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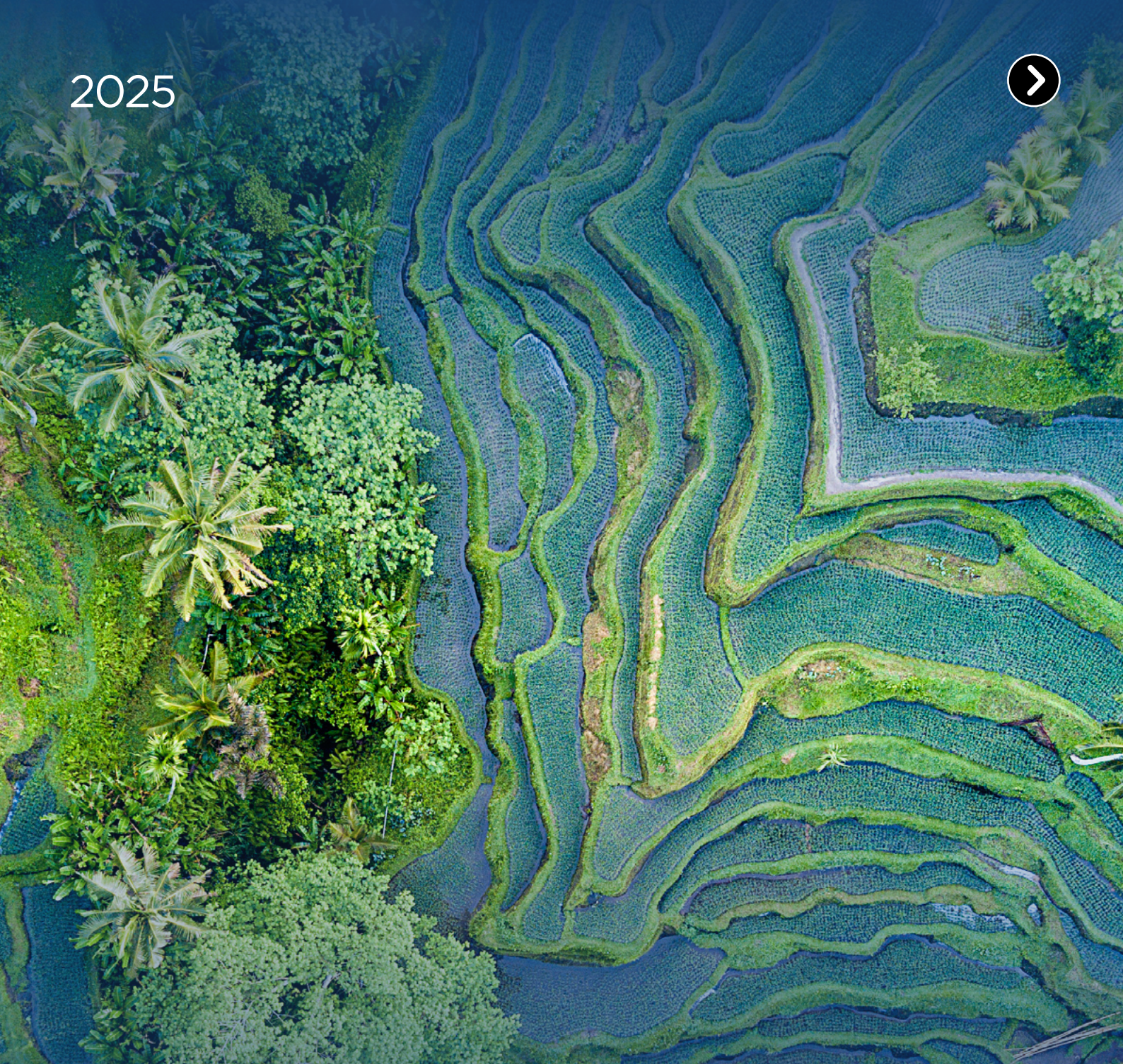

Companies and Climate Change

Meeting Paris Agreement Objectives

BMI
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AIIB
ASIAN INFRASTRUCTURE INVESTMENT BANK

Amundi
ASSET MANAGEMENT

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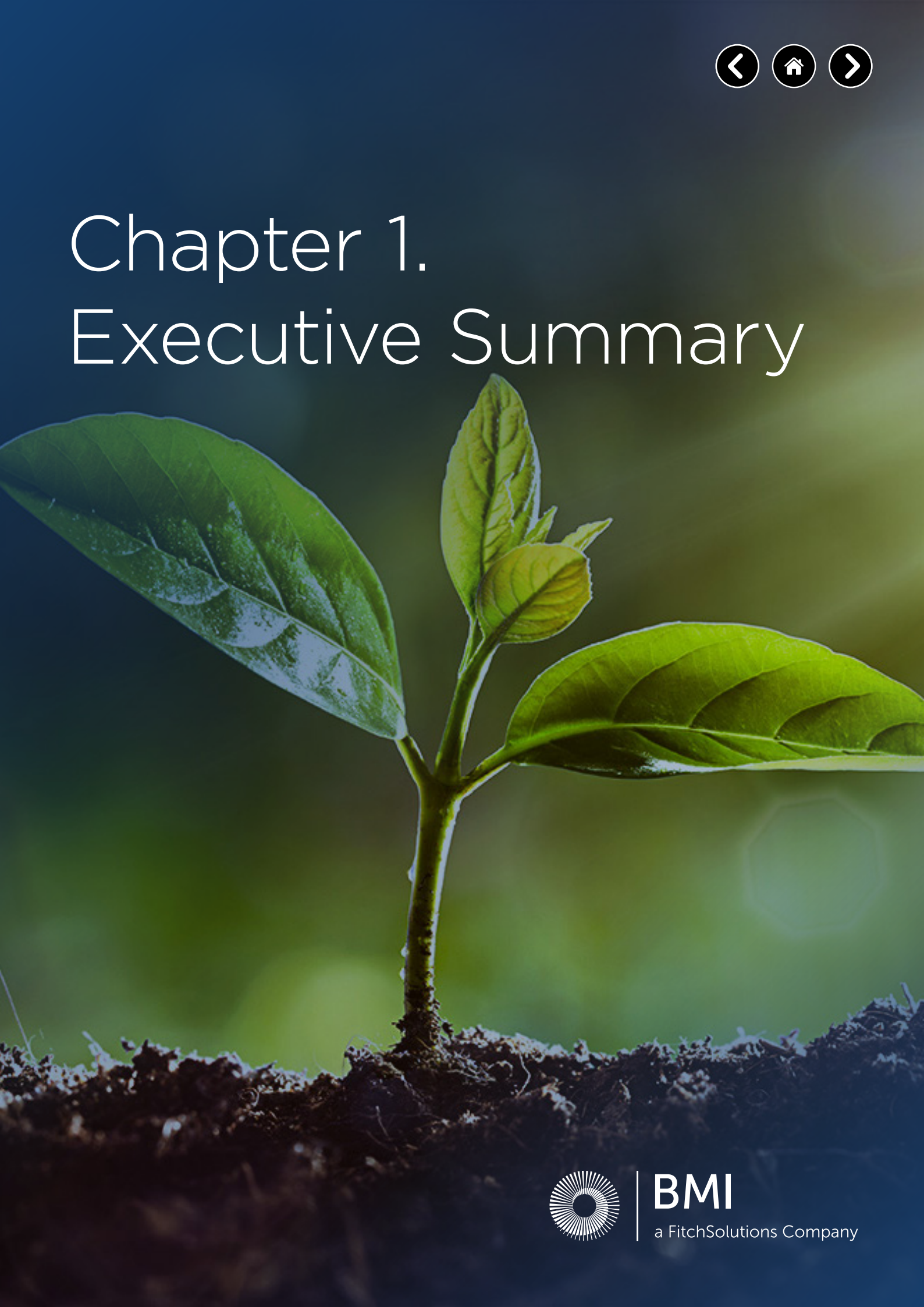

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Executive Summary

1. Project Introduction: Goal Of The Research

Welcome to the 2025 Companies and Climate Change research programme.

This research seeks to highlight the progress that is being made in achieving the transition to a low-carbon and climate-resilient economy as laid out in the Paris Agreement objectives. We have sought to evaluate and showcase progress on Mitigation, Contribution and Adaptation efforts through assessing companies, countries and sectors, spotlighting innovative and scalable solutions and showcasing outperformers in this space. The intention is to provide ideas and recommendations for industries and companies to foster further advancement towards a greener and climate-resilient future.

This is the third iteration in this report series, following the original 2022 edition and the follow-up addition in 2024. At the heart of this report series is the Climate Change Investment Framework (CCIF) as designed by the Asian Infrastructure Investment Bank (AIIB) and Amundi.

Companies And Climate Change Report Series Timeline

2022

- Launching the CCIF-aligned Sector Trackers (Utilities, Telecommunications, Transport and Energy)
- Debt issuer analysis
- Company Case Studies

Report Link

2024

- Launching the Low-Carbon Energy Transition Index, for country level insight
- Expanding The Sector Trackers to include Automotives, Technology & Electronics, Healthcare and Basic Industries.
- Company level analysis

Report Link

2025

- Updated Sector Trackers for all industries
- Evolved country analysis with the development of the BMI APAC Low-Carbon & Climate-Resilient Transition Index
- Company level analysis including the results of a B2B survey and Case Studies

The Paris Agreement objectives, which call for making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development, lie at the heart of this research programme. When developing our research, we have done so with consideration to the AIIB/Amundi CCIF. The CCIF aims to tailor investment portfolios that actively consider alignment with the Paris Agreement objectives. Where the CCIF translates the key objectives of the Paris Agreement into metrics that can be used to assess a specific instrument's alignment with the three pillars, our research takes a broader approach, seeking to understand the overall progress being made at a sector, company and country level. The research seeks to highlight areas of advancement that can be replicated and scaled, as well as identify impediments to progress and offer solutions. In particular, the research offers guidance for multilateral development banks (MDBs) which can and do play a crucial role in catalysing the transition to a low-carbon and climate-resilient world.

This latest research has been developed against a context of rising challenges to the green transition. Growing political instability and concerns over energy security and inflationary pressures placing constraints on both the public and private purse has had a clear impact on industries. Most notable is the declining performance of the Energy and Transport sectors in our BMI Sector Trackers.

However, despite this context, the research shows the power of regulatory bodies, consumer pressure and development bank financing in ensuring progress continues.

2. Research Approach

In exploring how best to assess progress towards a low-carbon and climate-resilient economy, we identified three areas to consider: sectors, companies and countries. By viewing progress through the lens of all three areas, we were able to develop a comprehensive view of the multiple stakeholders essential to progressing climate action. We have been able to identify outperforming sectors, companies and countries and understand what mechanisms, strategies, investments and tools have been most impactful in enabling the transition to date. Consequently, this research provides clear guidance and inspiration for entities to replicate and scale and therefore support the overall transition to a low-carbon and climate-resilient future.

i. Sectors

Our research approach starts with sectors, aiming to understand the progress industries are making on an individual and comparative basis. The intention is to understand which sectors are performing well, what approaches are being made and where impediments lie limiting further improvements. By understanding an overall sector, we can highlight a broader scope of relevant examples of best practice for industry participants to replicate and scale. Looking at a range of sectors on both an individual and comparative basis has also enabled us to find linkages between sectors, where sluggish progress in one (for example, Energy) is acting as an impediment to progress in another (for example, Transport), or where improvements in one (e.g. Utilities) are catalysing the advance of another (e.g. Technology & Electronics).

In our efforts to understand the progress individual sectors are making in transitioning towards a lower-carbon and climate-resilient future, we have sought both a quantitative and qualitative assessment.

Quantitative Sector Trackers: The quantitative approach is via our BMI Sector Trackers. The trackers are intended to illustrate how an industry is transitioning to a lower-carbon and climate-resilient business model by analysing data from a selection of primarily Asia-Pacific (APAC)-focused companies. First created in 2022 for the inaugural Companies & Climate Change Report, the trackers are a cutting-edge way of transposing the Paris Agreement Pillars into an index tracking an overall sector's performance by utilising average company performance in meeting these targets. The composition of the trackers provides insight into the various ways we can measure and track industries.

The tracker mirrors the Paris Agreement objectives of Mitigation, Contribution and Adaptation, by aligning relevant company metrics with the associated objective. We have also added a fourth pillar – Capability – intended to measure the financial capability of companies to meet ambitions and objectives related to a transition to a low-carbon, climate-resilient economy. Following an extensive search for the most commonly reported data for a sector and the most relevant to the Paris Agreement pillars of Mitigation, Contribution and Adaptation, we have updated our trackers for 2025.

Focus Sectors

- **Automotive:** Auto parts & equipment; auto manufacturers
- **Technology & Electronics:** Electronics; software & services; tech hardware and equipment
- **Basic Industries:** Building & construction, environmental services
- **Telecommunications:** Telecom-satellite; telecom-wireless; telecom-wireline integrated and services
- **Energy:** Gas distribution; integrated energy
- **Transport:** Rail; transport infrastructure services; trucking and delivery
- **Healthcare:** Health facilities; health services; medical products; pharmaceuticals
- **Utilities:** Electric generation/distribution; electric-integrated

These trackers are intended to provide a quantitative way to measure an overall industries' progress, rather than assessing an individual instrument or company. By using the average performance of a basket of companies, we can better gauge the overall progress made by an industry. This distinction is important when compared to the CCIF, which has been developed in order to tailor investment portfolios that actively consider alignment with the Paris Agreement objectives. The CCIF translates the key objectives of the Paris Agreement into metrics that can be used to assess alignment with the three pillars at an instrument level.

Qualitative Sector Insights: To complement this quantitative approach, we combine this with our qualitative expert insights into industries. In assessing a sector's performance, we highlight examples across Mitigation, Contribution and Adaptation, showcasing where an industry has made progress or potential areas for further investment. We provide real-life examples of how industries are finding solutions to the challenges of decarbonisation and adapting to climate change.

ii. Companies

Our company analysis brings in the view from industry participants, as well as providing case studies of best-in-class companies. Taking the company view gives us a range of examples that are relevant across industries. We also wanted to incorporate the views from industry participants who are actively working to navigate these challenges and find opportunities for growth. We therefore showcase the business strategies and priorities being developed in order to support the transition to a low-carbon and climate-resilient future.

In assessing companies, we have taken a two-pronged approach. To source a large sample of data, we carried out a survey of executives charged with their company's climate strategy. To provide greater depth and details on a company level, we also carried out four deep-dive cases studies of best-in-class performers.

Company Survey: To get the view from industry participants on the ground, BMI surveyed 200 senior executives in May 2024. The survey respondents sit on sustainability committees for APAC-based companies within the eight sectors included in this report. Their insights provide a view on their strategies, challenges and aims for climate change mitigation and adaptation, and their contributions to the transition.

Company Case Studies: We also sought to highlight best-in-class companies, to provide real life examples of progress being made that could be replicated and scaled. BMI undertook interviews with Heads of Sustainability and Chief ESG Officers, as well as researching company-specific ESG and Sustainability reports, disclosures and announcements on sustainability initiatives. The choice of companies was guided by firms' carbon neutral and net zero pledges, their engagement in setting commitments and targets via Science Based Targets initiative (SBTi). Four Case Studies have been developed from these interviews and research: Beijing Gas, Gamuda Berhard, Tencent and Indian Railways.

iii. Countries

The third element essential to understand the complete environment and progress on transition is at the country level. The policy environment, geography, climate and infrastructure in a given country has substantial influence on the ability of that country, and the companies and industries within it, to transition to a low-carbon and climate-resilient future.

In our research, we narrowed in on energy supply as the most pivotal catalyst for industry and companies. Without this, the broader transition of a country becomes untenable.

We developed a quantitative approach to understanding the transition of a country's energy supply, again mapping it to the Paris Agreement pillars of Mitigation, Adaptation and Contribution as well as incorporating a fourth pillar (to mirror that of the sector trackers) on Investment Risks. In developing the Index, we have incorporated a wide range of qualitative and quantitative factors to understand a geography's progress in the transition.

Country Energy Transition Index: The BMI APAC Low-Carbon & Climate-Resilient Transition Index maps country energy transition progress across the Paris Agreement objectives. The Index uses a range of indicators to offer a detailed analysis of each market's progress under the three Paris Agreement objective pillars. These include, for example, measures such as the carbon intensity of an economy (Mitigation pillar), a market's vulnerability to rising temperatures (Adaptation pillar), as well as a market's electric vehicle penetration ratio (Contribution pillar), which shows how supportive a government has been to its EV sector. The Index enables us to take a deep dive into the mitigation, adaptation, contribution and investment risk trends across countries in the APAC region to highlight progress, challenges and investment opportunities.

3. Key Findings

Across all three areas of research, some common themes have emerged that demonstrate the pathways to transition. Key catalysts for change include the availability of alternative energy sources, technological innovation, government regulations and mandates, financing and technical support, in particular from MDBs in the case of the latter two. Combined, these elements are enabling strides to be made in the transition to a low-carbon and climate-resilient future. However, as our analysis shows, progress is inconsistent across geographies and industries. By placing a spotlight on success stories, it is hoped that this research can provide a blueprint for broader adoption, as well as highlight areas for greater investment.

i. Importance Of Government Mandates On Disclosures

Our research illustrates the improvements in data availability and disclosures from companies on their climate-related performance, even compared to the first iteration of this research project in 2022. Much of this has been driven by the growth in government reporting mandates over recent years, especially across Asia. China, India, Thailand and Indonesia, are just some of the markets that have recently introduced or expanded ESG or Sustainability reporting requirements. This has increased the available data to assess company performance and, by extension, a sector's overall progress. Further enhancements in regulations on disclosure, especially for smaller economies, will be essential in order to enable investors to identify and support companies making progress on the transition.

Enhanced data availability has enabled us to form a much more accurate picture of a sector's transition progress through both more data, but also data that is more closely aligned with the areas around mitigation, adaptation and contribution.

Our research also illustrated the continued variations in data quality across the Paris Agreement objectives. Data disclosures vary significantly depending on both the size and geographic location of a company, as well as on the objective we assess. Data on contribution remains the most challenging to define and therefore track as it varies, depending on the ability to clearly link green investments to business lines. For example, in the Automotives, Energy and Utilities sectors, green investments are clearly defined. However, in the Technology & Electronics, Telecommunications and Basic Industries sectors, we have had to apply additional quantitative and qualitative overlay to identify green investments. Challenges are also faced when measuring adaptation, and there remains a reliance on the broader geographic exposure to assess adaptation risk, rather than companies providing bespoke adaptation risk assessments. Mitigation data remains one of the strongest areas of disclosure, with emissions reporting relatively high; however, data on waste management – a growing area of focus for reducing carbon footprints – is more varied on a sector-by-sector basis.

ii. Adaptation Moving Centre Stage

A notable shift since the initiation of this research in 2022 is the rise in focus on adaptation. This theme is evident in our BMI Sector Trackers. Adaptation is the highest scoring of the three Paris Agreement objectives, and almost all sectors have recorded improved scores in their adaptation inputs, reflecting the increasing focus on developing climate change resilience in recent years. As extreme weather events become more frequent, the financial impact to a company of being a laggard in this area is becoming more tangible and significant. Companies are therefore investing more heavily in ensuring adaptive measures are in place.

However, while improving, development is still at an early stage. In our company survey, the most common adaptation strategy was increasing insurance cover (43.5%). Many firms are still reviewing and planning ways to build resilience with 60% of respondents at the planning/reviewing stage of their adaptation strategies and just 37% of companies have implemented at least one of the strategies in developing climate change risk resilience.

One of the most common adaptation strategies noted across industries is building infrastructure resilience. For Basic Industries, a company's ability to develop efficient and climate resilient buildings is a key metric assessed in the Contribution pillar of their tracker. This forms both a key strategy associated with the industry's own transition and their contribution to the transition of other industries. Almost all sectors cite infrastructure and systems resilience to climate as a key mechanism of their adaptation planning. Within our survey, 41% of companies state that they have implemented physical infrastructure adaptations as part of their approach to develop climate change resilience, the second most utilised strategy after increasing insurance cover, as noted above.

The cost of investment in adaptation is high and can be prohibitive for small and medium enterprises (SMEs) and mid- and low-income countries. Here, MDBs are playing a crucial role in financial support for adaptation efforts.

iii. The Essential Role Of Technology

Several sectors are employing technology to support their transition to a low-carbon and climate-resilient future. This is highlighted on a company level, with our B2B survey recording that almost half of respondents across the eight sectors are already using AI for energy optimisation.

