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The Energy Trilemma Series – Part 1

The energy trilemma explained

Global Listed Infrastructure
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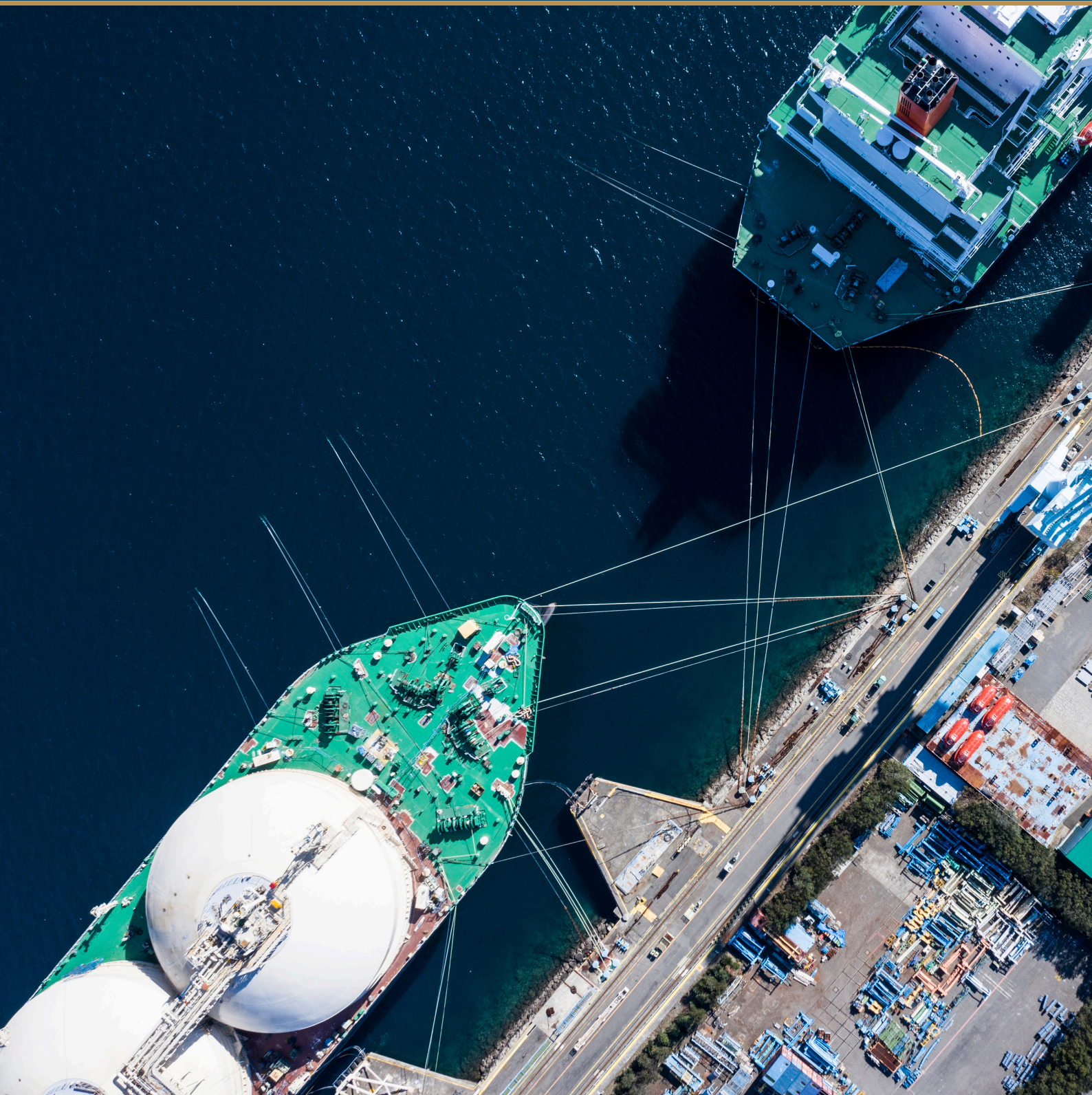


