

Asia's Net Zero Energy Investment Potential

March 2021



Summary

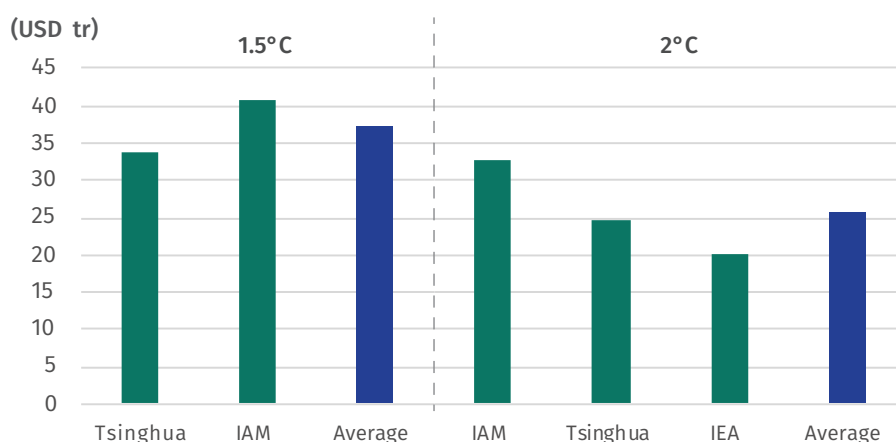
Asia is the world's largest and fastest growing consumer of energy as well as the largest emitter of CO₂. This is a result of its rapid economic development, dominant manufacturing base and dependency on coal as the primary source of energy. In this context, the decarbonisation of Asia poses an unprecedented challenge.

Rising to the occasion, China, Japan and South Korea have recently pledged net zero targets by the middle of this century, heralding a transformational change ahead in the Asian energy sector and potentially acting as the key catalyst for decarbonisation efforts in other Asian countries.

A key reason for the adoption of net zero is the significant economic benefits conferred. Renewable energy is now largely cheaper than fossil fuels, generates more employment per dollar of expenditure than fossil fuels and would significantly reduce fossil fuel imports.

Referencing studies conducted by the International Energy Agency (IEA), Tsinghua University and six integrated assessment models (IAM), the Asia Investor Group on Climate Change (AIGCC) **estimates that the investment opportunity for Asia's energy supply¹ to achieve net zero to be in the region of USD26 trillion (2°C scenario) to USD37 trillion (1.5°C scenario) cumulatively from 2020 to 2050** (equivalent to 1.7 per cent to 2.0 per cent of Asia's GDP). We expect more details on the required investment in the coming months when governments unveil their net zero roadmaps.

Figure 1: Asia energy decarbonisation investment scenarios (2020-50)



Source: Agencies, AIGCC estimates

The scale of this opportunity makes it the defining investment trend of this century and investors, companies and governments in Asia will need to work together to achieve these net zero goals, with action required across a range of fronts including policy, disclosure and investment.

We summarise the key conclusions of this report as follows:

Asia faces decarbonisation challenges from:

- A high reliance on fossil fuels which were responsible for 80 per cent of power generated amongst twelve major Asian countries in 2019.
- Uneven availability of both wind and solar resources, which are necessary for smoothing output, improving reliability of supply and reducing the need for storage.
- A lack of decarbonisation ambition and disappointing track record of implementing previous targets amongst six of nine Asian countries examined.

Asia is well placed to effect this transition:

- In China and India, renewable power costs are up to 25 per cent cheaper compared to developed countries, contributing towards China's renewable power achieving grid parity in 2021 and Indian solar power already undercutting coal power.
- Amongst the four largest economies in Asia, three (China, South Korea and Japan) have committed to achieving net zero, while India has set ambitious renewable energy targets whilst having exceeded the previous goal.
- Our projected estimate for Asia's decarbonisation investment of USD26 trillion (2°C scenario) to USD37 trillion (1.5°C scenario) is well within the means of most countries, representing 1.7 per cent to 2.0 per cent of GDP (a similar level to existing levels of spending on energy) and can be partially funded through the reduction of fossil fuel imports and redirection of fossil fuel capital expenditure.

Next steps towards decarbonisation to be undertaken:

- Governments need to set high and clear targets (i.e. net zero ambitions) whilst creating a conducive environment of regulations (i.e. mandatory renewable targets, grid connections) and commerce (i.e. feed-in-tariffs, emissions trading schemes, green finance).
- Governments will need to manage the social cost of decarbonisation by ensuring an equitable and stable transition of employment from fossil fuel sectors to renewable sectors and maintain financial market stability as fossil fuel assets are phased out.
- Companies need to play their part in complying with Nationally Determined Contributions (NDCs) at the minimum and adopting Paris-aligned science based targets as a base case, and adopt improved disclosure standards such as the Task Force for Climate-related Disclosures (TCFD) recommendations.

Investors can play a significant role through:

- Identifying and allocating capital towards sectors and companies well placed to enable decarbonisation efforts.
- Engaging with companies and policymakers to encourage the adoption of Paris-aligned climate targets and share best practices in terms of target setting and disclosure.

Assessing Asia’s decarbonisation investment potential

Three major studies provide the framework

A comprehensive assessment of the required investments to decarbonise Asia’s energy supply faces a myriad of challenges given the diversity of the region, uncertain pathways and evolving technology. We have identified three recent publicly available assessments that can assist:

- **IEA** estimates that under its Sustainable Development Scenario (SDS), which provides a 50 per cent probability of achieving a 1.65°C scenario, the cumulative energy supply investment in Asia would require USD13.9 trillion up to 2040.
- **Tsinghua University** estimates the cost of China’s investment in energy supply for a within 2°C and under 1.5°C scenarios at around USD14 trillion and USD20 trillion to 2050, respectively.
- **Integrated Assessment Models (IAM)** drawn from the International Institute for Applied Systems Analysis (IIASA) database of AIM/CGE, IMAGE, MESSAGEix-GLOBIOM, POLES, REMIND-MAgPIE and WITCH-GLOBIOM model sets,² point to a cumulative Asia ex-Japan energy supply investment requirement for within 2°C and under 1.5°C scenarios at around USD31 trillion and USD38 trillion to 2050, respectively.