It is also echoed in our sector insights, which show real-life examples of technology being deployed to support all three of the Paris Agreement pillars. Technology is crucial in supporting mitigation efforts. It is being used to measure and track emissions as well as gain efficiencies in the production processes that can reduce overall emissions. For example, technology is improving the efficiency of the automotive manufacturing process. It is also enabling major leaps in adaptation efforts. Expanding internet connectivity and moving services online is enabling sectors to build climate resilience into their offerings. In the Tencent case study, we highlight that the company's strategy on contribution includes a focus on digital solutions which facilitate the low-carbon transformation of the industries through improved reporting, managing and reducing resources, including energy and waste and moving to digital communications.

The resilience of many industries is highly reliant on increased digitalisation and therefore expanding critical digital infrastructure to mid- and low-income markets (where it has yet to be developed) but is crucial in supporting the broader Paris Agreement objectives. In the Healthcare sector, for example, the rollout of telemedicine in areas highly exposed to climate risk will support the improved provision and availability of healthcare services during and after a climate event. Digitalisation to better monitor and respond to climate risk is also highlighted for utilities and infrastructure. Technology is enabling the built environment to be developed and upgraded in a more climate-resilient way and at lower costs. By using digital twins and advanced building information modelling, for example, climate change scenarios can be run and enable pre-emptive action to improve the resilience of physical assets.

A note of caution is being raised around the energy intensity of technology such as AI, as is highlighted in our Technology & Electronics sector insight. Given its essential role in supporting the decarbonisation and improved climate resilience of other sectors, a focus should be placed on improving the climate credentials of technology services. Our report highlights the progress being made in reducing energy and water consumption of data centres, with operators focusing on innovations in power, cooling and space to mitigate their emissions. These efforts are being catalysed by government regulations around resource use, the drive to secure community support and more broadly the ESG reporting requirements of companies operating in this sector. There are also financial benefits to the companies.

iv. Energy Supply

The Utilities sector remains the top-performing industry in terms of progress against the Paris Agreement objectives, according to our BMI Sector Trackers. In contrast, the Energy sector has fallen into the bottom half of the rankings (compared to 2022). This trend is illustrative of several factors: market trends in recent years leading to a prioritisation of energy security; green investments increasingly being carried out by utility companies; and the challenge with greening a sector (energy) that is built on fossil fuels.

Progress across the full energy spectrum is needed in order to make significant strides in meeting the Paris Agreement goals. Our research illustrates the essential nature of greening the supply of energy in order to support the transition of all other industries. This focus on the progress being made within the Energy sector is highlighted by the energy transition focus of the BMI APAC Low-Carbon & Climate-Resilient Transition Index. Where a lack of green energy options are available, this creates a bottleneck for an industry to transition. For example, the Transport sector is the bottom-ranked sector within the tracker assessment, and a key challenge for the industry is the insufficient supply of alternative fuels (amongst other issues). For Technology & Electronics, the energy intensity of data centres has become a major concern (see iii. The Essential Role Of Technology). The implementation of renewable energy to source power is one of the most common themes across industries. Most prevalent for the Utilities sector, we note a rise in other industries either developing their own renewable energy sources to power operations or investing in grid-connected renewables projects to offset their energy consumption. The use of renewable energy is a key metric in the transition trackers for several sectors including Telecommunications, Automotives and Healthcare. Our survey reinforces the importance of adoption of renewable energy at a sectoral level, with 40% of respondents for seven of the sectors having implemented their own green power, with just Transport lagging at 30% implementation.

Our case study on Indian Railways illustrates the importance of renewable energy in supporting the decarbonisation of the railway sector. Although the company has pushed to electrify its railway lines, the country's electricity generation is primarily reliant on coal and so further steps by the energy sector are needed for greater transition progress to be made for the wider economy to benefit. As a result, Indian Railways is focused on investing in renewable power to support its operations, including solar and wind energy.

v. Sector Enablers Need More Support: Basic Industries, Transport, Energy

The research demonstrates that more work is needed to support the transition of key infrastructure industries of Energy, Transport and Basic Industries. This is essential to the broader economy transitioning, as these sectors are the foundations upon which other industries are built. Without access to green energy, green logistics and green buildings, the ability for a company, or industry as a whole, to transition is stunted. In this context, greater support for nascent and expensive technologies such as hydrogen, alternative fuels and green building materials would unlock even greater transitional support.

vi. Resource Optimisation And Waste Management: Circular Economy Emerging Trend

Resource optimisation and waste management is an emerging trend highlighted in the latest iteration of our research. Relevant for both mitigation and adaptation, resource management and optimisation is a common and growing theme across many of the industries assessed. Industries are seeking to be more efficient in their use of resources in order to reduce their carbon footprint. Equally, many highlight the challenges climate change is creating in securing resources, especially water, and note that increased recycling and shifting to using less or different resources is a crucial adaptation strategy.

Waste management and recycling is being deployed in several sectors to reduce overall emissions. For many sectors, waste management or recycling is a key metric in the Mitigation pillar of their transition trackers; however, it is also relevant for both contribution and adaptation measures. For the Basic Industries and Telecommunications sectors, recycling and waste management are key initiatives intended to reduce the industries' overall emissions profile, while the Automotives industry is investing heavily in recycling in order to reduce reliance on new mining (a heavy emitting sector). Investment by the Automotive sector also shows that the sector is adapting to climate risk, which could disrupt supply chains and access to raw materials. This trend also appears in the survey responses, with 72% of respondents from the Automotive sector stating that they have made very significant or significant progress in recycling waste. Across all eight sectors, 64% of respondents state that they have made a high level of progress on recycling waste.

Within resource optimisation, water management emerges as a standalone trend. Water management features as a key metric in several of our Sector Transition Trackers. This focus is also reflected in the survey, with 68% of respondents stating that they have made very significant or significant progress on optimising water use. 80% of respondents from the Technology & Electronics sector record the greatest levels of progress, highlighting the industry and specifically the data centre segment's emphasis on water recycling and managing use.

4. Recommendations For MDBs

MDBs have a crucial role to play in catalysing the transition to a low-carbon and climate-resilient global economy. To date, MDBs have outperformed their own targets for climate finance, and have set even more ambitious goals through to 2030. By utilising the research in this report, we can identify crucial areas of focus for MDBs in ensuring this capital is deployed in the most impactful way to support climate action.

i. Focus On Hard-To-Abate Infrastructure

Basic Industries, Transport and Energy are all laggards in their transition according to our BMI Sector Trackers and reinforced by our company survey. However, all three sectors are crucial in enabling the broader transition of the global economy. There are many positive examples of projects and activities; however, these are often at high cost and utilise nascent technologies, and so providing financing to scale these solutions is vital. Greening the built environment, logistics and supply chains and energy, all of which are crucial in underpinning the global economy, is essential. These sectors should form part of a priority list for sector investments and will have a multiplier effect on decarbonisation efforts for other industries.

ii. Mid- And Low-Income Country Support Needed

Financing support for low- and middle-income markets should be prioritised. In these countries, the infrastructure to support transition and adaptation is not being developed due to the higher risk nature of these markets and the lack of developed financing mechanisms. In particular, financing digital infrastructure, green energy and green logistics are all essential areas to catalyse progress in other sectors.

iii. Financing Hard-To-Fund Climate Adaptation Infrastructure

Often expensive and hard to monestise, climate adaptation infrastructure is an unlikely candidate for private investors, but also often unaffordable for governments to fund, especially in low- and middle-income markets. MDBs should seek to invest into climate adaptation infrastructure such as coastal defenses, drainage and heat insulation especially in countries where governments are unable to afford these measures.

iv. Accelerating The Growing Trend Of Waste Management

The importance of the circular economy is a common theme in our research, appearing both in the mitigation and adaptation assessments of companies and industries. Waste management is an emerging theme prevalent across many industries, in particular Technology and Electronics, Basic Industries and Healthcare. Industries are also looking at ways to reduce the overall need for new raw materials by exploring alternatives, improving recovery rates and enhancing recycling efforts, thereby reducing the need for energy-intensive resource extraction and refining. MDBs can play a crucial role in supporting and financing the circular economy and should focus efforts on waste management and recycling initiatives as well as raw material recovery. Crucial in accelerating this trend is both government regulations on the use of raw materials, as well as financing for innovative solutions such as alternative materials and less energy-intensive processes. By providing financing, especially de-risking instruments for innovative solutions and support to governments and local authorities through capacity building and policy developments, MDBs can help to scale solutions.

v. Scaling Innovative And Nascent Technologies

A common theme across our sector insights is the rise of innovative technologies and methods to support the transition to a low-carbon and climate-resilient world. In particular, hydrogen is cited across many sectors as crucial for decarbonisation efforts; however, its application is still in its infancy and so requires both additional financing as well as enhanced regulations to scale. MDBs can help in both these areas, providing guidance to governments on how to promote hydrogen usage in regulations, as well as providing de-risking financing for early-stage projects.

vi. Enabling Government Regulations

MDBs can work with governments and regulatory bodies to strengthen policy frameworks and build institutional capacity. Our report found that data availability had significantly increased over recent years and much of this has been driven by expansions of government-reporting mandates, including the introduction of mandates for the first time in many Asian markets. Where mid- and low-income markets do not have the capacity to develop these frameworks, MDBs can play a crucial role in supporting companies, exchanges and regulatory bodies in developing reporting guidelines.

vii. Adaptation Stipulation In Financing

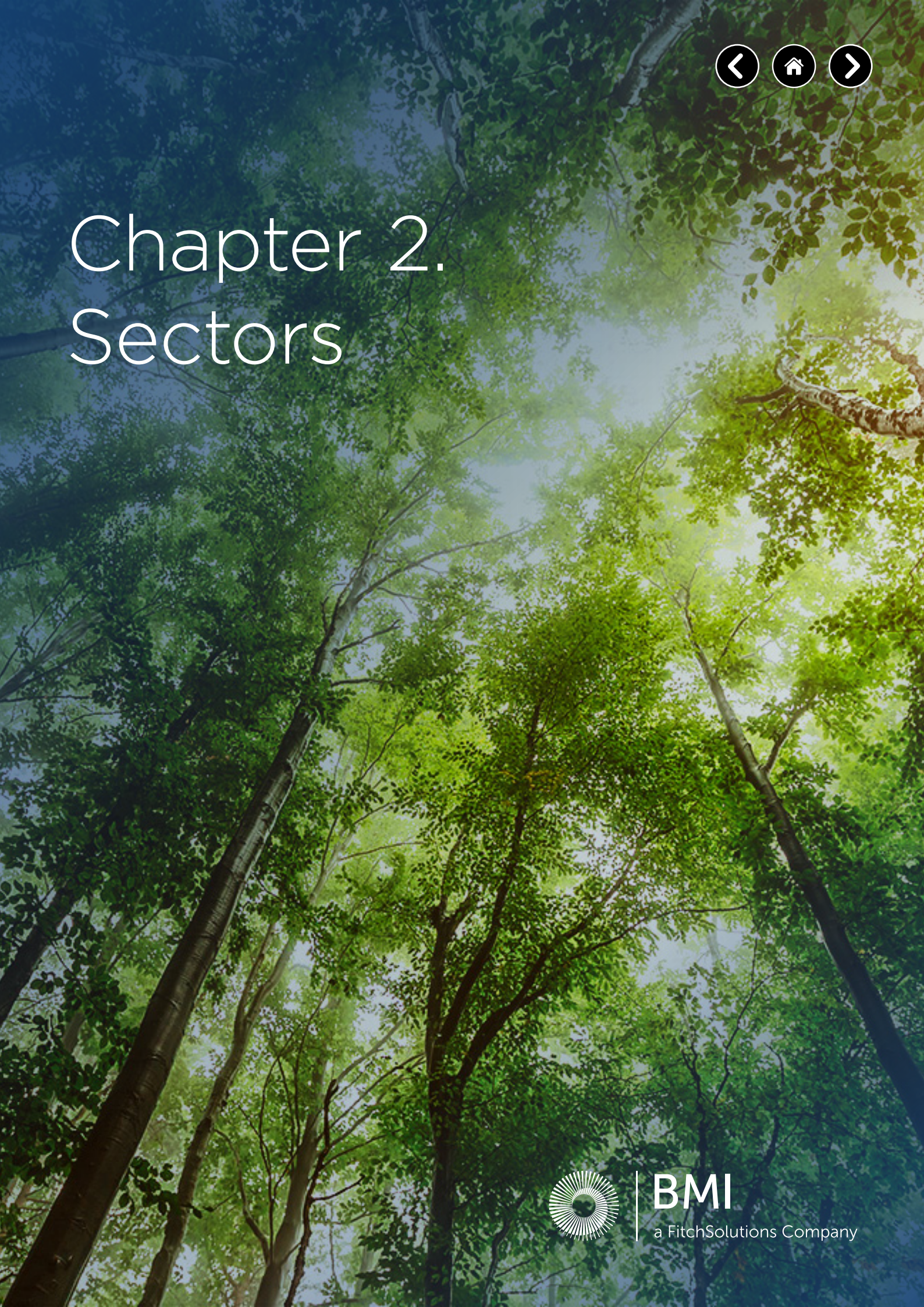
Integration of adaptation considerations into project financing, grants and research is a possible method to enhance climate-resilient infrastructure investment. New infrastructure developments are increasingly being designed to meet climate-resilient requirements. MDBs are crucial in facilitating investment in infrastructure through direct loans, equity and de-risking. This support should integrate recommendations on climate resilience for the infrastructure asset and could even be contingent on ensuring this is built into the design.

viii. Catalysing Private Sector Financing

The cost of transitioning to a low-carbon and climate-resilient global economy is considerable; however, there is substantial private capital looking to invest in sustainability initiatives. Matching this capital with the highest priority projects is where MDBs can play a crucial role, through a variety of mechanisms, including supporting bond issuance, providing de-risking financing and direct loans, as well as partnering with equity investors.

a. Sustainability Bonds: MDBs, especially in emerging markets, can play an important role in advising on the construction of bond frameworks and managing bond issuance. The presence of an MDB in this process supports in de-risking these issuances, especially for markets where bond issuances are relatively new. Green bonds have proven successful in many markets, while the nascent Adaptation bond market would benefit from MDB support to provide investor confidence.
b. MDBs can play an essential role in financing SMEs which are developing new technologies and solutions to support the transition and climate resilience. SMEs often struggle to access capital, especially those in low- and middle-income markets.
c. Partnering with funds to support equity investments into green projects is another crucial role for MDBs to play.
d. Direct loans to assets that might not be able to secure financing otherwise, either due to limited potential for private return, insufficient government financing, high risk environment or nascent technology.

Chapter 2. Sectors



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Sector Insights Overview

This chapter of the report explores how sectors are transitioning and assesses which sectors are making the greatest strides in meeting the Paris Agreement objectives. In our efforts to understand how sectors are transitioning to a lower-carbon environment and navigating climate change risk, we have sought both a quantitative and qualitative approach.

Firstly, we look at an industry-wide view (Sector Transition Tracker Insight Overview), utilising our sector Trackers to make quantitative comparisons across industries. For this report edition, we have updated our sector transition Trackers, which seek to measure companies on their performance against the Paris Agreement pillars. Originally launched in the 2022 edition of the Companies and Climate Change report, these trackers measure primarily APAC-based companies within eight industries (see figure 2.0). For each of the eight sectors, we have selected relevant metrics that represent that industry's performance on Mitigation, Contribution and Adaptation. The details on these metrics and why we selected them is outlined in the Sector Tracker segment of this chapter.

Subsequently, we take an industry-by-industry approach to assessing the performance and progress an industry is making. In the Sector Tracker segment, we detail the sector tracker on an industry level – providing a rationale for the metrics used. For the Sector Tracker Insight segment, we leverage the tracker, as well as company and sector data and combine this with our qualitative expert insights into industries. In assessing a sector's performance, we highlight examples across Mitigation, Contribution and Adaptation, showcasing where an industry has made progress or potential areas for further investment. We provide real life examples of how industries are finding solutions to the challenges of decarbonisation and adapting to climate change.

Fig 2.0: Sector Transition Trackers and Analysis

Sectors	Qualitative	Quantitative
Automotive	• Pillar-by-pillar assessment of industry performance • Analyst insights driven by deep sector expertise • Spotlight on initiatives companies are undertaking across the sector • Sub-sector analysis, showcasing differences within a sector • Technology overviews and assessments	• Pillar-by-pillar data insights on company performance on Paris Agreements objectives • Data-driven assessment of performance • Indicators chosen to reflect relevant factors on an industry-by-industry basis • Range of companies assessed, primarily across APAC • BMI proprietary forecasts
Basic Industries		
Energy		
Healthcare		
Technology & Electronics		
Telecommunications		
Transportation		
Utilities		

Source: BMI

Key Takeaways

- **Nuanced Approach With Some Common Themes:** The challenges of moving to a low-carbon and climate-resilient environment are unique for each sector, meaning each has its own approach to managing and meeting goals. However, there are several common themes that transcend industries, and illustrate the different approaches and mechanisms being employed by industry participants as a whole.
- **The Role Of Technology:** Several sectors are employing technology to support their transition to a low-carbon and climate-resilient future. Technology is being deployed to support all three of the pillars. In the Automotives sector, technology is improving efficiency of the manufacturing process, enabling reduced emissions, whilst the Healthcare sector highlights telemedicine as a key tool in climate adaptation. A note of caution is being raised around the energy intensity of technology such as AI, however, as the Technology & Electronics sector demonstrates in its contribution section substantial advances in reducing the energy intensity of data centres. This growing demand for AI and the implications for emissions and climate change is noted in the B2B survey (conducted in May 2024), which features in 'Chapter 3. Companies' and records that almost half of respondents across the eight sectors are already using AI for energy optimisation, highlighting AI is a risk to increased emissions, but it is also going to be part of the solution and is being developed to support the Paris Agreement objectives.
- **Renewable Energy Solutions:** The implementation of renewable energy to source power is one of the most common themes across industries. Most prevalent for the Utilities sector, we note a rise in other industries either developing their own renewable energy sources to power operations or investing in grid connected renewables project to offset their energy consumption. Indeed, the use of renewable energy is a key metric in the transition trackers for several sectors including Telecommunications, Automotives and Healthcare. This adoption of renewable energy at a sectoral level is further displayed in the B2B survey results. 40% of respondents for seven of the sectors have implemented their own green power, with just Transport lagging at 30% implementation.

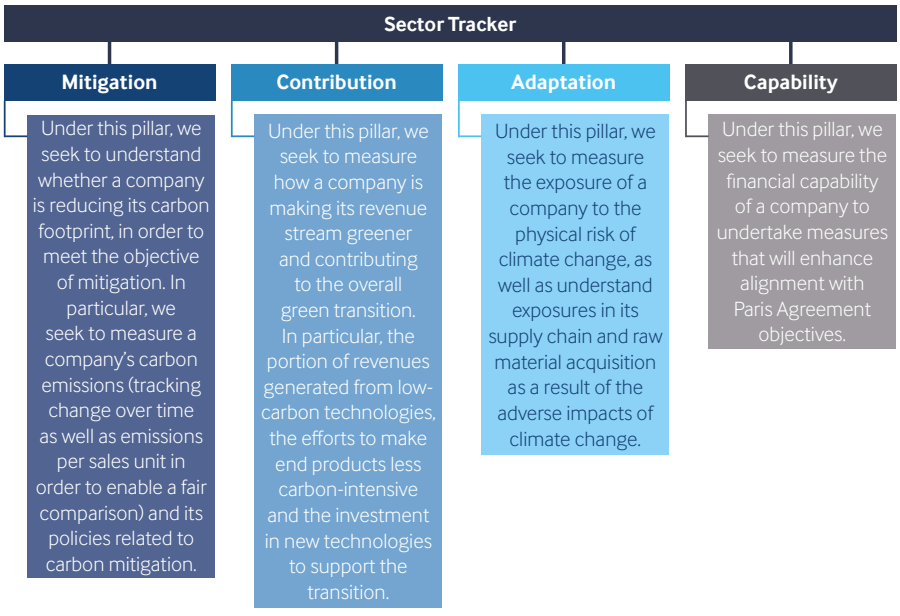
- **Resource Optimisation:** Relevant for both mitigation and adaptation, resource management and optimisation is a common theme seen across industries. Industries are seeking to be more efficient in their use of resources in order to reduce their carbon footprint. Equally, many note the challenges that climate change is creating in securing resources, especially water, and note that shifting to using less or different resources is a crucial adaptation strategy. Water management features as a key metric in several of our industry Transition Trackers. This focus is also reflected in the survey, with 68% of respondents stating that they have made very significant or significant progress on optimising water use. 80% of respondents from the Technology & Electronics sector record the greatest levels of progress, highlighting the industry and specifically the data centre segment's emphasis on water recycling and managing use.
- **Waste Management & Recycling:** On a related note, waste management and recycling is being deployed in several sectors to reduce overall emissions. For many sectors, waste management or recycling is a key metric in the Mitigation pillar of their transition trackers; however, it is also relevant for both contribution and adaptation. For the Basic Industries and Telecoms sectors, recycling and waste management are key initiatives intended to reduce the industry's overall emissions profile, whilst the Automotives industry is investing heavily in recycling in order to reduce reliance on new mining and adapt to climate risk, which could disrupt supply chains and access to raw materials. This is trend also appears in the survey responses, with 72% of respondents from the Automotive sector stating that they have made very significant or significant progress in recycling waste. Across all eight sectors, 64% of respondents state that they have made this high level of progress on recycling waste.
- **Infrastructure Resilience:** One of the most common adaptation strategies noted across industries is building infrastructure resilience. For Basic Industries, a company's ability to develop efficient and climate-resilient buildings is a key metric assessed in the Contribution pillar of their tracker. This forms both a key strategy associated with the industry's own transition and their contribution to the transition of other industries. Almost all sectors cite infrastructure and systems resilience to climate as a key mechanism of their adaptation planning. Progress is clearly being made in this area, with almost all sectors improving their scores on Adaptation in our 2024 update of our Transition Trackers, and Adaptation remaining the top-scoring indicator of the trackers. Within the survey, 41% of companies state that they have implemented physical infrastructure adaptations as part of their approach to develop climate change resilience, the second most utilised strategy after increasing their insurance cover.
- **Sector Tracker Performance:** Our sector Trackers highlight which industries are leveraging the abovementioned strategies, and others, to the most effect. The Utilities sector is the outperformer in terms of transition, followed by Automotive and Telecoms. The trackers also show that more progress is needed in the well-known hard-to-abate sectors of Energy, Basic Industries and Transport – which are ranked sixth, seventh and eighth respectively. However, our sector insights go beyond the data to illustrate the range of positive developments being made in these sectors, many of which could be rolled out more broadly to make meaningful progress in the transition to a low-carbon and climate-resilient economy.