Executive summary

A number of recent events, most notably the geopolitical upheaval and instability owing to Russia's invasion of Ukraine, are causing major disruptions to the global energy sector and shaping the pace and scale of the energy transition. Heightened energy security and affordability has quickly become a commonly held priority for governments around the world, as has the need to achieve more sustainable energy to help mitigate the negative impacts of climate change. Simultaneously achieving all three objectives of the energy trilemma – that is, ensuring energy sustainability, security and affordability – is a complex balancing act. We believe these dynamics are creating meaningful investment opportunities for infrastructure investors. In fact, we believe that concerted efforts to achieve energy security and affordability – the more immediately tangible dimensions of the trilemma – could accelerate the pace of the energy transition, rather than hinder it.

Understanding the intricacies of the energy trilemma – including opportunities to address current deficiencies and assess the risks stemming from failures to adequately balance these elements – is critical to energy infrastructure investing. In this first paper of our three-part The Energy Trilemma series, we explain the three dimensions of the energy trilemma with a particular focus on energy security and the need for governments to balance long-term outcomes across the dimensions. The second paper highlights the unique role that the North American midstream sector can play in addressing issues in the energy trilemma and the stronger investment outlook for natural gas infrastructure assets, given the renewed appreciation for the importance of energy security. The third paper then looks at our approach to environmental, social and governance (ESG) risks and how we specifically integrate this into our investment process to help balance long-term opportunities with stranded asset risks in the midstream space.

The energy trilemma

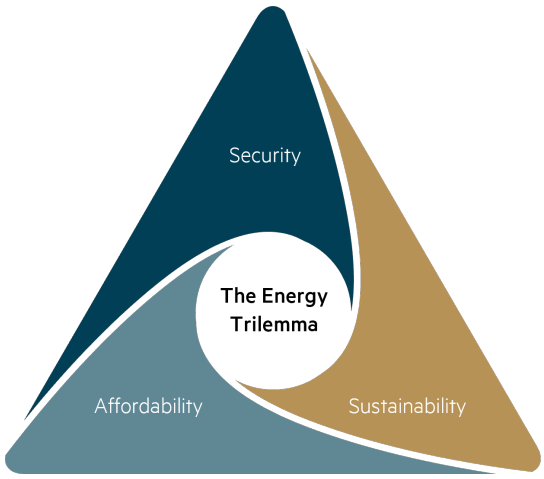
The energy sector is undergoing a rapid transformation towards a more sustainable and lower carbon future. According to the International Energy Agency (IEA), approximately US$1.0 trillion per year of investment in energy infrastructure will be required over the next three decades to achieve net zero emissions by 2050.[1] To support this transition, governments around the world are setting and accelerating their clean energy targets by incentivising investments across a wide range of initiatives – such as renewable generation penetration, transmission and distribution network expansions, energy efficiency measures and the development of low carbon solutions. These investments are expected to give rise to substantial long-term infrastructure investment opportunities across the energy value chain.[i]

Regardless of the pace of the energy transition, there is a growing appreciation that energy sustainability cannot be achieved without also ensuring security and affordability. Energy policymakers face the major challenge of striking a balance between achieving energy sustainability, security and affordability – a conundrum commonly known as the energy trilemma.

Current technologies can generally address any two of these dimensions reasonably well, but there are often trade-offs that make it difficult to simultaneously address all three dimensions at once. For example, while wind energy offers a clean source of electricity and is cost-competitive with other generation sources, the non-dispatchable nature of its output (driven by the availability of wind) creates problems of intermittency.

Wind energy can therefore detract from overall system reliability when not coupled with the right storage, baseload and grid infrastructure. While the recent focus has been on sustainability-led investments, measures to support security and affordability can also represent meaningful investment opportunities for certain energy infrastructure assets, such as North American midstream infrastructure. These investment opportunities are often underappreciated by some policymakers, regulators and investors.

Figure 1: The Energy Trilemma



i We discussed some of these opportunities across US regulated utilities in our whitepaper: The impacts of the energy transition on infrastructure needs in the US.