Figure 2: Estimates of decarbonisation investment opportunities in Asia

Agency	Country/ Region	Scenario	Sector	Cumulative inv. (USD tr)	
				2040	2050
IEA	Asia	Well below 2°C	Energy supply	13.9	
Tsinghua	China	Below 2°C	Energy supply	-	14.4
			Entire economy	-	18.4
		Below 1.5°C	Energy supply	-	19.9
			Entire economy	-	25.4
IIASA	Asia ex-Japan	Below 2°C	Energy supply	-	31.1
		Below 1.5°C	Energy supply	-	38.4
	China	Below 2°C	Energy supply	-	13.9
		Below 1.5°C	Energy supply	-	16.5

Sources: Agencies, AIGCC estimates

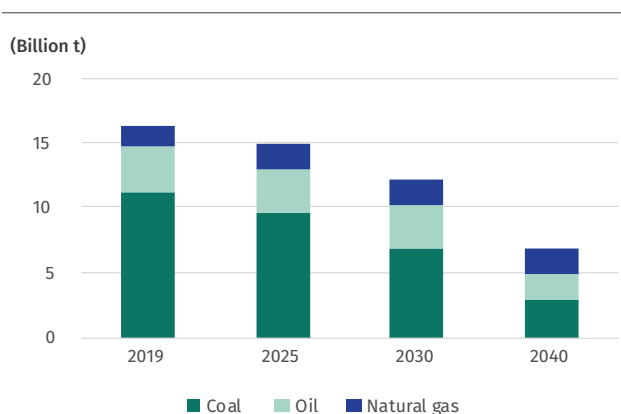
To arrive at an estimate of Asia’s total net zero energy investment potential we proceed in the following sections to:

- Provide more background on each model including key assumptions and forecasts.
- Adjust the estimates in each model to approximate the 2050 timeline, include all of Asia and encompass energy supply only.
- Calculate an average of these adjusted estimates to arrive at a composite estimate for 1.5°C and 2°C scenarios.

IEA SDS model for Asia to 2040

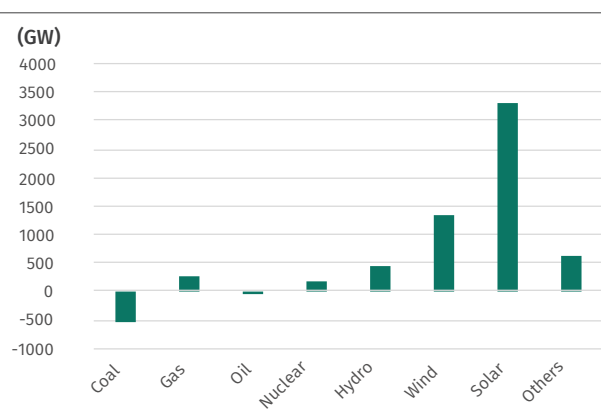
The IEA's Sustainable Development Scenario (SDS) models a pathway for net zero CO2 emissions globally by 2070, which would provide a 50 per cent probability of limiting the temperature rise to less than 1.65°C, in-line with the Paris Agreement. This model is less ambitious compared to the other two models due to the 1.65°C ambition (vs 1.5°C for the other two) and projections that only reach to 2040.

Figure 3: IEA SDS Asia CO2 emissions



Source: IEA

Figure 4: IEA SDS Asia CO2 net power additions (2020-40)



Source: IEA

Since this model only projects investments to 2040, we multiply the required investment to 2050 by a factor of 1.5x to factor in a linear increase in required investment. This extrapolation leads us to conclude that the IEA SDS scenario for Asia (which we consider to be a 2°C scenario) would require a total investment of USD20.2 trillion from 2020-50.

Figure 5: IEA SDS investment potential for Asia, adjusted to 2050

Category	Cumulative investments (USD trillion)	
	2020-40	2020-50
Renewable	6.0	9.0
Networks	6.4	9.6
Fossil fuels	0.6	0.9
Nuclear	0.5	0.7
Total		20.2

Source: IEA, AIGCC estimates

The limitation of this approach is that a linear extrapolation from 2040 to 2050 is simplistic given the multiplicity of variables such as power demand growth, renewables mix, technology costs and storage costs. A complete assessment of these variables is beyond the scope of this report, but we believe that the linear extrapolation is reasonable as the declining cost of renewables technology is likely to be offset by the higher costs of storage investment to backstop intermittency which escalates in the final stages of decarbonisation.³

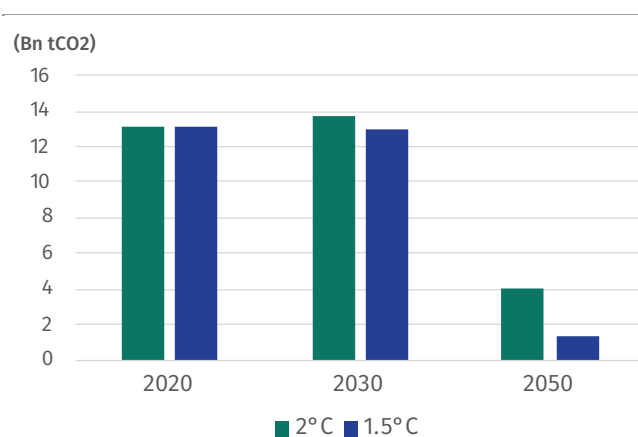
The IEA will be releasing a new report in May 2021 that will set out in detail what is needed to fully decarbonise the energy sector and be fully in-line with a 1.5°C scenario. For now, we incorporate this SDS scenario in our 2°C investment assessment and do not have an IEA scenario for a 1.5°C assessment.

Tsinghua low carbon development strategy for China

In October 2020, the Institute for Climate Change and Sustainable Development (ICCS) at Tsinghua University published its primary findings on China’s long-term low carbon development strategy and transition pathways. A multi-disciplinary team of 24 leading research institutions and think tanks conducted 18 sub-projects to explore pathways to achieve net zero emission in China by 2050.

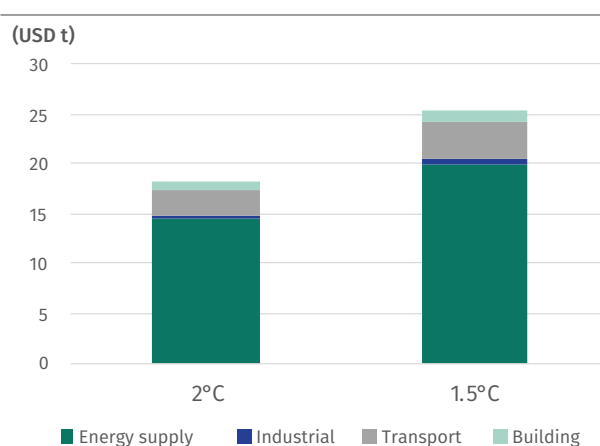
This study models China’s pathways to a 2050 net zero outcome based on a 1.5°C and 2°C scenario. Both pathways model for a stabilisation of emissions from 2020 to 2030, with major reductions coming during the 2030-50 timeframe.