Sector Transition Tracker Insight Overview

The BMI sector trackers are intended to illustrate how an industry is transitioning to a lower-carbon and climate-resilient business model by analysing data from a selection of primarily APAC-focused companies. First created in 2022 for the inaugural Companies & Climate Change Report, the trackers are a cutting-edge way of transposing the Paris Agreement Pillars into an index tracking companies' performance in meeting these targets.

The composition of the trackers provides insight into the various ways we can measure and track industries, and highlights the most relevant data for analysts to use in assessing an industry's performance. Following an extensive search for the most commonly reported data for a sector and the most relevant to the Paris Agreement pillars of Mitigation, Contribution and Adaptation, we have updated our trackers for 2025.

Fig 2.1: Sector Tracker Overview



Source: BMI

We have also retained the additional fourth pillar – Capability. The intention is to measure the financial capability of companies to meet ambitions and objectives related to a transition to a low-carbon, climate-resilient economy. Reducing the carbon footprint, protecting against physical risk and investing in green technologies are all capital-intensive processes and therefore any transition will be partly contingent on a company's financial health and capacity. Those companies in a more financially stable position, with access to capital, are better placed to set meaningful targets and green business plans and actually fulfil on them. It is important to note that any investment should be recouped in the longer term, as greater alignment with the Paris Agreement objectives will create a more financially sustainable company, whose revenue streams are protected from climate impact, and are more suited to a lower-carbon economy.

Indicative of progress being made in reporting by companies, in several instances we have updated individual data items or the metrics within an entire pillar, as improved data have become available. Expansions of government reporting mandates, including the introduction of mandates for the first time in many Asian markets, has accelerated the reporting of climate data and vastly improved transparency. This has led to two clear outcomes in our trackers: first, there are far fewer sectors being penalised owing to lack of data; the Automotive and Healthcare sectors, in particular, have seen a vast improvement in data availability. Second, we have adjusted the tracker inputs for some sectors to reflect new data that better showcase the sector's progress on the Paris Agreement. For example, the Transport tracker has had a major overhaul, whilst the Utilities tracker has had more modest but also meaningful changes, especially in the Mitigation pillar.

Overall Performance

- **Utilities** is the top-ranked sector in our transition trackers, with an average transition score of 55.6 (higher score denotes greater progress on transition). This is supported primarily by its very strong score for Adaptation of 67.4. This is the highest score of any sector, across any pillar. Notably, Utilities was also the top-ranked industry in our 2022 sector trackers.

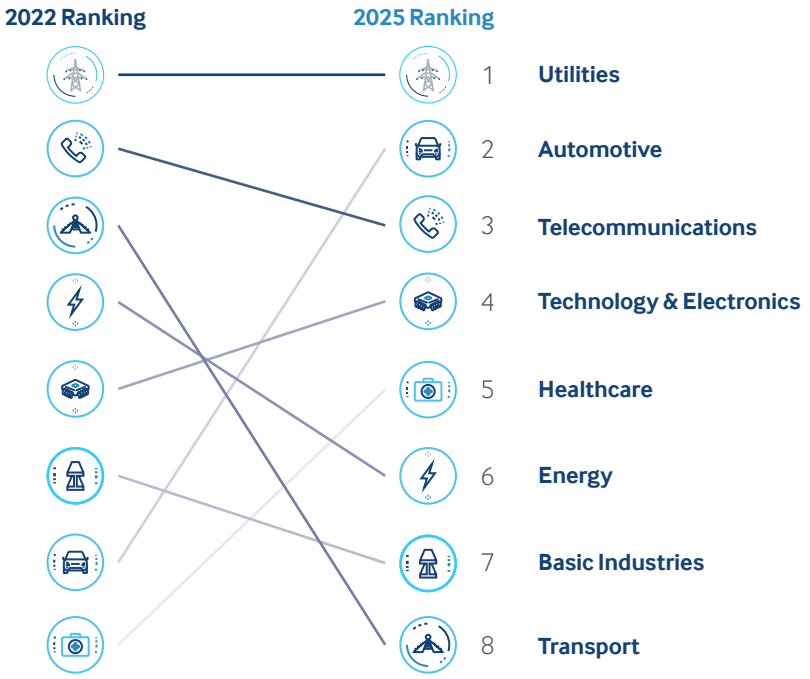
  The Utilities Index has been amended since the 2022 version as a result of newly available data. Therefore, a like-for-like data comparison is less meaningful; however, the continued outperformance of the sector illustrates the best-in-class transition it is undertaking.

- The **Automotive** sector has made clear progress in decarbonisation through electric and alternative fuel vehicles. The sector ranks third for its overall transition score. This ranking is a vast improvement on 2022, where it was in seventh place. However, this does not necessarily reflect a major improvement in the underlying performance of the sector, but advances in reporting. One of the biggest issues pulling down scores for automotive companies in 2022 was lack of data. In the most recent update, we have seen a significant expansion in data availability, supporting a vastly improved picture for the sector.

- **Healthcare** is another big mover in terms of sector rankings between 2022 and 2025. In 2022, Healthcare was in last position, but has climbed up to fifth overall. Improvements in reporting have played a major role in the overall score improvement. Mitigation in particular has seen substantial score improvements.

- The **Transport** sector is a major source of carbon emissions and therefore its decarbonisation is essential to meeting Paris Agreement goals. However, the sector underperforms in our transition trackers, coming in eighth place. This is a considerable drop in performance versus our 2022 data, where Transport was second. As noted, the entire tracker has been updated with new, more relevant data. As we are able to shine a better light on the sector, we can see areas of underperformance versus other sectors. In particular, the sector performs poorly on Contribution.

Fig 2.2: Sector Tracker Performance 2025 Ranking Vs 2022 Ranking



Source: BMI

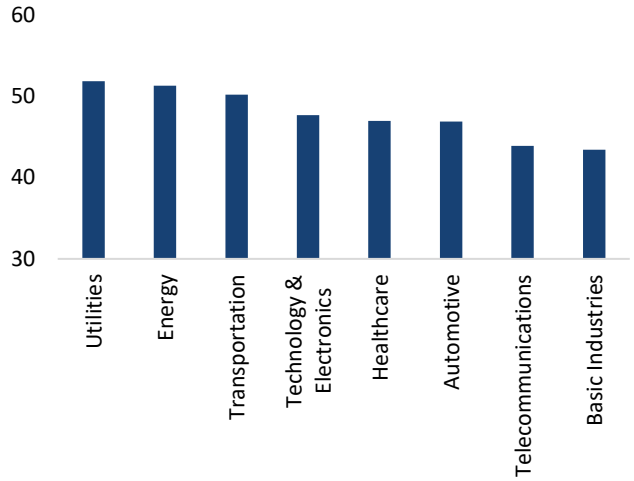
Given the Transport sector's sizable contribution to greenhouse gas emissions – the sector is the third largest contributor to greenhouse gas emissions in the region, accounting for 14.3% of total emissions as of 2021 (latest available reading) – its underperformance is significant. The sector has struggled to keep up its decarbonisation efforts with the pace of other industries owing to a few key factors: (i) economic growth in the APAC region has driven emissions higher; (ii) the high cost and slow progress made in the development and adoption of new fuel technologies; and (iii) the industry has been slow to set net zero targets, as seen in our survey data. These factors have contributed to the Transport sector's underperformance. For more detail, please see our Transport sector deep dive.

- The other sectors covered in our trackers – **Telecommunications**, **Technology & Electronics**, **Energy** and **Basic Industries** – all perform similarly to their 2022 rankings. Telecommunications and Technology & Electronics have long been ahead of their peers in terms of reporting, setting net zero targets and overall consideration of decarbonisation. Basic Industries and Energy, responsible for a higher portion of global carbon emissions, have lagged. Both sectors are hard to abate, given the centrality of carbon-emitting materials to their core revenues and business lines. We have seen limited progress above and beyond other sectors since 2022, indicating that more work is needed to decarbonise these sectors.

Mitigation

- Most sectors have improved their scores on Mitigation – we no longer have any scoring in the 30s compared to four sectors in 2022 (Technology & Electronics, Healthcare, Basic Industries and Automotive). This is reflective of both overall progress on mitigation of carbon emissions as well as increased reporting in this area. Several sectors have seen a reduction in the number of data gaps on mitigation. This trend aligns with our survey data that show that the vast majority of companies now have net zero targets (the B2B sector survey conducted for this project records that 69% of respondents now have a target to reach net zero between 2030-2040).

Fig 2.3: BMI Sector Tracker Mitigation Scores



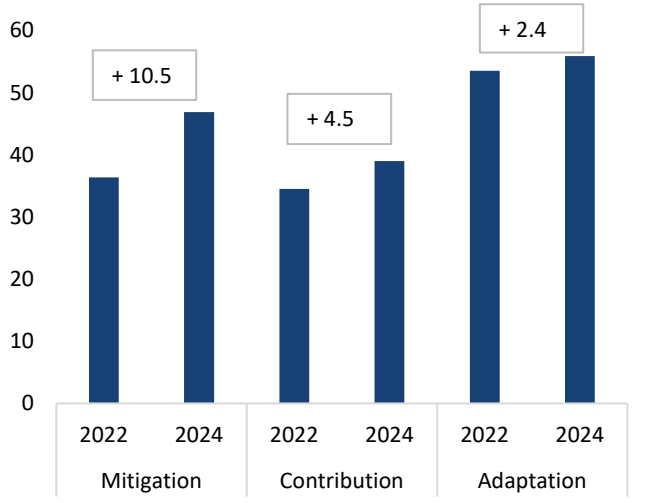
Note: Higher score denotes greater progress on transition. Source: BMI

- **Energy** and **Transport** are two of the most critical sectors to decarbonise, given their large share of overall emissions. Both are notable laggards in the overall rankings, but perform relatively well on their Mitigation scores. Energy ranks second for Mitigation compared to sixth overall, whilst Transport is third compared to eighth overall.

  Energy companies have long been in the spotlight for carbon emissions, which has driven increased data transparency and accountability in the sector, supporting its performance on Mitigation. In particular, we can point to high data availability, reduction in carbon emissions and ambitious net zero targets, owing to significant regulatory and consumer pressure, as supporting their performance in the Mitigation component of the tracker.

- **Healthcare** has seen significant improvements in Mitigation. This is indicative of progress being made in the Healthcare sector to decarbonise. The industry has historically been a low priority for decarbonisation given its importance to public health and the nature of the industry's reliance on single use products, plastics and chemicals. The sector will continue to be a laggard in the transition to a low-carbon economy, hence its fifth-place ranking, given that the priority will remain offering healthcare solutions over decarbonising. However, companies in this industry are increasingly under regulatory, consumer and client pressure to make progress in this area, and this is showing in the improved reporting for the sector.

Fig 2.4: Healthcare – Mitigation Saw Greatest Strides

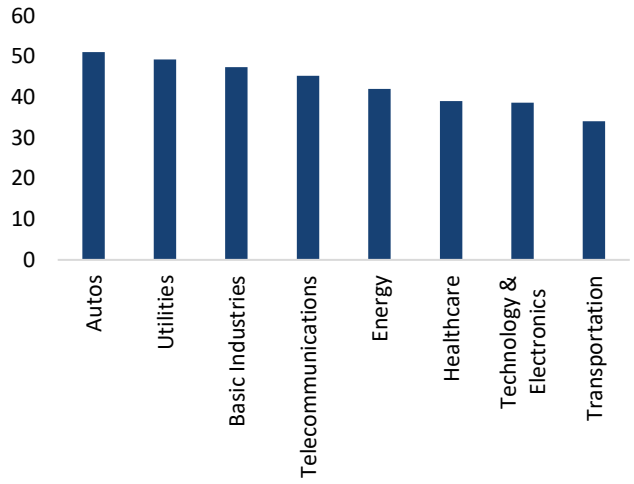


Note: Increase in overall score highlighted above the columns. Higher score denotes greater progress on transition. Source: BMI

Contribution

- Sector rankings and scores for Contribution have remained largely stable over the last three years. Three of the top four sectors have remained in place (Telecommunications, Utilities and Basic Industries).

Fig 2.5: BMI Sector Tracker Contribution Scores

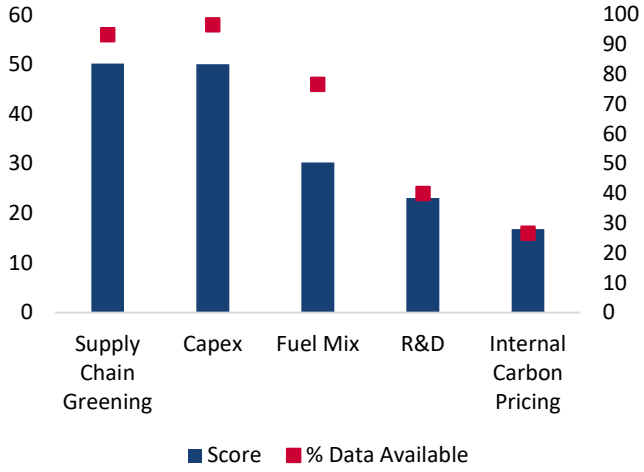


Note: Higher score denotes greater progress on transition. Source: BMI

- **Automotive** and **Utilities** score particularly well on contribution. There is a clear correlation between the core business and decarbonisation and investments in electric and alternative fuel vehicles for the automotive sector, and renewable energy solutions for the Utilities sector, which represent clear pathways to meet contribution targets. This enables these sectors to leverage a large portion of research and development (R&D) investment in carbon mitigation solutions.
- **Basic Industries** is in third place for contribution, which is by far its best-performing component in the tracker. Infrastructure Efficiency – one of the indicators within Contribution – has high overall average scores. The metric measures the extent to which new developments are incorporating energy efficient capabilities into their design. Increasingly, building permitting and tendering processes take into account the green credentials of a building's design, therefore supporting an overall improvement in this component. Companies within the sector also score well for capex and low emissions projects.
- **Transport** scores the lowest of all sectors for Contribution. One of the biggest weaknesses for the sector is a lack of reporting. Across key elements of the Contribution component – R&D and Internal Carbon Pricing – data gaps are high, with only 40% or less of companies reporting information.

  A key element measured for this component is the fuel mix; however, the sector has struggled to make significant strides in this area. Despite high available data, the scores remain poor. Biofuels are seen as an essential piece of the sector's decarbonisation push; however, the production volumes remain far below what is needed to substantially displace demand for conventional fossil fuels.

Fig 2.6: Data Reporting Dragging Down Transport Contribution Score

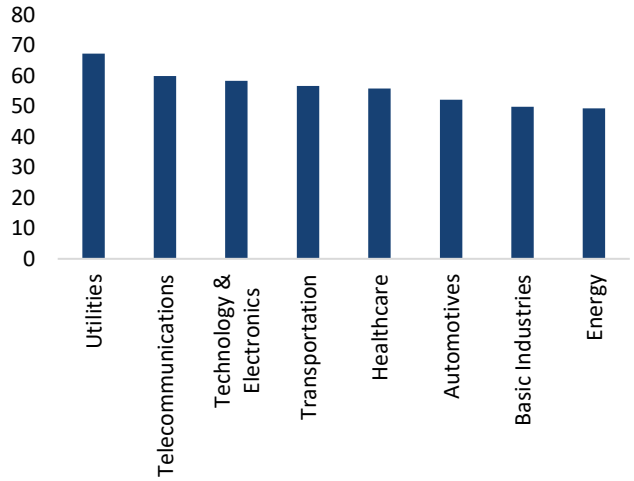


Note: Higher score denotes greater progress on transition. Source: BMI

Adaptation

- The Adaptation pillar of the Index has the highest overall score on average, and is the only pillar where scores of 60 or higher are registered (Utilities and Telecommunications). This is consistent with our 2022 trackers, whereby Adaptation also received the highest average score. However, almost all sectors have recorded improved scores in this area reflecting the increasing focus on developing climate change resilience in recent years. As extreme weather events become more frequent, the financial impact to a company of being a laggard in this area is becoming more tangible and significant, and so companies are investing more heavily in ensuring Adaptive measures are in place.

Fig 2.7: BMI Sector Tracker Adaptation Scores



Note: Higher score denotes greater progress on transition. Source: BMI

- **Utilities** remains in first place for Adaptation. The critical nature of the sector's infrastructure means that there is a strong incentive to ensure that it is adapted to withstand extreme weather events.
- The **Telecommunications** and **Technology & Electronics** sectors perform well for Adaptation, ranking second and third respectively. The critical nature of digital infrastructure (which spans both sectors) has led to increased government regulations and oversight on its resilience to extreme weather events. There has also been growing focus on making the supply chain and operations of digital infrastructure more environmentally resilient. For example, reducing the high levels of water and energy consumption of data centres has been a priority for governments. On the supply chain side, the growing disruption to materials supply from geopolitical risks has seen the industry diversify its supply chain, and in doing so has enabled companies to also consider the climate change resilience of source markets in their decisions.
- **Energy** has the lowest ranking for Adaptation. We see a significant gap in company performance on Adaptation in the industry, with large international energy majors performing relatively well on this component, versus emerging market state-owned enterprises (SOEs). Looking at climate change vulnerability for example (an indicator within Adaptation), we see that many of the SOEs have high geographic exposure to markets prone to extreme weather events. However, as they are tied to these geographies, they are therefore unable to mitigate this risk by geographically diversifying or withdrawing from the market altogether, compared to the international energy majors.

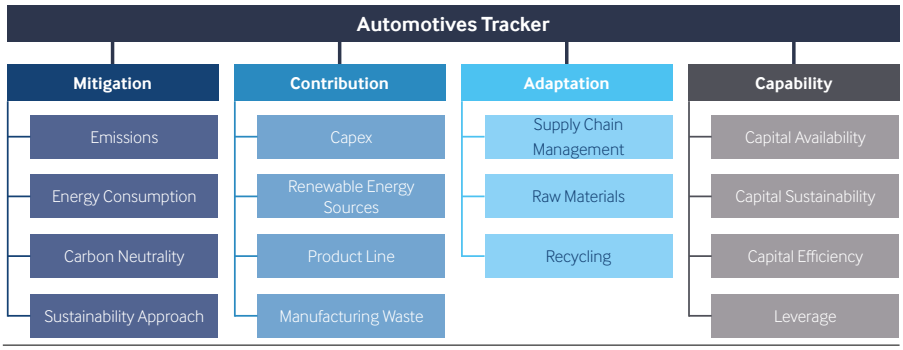
Sector Tracker: Automotive

In the context of this report, automotive means auto parts & equipment and auto manufacturers. Using the AIIB-Amundi Climate Change Investment Framework (CCIF), the Automotive Sector Tracker aims to capture the extent to which operations, investments and strategies of companies operating in this sector align with the Paris Agreement goals of Mitigation, Adaptation and Contribution to the transition.