Security

Energy security relates to the ability to ensure that there are always sufficient resources available to meet current and future energy demands. Without energy security, households would not be able to reliably heat or cool their homes, there would be disruptions to many industrial processes and an impact to the overall standard of living. While there are a broad range of factors to consider in relation to energy security, the considerations can broadly be classified into three groups:

1 the management of domestic energy sources, such as electricity generation mix, reserve margins and natural resource endowment;

2 the management of external energy sources, such as diversity of energy supply, threat of geopolitical risks and energy import infrastructure; and

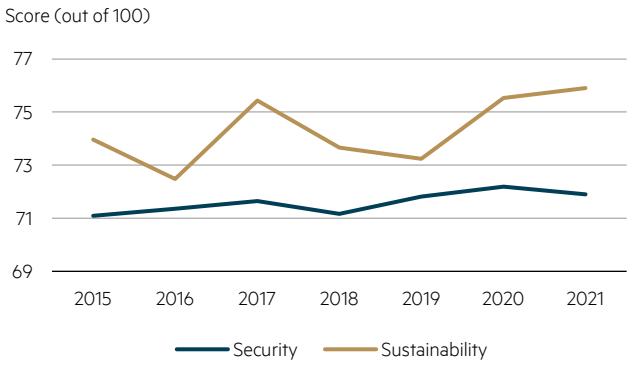
3 the resiliency of energy infrastructure, such as cybersecurity threats, physical hardening and network redundancies.

According to the World Energy Council's Trilemma Index, progress on energy security tends to lag progress on sustainability and affordability at a global level.[ii] In 2021, the average country score (out of 100) on energy security was 56.7, compared to 65.0 for sustainability and 69.0 for equity, which encompasses affordability and accessibility. The gap in scores has also widened over the years, in part reflecting a lack of investment in addressing energy security. Generally, countries that are well endowed with diverse natural energy resources – such as oil, gas and hydro-power – and have good interconnectivity with neighbouring countries – for example, Canada, US and Brazil – score relatively well on energy security. North American midstream assets are examples of critical infrastructure that enable improvements in global energy security.

Energy transition risks

The recent prioritisation of decarbonisation in the energy sector to address the sustainability dimension of the trilemma, through a greater share of renewables in the energy mix, has in some cases come at the detriment of energy security. This is particularly true in Europe, where ambitious decarbonisation goals combined with a limited supply of economic natural resources have left some countries exposed to energy security risks. For example, while Germany has accelerated progress on improving its energy sustainability over the past several years, in large part stemming from energy transition ("Energiewende") policies (which focus on supporting investment in renewables and a phase out of nuclear and coal), energy security policies appear to have been de-prioritised. This is evident in the country's scoring on the World Trilemma Index since 2015, which shows improvements on measures of sustainability, but little change on measures of energy security (Figure 2). Some of the vulnerabilities in energy security were exposed following Russia's recent invasion of Ukraine, given Germany's heavy reliance on Russian energy imports.

Figure 2: World Energy Trilemma Index – Germany's improving energy sustainability has left energy security lagging



Source: World Energy Council (2021)

Note: Scores for Security and Sustainability each represent a weighted average of sub-indicator scores (e.g. diversity of primary energy supply, energy storage, etc). Scores are determined by the World Energy Council in partnership with Oliver Wyman.

The primary means through which the energy transition threatens reliability is the intermittent nature of renewables – that is, these resources do not produce electricity when the sun does not shine, and the wind does not blow. This consideration can sometimes be overlooked in studies comparing the costs of standalone renewable generation to conventional generation based on the levelised cost of energy (LCOE) which does not account for externalities, such as the costs of firming the grid. Recent high-profile energy reliability events, such as the August 2020 California rolling blackouts, have highlighted such vulnerabilities of regional energy systems with insufficient support from inter-regional transmission and energy storage assets to accommodate the higher renewable penetration.[2] To some extent, these events have shifted policy decisions towards becoming more balanced by giving greater consideration to reliability-driven investment needs.