Figure 6: China’s GHG emissions in the 2°C and 1.5°C scenarios



Source: Tsinghua

Figure 7: Cumulative Chinese investment required to 2050



Source: Tsinghua

We regard this study as the most comprehensive and up-to-date model of the largest economy in Asia, which is based on the key assumptions outlined in Figure 8.

Figure 8: China’s energy mix in 2°C and 1.5°C development pathways

(%)	2020	2050	
		2°C	1.5°C
Electricity/Primary Energy	45	>70	85
Electricity from:			
- Non-fossil fuels	32	90	>90
- Coal	65	<10	<5

Source: Tsinghua

We believe that extrapolating Tsinghua’s estimate of China’s required investment to the rest of Asia on the basis of present fossil fuel demand that needs to be replaced, is a useful exercise in gauging the potential investment requirement for Asia. **This process leads us to an estimated investment in Asia’s energy system of USD25 trillion in a 2°C scenario and USD34 trillion in a 1.5°C scenario as detailed in Figure 9 below.**

Figure 9: Asia’s potential investment in energy systems (Tsinghua extrapolation, 2020-50)

	2019 fossil fuel (Exajoules)	2°C USD t	1.5°C USD t
China	120.6	14.4	19.9
India	31.0	3.7	5.1
Japan	16.3	2.0	2.7
South Korea	10.8	1.3	1.8
Taiwan	4.4	0.5	0.7
Malaysia	4.0	0.5	0.7
Thailand	5.3	0.6	0.9
Indonesia	8.4	1.0	1.4
Philippines	1.8	0.2	0.3
Vietnam	3.5	0.4	0.6
Total	206.0	24.6	33.9

Source: Tsinghua estimates for China, AIGCC estimates for other countries

The limitations of this approach of extrapolating China’s decarbonisation investment to the rest of Asia are that it fails to take into account:

- Each country has different input costs. For example, decarbonising Japan and South Korea may cost more than China on a per unit basis due to their higher land and labour costs
- Decarbonising large land masses such as China and India may be more easily accomplished compared to decarbonizing archipelagos such as Indonesia and Philippines.

Integrated Assessment Models for Asia ex-Japan under 1.5°C and 2°C scenarios

Based on published research by a team of climate researchers,⁴ we draw upon six global energy-economy models, or integrated assessment model (IAM) frameworks as detailed below to derive an estimate of the investment needed in Asia ex-Japan to achieve a 1.5°C and 2°C outcome.

These models span a range from least-cost optimisation to computable general equilibrium model, and from game-theoretic to recursive-dynamic simulation models. The authors thus believe that this diversity generates findings that are robust and encompass a wide scope of technologies and their outcomes.

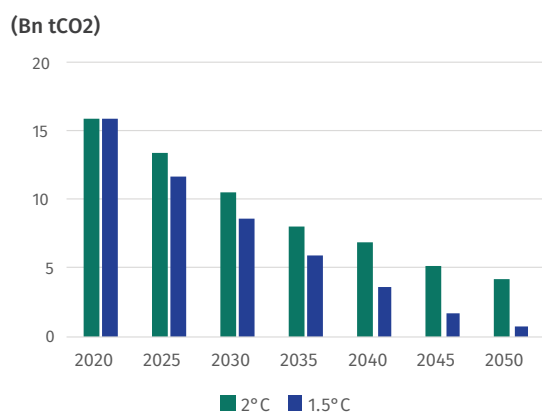
Figure 10: Details of Integrated Assessment Models

Acronym	Model	Developer
WITCH	World Induced Technical Change Hybrid	European Institute on Economics and the Environment
AIM/CGE	Asia Pacific Integrated Model	National Institute for Environmental Studies
IMAGE	Integrated Model to Assess the Global Environment	PBL Netherlands Environmental Assessment Agency
MESSAGEix-GLOBIOM	Model for Energy Supply Strategy Alternatives and their General Environmental Impact - Global Biosphere Management	International Institute for Applied Systems Analysis
POLES	Prospective Outlook on Long-term Energy Systems	Joint Research Centre of the European Commission
REMIND-MAgPIE	Regional Model of Investment and Development - Model of Agricultural Production and its Impacts on the Environment	Potsdam Institute for Climate Impact Research

Source: Agencies

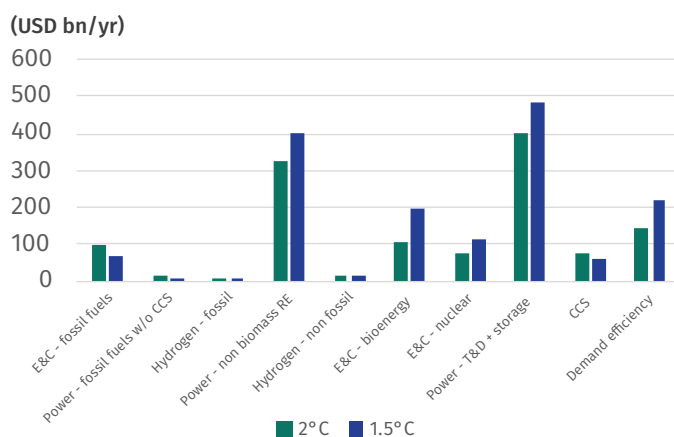
Using these six models, we have extracted the emissions pathways and required investment in the Figure 11 below. The average of these six models indicate an annual energy investment requirement (excluding carbon, capture and storage (CCS) and demand side energy efficiencies to maintain uniformity with the IEA and Tsinghua scenarios) for Asia ex-Japan of USD1.3 trillion per annum in a 1.5°C scenario (or total of USD38.4 trillion from 2020-50) and USD1 trillion per annum in a 2°C scenario (or total of USD31.1 trillion from 2020-50).