A fourth dimension, financial capability, has been added by BMI to assess a company's financial strength and ability to deliver on its climate objectives.

Mitigation

Assessing an auto company's mitigation effort with respect to GHG emissions should encompass two different angles: the emissions impact of the company's products and its operations. While public attention tends to focus on the vehicles produced and the electrification strategies of a company, vehicle manufacturing and delivery of the product are energy-intensive processes which also require attention. Where companies are actively reporting emissions data for both product ranges (in the case of carmakers) and business operations, this is relatively transparent. However, evaluating the potential efficacy of corporate net zero carbon goals (where applicable) and assessing the sustainability approach of companies can be subjective.



Source: BMI

Adaptation

In a mature industry such as the Automotive industry, the adaptation pillar represents one of the greatest challenges as it encompasses changes being made by companies to limit future environmental damage, particularly in relation to the supply chain. The shift to electric vehicles (EVs) requires new metals for batteries and the associated mining process to retrieve them. Therefore, this pillar considers sustainability initiatives related to sourcing components and raw materials, as well as investing in measures such as recycling to reduce the demand for new mining. This is also an area where digitalisation could play a bigger role as technology such as Blockchain can be used to track the journey of components, enabling Original Equipment Manufacturers (OEMs) to be more pro-active in ensuring their suppliers align with their values. One such example is Volkswagen, which announced in 2019 that it would use Blockchain to increase transparency in its raw materials supply chain, ensuring that metals are mined with minimal environmental impact.

Contribution To The Transition

The product lines of autos companies play a key part in the green energy transition and can be relatively easy to track by measuring the proportion of a company's product range which is low- or zero-emission vehicles, whether that be electric or another technology such as hydrogen fuel cell, and related components for those companies in the supply chain. However, this pillar of the tracker also considers contributions to the transition from the manufacturing process, such as the use of renewable energy to power facilities and efforts to reduce manufacturing waste, which are not always as widely reported.

Capability

BMI has also added a fourth pillar to consider: Capability. This fourth pillar has been added to reflect the fact that reducing carbon footprint, protecting against climate change risk and investing in green technologies are all capital-intensive processes, and therefore any transition will be partly contingent on a company's financial health and capacity. Those companies in a more financially stable position, with access to capital, are better placed to set meaningful targets and fulfil them with actions.

Sector Tracker Insight: Automotive

Improvement In Mitigation Score Positive For Broader Decarbonisation

In our 2024 edition of the Companies and Climate Change report, the biggest positive change in score for the Automotive Sector Tracker compared to the 2021 edition is an increase in the average score for Mitigation. This is partly due to improvements in reporting, with over 50% of the Mitigation indicators now reported by companies in the tracker, and also down to improvements in the relevant operational processes which mitigate climate change. Both are positive for the broader decarbonisation of the Automotive sector as it shows a push beyond just focusing on product ranges as a channel for addressing the impact of climate change.

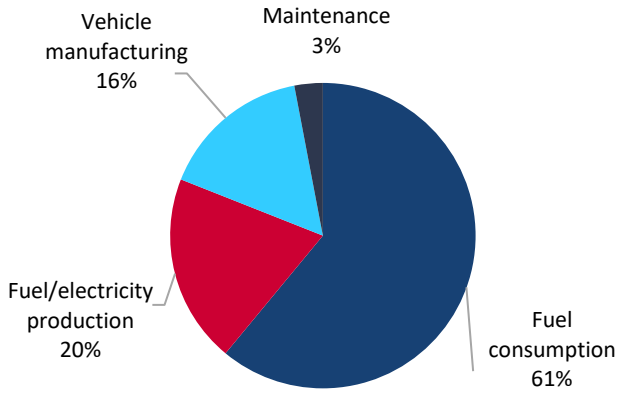
The Mitigation indicators focus on areas such as greenhouse gas (GHG) emissions and energy consumption, both of which are particularly prevalent in an energy-intensive process such as vehicle and component manufacturing. It is likely that the shift towards electric and other low- or zero-emission vehicles, particularly at the increased pace of adoption witnessed since the COVID-19 pandemic, when policymakers supported the production and sales of EVs as a way of kickstarting the industry after lockdown has highlighted the mismatch. This mismatch is between producing cleaner vehicles but doing so with facilities or processes which generate high levels of pollution.

Automakers Face Unique Balancing Act Between Mitigation And Contribution

The Automotive sector faces a delicate balancing act in addressing the challenges of climate change and meeting the goals of the Paris Agreement. While the growth of EV adoption will make a substantial contribution to decarbonising the sector, data show that the production of these vehicles and their key components generates higher emissions than their internal combustion engine (ICE) counterparts. According to a report produced by EV makers Polestar and Rivian in 2023, emissions from the combined manufacturing of a battery electric vehicle (BEV) and its battery are 40% higher than the emissions from production of ICE vehicles. This is not to say that ICE manufacturing is substantially less damaging. The report highlights that the manufacturing of a vehicle accounts for 16% of emissions in a vehicle's lifecycle compared to over 60% from fuel consumption over an average ICE passenger vehicle's life cycle, and this element garners the most focus in relation to decarbonisation.

Therefore, the reporting of improvements in areas such as GHG emissions and commitments to carbon neutrality – the two Mitigation indicators where most companies scored the highest in the tracker – shows that the manufacturing side of the Automotive sector is pivoting to a position where it can better support the positive environmental impact of its end products. However, the focus on manufacturing emissions, and Scope 3 emissions in particular, does not end here. Emissions from a company's supply chain also contribute to the emissions profiles of vehicle manufacturing and automakers are increasingly cognisant of the fact, employing increasingly sophisticated methods to track inventories and suppliers as part of their broader efforts to reduce emissions and meet sustainability goals.

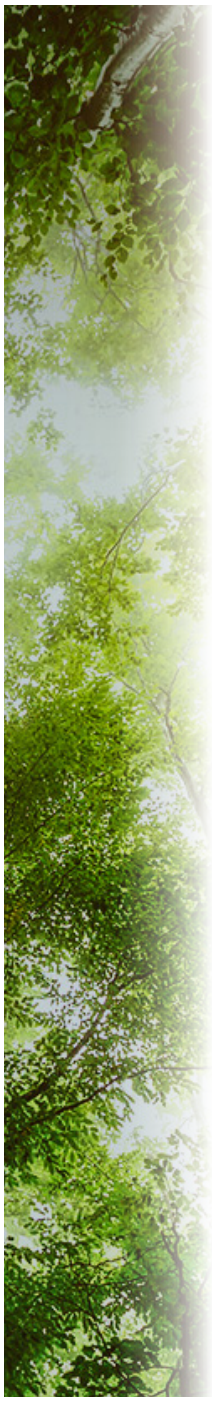
Fig 2.8: Average Passenger Car Lifecycle Tailpipe Emissions



Source: Green NCAP, ICCT

In the APAC region, regulation around reporting these manufacturing emissions is also growing in key autos markets. China's Corporate Social Responsibility (CSR) Reporting requires large SOEs to disclose environmental information, including emissions data, while in Japan, large-scale emitters are required to report their GHG emissions annually under the Act on Promotion of Global Warming Countermeasures. Similarly, Korea's **Greenhouse Gas Inventory and Research Center (GIR)** manages the national GHG inventory and oversees corporate emissions reporting, while India's National Action Plan on Climate Change (NAPCC) includes various initiatives that indirectly promote emissions reporting such as the **National Mission for Enhanced Energy Efficiency**. Although APAC markets are at different stages of implementing emissions reporting frameworks, the increasing focus on sustainability and climate change mitigation in the region, particularly for heavy industries such as automotive manufacturing, suggests that emissions reporting requirements will continue to evolve and become more stringent, providing greater certainty and clarity for companies operating in the region.

There is also a drive from autos companies to reduce manufacturing emissions and create a more sustainable ecosystem to align with their product portfolio. In some cases, this has led to a shift in business model to adopt a vertical approach whereby more of the supply chain is brought in-house. Tesla was an early proponent of this strategy, producing its own EV batteries and sourcing key inputs from mining companies directly. General Motors has also employed this approach with its Ultium battery joint venture and investments in lithium mines. This not only ensures the availability of supplies at a time when carmakers have suffered from numerous severe disruptions to the global supply chain, but also enables carmakers to have more control over the operations (and areas such as sustainability) within key elements of their supply chain.

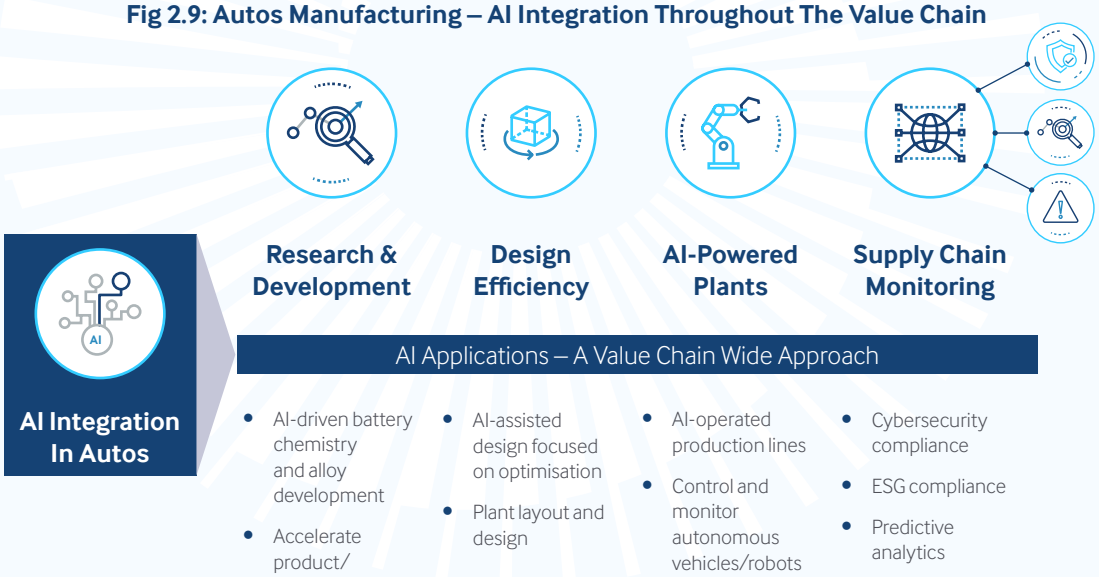


Technology Evolving To Track Value Chain

Automotive manufactures are embracing emerging technologies, such as AI to support emissions reduction efforts. Firstly, using technology to increase the efficiency of the manufacturing process, which lowers the demand for energy and by extension cuts emissions. Secondly, using carbon tracking software that can help manufacturers track and report their emissions, can increase awareness and accountability.

The focus on sustainability from design to end-of-life stages will generate more highly automated and flexible BEV manufacturing processes, such as 'digital twinning' which uses digital models of vehicles or components during the design and development stages to avoid the production of several prototypes, thus saving on energy and materials. One example of this is Hyundai's Innovation Centre, which was inaugurated in Singapore in Q4 2023 and makes use of digital twin technology and automated manufacturing.

Fig 2.9: Autos Manufacturing – AI Integration Throughout The Value Chain



Source: BMI

Carbon tracking software can also play a role in helping automotive companies reduce their emissions by providing detailed insights, enabling data-driven decision-making and facilitating compliance with regulatory requirements. The software enables companies to accurately measure and report their GHG emissions across various facets of their operations, including manufacturing processes, supply chain logistics and vehicle emissions. This allows companies to target their reduction efforts more effectively and work with their suppliers to reduce emissions or switch to more sustainable alternatives.

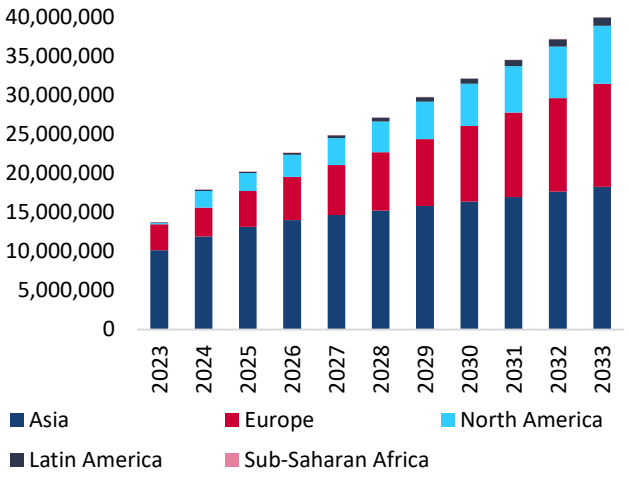
APAC Offers Distinct Contribution Opportunities

For the majority of autos companies, both vehicle manufacturers and those in the supply chain, producing or supplying low- and zero-emission vehicles is one of the most clear contributions to meeting Paris Agreement targets they can make. With regard to EVs in particular, the APAC region is well placed to make a considerable contribution given that it includes China, the world's largest EV market. However, since the previous report, we have seen adoption of EVs increasing in other markets across the region and even areas of specialty developing, such as electric motorcycles and mopeds which are specific to the region.

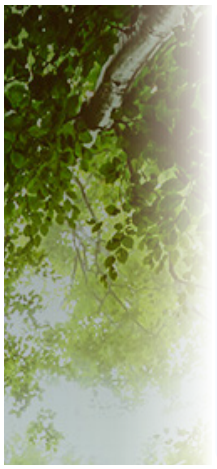
In 2023, total EV sales in the APAC region reached 9.7 million units, compared with just 3.5 million in 2021, while the total EV fleet surpassed 25 million units, up from just 8.7 million in 2021. This means that EVs accounted for 4.1% of the total vehicle fleet in the region by 2023. BMI forecasts that APAC EV sales will reach 17 million units by 2033, accounting for 28% of total sales while the EV fleet of 122 million units will constitute 14% of the region's vehicles in operation. To put this into a global context, EV sales in the APAC region accounted for 66% of the global total in 2023, and BMI forecasts this to increase to 68% in 2024. Although the share is projected to decline to 51% by 2033, as other regions gain momentum in terms of EV adoption, this shows that the APAC region will continue to be a significant driver of global automotive decarbonisation over the coming decade.

Focusing purely on these forecasts overlooks the fact that aside from scale, the APAC region also offers some unique growth opportunities which have developed as individual markets in the region follow their own specific decarbonisation paths. These specialities appear both on the vehicle front, where the thriving two- and three-wheeler market in South East Asia has created a niche opportunity for electrification, and also on the services side where insufficient charging infrastructure has given rise to battery swapping businesses. While developments such as this compound the positive environmental impact of the growing electric passenger and commercial vehicle market, they also provide specialist commercial opportunities for companies not involved in the more traditional EV sector.

Fig 2.10: Global – Total EV Sales By Region, units



e/f = BMI estimate/forecast. Source: National sources



Electric Two-Wheelers And Battery Swapping

Large-scale two- and three-wheeler markets in the APAC region have created a region-specific opportunity to decarbonise a large proportion of the local road transport sector. Traditional motorcycle companies and startups alike are capitalising on the electrification trend. Industry leaders such as Honda and Yamaha produce E2Ws for the region, the relatively small number of parts and easy assembly process for E2Ws has also enabled local startups such as Deco Green Energy, which leads the market in Thailand and Gesits in Indonesia to play a role.

Battery swapping services services are a growing trend in this segment. The increased number of batteries required for swapping does put further strain on raw materials sourcing and generate more end-of-life batteries; however, this should be weighed against the contribution to decarbonising the region's vehicle fleet through its lower costs, and the increase in recycling facilities in the region will also support battery swapping.

Need For Adaptation Already Here

Automakers have become increasingly aware of the negative implications of climate change on their own businesses as a number of extreme weather events have impacted production lines. In 2021, the impact of the semiconductor shortage, which had already caused widespread disruption, was exacerbated by an extreme winter storm in Texas, causing widespread power outages and impacting semiconductor production. This compounded the supply chain issues for automakers, leading to production delays and temporary plant shutdowns. In the same year, severe flooding affected parts of Germany, Belgium and the Netherlands, causing extensive damage to infrastructure and industrial facilities. The flooding disrupted automotive supply chains and logistics in Europe, particularly affecting suppliers of components and raw materials. Several automotive suppliers, including Continental and Robert Bosch, had to halt production due to damage to their facilities and transportation networks. Flooding has also been prevalent in the APAC region. In 2020, Hyundai and Kia's operations in Korea were impacted as both their own facilities and those of their suppliers were hit by severe flooding.

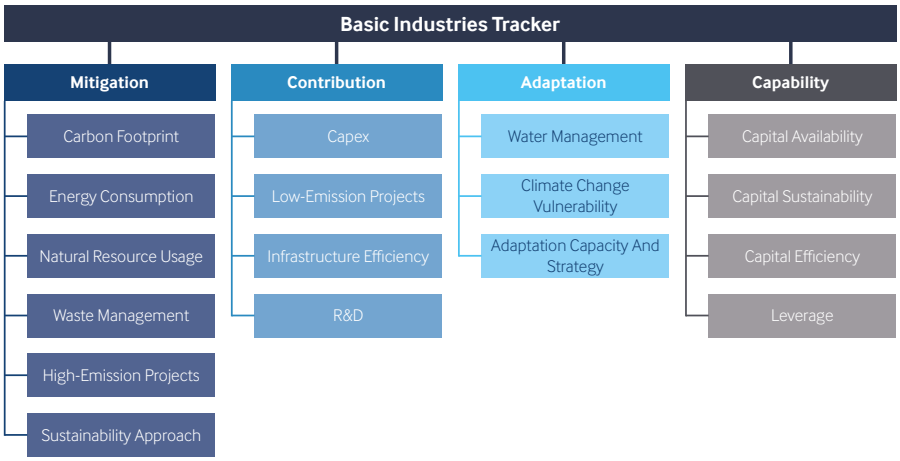
Furthermore, the growing use of technology outlined in the Mitigation section has the potential to worsen the climate situation and increase the need for adaptation measures. A major risk to AI use in the Automotive sector is the high energy consumption of AI platforms. AI algorithmic and data-processing capabilities are expanding rapidly, leading to wider product offerings and, in turn, increased energy and water consumption as part of model learning and sophistication efforts. The continued development and growth of AI will also increase the need for supercomputers, which will place additional strain on national power grids, further fuelling sustainability concerns.

Sector Tracker: Basic Industries

In the context of this report, basic industries means building and construction, and environmental services. Using the AIIB-Amundi Climate Change Investment Framework (CCIF), the basic industries index aims to capture the extent to which operations, investments and strategies of companies operating in this sector align with the Paris Agreement goals of Mitigation, Adaptation, Contribution to the transition, plus financial Capability.

Mitigation

The Mitigation pillar comprises six segments, the first of which is based on a company's GHG emissions intensity and growth. Here, the Index assesses each company's percentage change in emissions between 2019 and 2023 and gives a ranked score relative to the other companies in the Index. This score is combined with a carbon intensity score, which measures the total emissions per unit of total sales for the company.



The energy consumption segment assesses each company's total energy consumption in thousand kilowatt hours (KWh) and then ranks each company's total energy consumption per unit of total sales to calculate a score. Meanwhile, the fuel mix segment considers what types of fuels are used by the company, including use of coal, oil/diesel, natural gas and renewables.

Waste management is a weighted average of two scores relating to waste and waste recycling. More weight is given to the score for recycling, a qualitative assessment of the extent to which each company recycles waste. Where available, the score considers data on waste recycled by a company, as a share of total waste. The score related to waste assesses the total waste of a company and then generates a score based on the total waste per unit of sales compared to other companies.

The High Emissions Projects measure is driven by an assessment of the relative share of each company's project pipeline value in USD terms accounted for by high-emission projects, in order to gauge the impact of the projects on GHG emissions. This is calculated using BMI's proprietary Infrastructure Key Projects Data.

The final segment, sustainability approach, is qualitative. By researching and analysing each company's annual reports, sustainability reports, websites and other official documentation, the Tracker assesses a company's commitment to supporting mitigation efforts. Scoring considered aspects such as the presence of dedicated committees, budgetary allocations, internal policy formation, disclosure practices, mitigation commitments, supply chain management guidance and plans in place to achieve these targets, as well as the existence of policies around aspects such as energy efficiency, waste reduction, water use and climate change.