One of the major challenges to ensuring reliability in an electricity network with a high proportion of renewable generation is providing sufficient power in the evening, as wind and solar generation tapers while electricity use ramps up. A recent study by the PJM regional transmission organisation (which covers the 13 states in the US northeast and the District of Columbia) found that there is an increasing need for balancing resources to meet these ramping requirements.[3] It found that in 2035 under an 'accelerated scenario', where 70% of generation is carbon-free, half of the supply needed to meet evening demand would need to come from thermal resources, with the remaining half coming from a combination of hydro, storage and regional interconnectors. These findings underscore the ongoing long-term infrastructure investment required to support reliability in an increasingly electrified economy, particularly in midstream gas transmission, electricity transmission and energy storage.

ii Data from The World Energy Council's Energy Trilemma Index tool available here.

Geopolitical risks

For countries with a high reliance on energy imports, ensuring an uninterrupted supply of energy can be maintained is paramount to achieving a high level of energy security. However, geopolitical events can very quickly threaten national security through the weaponising of energy or the interruption of critical energy infrastructure, both of which have potentially negative consequences for the energy transition and affordability. Minimising geopolitical risks to energy security requires investment in the necessary infrastructure to increase energy independence (for example in renewables, transmission and energy storage) and a diversification of energy supply with partner countries.

The recent Russian invasion of Ukraine highlights the vulnerability of some European countries to geopolitical energy security risks. The heavy reliance on Russian energy imports (45% of gas imports, 25% of oil imports and 45% of coal imports came from Russia in 2021) has made it difficult for European governments to place sanctions on Russian energy without inflicting significant economic damage to their own economies and causing undue harm to civilians due to energy shortages. As a result, measures to address energy security by improving energy independence have been urgently prioritised, causing widespread changes to global energy markets. These have been set out in the REPowerEU plan which details over €210 billion of investments by 2027 across energy savings, diversification of energy supplies and an accelerated roll-out of renewable energy (see box on The REPowerEU Plan). The strengthened focus on energy security will in turn drive supporting investments in allied countries outside of the EU, such as new liquefied natural gas (LNG) export terminal capacity, to support the EU's diversification of gas supply.

The REPowerEU Plan

The REPowerEU Plan is the European Commission's response to the huge disruption to global energy markets caused by Russia's invasion of Ukraine. The plan is focused on measures to rapidly reduce the region's dependence on Russian fossil fuels and to accelerate the energy transition through a combination of energy savings, diversification of energy supplies and faster deployment of renewable energy. The plan intends to make Europe independent of Russian energy well before 2030.

Efforts to improve energy security include:

- Diversifying gas supplies through common purchases, including 50 billion cubic meters (bcm) of new LNG imports and 10 bcm of new pipeline imports
- Filling gas storage capacity above 90% of capacity by 1 November each year (80% in 2022)
- Increasing the production of biomethane by 17 bcm
- Targeting 10 million tonnes of imported renewable hydrogen

Efforts to improve energy sustainability include:

- Increasing the European renewables target for 2030 to 45% from 40%
- New legislation and recommendations to reduce the length of the renewables permitting processes
- Targeting 10 million tonnes of domestically produced renewable hydrogen

Physical climate risks

Climate change has increased the frequency and severity of extreme weather events around the world, which increases the risk of physical damage to critical energy infrastructure (Figure 3). For example, the Woods Hole Research Center estimated the likelihood of severe hurricanes – which pose high risks to energy infrastructure such as transmission and distribution lines, renewable generation and energy export terminals – is expected to double over 2031-2050 in the southeastern United States compared to a 1% annual likelihood over 1981-2000.[4] More broadly, their climatological analysis projected that physical climate risks are expected to intensify in many parts of the world, which are likely to disproportionately affect poorer countries that are less able to adapt.