Figure 11: Asia ex-Japan's GHG emissions pathways



Source: IIASA

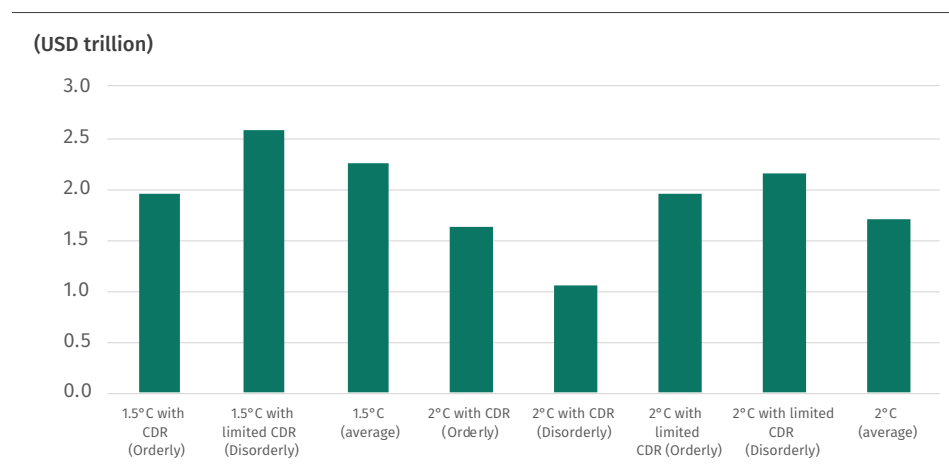
Figure 12: Asia ex-Japan's energy investment required to 2050



Source: IIASA

Since the data from these IAM's are not available for Japan, we have used estimates from the Network for Greening the Financial System (NGFS) scenarios to estimate decarbonisation costs for Japan, where we estimate energy investment needs of USD1.7-2.3 trillion for 2°C and 1.5°C scenarios, respectively, as detailed in Figure 13 below.

Figure 13: NGFS decarbonisation investment scenarios for Japan (2020-50)



Source: NGFS, AIGCC estimates

By combining the assessments of IAM for Asia ex-Japan and NGFS for Japan, we arrive at a total investment requirement for Asia's energy system of USD33 trillion in a 2°C scenario and USD41 trillion in a 1.5°C scenario as detailed in the figure below.

Figure 14: Asia's potential investment in energy systems

	2°C	1.5°C
	USD t	USD t
Asia ex-Japan	31.1	38.4
Japan	1.7	2.3
Total	32.8	40.7

Source: IIASA, NGFS, AIGCC estimates

Cumulative investment of USD37 trillion in a 1.5°C scenario

From these three scenarios detailed above, we arrive at our estimate for Asia’s potential investment in energy systems at USD26 trillion (2°C scenario) to USD37 trillion (1.5°C scenario), as detailed in the figure below.

Figure 15: Asia’s potential investment in energy systems (2020-50)

(USD t)	2°C	1.5°C
IEA SDS (to 2050)	20.5	n.a.
Tsinghua (inc. Rest of Asia)	24.6	33.9
IIASA (inc. Japan)	32.8	40.7
Average	25.9	37.3

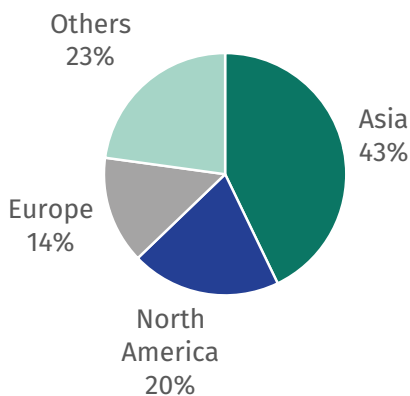
Source: Tsinghua, IIASA, AIGCC estimates

- The range of USD26 trillion and USD37 trillion is equivalent to 1.5 per cent to 2.0 per cent of Asia’s GDP, which compares with Intergovernmental Panel on Climate Change (IPCC) estimates of required global investment of 2.5 per cent of global GDP between 2016-35 in its Special Report on Global Warming of 1.5°C.⁵
- We believe the level of investment (as a per centage of GDP) in Asia may be lower than the IPCC’s global estimate as Asia’s cost of renewables power is up to 25 per cent cheaper in China and India compared to the United States (US) and European Union (EU), as detailed in the final section of this paper, due to lower labour and component costs.

Reimagining Asia's energy landscape

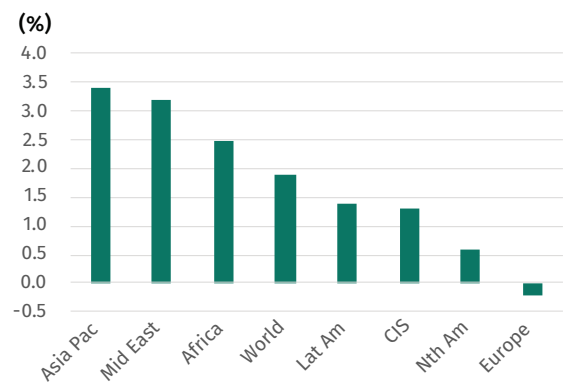
The decarbonisation of Asia's energy landscape presents an unprecedented challenge. In the global context during 2019, Asian demand constituted 43 per cent of energy, 76 per cent of coal, 36 per cent of oil and 21 per cent of natural gas. Asian energy demand is growing at the fastest rate in the world at double the global average for the past decade.

Figure 16: Global energy demand breakdown (2019)



Source: BP

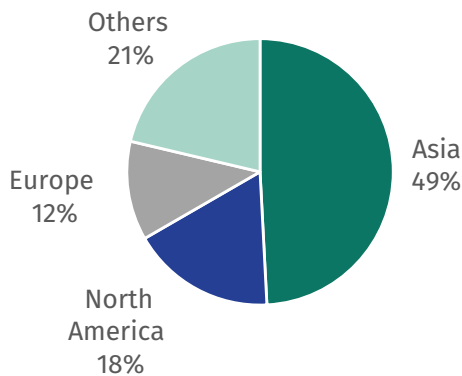
Figure 17: Regional energy demand growth (CAGR, 2009-19)



Source: BP

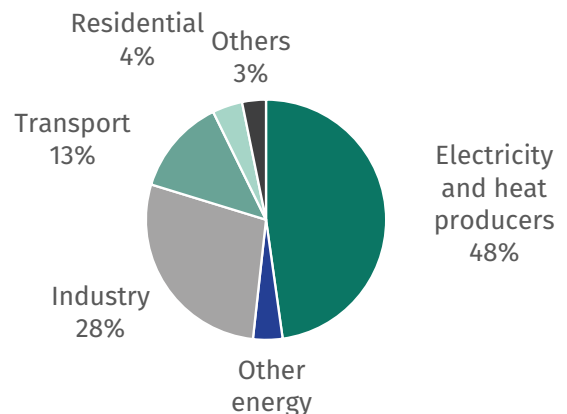
Reducing Asia's emissions are critical as Asia is responsible half of global CO₂ emissions (17 gigatonnes per annum). By fuel, the majority of Asia's CO₂ emissions stem from coal combustion, which accounts for 72 per cent of global CO₂ emissions from coal and 32 per cent of aggregate global CO₂ emissions. By sector, power generates almost half of Asia's CO₂ emissions, followed by industry (28 per cent) and transport (13 per cent).