Adaptation

Adaptation is divided into three segments, the first of which assesses a company's water management practices. This is made up of a score assessing a company's total water use per unit of total company sales compared to other companies, which is then combined with a qualitative score assessing the extent of company efforts to recycle water. This qualitative score is informed where available by company data on water recycling as a share of total water use. Climate change vulnerability is a function of the company's exposure to climate change risks based on its operating location. The last of these three segments, adaptation capacity, refers specifically to the response capacity and preparedness of each company to adapt to climate change. This considers both the company's geographic location and strategy.

Contribution To The Transition

Contribution is divided into four segments, beginning with capex which measures the overall investment undertaken by the company over the most recent reporting year. The low-emissions projects score combines a qualitative score of a company's efforts to pursue low emissions and resilient projects with a quantitative measure of the number and value of low emission projects within

a company's project pipeline. This is also calculated using BMI's Infrastructure Key Projects.

The infrastructure efficiency segment is a qualitative measure of the extent to which companies are pursuing energy efficiency in structures and whether a company has adopted a green building policy.

Finally, the R&D segment considers a company's contribution towards innovation and improvement in the industry. This is done by combining a quantitative measure of R&D as a share of company revenue with a score derived from qualitative analysis using company annual reports and other official documentation to consider each company's efforts in adopting green technologies.

Capability

BMI has also added a fourth pillar to consider financial capability. This fourth pillar has been added to reflect the fact that reducing carbon footprint, protecting against climate change risk and investing in green technologies are all capital-intensive processes, and therefore any transition will be partly contingent on a company's financial health and capacity. Those companies in a more financially stable position, with access to capital, are better placed to set meaningful targets and fulfil them with actions.

Sector Tracker Insight: Basic Industries

Progress On Carbon Mitigation, More Focus Needed On Scope 3 Emissions

In the previous edition of the Companies and Climate report, the Basic Industries sector ranked in the bottom half of the sectors, only above Automotive and Healthcare (see Sector Tracker diagram in Introduction). It scored especially poorly for the Adaptation and Mitigation pillars. This analysis presents the progress made by companies in this sector on their transition journey to a low-carbon economy.

Overall, we note an improvement from basic industry companies in their breadth of disclosing Scope 1 and 2 carbon emissions from the previous report. However, the majority of companies remain reliant on the procurement of emission-intensive energy sources, such as coal, oil and natural gas, with only a small portion of businesses procuring energy from non-hydropower renewables.

Scope 3 emissions account for a large portion of company emissions in this sector, and this is an area in which there has been less progress in terms of data reporting and disclosures. Sources of these Scope 3 emissions range from upstream – including materials and sub-contractors – to downstream – including the sold goods and services, waste disposal and the operational emissions from the constructed asset itself.

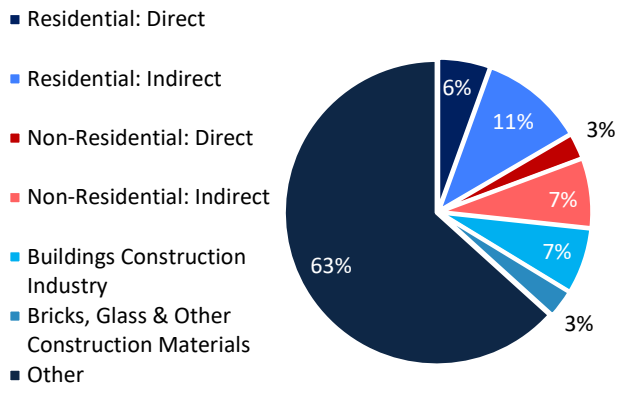
Impact Of Building Industry On Climate Change Mitigation And Role Of Regulation

The decarbonisation of the Basic Industries sector is integral to global climate change mitigation, including efforts to meet GHG reduction commitments set out under the 2015 Paris Climate Change Agreement. According to the UN Environmental Programme, the building and construction sector as a whole (including the production of cement and other materials and the operational emissions of buildings constructed with those materials) accounted for 37% of global GHG emissions in 2022.

Industry level frameworks and initiatives have developed, which offer guidance and reporting standards. The Institutional Investors Group on Climate Change (IIGCC), for example, provides guidance for infrastructure assets; this is a complement to its Net Zero Investment Framework that details best practices for sustainability reporting by infrastructure assets. Green building certification programmes in some markets, such as the Leadership in Energy and Environmental Design (LEED) in the US and the Building Research Establishment Environmental Assessment Method (BREEAM) in the UK, are examples of sustainability certifications.

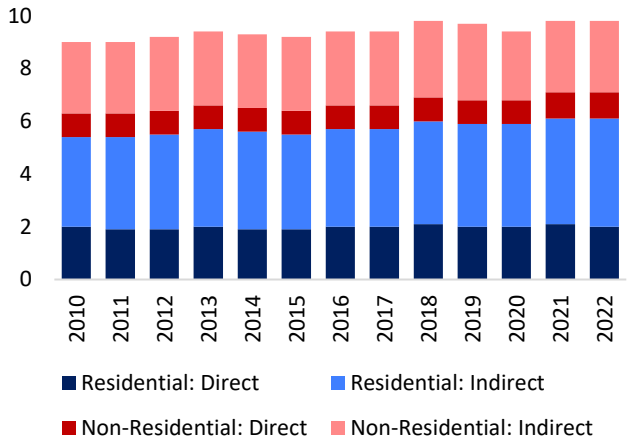
The need for greater regulation to make deeper inroads into emissions reduction is clear and momentum is building globally, specifically with policies aimed at reducing emissions from the materials industry. The EU has been a leader in this regard, with carbon pricing through the European Emissions Trading System (EU ETS), and permit prices have risen considerably since 2020. Carbon pricing through the ETS has incentivised companies in the EU to adopt emissions-reduction strategies, including, for example, the adoption of more energy-efficient kilns and the development of new lower-emission forms of concrete. Looking ahead, the tightening of rules under the ETS as a result of reforms adopted in April 2023 should increase the cost of emitting carbon further for materials providers, further incentivising emissions reduction as companies seek to mitigate the expanding cost associated with high emissions. A similar strategy is under way in the APAC region with the introduction of market-specific emissions trading systems in China, Thailand and Indonesia, which will encourage companies to offset more emissions from hard-to-abate activities, such as

Fig 2.11: Global – % Share Of CO2 Emissions By Sector (2022)



Source: IEA, BMI

Fig 2.12: Global – CO2 Emissions In Buildings, GtCO2



Source: IEA, BMI

within the cement and coal sector. For example, in 2023 Indonesia introduced a nationwide ETS, making it the most recent APAC market to implement a nationwide ETS. By covering coal-fired power plants in the market, the ETS has jurisdiction on over 26% of emissions in the market. This followed the notable implementation of China's nationwide ETS in 2021, building on several subnational ETS that were introduced during the previous decade. Draft guidance issued by Chinese authorities in 2024 indicate their intention to extend the ETS beyond power generation, to cover emissions entailed in cement and aluminium in the near term.

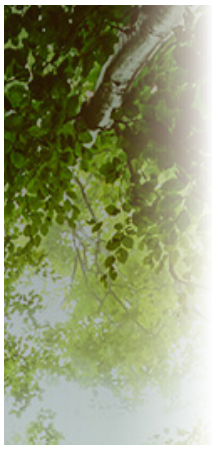
Additionally, the initial adoption of the first carbon border adjustment mechanism (CBAM) globally by the EU in October 2023 will place pressure on exporters of key materials such as cement, steel, iron and aluminium located outside the EU as the implementation of the CBAM ramps up in the coming years. During an initial period to 2025, importers are required to report embedded emissions in their imports ahead of the CBAM's definitive regime from 2026, in which emissions certificates would be traded among importers in accordance with the EU ETS. With other markets, such as the UK having similarly announced a carbon border, to take effect in 2027, and the likes of Australia also consulting industry on the potential adoption of CBAMs, there is further potential for pressure on supplier, particularly in developing markets.

Fig: 2.13: Select China Regions And APAC Markets – Carbon Pricing Instruments Implemented/Under Consideration By Jurisdiction

Jurisdiction	Instrument Name	Type	Status	Share Of Jurisdiction Emissions Covered
Beijing, China	Beijing pilot ETS	Subnational – City ETS	Implemented in 2013	24%
Guangdong exc. Shenzhen, China	Guangdong pilot ETS	Subnational – State/Province ETS	Implemented in 2013	40%
Shanghai, China	Shanghai pilot ETS	Subnational – City ETS	Implemented in 2013	36%
Shenzhen, China	Shenzhen pilot ETS	Subnational – City ETS	Implemented in 2013	30%
Tianjin, China	Tianjin pilot ETS	Subnational – City ETS	Implemented in 2013	35%
Chongqing, China	Chongqing pilot ETS	Subnational – City ETS	Implemented in 2014	51%
Hubei, China	Hubei pilot ETS	Subnational – State/Province ETS	Implemented in 2014	27%
Korea, Rep.	Korea ETS	National ETS	Implemented in 2015	89%
Fujian, China	Fujian pilot ETS	Subnational – State/Province ETS	Implemented in 2016	51%
Singapore	Singapore carbon tax	National Carbon Tax	Implemented in 2019	79%
China	China national ETS	National ETS	Implemented in 2021	31%
Indonesia	Indonesia ETS	National ETS	Implemented in 2023	26%
Thailand	Thailand ETS	National ETS	Under consideration since 2016	-
Brunei Darussalam	-	National	Under consideration since 2021	-
Malaysia	Malaysia ETS	National ETS	Under consideration since 2021	-
Pakistan	Pakistan ETS	National ETS	Under consideration since 2021	-
Philippines	Philippines	National	Under consideration since 2024	-
Viet Nam	Viet Nam ETS	National ETS	Under development since 2017	-
India	India ETS	National ETS	Under development since 2024	-

Source: World Bank

Alongside increased regulation, there needs to be more pressure placed on reducing carbon emissions during the development of assets. This, along with basic industries participants' own emissions reduction targets, is increasingly serving as a hard incentive for construction companies to adopt lower-emission construction materials and methods.



Materials And Machinery Evolving To Reduce Emissions

Cement and steel are among the most energy-intensive and largest emitters of CO2 in the construction sector, with producers of these materials under increasing pressure to reduce the environmental impact of their production. The use of 'blended' concrete, composed of Portland cement and a combination of any one or more supplementary cementing materials like limestone, slag cement, silica fume or fly ash, is an example of the development of low-emission materials. In APAC, companies like Siam Cement, Heidelberg Cement and Gamuda are seeking to meet the growing demand for lower-emission concrete via the exploration of such blends.

The construction sector is also looking into low- or no-emission machinery; for example, Doosan, Caterpillar, CNH Industrial and other construction machinery providers are exploring electric variants of their forklifts, excavators and trucks.

Contribution To Low-Carbon Economy Requires R&D Commitment And Innovative Mindset

The ability of companies in the Basic Industries sector to contribute to climate change transition and the low-carbon economy varies depending on the core of their operations and their overall financial position. For example, companies predominantly involved in residential construction and other more cyclical forms of construction tend to see greater fluctuations in their activity levels, their operating income and crucially their operating cash flow generation. Infrastructure operators, civil engineering companies and, in some cases, construction machinery manufacturers, tend to see greater resilience in their income generation across the economic cycle, with this body of companies tending to exhibit relatively higher levels of operating cash flow. As a result, these companies have greater capacity to finance meaningful capital expenditure, commit to greater R&D spending or take a lead in more complex low-emission project works.

Construction machinery manufacturers, operating upstream from actual construction work, are capable of leading the contribution from the Basic Industries sector to energy transition. In having greater financial capacity to pursue R&D spending, they are well placed to explore low-emission, often autonomous versions of their existing products. This is particularly so, given that these manufacturers are subject to increasingly stringent regulatory standards on tailpipe emissions produced by their construction machinery. In turn, companies operating further downstream in the construction process should consider the attractiveness of replacing their existing construction machinery, which would then realise a reduction in the emissions associated with their core operations. Construction machinery manufacturers are able to effectively determine the pace and direction of the innovation cycle within the industry through the speed at which industry participants adopt the latest generation of lower-emission construction machinery. More broadly, the closed, repetitive environment entailed in some heavy industry settings, such as on construction sites, could sustain demand among end-users for autonomous on-site equipment. We are already witnessing greater levels of innovation in the mining sector; for example, in Caterpillar's range of autonomous trucks for haulage and the onsite transportation of materials. The prevalence of closed environments across the Basic Industries sector highlights the applicability of adopting autonomous heavy equipment, enabling the removal of workers from hazardous or remote environments and, ultimately, enhancing the safety of onsite works.

Similarly, the robust financial capacity of construction companies with public client bases enables them to be more selective in favouring projects with lower expected emissions. Even if civil engineering companies choose not to adopt a more selective approach, tendering processes for infrastructure projects increasingly consider a company's commitments to emissions reduction when assessing bids. This will prove a common feature of public procurement as a means for public authorities to exert greater control in disincentivising emissions-intensive practices within their jurisdiction.

The recycling of building materials, whether by construction companies recycling onsite waste or the direct procurement of recycled materials, is another way for businesses in the Basic Industries sector to improve their sustainability credentials. Where companies undertake internal production of construction materials, whether via recycling or virgin materials processing, this can enable strategic cost management by insulating them from commodity price fluctuations. Asphalt, the most recycled material globally, seems an obvious construction input for basic industries to adopt.

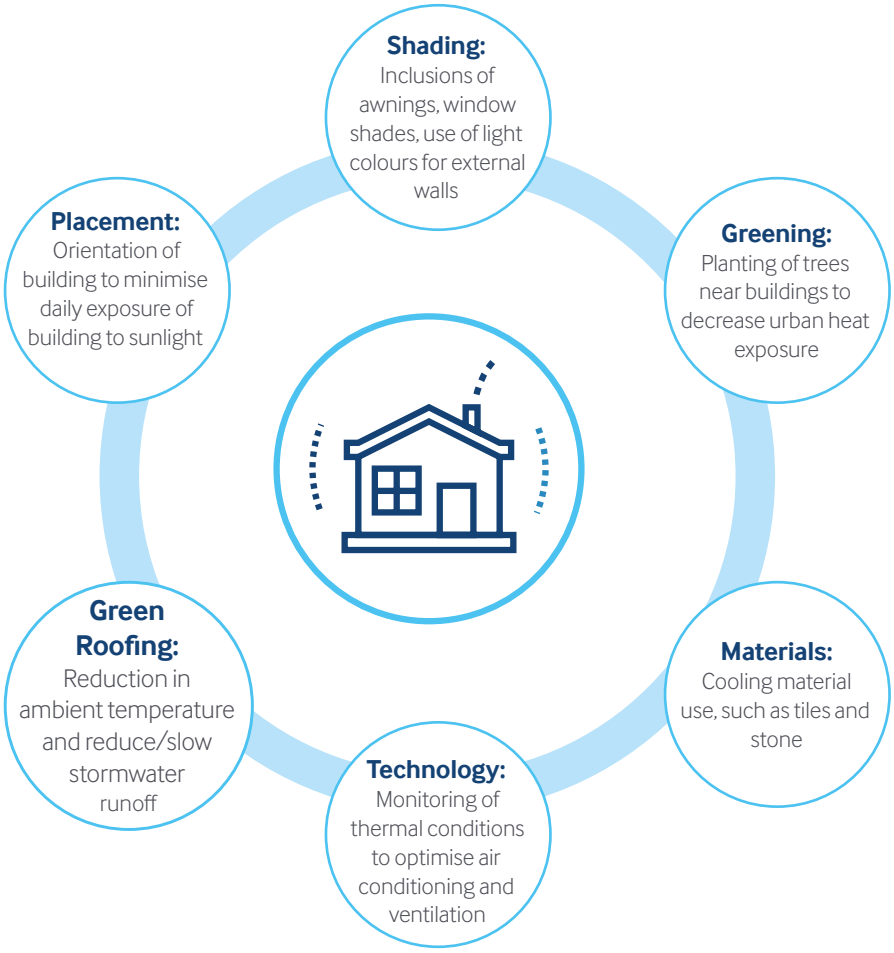
Additionally, the procurement of recycled materials offers the potential for basic industries companies to explore lower-emission composite materials. Composite materials – a hybrid of two or more constituent materials – can be customised to achieve a combination of properties superior to the individual ingredient. Combinations involving wood and plastics fibres are most prevalent, as they allow for advantages in durability and lifespan. When manufactured with recyclable ingredients, they offer sustainability advantages, with recycled composites effectively absorbing construction sector waste.

Adaptation Important For Building Resilience

Adaptation efforts by basic industry companies relate to ensuring that operations could withstand increased physical risks induced by climate change and a greater scarcity of natural resources. These efforts tend to focus on improving the resilience of tangible assets to a harsher physical environment; these could occur where (i) extreme weather events become a regular occurrence; (ii) adequate access to water and other natural resources becomes less certain; or (iii) a company's operating costs increase due to an adverse change in the physical environment.

The changing face of project types will be a primary manifestation of adaptation; there will be an uptick in (i) flood prevention-related enhancements to structures; (ii) water desalination and resource management projects; and (iii) physical enhancements to buildings to remain viable for withstanding extreme weather conditions, such as heat and hurricanes. While building materials such as timber are less suited to warmer climate, blended concrete and other low-emission derivatives of cement will remain viable for withstanding extreme heat and wind events. In some cases, the development of building materials capable of adapting to harsher climates will complement the development of low-emission materials.

Fig 2.14: Climate-Proofing Buildings: Withstanding Extreme Heat



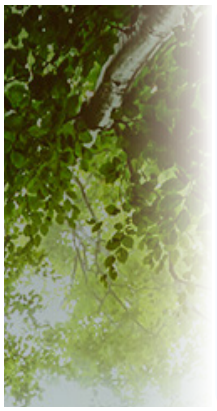
Source: City of Sydney, Climate Adapt – EEA, UN Environment Programme, BMI

Achieving complementary efforts in other aspects of building adaptation may prove more challenging. For example, in markets where air conditioning has long been utilised in buildings due to heat levels, the evolution of air conditioning solutions will decrease emissions. However, in markets which previously did not rely on air conditioning in their buildings, due to the fact that the environment was more temperate, the greater implementation of air conditioning solutions (even those that have been developed to be low emissions) will outweigh the incremental efficiency gains realised across generations of air conditioning systems, as climate change risk leads to higher temperatures and heat waves.

The use of scenario planning, often using digital twin models, will become a necessity for companies to forecast how assets may fare during extreme weather events, inform existing adaptation plans and identify any vulnerabilities to physical risks. A digital twin is a digital replica of a physical entity, such as a building, which can reflect all details of an entity. It can be used during the design, production and operational phase of an asset to simulate its performance under numerous climate change-related scenarios, along with modelling the impact of adaptation efforts on the asset's climate resilience.

Pre-emptive action to directly improve the resilience of physical assets often necessitates both maintenance to the direct structure as well as any surrounding infrastructure. For example, wildfires, high humidity and freeze-thaw events can pose a greater challenge for companies seeking pre-emptive resiliency.

While the prominent development of technologies such as AI and digital twins offers construction companies an incentive to consider their adoption, the slow-moving nature of the innovation cycle within the Basic Industries sector leaves a need for regulation to ensure decarbonisation. Given the emissions intensity of the sector across its value chain, carbon pricing and equivalent measures remain a natural fit for regulators to impose their will on the construction process.



BIM, AI And Drones Support Mitigation And Adaptation

Building Information Modelling (BIM) can reduce a project's environmental impact. The use of drones can monitor on-site operations to identify and mitigate inefficiency or waste. Modular construction methods can also support emissions reduction. 4D and 5D BIM projects integrate scheduling, cost and material estimations, ensuring more efficient management of resources, while 6D BIM accounts for facilities management and energy consumption, with a direct impact on its sustainability assessment.