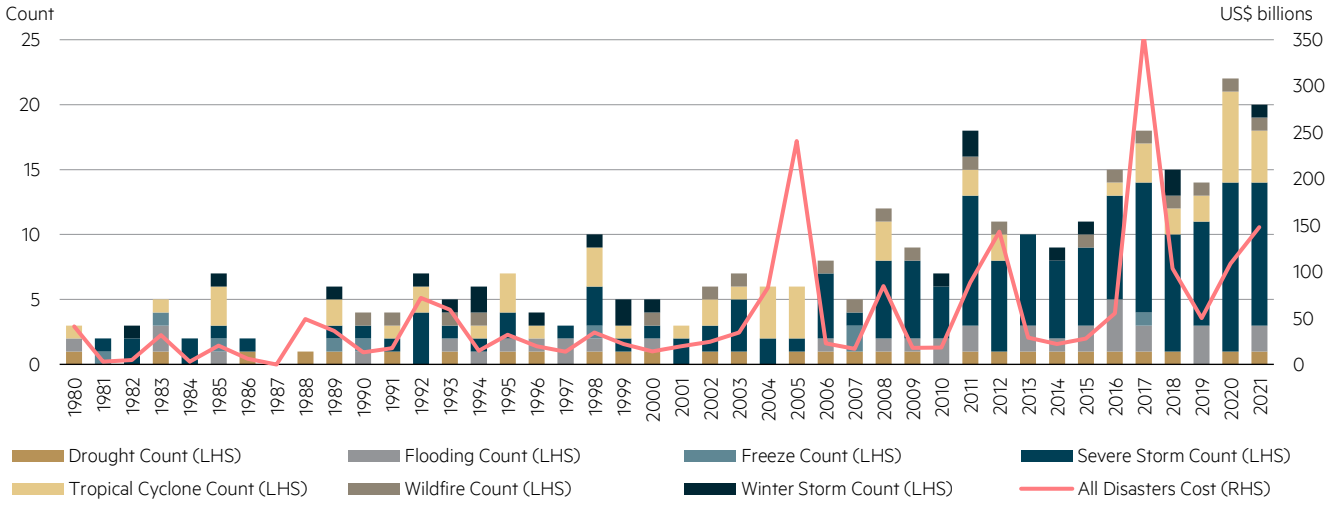
While an acceleration of the global decarbonisation effort is necessary to address the underlying cause of increased physical climate risks, the long-term unabated acceleration of greenhouse gas (GHG) emissions to date means that further warming, and hence the increased frequency and severity of extreme weather events, is largely "locked in". As a result, there is an increasing need for investments in the hardening of energy infrastructure to ensure energy security can be maintained in a world of increasing physical climate risks. Multi-year asset hardening investments are occurring in places such as California, where overhead wires are being undergrounded and covered to reduce wildfire risks. Similar hardening investments are expected in Texas once the commission completes its weatherisation standard (expected by March 2023) following the devastating February 2021 Texas winter snow and ice storm, which led to 246 deaths.

Cybersecurity risks

Today's energy infrastructure systems are being increasingly digitised and integrated, therefore requiring them to become smarter and more efficient. These advancements also come with increased risk of cyberattacks. Energy infrastructure assets are particularly vulnerable to exploitation given they have strong interdependencies between the physical assets and the cyber networks. The number of threats continue to rise and become more sophisticated, with research suggesting that nation state cyberattacks have doubled between 2017 and 2020 and that 10% of these were on critical infrastructure assets.[5]

The cybersecurity investments needed to protect against these threats continues to grow.[6] High profile events such as the May 2021 Colonial Pipeline ransomware cyberattack, which forced the pipeline to shut down and resulted in shortages of diesel, petrol and jet fuel in Florida, Virginia, North Carolina and Georgia, highlight both the vulnerability and the need for future investments.

Figure 3: Natural disaster costs in the US (inflation adjusted)



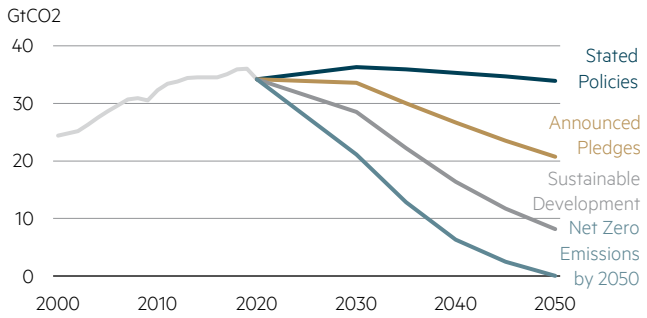
Source: National Centers for Environmental Information (2021)