Figure 18: Global CO₂ emissions by region (2019)



Source: IEA

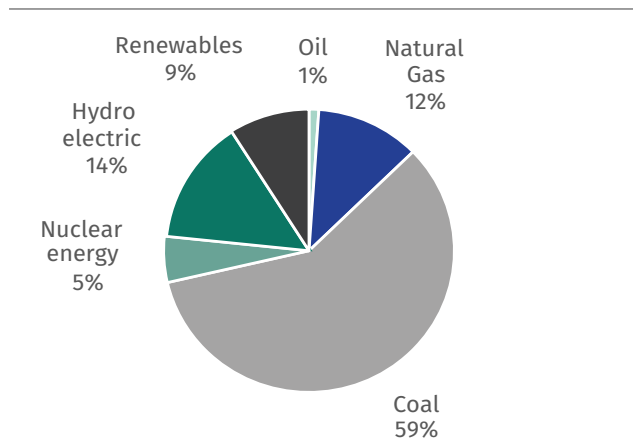
Figure 19: Asia CO₂ emissions by sector (2019)



Source: IEA

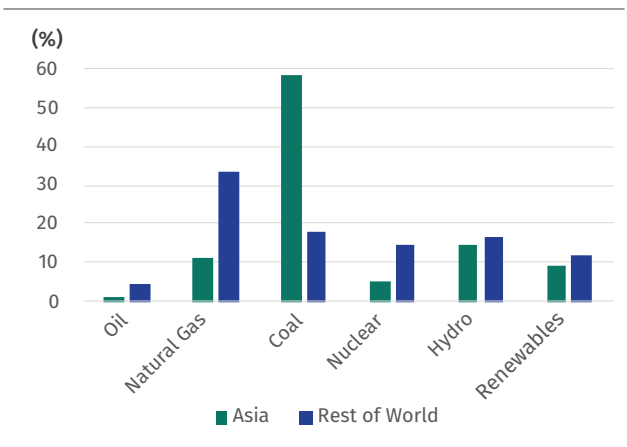
We attribute Asia’s high intensity of carbon emissions to the heavy dependency on coal for power generation, which constituted 59 per cent of Asia’s total power generation in 2019. This is over three times the average of coal power generation levels in the rest of the world, who use comparatively more natural gas and nuclear power.

Figure 20: Asia power generation breakdown by fuel (2019)



Source: IEA

Figure 21: Asia vs Rest of World power generation mix (2019)

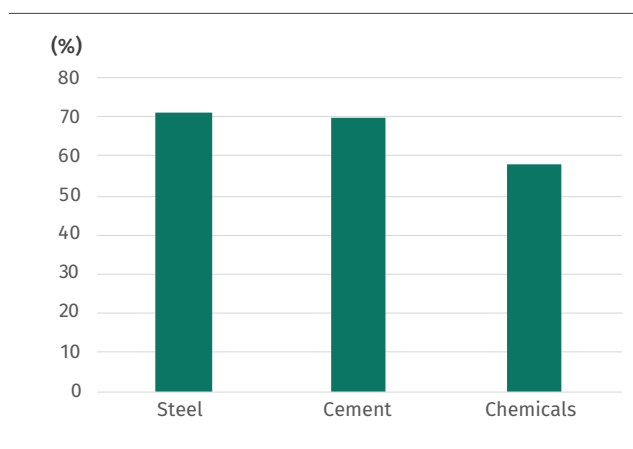


Source: IEA

Heavy industry is another key carbon emitter and Asia is a dominant producer of steel, cement and chemicals, commanding an average global share of 66 per cent among these sectors in 2019. There are considerable hurdles to decarbonising these sectors, which necessitate the adoption of new production technology such as the use of green hydrogen to substitute coking coal to produce green steel.

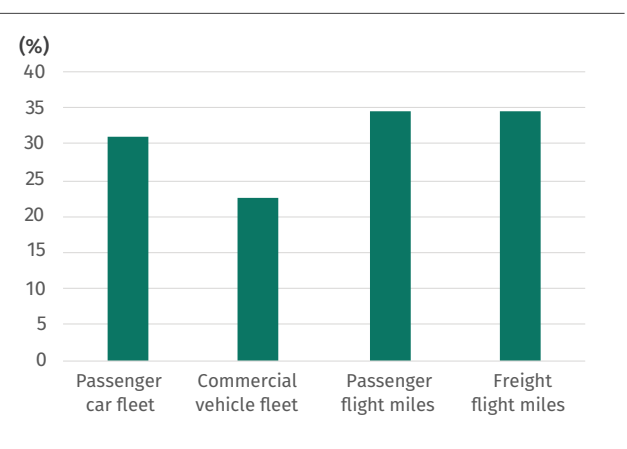
Asia is also home to around one-third of the global transport fleet, which accounts for 13 per cent of the region’s emissions. This includes a passenger car and commercial vehicle fleet of around 300 million vehicles and 78 million vehicles, respectively. Converting a large proportion of these fleets to electric or hydrogen poses a significant challenge given the financial and infrastructure hurdles to be overcome.

Figure 22: Asia global share of heavy industry (2019)



Source: CEIC

Figure 23: Asia global share of road and air transport (2019)