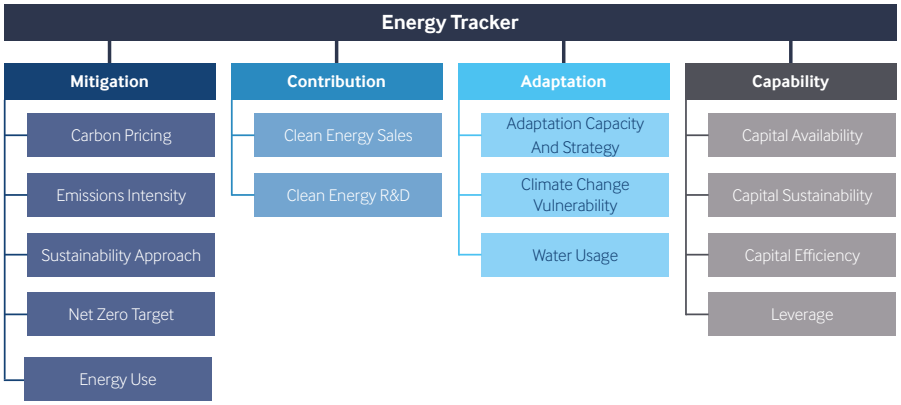
AI and digital twins, meanwhile, can be utilised to monitor the operation of a physical asset and its key attributes, such as its energy consumption. These data can be captured and applied to scenario analysis, such as for the asset's operation under different physical environments, leaving the asset owner well informed of any remedial works to enhance the asset's resiliency.

Sector Tracker: Energy

In the context of this report, energy means gas distribution and integrated energy. Using the AIIB-Amundi Climate Change Investment Framework (CCIF), the Energy Sector Tracker aims to capture the extent to which operations, investments and strategies of companies operating in this sector align with the Paris Agreement goals of Mitigation, Adaptation and Contribution to the transition. A fourth dimension, financial Capability, has been added by BMI to assess a company's financial strength and ability to deliver on its climate objectives.

Mitigation

We have assessed 'Mitigation' from two separate but interrelated angles. Firstly, we consider a company's existing operations, evaluating its energy-use practices, the emissions intensity of its operations and how its emissions have trended historically. Secondly, we consider whether the company has a net zero target in place and the scope, scale and effectiveness of its emissions reduction strategy. Where possible, the Tracker uses quantitative data points to compare performance across companies. However, this has been augmented by some more qualitative assessments, either to adjust the scores where, due to data issues, direct comparison was not possible, or where the data did not fully reflect a company's performance.



Source: BMI

Adaptation

The scoring of 'Adaptation' is based on a company's exposure to physical climate risks in the countries in which an entity operates and the willingness and ability of these countries to adapt to climate change. The former is assessed by the risk of extreme weather events and natural disasters, while the latter is based on a range of social, political, legal, institutional and economic indicators. At the company level, we have assessed the distribution of a company's assets across areas of high climate hazard risk, as well as the steps being taken to improve resilience, such as through improved water management practices. However, it should be noted that although energy companies have a wide range of adaptation measures available to them, they generally do not report on specific policies or investments.

Contribution

While 'Mitigation' deals largely with Scope 1 and 2 emissions, 'Contribution' is more concerned with Scope 3. It is more difficult to assess, due to issues of data availability, as well as differing opinions as to which products, technologies and services are truly 'green'. For the purposes of this tracker, we have compiled company-level data on existing production capacity, sales, R&D and investment in carbon capture, utilisation storage and low-carbon energies, such as renewable power, clean hydrogen and advanced biofuels, while excluding natural gas. As with 'Mitigation', we rely mainly on quantitative data points, but make qualitative interventions where necessary to more accurately reflect company performance.

Capability

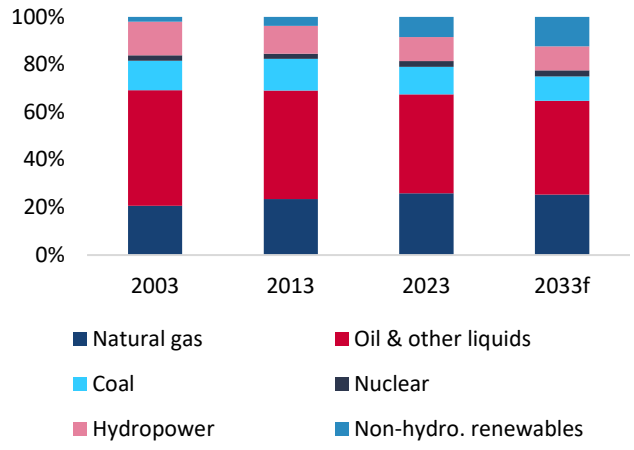
BMI has also added a fourth pillar to consider: financial capability. This fourth pillar has been added to reflect the fact that reducing carbon footprint, protecting against climate change risk and investing in green technologies are all capital-intensive processes, and therefore any transition will be partly contingent on a company's financial health and capacity. Those companies in a more financially stable position, with access to capital, are better placed to set meaningful targets and fulfil them with actions.

Sector Tracker Insight: Energy

Rising Scores For Mitigation Reflect Early Progress In Emissions Abatement

Reducing emissions in the Oil & Gas (O&G) sector is crucial if global climate targets are to be met. The combustion of oil and natural gas currently accounts for over 50% of global GHG emissions, and its share is set to rise over the coming decade. The challenge is substantial: underlying energy demand continues to grow and bottlenecks to the deployment of renewables mean that fossil fuels will retain a significant share of the energy mix for the foreseeable future, as per the chart in figure 2.15. Satisfying rising global energy needs while reducing emissions on a net global basis requires immediate and robust action by O&G companies.

Fig 2.15: Global – Energy Production By Source, % Total Production



f = forecast. Source: BMI

Progress is already being made, as reflected in our updated Energy Transition Tracker, which recorded an average Mitigation score of 51.3, up from 47.5 in our previous report. An increased number of O&G companies have put net zero targets in place over recent years and a majority of the companies in our tracker are now aiming to reach carbon neutrality by 2050 or before. Currently, most of the focus by the industry is on tackling Scope 1 and 2 emissions and public disclosure on related metrics is improving, encouraged by tightening regulatory requirements and increased shareholder pressure. The sector has a range of technically feasible abatement options available to it, many of which are economically viable at current price levels. These include energy efficiency improvements, electrification and a switch to low-carbon fuels, equipment upgrades, improved leak detection and repair, flaring reductions and the deployment of carbon capture technologies.

Investments have yielded gains and the carbon intensity of O&G operations has structurally declined over the past decade. According to the Oil & Gas Climate Initiative – an organisation representing the 12 largest O&G producers, which collectively account for more than 25% of global output – its members are on track to reduce upstream carbon intensity by 26% by 2025, versus a 2017 baseline, having already achieved over a 20% decline to date. However, few companies are fully aligned with the Paris Agreement goals, and the sector is far adrift of a 2.0°C pathway.

Substantial capital outlays are required, to affect meaningful reductions in absolute emissions, with the International Energy Agency (IEA) estimating that around USD600 billion must be directed towards low-carbon spending by 2030, to bring the industry on track to reach net zero by 2050. This would require an allocation of around 15% of total O&G sector spending towards

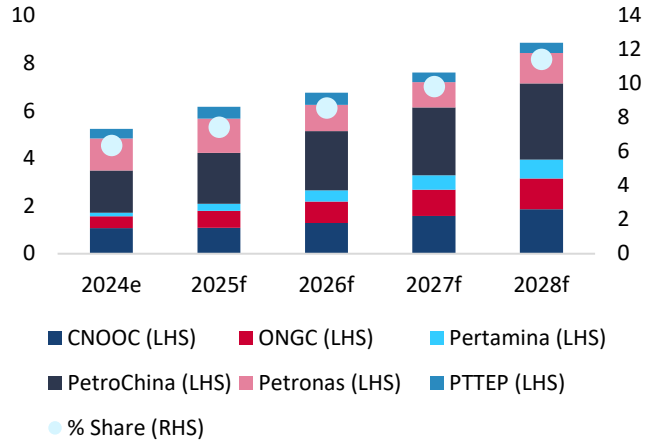
Fig 2.16: Recent Project FIDs – Select Companies – Options For Decarbonisation

Company	Project	Country	Method of Abatement
Royal Dutch Shell	Sparta	US	• All-electric topside compression equipment
TotalEnergies	GranMorgu	Suriname	• All-electric FPSO, with zero routine flaring • Waste heat recovery unit and optimised water cooling • Permanent methane detection and monitoring system
TotalEnergies	Kaminho	Angola	• All-electric FPSO, with zero routine flaring
TotalEnergies	Atapu-2 and Sépia-2	Brazil	• All-electric FPSO, with zero routine flaring • Waste heat recovery unit • Cargo oil tank gas recovery • Variable speed drive for compressors and pumps
TotalEnergies	Marsa LNG	Oman	• 100% solar-powered
TotalEnergies	Ubeta	Nigeria	• 5MW solar power plant developed on site • Electrified drilling rig

Source: Company data, BMI

decarbonisation, far above current levels, which we estimate at below 5% globally. However, the focus on emissions reductions is increasing. In Asia, we have seen a step change in the approaches being adopted by the national oil corporations (NOCs). Most major NOCs have net zero targets in place, with India's ONGC the most ambitious, aiming to reach net zero by 2038 and committing over USD24 billion to fund the transition.

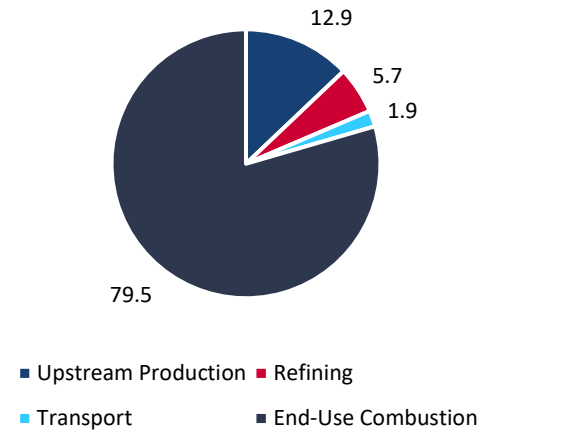
Fig 2.17: Asia – NOCs' Low-Carbon Capital Expenditure, USDbn & share of total spending, %



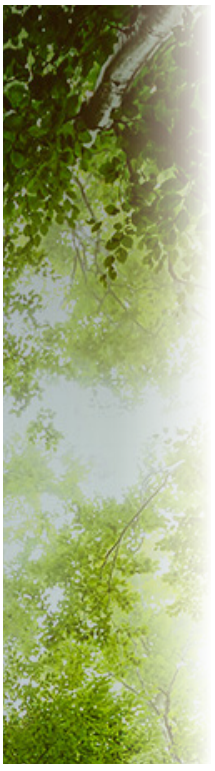
e/f = BMI estimate/forecast. Source: Company data, BMI

While there is significant progress being made on mitigation, there are several weak spots in the current approach. Firstly, many companies do not fully articulate their net zero strategies and fail to include robust interim targeting. Secondly, their strategies often include the use of carbon offsets, which is problematic given that these offsets may not yield emissions reductions on a net global basis. Thirdly, there is insufficient focus on Scope 3 emissions, which are generally not included in carbon neutrality targets. Scope 3 covers emissions incurred at the point of combustion by the end user and typically accounts for the lion's share of full lifecycle emissions for oil and gas.

Fig 2.18: Global – Average Share Of Emissions Across The Full Lifecycle Of A Barrel Of Oil, %



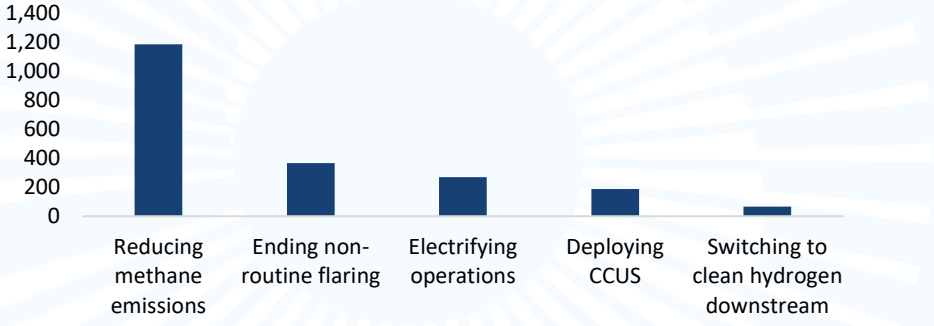
Source: Oil Climate Index, BMI



Combating Methane Emissions

A key contribution the O&G sector can make is in curbing its methane emissions. Methane is a highly potent greenhouse gas, and is the second largest contributor to climate change, accounting for about 30% of surface temperature rises since the Industrial Revolution. There are a number of technologically mature and relatively low cost options for abatement, including the reduction of gas venting and flaring, improved leak detection and repair, the replacement of pneumatic devices with electrical or mechanical ones and a switch away from natural gas as an energy source.

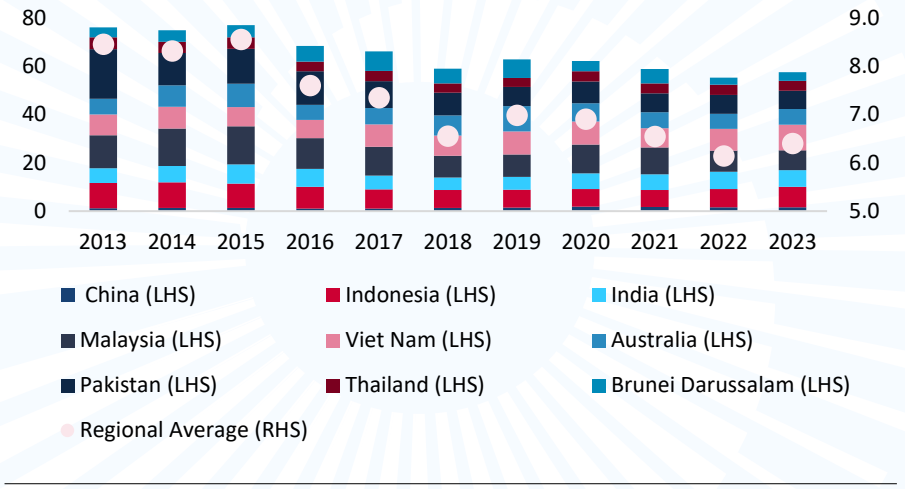
Fig 2.19: Global – Key Drivers Of O&G Sector Emissions Reductions, Scope 1 & 2, 2023, mt CO2-eq



Source: International Energy Agency, BMI

A number of O&G producers have already been tackling their methane emissions and several sector-specific initiatives are under way, including the Oil & Gas Climate Initiative, the Oil & Gas Methane Partnership and the Methane Guiding Principles. The industry's efforts are bearing fruit. For example, gas flaring intensity has fallen over the past decade, with flaring intensity amongst Asia's key oil producers declining from 8.5 cm/bbl in 2013, to 6.4 cm/bbl in 2023 according to the World Bank.

Fig 2.20: Asia – Key Oil Producers' Gas Flaring Intensity, cm/bbl



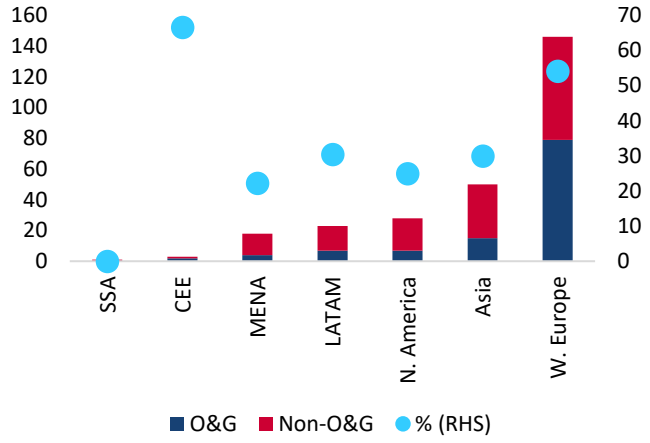
Source: International Energy Agency, BMI

Energy Sector Underplaying Hand In Contribution

The average Contribution score in our Energy Transition Tracker has fallen since our previous report, dropping from 43.7 to 42.0. While this partly reflects a shift in our methodology, it also underscores some of the challenges the industry faces. O&G producers can play a pivotal role in developing new technologies, particularly in areas that overlap with their core competencies, including advanced biofuels, clean hydrogen and ammonia, carbon capture, utilisation and storage (CCUS), and certain segments of the green power and e-mobility sectors. However, contributions will vary widely across the industry. Integrated oil companies (IOCs) and NOCs are leading contributions in this area.

O&G companies are making significant inroads in the development of clean hydrogen technologies and we estimate that they are involved in over 40% of the projects currently sitting in the global pipeline (figure 2.21). The industry overlaps with their core competencies, allowing them to leverage existing assets and technical expertise. However, as it matures, an increasing diversity of players are becoming active in the sector. We expect that the bulk of investment will flow to green hydrogen, given that it offers greater emissions reduction potential and will be more cost-competitive over the long term. However, several blue hydrogen projects are under development. For example, in Asia, CNPC is developing the North West blue hydrogen hub, which aims to capture 1.5 mtpa of CO2 in its first phase (2025), 3.0 mtpa in its second phase (2030) and reach 10.0 mtpa by 2040. Western Europe currently dominates the project pipeline, but Asia ranks second, and the region – led by Australia – is advancing rapidly in the sector.

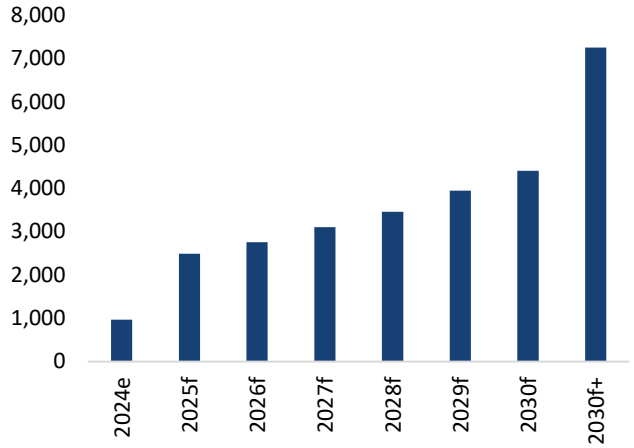
Fig 2.21: Global – Current Green And Blue Hydrogen Project Pipeline, count of projects involving O&G companies (LHS) and % share of total (RHS)



Source: BMI

O&G companies can also use existing expertise to accelerate the deployment of advanced biofuels, and we are seeing rapid growth in this sector, albeit from a very low base. Efforts are focused on the production of renewable diesel and sustainable aviation fuel (SAF), which will play an important role in decarbonising the industrial, maritime and aviation sectors. As per the chart in figure 2.22, we are forecasting robust growth in SAF production over the coming decade, albeit from a very low base, with output rising by nearly 900% by 2030. However, there are several barriers to the wider uptake of these fuels, including feedstock limitations and poor cost-competitiveness with conventional oil.

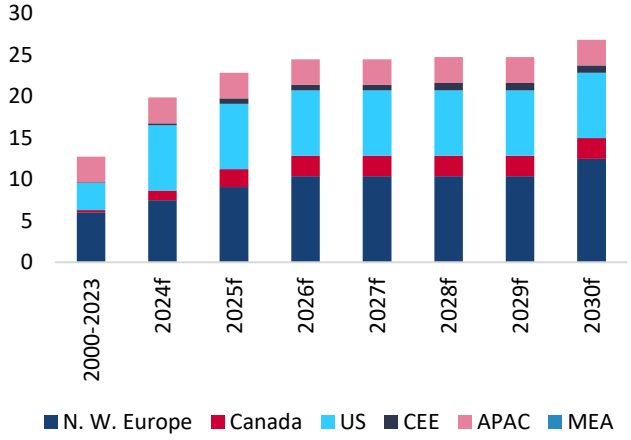
Fig 2.22: Global – Cumulative SAF Production Growth, mn gal



e/f = estimate/forecast. Source: BMI

Differing policy and regulatory backdrops are crucial in determining production levels and this is reflected in the project pipeline. For example, over 75% of the SAF projects we track and around 85% of planned crude-to-biofuels refinery conversions are in Western Europe and North America, where environmental policies are generally more advanced and better aligned with O&G sector policies, and where financial aid is available. Even with this support, some low-carbon ventures face challenging conditions. As per the chart in figure 2.23, BMI forecasts only relatively muted growth in crude oil to biofuel refinery conversions – around 10% over 2024-2030 – and currently factor in no additional projects in the Asia region.

Fig 2.23: Global – Crude Refinery To Biofuels Conversion Forecast, mtpa



f = forecast. Source: BMI

Climate-related policies and regulations are catching up in regions outside of North America and the EU, although energy market distortions over 2021 and 2022 have stunted progress globally, with security of supply concerns moving back up the agenda over recent years. As a result, several major oil companies have watered down their climate targets.