Sustainability

Energy sustainability reflects the provision of energy from non-depletable resources that does not compromise the environment or the needs of future generations. Given around three-quarters of the world's global GHG emissions come from the energy sector and its end uses, deep decarbonisation is critical to achieving long-term energy sustainability if the world is to achieve the long-term temperature goal of the Paris Agreement.[7] The mitigation of GHG emissions is critical to limiting the worst effects of climate change, which also comes with profound economic implications – most especially for developing countries in the Global South. Research undertaken by the Swiss Re Institute shows that the world stands to lose 10% of its total economic value by 2050 if climate change continues along on its current trajectory.[8]

Considering the substantial physical and socioeconomic risks associated with climate change, global efforts directed towards reducing GHG emissions are expected to remain a high priority. The Intergovernmental Panel on Climate Change (IPCC) outlined in its Sixth Assessment Report that the world must drastically reduce GHG emissions within the next three years to avoid the worst impacts of climate change. Further, emissions must peak by 2025 and decline 43% by 2030 if the target to limit global warming to 1.5ºC above pre-industrial levels is to remain attainable.[9] Of the IEA scenarios, the Net Zero Emissions by 2050 scenario is the only scenario consistent with achieving the 1.5ºC goal (Figure 4).

Figure 4: CO2 emissions in the WEO 2021 scenarios over time



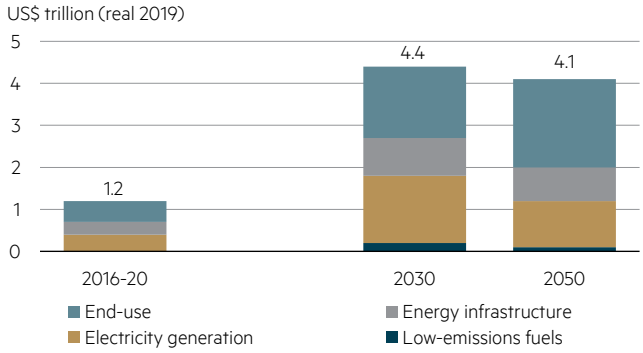
Source: International Energy Agency (2021), World Energy Outlook 2021, IEA, Paris

Disclaimer: Forward-looking statements are provided as a general guide only and should not be relied upon as an indication of the future performance.

With over three-quarters of global GHG emissions produced from the use of energy, it is imperative that the global energy system transitions towards cleaner low and zero carbon technologies and solutions.[10] While investment in renewable energy has increased over the past decade, there remains a significant disconnect between current emissions trends and the goals of the Paris Agreement.[iii] Therefore, researching and engaging with companies on their emissions reduction initiatives and climate risk management remains a priority in our ESG efforts, particularly in relation to midstream infrastructure companies.[iv]

In the IEA's Net Zero by 2050 scenario, annual investment in clean energy must increase approximately 267% to $US4.4 trillion by 2030, compared to current levels of $US1.2 trillion (Figure 5). The magnitude of additional clean energy investment needed to achieve net zero by 2050 follows decades of inaction and underinvestment in addressing climate change.

Figure 5: Annual clean energy investment in the net zero pathway



Source: International Energy Agency (2021), Net Zero by 2050

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Without rapid and widespread decarbonisation of the energy sector, global warming and the ensuing climate-related catastrophes are expected to intensify. Severe weather conditions are a leading cause of energy infrastructure damage and power system failures which undermines energy reliability.[11] Moreover, the costs of damage inflicted by extreme weather events are often passed through to customers, resulting in lower energy affordability. The magnitude of these losses can be extreme and continues to rise over time (Figure 3). Research by Morgan Stanley found that property and infrastructure damage from natural disasters accounted for an estimated two-thirds of global economic losses in 2017.[12] The sustainability of energy networks can play an important role in the energy trilemma to help minimise the risk of climate-induced reliability failures and associated affordability shocks.