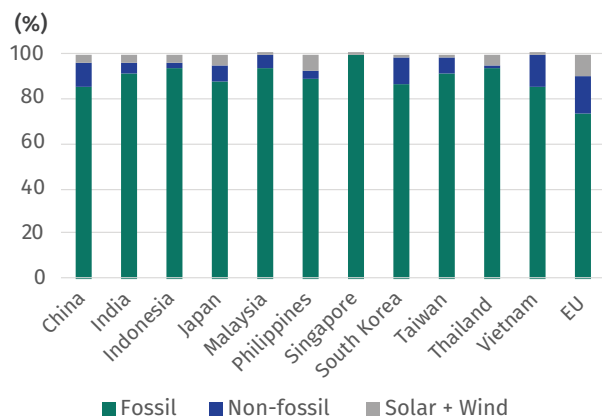


Source: OICA, IATA

Decarbonisation pathways and country breakdown

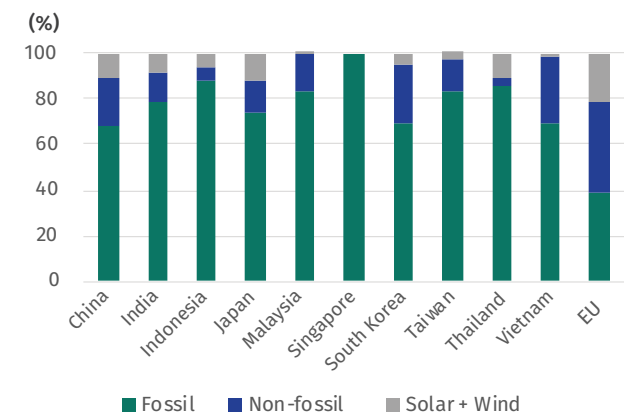
The challenge of decarbonising Asia is apparent from the pre-dominance of fossil fuels to generate energy. In 2019, fossil fuels constituted an average of 91 per cent of total energy generated and 80 per cent of power generated amongst twelve major Asian countries. In contrast, Europe relied on fossil fuels for 74 per cent of total energy generated and only 39 per cent of power generated for the same period.

Figure 24: Asia's energy generation mix (2019)



Source: BP

Figure 25: Asia's power generation mix (2019)

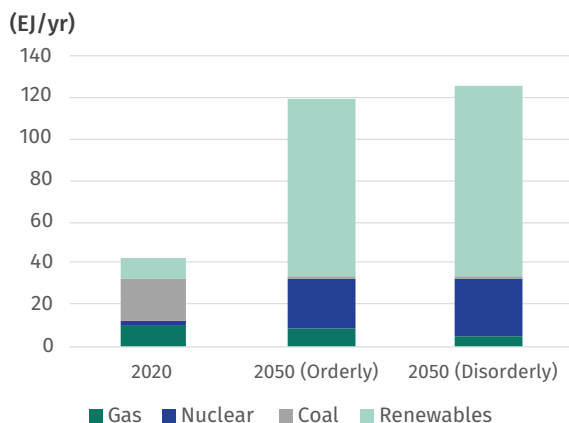


Source: BP

According to climate scenarios set out by the Network for Greening the Financial System (NGFS),⁶ the pathways for Asia to decarbonise involve:

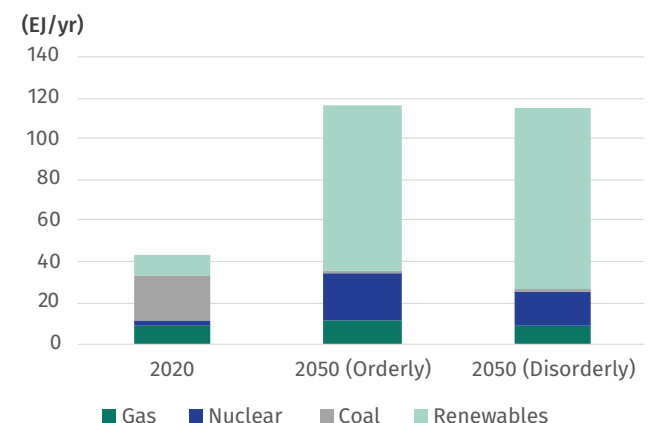
- In the average of 1.5°C scenarios, the proportion of power needs to rise for renewables to 73 per cent and nuclear to 22 per cent, and a concurrent decline in gas to 5 per cent and coal to 0 per cent by 2050.
- In the average of 2°C scenarios, the proportion of power needs to rise for renewables to 69 per cent and nuclear to 16 per cent, and a concurrent decline in gas to 8 per cent and coal to 0 per cent by 2050.

Figure 26: Asia's power generation mix pathway - NGFS 1.5°C scenario



Source: NGFS

Figure 27: Asia's power generation mix pathway - NGFS 2°C scenario



Source: NGFS

We believe that Asian countries' potential to decarbonise are likely to depend on the following non-exhaustive factors:

- Sufficiency of both solar and wind resources since these resources are complementary in smoothing power output, improving reliability of supply and reducing the need for storage.
- Successful adoption and economical implementation of power storage solutions such as batteries and hydrogen, which have yet to be commercialized at a large scale.
- Government ambition in setting high bars (i.e. net zero ambitions) whilst creating a conducive regulatory (i.e. mandatory renewable targets, grid connections) and commercial environment (i.e. feed-in-tariffs, hydrogen infrastructure).
- Track record of achieving previous renewables targets, as this points to the respective countries' ability to muster the necessary resources to effect this change.

In Asia, we believe that China, India and Vietnam have the most realistic chance of reaching their 2030 wind and solar capacity targets as their current installed capacities are already 45 per cent, 19 per cent and 66 per cent of their 2030 targets, respectively. Japan and South Korea, who have less solar resources and greater seasonality of energy demand, are likely to require green energy imports to decarbonise.

Figure 28: Summary assessment of Asian countries decarbonisation potential

Country	Resource		Net zero	RE capac. (2019, GW)	RE target		RE actual vs target (2020)
	Solar	Wind			(GW)	Year	
China	High	High	Yes	416	>1200	2030	Exceeded
India	High	High	No	73	450	2030	Exceeded
Indonesia	High	Low	No	0	6.5	2025	Missed
Japan	Low	Medium	Yes	66	45 (wind)	2040	n.a.
Malaysia	High	Low	No	1	7	2025	Missed
S. Korea	Low	Medium	Yes	12	185	2034	n.a.
Taiwan	Low	Medium	No	5	27	2025	n.a.
Thailand	High	Low	No	4	18	2037	n.a.
Vietnam	High	Low	No	8	14	2030	Exceeded

Source: BP, NREL, Agencies, AIGCC estimates

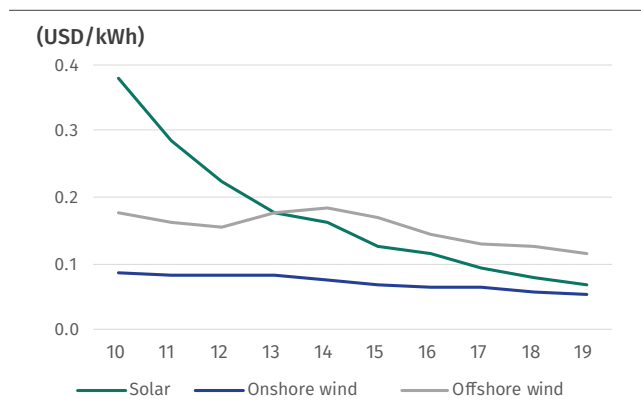
Going green is good business

In September 2020, China became the first major Asian economy to make a net zero pledge, which was followed by Japan and South Korea. We believe these announcements stem from the necessity to combat climate change, rapidly improving economics of renewable energy and need for economic stimulus.

