unless attributed to others, any opinions expressed are our current opinions only. Certain information presented may have been provided by third-parties. IEEFA believes that such third-party information is reliable, and has checked public records to verify it where possible, but does not guarantee its accuracy, timeliness or completeness; and it is subject to change without notice.