Furthermore, renewable energy development can help to strengthen national energy security. For example, regions with limited reserves of domestic oil and gas can, in part, reduce their reliance on imports to meet energy demand through large-scale build out of renewable capacity. Scaling up renewables also contributes to a greater diversity of primary energy sources, which is another key to achieving energy security.

iii The temperature goal of the Paris Agreement involves limiting global warming to well below 2ºC, with 1.5ºC being the long-term objective, compared to pre-industrial levels.

iv In the third paper of this series, we detail our approach to ESG risks for midstream companies and discuss how we integrate these risks into our investment process.

Affordability

Energy affordability relates to the ability for households and businesses to access energy at reasonable prices that fosters productive long-term economic growth. In many ways, energy can be considered a public good and so governments should strive to achieve fair prices that will ensure everyone can attain an adequate standard of living by accessing energy for essential services such as heating, cooking and transportation. In 2020, it was estimated that 8% of the EU population were unable to keep their home adequately warm, and this is likely to have worsened more recently as global energy prices have continued to rise.[13]

Achieving energy affordability is particularly important and often prioritised in low-income countries, as this can be a major constraint on a country's ability to grow. Research has found that there is a significant negative relationship between energy poverty (low affordability) and economic growth in both the short and long run.[14] From a global societal perspective, access to affordable energy, which is an enabler of increased economic activity, is considered as essential by the World Bank in the fight against poverty. Specifically, countries in Asia and Africa have tended to benefit most from improvements in energy affordability.[15]

Energy affordability issues also have the potential to threaten the urgent need to address climate change, as international cooperation is increasingly necessary for many developing countries to achieve net zero emissions. Affordability issues were at the core of many of the decisions and resolutions at the latest UN Climate Change Conference (COP26) that aimed to build on the Paris Agreement. Developed countries were urged to provide financial resources to assist developing countries with respect to both mitigation of and adaptation to climate change risks. Developed countries with abundant supplies of low-cost energy resources, such as the US and Canada, are seen as having the ability to help other countries achieve their decarbonisation goals more affordably. For example, North American exports of LNG to countries such as China and India have achieved significant emissions reductions through the displacement of high-emitting coal in power generation without sacrificing economic growth.[v]

Addressing energy affordability in the medium- to long-term requires significant investment in energy infrastructure. Recent analysis by the US Energy Information Administration (EIA) projected that not building any interstate natural gas pipelines from 2024 onwards would result in gas prices being 11% higher in 2050 than under their baseline reference case, but with only slightly reduced emissions since a higher level of coal-fired power generation would be needed.[16] A similar problem of underinvestment in energy infrastructure across Europe is a key reason why the current high energy prices in the region are widely expected to persist for some time, and has invoked temporary government intervention measures – such as windfall taxes, price caps or direct subsidies – in an effort to address affordability concerns in the near-term.

v Each cargo of LNG that displaces coal in power generation reduces GHG emissions by an estimated 150,000 tons.

Conclusion

The energy trilemma offers a useful framework for considering the balance of policymakers' priorities in the context of current and future investment opportunities. In recent years, energy policies have tended to focus on driving energy sustainability – for example, through the setting of increasingly ambitious renewable energy targets and the use of subsidies and tax credits to encourage a timely shift away from fossil fuels. In some cases, this has come at the detriment of ensuring ongoing energy security and affordability. The need for a balanced approach to the global energy trilemma is clear – without energy security and affordability, the task of achieving energy sustainability will be near-impossible. As a result, despite the urgency of addressing climate change, it is possible that the pace of the energy transition will be more measured as some of the focus shifts to the other pillars of the trilemma.

Several recent events have highlighted the potentially devastating consequences of underinvestment in energy security and affordability, which in turn have brought these considerations back to the forefront of policy discussions. However, there are no quick long-term solutions to the multi-faceted energy security problems. We believe that continued investment in certain energyinfrastructure is necessary to ensure an appropriate level of energy security and affordability can be achieved going forward.

In the next part of this series, we highlight the unique opportunities that the North American midstream sector can play in addressing the challenges of the energy trilemma.

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