The improving economics of renewable energy have been driven by a dramatic fall in costs. Over the past ten years, the global weighted levelised cost of electricity (LCOE) from utility-scale renewable power generation for solar and wind (offshore and onshore) have fallen by 82 per cent and 33 per cent respectively, according to the International Renewable Energy Agency (IRENA).

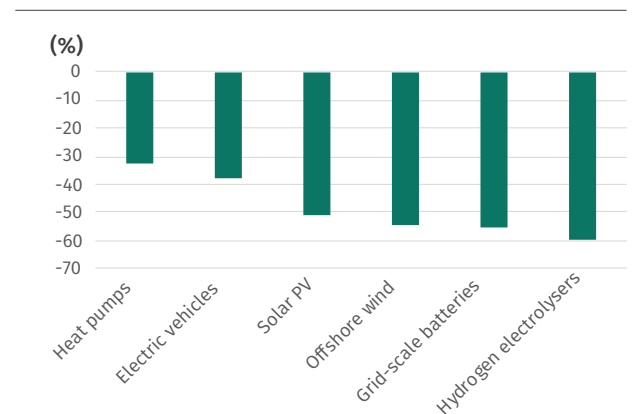
The IEA forecasts these cost reductions to continue, with absolute cost declines of up to 60 per cent for major renewable technologies over the next two decades from technological advancement and economies of scale. This will further enhance the already favourable economics of renewable power and accelerate its adoption in Asia, where renewables constituted only 9 per cent of electric power generated in 2019.

Figure 29: Global weighted average LCOE trend



Source: IRENA

Figure 30: Capital cost reductions (2040 vs 2019)

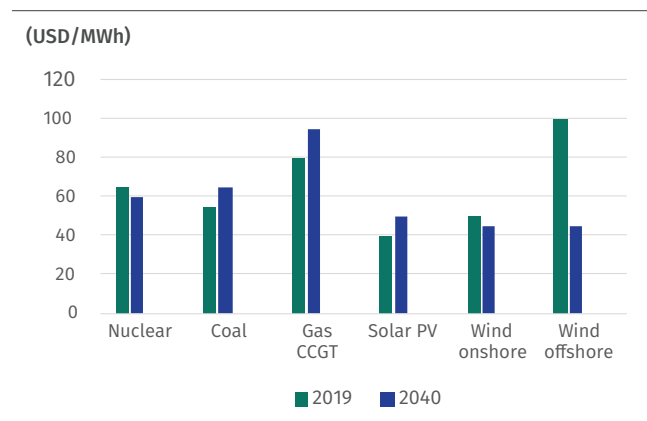


Source: IEA

As the proportion of renewable energy increases, it has become more important to capture the full cost of renewable power due to the issue of intermittency. The IEA has addressed this by combining LCOE with additional costs from accounting for flexibility and capacity to generate a value-adjusted LCOE (VALCOE). Even so, the VALCOE remains materially lower than fossil fuels at present, and the IEA expects this cost differential to further widen by 2040.

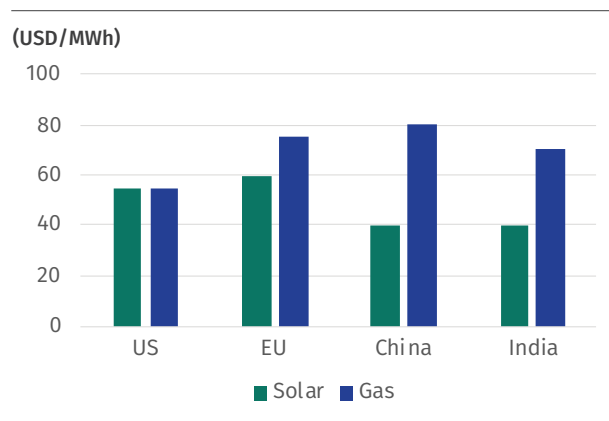
We expect the benefit of lower renewables cost to be especially pronounced in selected countries in Asia since VALCOE of renewables is up to 25 per cent cheaper in China and India compared to the US and EU. In addition, the cost advantage of renewables vs fossil fuels in the US and EU is also much smaller in comparison to China and India.

Figure 31: China value-adjusted levelized cost of electricity (VALCOE) comparison



Source: IEA

Figure 32: Global comparison of VALCOE of solar vs gas (2019)



Source: IEA

An additional benefit of deep decarbonisation would be a sharp reduction in fossil fuel imports, which we estimate to have totaled USD820 billion for Asia in 2019. Assuming a similar level of energy prices going forward, this would be equivalent to a cumulative sum of USD25 trillion over the next 30 years, which would significantly defray the costs of the energy transition.

Figure 33: Fossil fuel import costs in 2019 (USD billion)

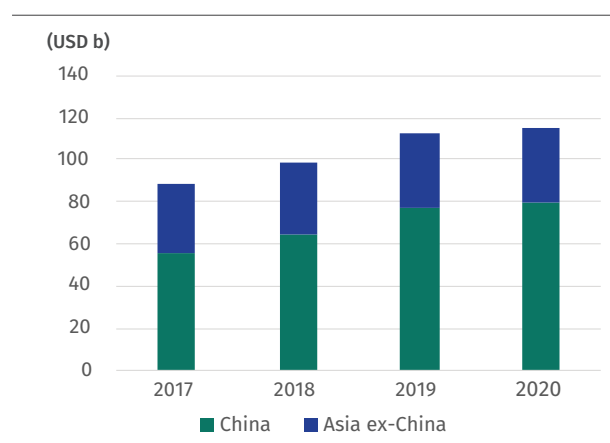
Country	Oil	Gas	Coal	Total
China	258	42	23	324
India	119	10	10	139
Japan	74	23	12	110
South Korea	70	21	14	105
Taiwan	21	7	7	36
Malaysia	24	2	3	29
Philippines	10	1	12	23
Thailand	21	0	1	22
Indonesia	22	0	0	22
Vietnam	10	1	0	10
Total	630	107	83	820

Source: National Statistics Offices, AIGCC estimates

Another source of investment in renewables could come from redirecting capital expenditure (capex) from the oil & gas industry. In 2020, we estimate that the major Asian oil companies cumulatively incurred capex of USD115b with China accounting for 70 per cent of total Asian expenditure, and with minimal amounts directed towards renewable capex.