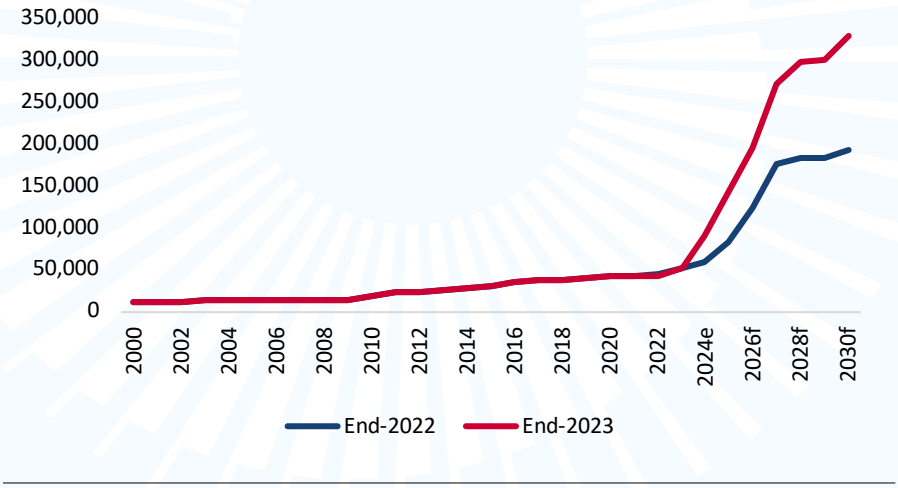
Over time, O&G companies that fail to adequately contribute to the energy transition face rising risk, including deteriorating operational and financial performance, reputational damage, climate litigation, reduced access to capital and loss of market share. However, they are currently walking a tightrope between diversifying their portfolios and satisfying the demands of their investors. The industry is characterised by higher returns on investment and larger shareholder distributions, relative to the clean energy space. In the past, attempts to diversify away from their core areas of operation have sometimes been punished in the stock market and shareholders are not always supportive of more ambitious climate targets. We expect further progress on contribution over the coming decade, but policy and regulatory improvements are urgently needed to spur action at the company level.

Carbon Capture, Utilisation And Storage (CCUS)

CCUS can contribute to significant emissions reductions in the O&G sector and heavy industries (such as steel, cement and chemicals) and can complement ongoing efforts to decarbonise the global power supply. It is also central to novel carbon removal solutions, including bioenergy with carbon capture and storage and direct air capture and storage.

Governments are recognising the need for greater support of the CCUS sector. Notably, the US, Canada, EU, UK, Norway, China and Australia are providing a range of tax credits, subsidies, grants, low-cost loans and other incentives to accelerate deployment. In response, the project pipeline is growing rapidly, with our capacity forecast for 2030 rising from 192,036mt and the end of 2022, to 328,560mt by the end of 2023.

Fig 2.24: Global – CCUS Capacity Growth Forecast, CO2 Capture, mt



e/f = estimate/forecast. Source: BMI

The scope for CCUS deployment in Asia is substantial. Market participants are exploring the development of CCUS hubs, including cross-border projects, which capture CO2 in areas of high industrial emissions and transport them to available sinks, such as in Australia, China, Indonesia and Malaysia. The Oil & Gas Climate Initiative is strong proponent of CCUS and its members are currently pursuing the development of at least 11 hubs in Asia, including: China (Junggar Basin, Chongqing, Daqing, Jiangsu, Hianan and Daya Bay), Japan (Osaka, Nagoya), Singapore (Jurong Island), Indonesia (Java) and Australia (Karratha).

Energy Sector Lagging On Adaptation

The O&G sector is heavy exposed to physical climate risks, due to the geographical spread of its operations, the water-intensive nature of its production and the long-lived nature of its asset base. Despite this, progress towards climate change risk adaptation has been relatively limited. This is evident in our Energy Transition Tracker, which reported an average Adaptation score of 49.3, down from 53.9 in our previous report. The decline is partly due to higher assessed climate hazards, but also reflects gaps in the industry's adaptation responses. Physical climate risks for the O&G sector span four key areas, as seen in figure 2.25.

Exposure to these risks is heavily influenced by the location of a company's asset base, and portfolio restructuring can be an effective means to reduce climate hazards. This tactic is only available to larger, diversified companies and has already been employed to improve GHG emissions profiles, with corporations divesting their more emissions-intensive assets. However, as an approach to either climate mitigation or adaptation, it is deeply flawed, offering gains at the company but not the broader global level.

The sector is pursuing other, more valuable means of adaptation, including investment in resilience infrastructure to protect operations in coastal and riverine areas, and increased spending on water desalination projects. O&G companies are making particular progress on the latter. For example, CDP has awarded three O&G companies with 'A-' ratings on their water security programmes – TotalEnergies, Sasol and Osaka Gas – designating them as market leaders in this area and reflecting high standards of monitoring and disclosure. TotalEnergies and Sasol are also signatories to the CEO Water Mandate, a UN initiative set up in 2007 to promote improve water stewardship.

Fig 2.25: Physical Climate Risks For The O&G Sector

Storms And flooding: Climate change will increase the frequency and severity of extreme weather events. This puts O&G infrastructure at risk, with a significant share of the sector's assets concentrated in coastal and riverine locations.

Wildfires: Climate change will increase the frequency and severity of wildfires. These can disrupt O&G operations and damage infrastructure, which is especially vulnerable due the flammability of oil and gas.

Melting Permafrost: Around 70% of Arctic infrastructure (largely O&G infrastructure) is in areas of thawing permafrost. This puts assets at risk, most acutely in Russia, given the higher concentration of its production in the Arctic.

Water Scarcity: Many O&G production processes are highly water-intensive and a large proportion of resources are located in areas of high-water stress. Extreme heat and droughts will only exacerbate the issue.

Fig 2.26: Table – Case Study: TotalEnergies

Water Policy Strategy	Key Targets	Key Projects Under Development
• The company sets water targets across business units, develops site water stewardship with third-party verification and monitors water-related performances • At the project level, it integrates resilience to water issues in its installations, evaluates water regulation evolution and the capex of retrofits, and assesses vulnerability to centenary events	• Water Stress: To ease water pressures, the company has set a target to reduce freshwater withdrawals by 20% vs. 2021 levels by 2030 • Water Pollution: To improve water quality, the company has committed to reduce the hydrocarbon content of onshore discharge water to 1 mg/l by 2030, exceeding EU regulation targets	• The company has approved a large-scale project for reducing freshwater withdrawals at the Antwerp refinery & petrochemicals complex. The project, which is slated for completion in 2025, involves treating and using wastewater from local households and should reduce freshwater usages by 9Mcm per year • In Iraq, TotalEnergies has signed an agreement for the construction of a large-scale seawater treatment unit to increase water injection capacities in southern Iraq fields without increasing freshwater withdrawal, to avoid increased pressure in a high water-stress region

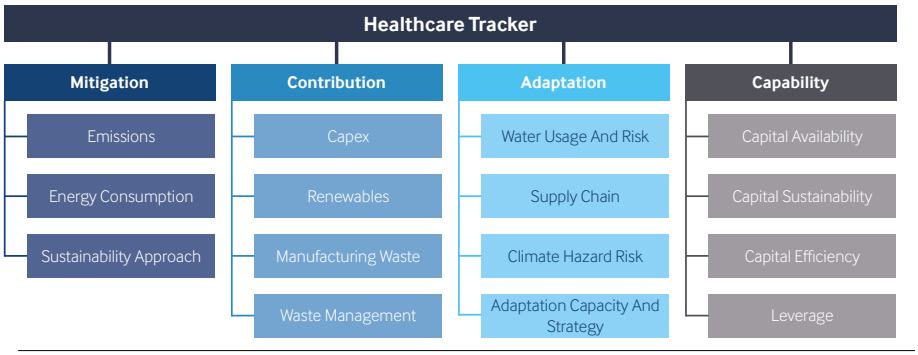
Source: TotalEnergies

Sector Tracker: Healthcare

In the context of this report, healthcare means health facilities; health services; medical products and pharmaceuticals. Using the AIIB-Amundi Climate Change Investment Framework (CCIF), the Healthcare Sector Tracker aims to capture the extent to which operations, investments and strategies of companies operating in this sector align with the Paris Agreement goals of Mitigation, Adaptation and Contribution to the transition. A fourth dimension, financial Capability, has been added by BMI to assess a company's financial strength and ability to deliver on its climate objectives.

Mitigation

Over the past decade, the healthcare sector has intensified efforts to mitigate climate change. This has primarily been achieved by reducing GHG emissions in the production of medical products (including pharmaceuticals and medical devices) and in delivering medical services, particularly within hospitals. The healthcare sector is also increasingly tracking and reducing energy consumption in manufacturing and general operations, specifically in its usage of electricity and natural gas. In terms of the industry's approach to sustainability, healthcare prioritises the reduction of medical waste (some of which is hazardous), energy efficiency policies and water management, which is particularly important in the manufacture of pharmaceuticals.



Source: BMI

Adaptation

Healthcare is one of the most globalised sectors, with supply chains that are highly exposed to climate hazard risks, such as droughts, floods and other natural disasters. The healthcare sector has been increasingly focusing on adaptation strategies to build more resilient supply chains and ultimately ensuring continuity of care to patients in the face of climate shocks. Continued access to essential raw materials for pharmaceuticals and medical equipment will be critical, necessitating strategic stockpiling, diversification of supply sources and the integration of climate risk assessments into procurement practices. Access to water is also increasingly becoming a key priority for the healthcare sector, particularly in water-stressed regions, such as the Middle East and North Africa. Healthcare companies are seeking to measure and reduce total water usage in production processes and general operations.

Contribution To The Transition

In terms of contribution to the transition, the healthcare sector is gradually increasing investments in renewable energy sources, such as solar power and biomass generators, for manufacturing plants, hospitals and clinics. This trend is especially noticeable in newly constructed facilities and is highlighted in corporate reports. Another important focus in the transition to a low-emission future is the effective management of healthcare waste. Healthcare produces large quantities of waste, which are often difficult to recycle due their hazardous nature. The industry is becoming more involved in developing tools and practices that minimise excessive waste of products that are difficult to recycle, introducing waste reduction protocols to ensure environmental sustainability without compromising patient safety.

Capability

BMI has also added a fourth pillar to consider: financial capability. This fourth pillar has been added to reflect the fact that reducing carbon footprint, protecting against climate change risk and investing in green technologies are all capital-intensive processes, and therefore any transition will be partly contingent on a company's financial health and capacity. Those companies in a more financially stable position, with access to capital, are better placed to set meaningful targets and fulfil them with actions.

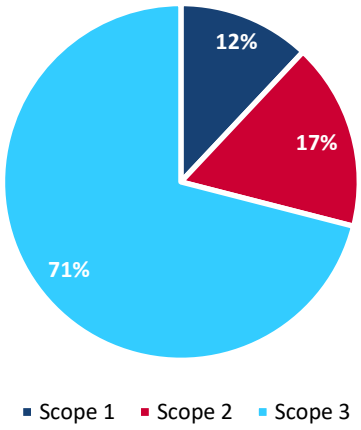
Sector Tracker Insight: Healthcare

Mitigating Carbon Footprint By Optimising Energy Consumption And Addressing Healthcare-Specific Emissions

The healthcare sector is often overlooked in terms of its environmental impact when compared to other industries, yet it contributes significantly to global greenhouse gas (GHG) emissions, accounting for an estimated 5% of the total carbon footprint worldwide. The healthcare sector has intensified efforts to mitigate climate change, particularly by disclosing its Scope 1 and 2 emissions. On the other hand, we have noted limited, albeit growing, efforts in Scope 3 emissions reporting which are constrained by this sector's complex global value chains, inconsistent reporting methodologies and a lack of transparent disclosures in both upstream and downstream activities. Overall, it is estimated that Scope 1 and 2 emissions make up 17% and 12% of the sector's worldwide footprint respectively, while Scope 3 account for the largest share equating to 71%. Despite the greater impact of Scope 3 emissions, current sector efforts are limited to addressing Scope 1 and 2 emissions, with significant strides being made towards improved energy management and reduction of sector-specific emissions.

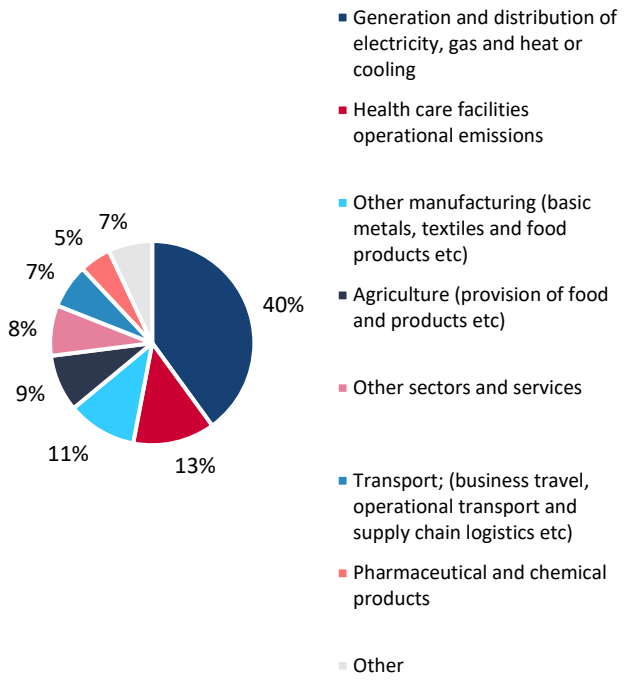
According to Healthcare Without Harm, the largest non-profit organisation working to reduce the environmental footprint of the healthcare sector, around 53% of healthcare's climate footprint arises from energy use, primarily consumption of electricity and gas across all three scopes (figure 2.27). Healthcare companies have intensified their efforts in reducing overall energy consumption, with GHG mitigation initiatives becoming largely common across the sector. A key example of this effort is the growing adoption of the ISO50001 framework developed by the International Organization for Standardization. The ISO50001 provides a robust framework for organisations to systematically improve their energy management, by helping develop company-wide energy management policies, establish energy reduction targets and improve overall energy performance, ultimately resulting in decreased GHG emissions. For example, companies that have achieved the ISO50001 certificate, such as Wuxi Apptec and Jiangsu Hengrui Medicine, have implemented innovative heat recovery technologies successfully improving energy management. WuXi AppTec equipped air compressors with heat recycling devices at its Changzhou manufacturing site and employs heat pumps instead of steam heaters for their Heating, Ventilation and Air Conditioning (HVAC) system. This resulted in roughly 20,000 tonnes of steam and 680,000 kWh of energy saved. Similarly, Jiangsu Hengrui Medicine has implemented significant measures to enhance flue gas heat recovery. Starting in April 2023, the company installed recovery equipment designed to create a heat exchanger circulation system connecting the boiler exhaust chimney with the boiler water tank. Between May and November 2023, the system successfully saved more than 15,000m³ of natural gas, ultimately reducing both energy consumption and GHG emissions.

Fig 2.27 Global: Healthcare Sector GHG Emissions By Scope



Source: Healthcare Without Harm, BMI

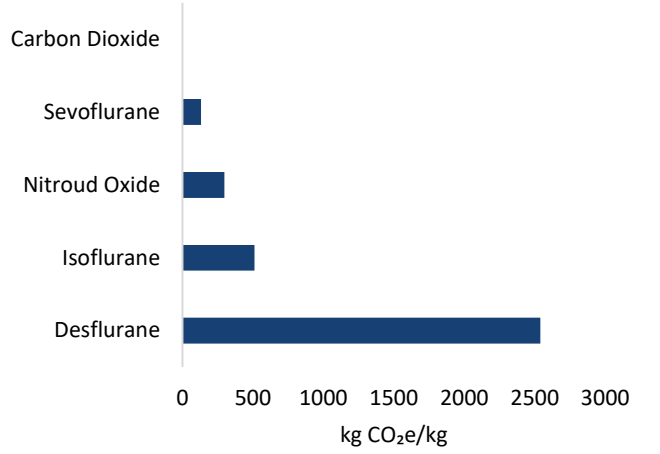
Fig 2.28: Global – Healthcare Climate Footprint By Source



Source: Healthcare Without Harm, BMI

While more than half of healthcare's footprint comes from energy usage, the sector is increasingly recognising the impact of more healthcare-specific sources of emissions, primarily anesthetic gases. These gases are potent greenhouse gasses, with global warming potentials (GWP) ranging from 130 kg CO_2e/kg for sevoflurane up to 2540 kg CO_2e/kg for desflurane (Fig 4.3). According to calculation based on data from the UNFCCC, Healthcare Without Harm estimates that nearly 1% of healthcare's global climate footprint is attributed to the sector's use of anesthetic gases. Despite their environmental impact and the global effort to phase out hydrofluorocarbons (e.g. desflurane) under the Montreal Protocol, Kigali Amendment (October 2016) anesthetic gasses are exempt from regulatory measures due to their medical necessity. Nevertheless, we have noted a proactive effort from governments and national health bodies in limiting the use of climate impactful anesthetic gases. For example, the European Union has formulated a proposal to ban the use of desflurane by 2026 aside from exceptional medical circumstances, while the UK's National Healthcare System (NHS) started decommissioning the use of desflurane in early 2024. Similar trends are being seen in the Asia-Pacific (APAC) region, where two of the largest private hospital networks, IHH Healthcare and Ramsey Care, are proactively aiming at reducing anesthetic gas emissions by replacing desflurane with less climate impactful alternatives, such as Sevoflurane and Isoflurane, and reducing the gas diffusion flow to minimise waste.

Fig 2.29: Global Warming Potential (GWP) Of Anesthetic Gasses



Source: Andersen et al., 2023, BMI

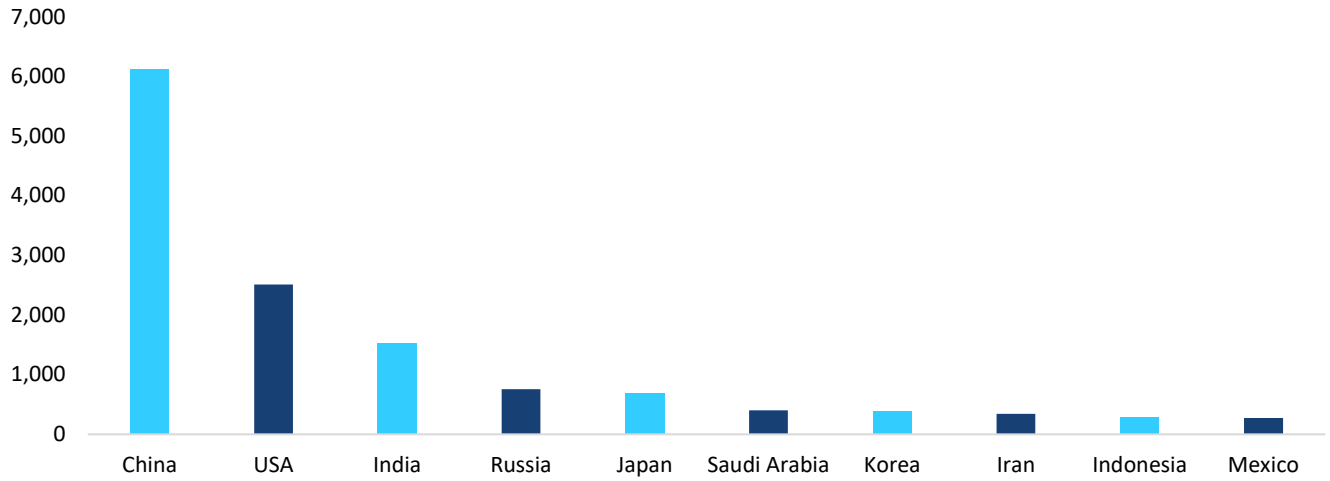
The healthcare sector faces a difficult challenge with the mitigation of emissions, as it must balance the necessity of providing life-saving treatments with the urgent need to reduce its environmental footprint. There is no indication that healthcare systems reward or incentivise sustainability. Health systems view healthcare as a cost to minimise rather than optimise from an environmental perspective. This drives companies to compete on price, leading the sector to prioritise decreasing costs over meeting sustainability targets. For example, national processes for appraising medicine values and reimbursement decisions (i.e. Health Technology Assessments) or government tenders for medicine procurement primarily focus on cost-effectiveness of medicines and overlook their environmental footprint. As a result, companies are hesitant to invest in greater sustainability initiatives without assurance that such efforts will be recognised. According to the World Health Organisation (WHO), the sector receives only 0.5% of global climate financing.