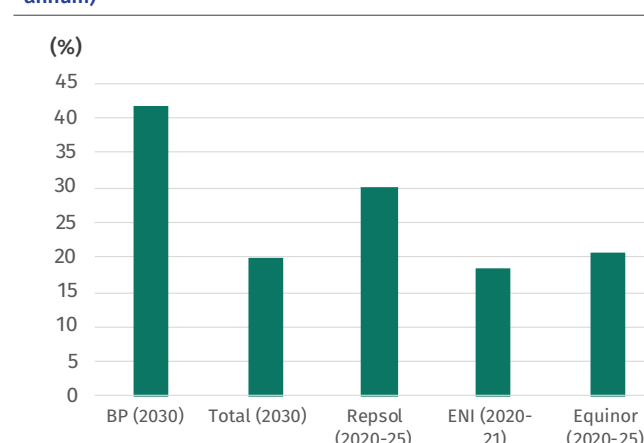
In 2020, European oil majors announced low carbon investment capex targets of an average of 26 per cent of total capex for the 2020-30 period. We calculate that if Asian oil companies were to announce a similar level of low carbon capex, this would unlock an additional USD30b per annum of renewables investments in Asia, equivalent to 4 per cent and 2.5 per cent of our estimate of Asia's required investment for the 2°C and 1.5°C scenarios respectively. As we would expect the ratio of low carbon capex to substantially rise in the medium-to-longer term, the importance of this contribution is likely to proportionately rise.

Figure 34: Asian oil sector capex



Source: Companies

Figure 35: EU oil majors low carbon capex share targets (per annum)



Source: Companies

Most long-term scenarios modeling net zero targets include the imposition of a carbon tax, and this can be an additional source of revenue for governments, as even in 1.5°C scenarios residual CO₂ is still expected to be generated. Using the carbon emissions pathway from Tsinghua and extrapolating to the rest of Asia, we estimate that Asian governments can generate carbon tax revenues in the range as detailed in Figure 36.

Figure 36: Scenario analysis of potential carbon tax revenues in Asia

Carbon tax (USD/t CO ₂)	2030 (USD b)	2050 (2°C) (USD b)	2050 (1.5°C) (USD b)
20	339	95	48
40	679	190	95
60	1017	284	143
80	1357	379	191
100	1696	474	239

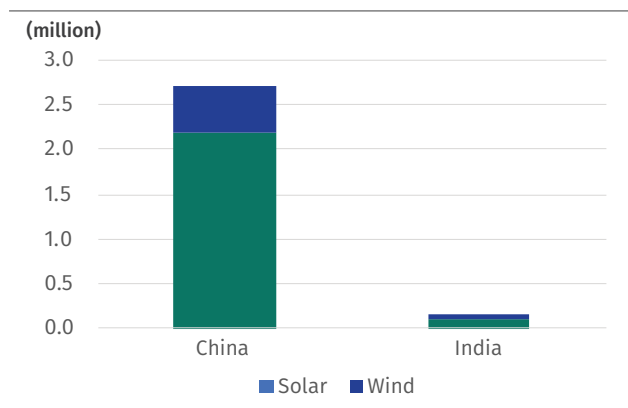
Source: BP, Tsinghua, AIGCC estimates

The adoption of renewable energy can also lead to higher net employment, as studies have shown that spending on renewable energy produces about twice as many jobs per dollar of expenditure than an equal amount of spending on fossil fuels.⁷

In addition to direct employment in renewable energy production, jobs will be created through investments in smart grids, transmission and distribution networks, storage capacity, charging infrastructure and construction. A successful transfer of skills from the fossil fuel industry to renewables will therefore play an important role in mitigating higher unemployment from the fossil fuel industry.

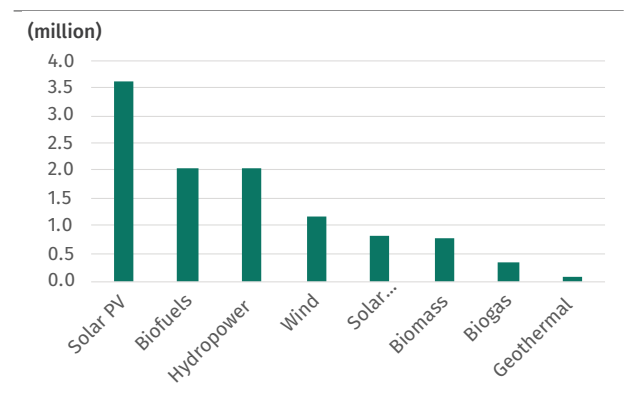
Globally, IRENA estimates that renewable energy employment could expand to 25 million workers by 2030, outpacing job losses in the fossil fuel sector by around 6 million workers. In 2018, IRENA estimated total direct employment in solar and wind sectors in China of 2.3 million workers, a similar number to the coal industry, showing the potential for renewables to provide a net expansion of employment as renewables energy constituted just 5 per cent of China's primary energy demand vs 58 per cent for coal.

Figure 37: Renewable energy employment (2018)



Source: IRENA

Figure 38: Global renewable energy employment (2018)



Source: IRENA

References and Footnotes

1. Energy supply is defined as broad coverage of different energy technologies including resource extraction, power generation, fuel conversion, pipeline and transmission and energy storage.
2. See Figure 10 for full details of these six global energy-economy models
3. Wood Mackenzie (June 2019), Deep decarbonization requires deep pockets
4. Nature Energy (July 2018), Energy investment needs for fulfilling the Paris Agreement and achieving the Sustainable Development Goals
5. [IPCC Special Report: Global Warming of 1.5 °C - Summary for Policymakers](#)
6. [AIGCC Policy Update \(July 2020\), Central bank climate scenarios: Unpacking the NGFS](#)
7. Political Economy Research Institute (2017), Renewable Energy Investment and Employment in China

About

The Asia Investor Group on Climate Change (AIGCC) is an initiative to create awareness and encourage action among Asia's asset owners and financial institutions about the risks and opportunities associated with climate change and low carbon investing. AIGCC provides capacity and a trusted forum for investors active in Asia to share best practice and to collaborate on investment activity, credit analysis, risk management, engagement and policy related to climate change.

AIGCC members come from 11 different markets in Asia and internationally, and include asset owners and managers with a combined AUM of over US\$13 trillion. With a strong international profile, the AIGCC network of members and key stakeholders include asset owners and managers, government pension and sovereign wealth funds, family offices and endowments. AIGCC represents the Asian investor perspective in the evolving global discussions on climate change and the transition to a net-zero emissions economy.

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We would like to thank GIC Private Ltd for their assistance in reviewing this report and AIGCC members for their input.



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