Furthermore, a lack of specific regulations targeting emissions reduction in the healthcare sector means that sustainability efforts are largely driven at an individual organisational level, as opposed to a sector level, potentially slowing the overall progress towards meeting the commitments set out under the 2015 Paris Climate Change Agreement. Nevertheless, in recent years, we have noted an increasing awareness from key stakeholders on the healthcare sector's role in climate change. For instance, during the 28th global climate summit, COP28, the WHO called for a unified action towards decarbonising healthcare systems by unveiling the 'Declaration on Climate and Health'. Endorsed by 123 countries, the Declaration marks a world first in governments acknowledging the crucial role the healthcare sector plays mitigating GHG emission and addressing climate change. This growing recognition is a pivotal step towards aligning healthcare sustainability efforts with global climate goals.

Contributing To The Transition To A Low-Emission Future By Increasing Access To Renewable Energy And Improving Waste Management

The healthcare sector is highly energy-intensive due to its expansive global supply chain and the requirement for uninterrupted power supply to provide care 24 hours a day. Considering the sector's substantial energy demands, access to renewable energy is crucial for the industry's contribution towards a low-carbon economy. Although the sector is gradually increasing investments in on-site renewable energy sources, such as solar power and biomass generators, the majority of consumed energy still comes from national grids. Therefore, access to renewable energy from domestic grids is essential to significantly reduce the healthcare sector's carbon footprint. This is particularly relevant in the APAC region, where high volume of medicines and pharmaceutical raw materials (Active Pharmaceutical Ingredients, APIs) are manufactured, but power grids are fossil fuel-heavy and green energy sources are less prevalent (figure 2.30).

Fig 2.30: Top 10 Global – Electricity Generated From Fossil Fuels (TWh)

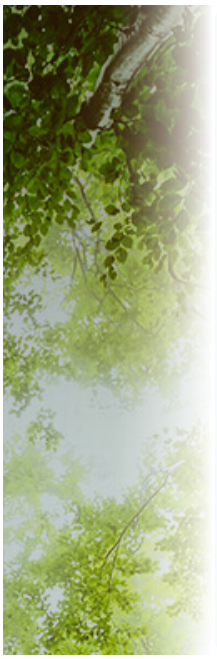


Note: APAC markets highlighted. Source: OurWorldInData, BMI

It is estimated that China and India are responsible for over 50% of the manufacturing and distribution of medicines and APIs, thereby acting as major contributors to the healthcare sector's global emissions. In an effort to transition the sector towards a low GHG emission model, in January 2024 five global healthcare leaders (AstraZeneca, Lonza, Novartis, Novo Nordisk and Roche) signed a multi-buyer power-purchase agreement (PPA) in China with green technology company Envision Energy to unlock access to renewable power. The three-year energy agreement will supply 200 GWh of renewable electricity, resulting in annual emissions savings of approximately 120,000 tonnes of carbon dioxide equivalent (CO_2e). Additionally, these companies are also discussing expanding the initiative to India in order to unlock renewable energy in Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Tamil Nadu. These recent renewable energy PPAs represent a significant effort from the global healthcare sector to contribute to the decarbonisation of their operations in Asia. By focusing the efforts on the APAC region, pharmaceutical companies are aiming to decarbonise the most environmentally impactful part of their supply chain, therefore effectively contributing to the transition towards a low-carbon economy.

The recycling of medical material represents another key opportunity for the healthcare sector to contribute towards a more sustainable future. The sector generates a high waste-to-product ratio throughout its entire lifecycle, from R&D to end-use consumption. For instance, the development and commercialisation of a new medicine averages a lab-to-market timeline of 10 years, but has a regulatory approval rate of only 10%. This implies that the vast majority of GHG emissions during the pharmaceutical R&D phase are associated with products that will never reach the market. Given the high scientific complexity behind medicine development, the sector will continue to face low levels of R&D success rates, meaning that high levels of GHG emissions associated with unsuccessful development programmes are unlikely to be eliminated or reduced. Similarly, from the perspective of end-use consumption, the healthcare sector heavily relies on single-use clinical items to maintain sterility and ensure patient safety, leading to high GHG emissions due to the continuous need to manufacture new items. This issue was particularly pronounced during the COVID-19 pandemic, which saw a dramatic increase in the use of single-use face masks and other disposable personal protective equipment.

Despite these challenges, the healthcare sector has the opportunity to significantly improve waste management through the adoption of innovative technologies that enable effective recycling without compromising product quality and patient safety. Such technologies extent from simple depolymerisation for recycling of plastic packages to adsorption techniques to capture precious metals (e.g. platinum and palladium) from pharmaceutical waste streams, which can then be reused in future catalyst reactions. Implementing such sustainable practices could drastically reduce the industry's environmental impact, paving the way for a more eco-friendly future in healthcare. By prioritising recycling and waste reduction strategies, the healthcare sector can play a crucial role towards contributing to the creation of a pathway to low GHG emissions.



Reducing Solvent Use And Recycling

Rigorous manufacturing compliance regulations and stringent purity standards for raw materials, which ultimately diminish the capacity for material recycling. Nevertheless, drugmakers have demonstrated their growing efforts towards minimising manufacturing waste and increasing material recycling. Solvent recycling has emerged as a key focus area.

The increasing adoption of green-chemistry technologies will improve solvent use management, by both minimising solvent use as well as increasing solvent recycling. For example, Wuxi Apptec, one of the largest API manufacturers in China, has been advancing its enzyme technology platform which enables API manufacturing via enzyme-catalysed reactions requiring minimal solvent use. This has resulted in the reduced use of around 1,700 tonnes of organic solvents. Similarly, Sinobiopharma has been exploring the use of supercritical fluid technology in the preparation of pharmaceutical formulations, reducing solvent waste by roughly 60%. In 2023, the company reduced the generation of hazardous solvent waste by 10 tonnes through the application of supercritical technology. Other companies are focusing on solvent recycling via a range of solvent purification technologies, such as distillation, supergravity and membrane separation. For example, in 2023, Jiangsu Hengrui Medicine reported 32,800m³ of solutions processed, with 18,800 m³ (around 57%) of solutions successfully recycled and reused. By 2025, the company aims to reutilise at least 70% of solvent waste by leveraging recycling technologies.

Adaptation Strategies To Build A Climate-Resilient Health System

Climate change has exacerbated weather hazards, driving the need for the healthcare sector to implement adaptation strategies and ensure climate-resilient health systems. The implications of climate change on the healthcare sector can extend from structural strain on infrastructure and to scarcity of natural resources to rising incidences of heat-related illnesses and vector-borne diseases. The sector's adaptation efforts can manifest in diverse ways, but all aim to maintain continuity of care to patients in the face of climate shocks.

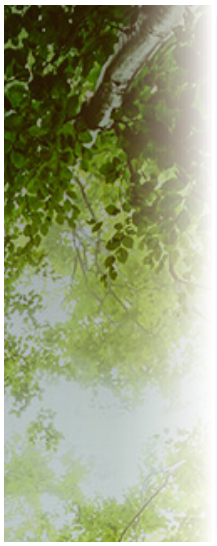
A key adaptation focus for the healthcare sector, particularly the pharmaceutical industry, is the strengthening of its supply chain resilience. The pharmaceutical supply chain is currently highly fragmented and reliant on a 'just-in-time' inventory management model, making it very susceptible to external shocks, whether these are environmental or geopolitical in nature. The COVID-19 pandemic further exposed these weaknesses, highlighting the need for more robust systems to ensure the continuous availability of essential medical supplies and medications. To address these vulnerabilities, we have noted an increased effort from drugmakers and governments to ramp up the localisation of pharmaceutical manufacturing and minimise exposure to international supply chains. For example, as part of the 2024-2029 Political Guidelines, the EU will propose a Critical Medicines Act designed to reduce dependencies relating to critical medicines and increase EU-based manufacturing of key pharmaceutical products and raw materials. Similar efforts can be also witnessed across the APAC region. For instance, in 2020, India launched the Production Linked Incentives scheme (PLI) designed to boost the domestic production of pharmaceutical APIs and diversify its supply chain. On a similar note, in 2023, Indonesia enacted the Health Omnibus Law which stipulates that healthcare facilities need to prioritise the use of drugs manufactured using locally sourced raw material. While these initiatives are primarily aimed at enhancing supply chain robustness, they also indirectly contribute to making the healthcare system more resilient to climate-related hazards. By localising production and diversifying supply chains, these measures help mitigate risks associated with environmental disruptions, such as extreme weather events or natural disasters, which can severely impact global logistics and therefore access to essential medicines. The increased focus on developing local capacities ensures that healthcare systems can maintain critical operations during crises, thereby enhancing overall resilience to a range of potential climate impacts.

Another crucial element for a climate-resilient healthcare sector is the preparedness to address diseases induced by climate change. Rising temperatures and heavy precipitations have increasingly created conditions conducive to the spread of vector-borne diseases such as malaria, dengue fever and chikungunya. While vector-borne disease control programmes are relatively well established, climate change could alter the geographic range of disease incidence, their seasonality and transmission intensity. Building climate resilience in the healthcare sector will necessitate a multifaceted approach that includes the integration of climate data. For example, utilising climate-informed health warning systems can help the sector monitor the shifting patterns of these infectious diseases and effectively guide preventative measures. A prominent example of such an effort is the malaria surveillance project in Nepal, launched by leading anti-malaria manufacturer, GSK, and technology company, Microsoft in

September 2022. The project involved installing 'biological weather stations' across three distinct habitats in Nepal, monitoring insect species and collecting data on climate impact on disease transmission. Leveraging climate data into disease surveillance systems will help inform local decision-making and build health systems more resilient to health emergencies induced by climate change.

Fig 2.31: Building Blocks For A Resilient Health System

Source: Adapted from WHO's Climate Resilient Health Systems Framework, BMI



Telehealth As An Adaptation Tool

Telemedicine has emerged as a promising solution to adapt to climate change challenges by providing remote consultations and medical services, thereby reducing the need for physical travel and allowing for continued access to healthcare even in the face of infrastructural disruptions. By leveraging telemedicine, healthcare systems can maintain a level of service continuity, offering timely medical advice and treatment to individuals who might otherwise be cut off from care. This technology can be particularly beneficial in rural and remote areas, where healthcare facilities are sparse and distances to the nearest hospital can be prohibitive, especially during extreme weather events. In addition, telemedicine platforms can facilitate better coordination among healthcare providers, ensuring that patient information is quickly shared and that critical decisions can be made in a timely manner.

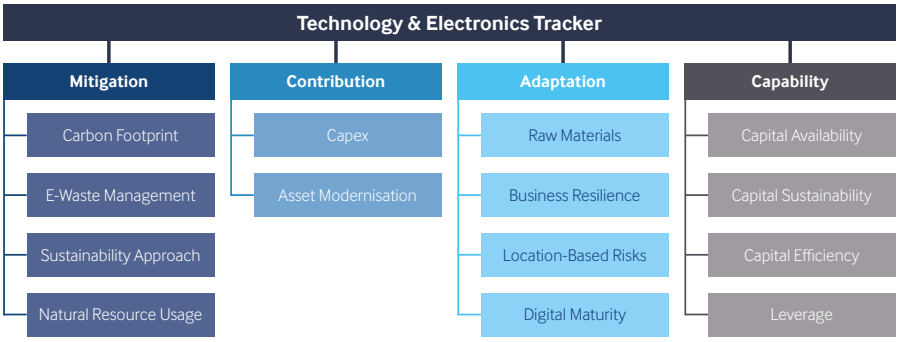
The successful implementation of telemedicine requires robust digital infrastructure and equitable access to technology, which remains a challenge in many parts of the APAC region. Addressing these barriers through investment will be crucial to fully harness the potential of telemedicine and improve health outcomes in the face of increasingly frequent and severe extreme weather events.

Sector Tracker: Technology & Electronics

In the context of this report, Technology & Electronics, software & services and tech hardware and equipment. Using the AIIB-Amundi Climate Change Investment Framework (CCIF), the Technology & Electronics Sector Tracker aims to capture the extent to which operations, investments and strategies of companies operating in this sector align with the Paris Agreement goals of Mitigation, Adaptation and Contribution to the transition. A fourth dimension, financial Capability, has been added by BMI to assess a company's financial strength and ability to deliver on its climate objectives.

Mitigation

The Technology & Electronics companies assessed through the Index are, in the main, either original design manufacturers (ODMs) or original equipment manufacturers (OEMs) that produce software or hardware (components or finished goods) for themselves or other parties positioned up or down their value chain. Manufacturing is both raw material- and energy-intensive, and efforts aimed at mitigating climate change tend to pivot around the most directly controllable aspects of production, namely carbon emission reduction and the management of product end-of-life waste materials (e-waste). The sustainability of operational activities, such as product packaging and distribution, is also being tackled through alternatives to plastic packaging.



Source: BMI

Over the last seven years, OEMs and ODMs have been making considerable efforts to collect data regarding raw material and power consumption and sourcing (scope 1 and scope 2), as well as scope 2 and scope 3 contributions from sub-contractors and customers. This has enabled companies to construct and implement wide-ranging mitigation plans, with both short- and long-term objectives.

Adaptation

The Technology & Electronics sector's high dependence on raw materials and the need to keep production costs low means that the adaptation pillar is quite difficult to assess as regards the transition process. The most potent challenge is that of raw material consumption: electronics remain highly dependent on rare earth elements (REEs), metals, minerals and chemicals. These may be used directly, as conductors or agents, or indirectly as part of the manufacturing process. While REEs are abundant and key metals and minerals remain in reasonably good supply (shifting geopolitics notwithstanding), companies must look to improve supply chains with regards to ethical sourcing and ensuring that employees are equipped with the tools and the flexibility to adapt their workflow processes around the changing climate.

Resources such as water are often used in the production process, most notably for cooling or cleaning purposes and, among other things, companies must consider the burden they are placing on local water supplies. Companies must also consider how they can mitigate risks relating to water supply shortages under changing climatic conditions – notably, drought and shorter but more intense rainy seasons are becoming more frequent and disruptive across Asia-Pacific (APAC), meaning that the timely capturing and cleaning of deposited water supplies must be planned for with as much intensity as developing solutions to scale water usage in order to reflect changing local supply conditions.

Contribution

Asset modernisation is a key element of Technology & Electronics companies' efforts to decarbonise. Companies must replace ageing, power-inefficient plants with low-energy systems. Automation – which can range from simple digital quality-control systems to sophisticated robotic assembly systems – is helping to accelerate production with fewer faults or wastage of raw materials. Offices and plans are also being decarbonised, with clear efforts being made to switch to renewable energy and energy-efficient lighting and heating systems. Changes to distribution systems are also being pursued, with lighter and more ergonomic recyclable packaging as well as the introduction of electric-powered vehicles. In this regard, companies that have significantly increased their capital expenditures and research and development budgets to address their contribution efforts score well in this category.

Capability

BMI has also added a fourth pillar to consider: financial capability. This fourth pillar has been added to reflect the fact that reducing carbon footprint, protecting against climate change risk and investing in green technologies are all capital-intensive processes, and therefore any transition will be partly contingent on a company's financial health and capacity. Those companies in a more financially stable position, with access to capital, are better placed to set meaningful targets and fulfil them with actions.

Sector Tracker Insight: Technology & Electronics

Data Centres Balancing Rapid Growth With Emissions Mitigation

Throughout the development of the Technology & Electronics Tracker, a significant theme that emerged is the role of data centres in advancing the objectives of the Paris Agreement. Data centres are a critical component of the entire technology and electronics value chain, containing a variety of hardware and electronics to sustain software applications and deliver related services. As data centres are central to the future development of the technology and electronics sector, and Asian digital transformation more specifically, it is more crucial than ever for the industry to navigate these demands effectively.

Data centres, with their resource-intensive requirements, present a significant challenge for emissions reduction. The extensive use of servers, microchips, HVAC systems, cooling solutions and fiber cables significantly elevates the carbon intensity of data centre facilities. In Asia, the sheer scale of data centres, with some spanning over 200,000 square meters, underscores the vast amount of electronics and hardware involved.

Unlike conventional consumer electronics, data centres demand substantial energy to ensure uninterrupted 24/7 operations, coupled with rising water usage for cooling, positioning them at the forefront of sustainability efforts. This has prompted a surge in municipal and national regulations across Asia, aimed at managing the expansion and promoting the sustainable development of data centres, reflecting their critical role in the region's transition towards more sustainable technology practices. Data centres as a technology asset have received more regulatory scrutiny over the past two years compared to other verticals such as consumer and enterprise electronics.

As Asian governments and enterprises continue to place AI at the forefront of their national agendas as a means to boost their growth, the amount of data centres being built in Asia has surged since 2022, and the region now accounts for at least 10% of the world's data centre base according to March 2024 Visual Capitalist data. The ongoing and anticipated surge in cloud computing spending from Asia-based companies, turbo-charged by AI, is expected to lead to the region accounting for over 25% of the global cloud market value. The technology and electronics sector therefore offers a huge economic and growth opportunity for the region, but the sector must be in lockstep with its expansion addressing its existing and future emissions and develop resilience to its high exposure to the risks of climate change.

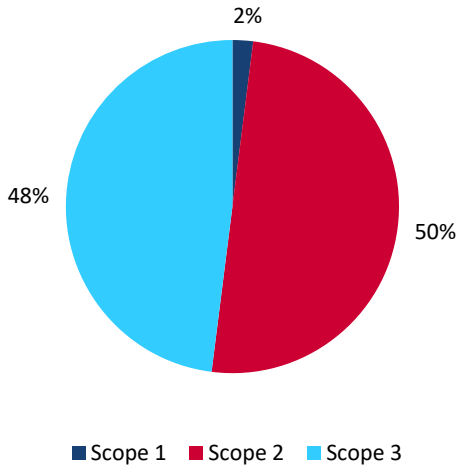
The generative AI revolution is rapidly accelerating the deployment of high-performance computing electronics across Asia, with profound implications for the mitigation of greenhouse gas (GHG) emissions. Asia-based companies, research institutions and households are increasingly embedding AI into their operations and lives and this is leading to an unprecedented demand for specialised hardware such as graphics processing units (GPUs), tensor processing units (TPUs) and application-specific integrated circuits (ASICs). This surge in computational requirements is driving the expansion and intensification of data centre operations and, with it, data centres' carbon emissions, with almost 10GW of data centre computing capacity in service at the end of 2024 in Asia.

Data centre operators face mounting pressure to mitigate their environmental impact, as these facilities are energy-intensive and contribute significantly to carbon emissions (Morgan Stanley research estimates data centres will contribute 2.5 billion metric tons of carbon dioxide-equivalent emissions globally through the end of the decade). The challenge lies in balancing the exponential growth of AI with the urgent need for sustainable practices, pushing the industry to innovate in areas like energy-efficient cooling systems, renewable energy adoption and optimised hardware designs that maximise performance while minimising power consumption.

Scope 1 emissions stemming from data centres, based on BMI estimates from industry averages, account for approximately 1.3% of the segment's total emissions. Emissions within this scope primarily originate from the direct use of fossil fuels, such as diesel for backup generators. These emissions, while relatively small, are essential for ensuring uninterrupted operations during power outages. Scope 2 emissions, constituting the largest portion at about 50% of total emissions, arise from indirect sources, predominantly the consumption of electricity for powering and cooling the data centre infrastructure. This significant share underscores the energy-intensive nature of data centre operations, and it is here where the sector must focus its efforts to decrease emissions and align with the Paris Agreement objective of mitigation. It is also where there are the greatest opportunities to provide the sector with alternatives and support its transition with solutions such as the adoption of renewable energy sources and improved energy efficiency measures being implemented by the companies that were reviewed for the tracker.

Fig. 2.32: AI's Energy Intensity Demand Elevates Scope 2 And Scope 3 Emissions Profiles

Asia – Estimated Data Centre Industry Emissions By Scope, % (2023)



Note: BMI estimate. Source: Asian Data Centre Operators, BMI

Scope 3 emissions, accounting for 48.2% of the total, are associated with the broader supply chain and lifecycle impacts. These include emissions from the production of hardware and equipment, business travel and other indirect operations related to data centres. The substantial contribution of Scope 3 emissions emphasises the importance of considering the entire value chain in sustainability efforts and the need for collaboration with suppliers and partners to achieve comprehensive emissions reductions across the data centre industry.

The rapid adoption of AI technologies across Asia is prompting hardware vendors and data centre platforms to address the interconnected challenges of power consumption, space utilisation and cooling requirements. This triad forms the core of the AI resource economy, where increased high-density power deployments necessitate more space for computing equipment and, consequently, additional cooling infrastructure to maintain operational stability. To mitigate the rising emissions associated with AI-related use cases, key players in the Asian data centre industry are implementing diverse strategies that converge on these three resource spheres.

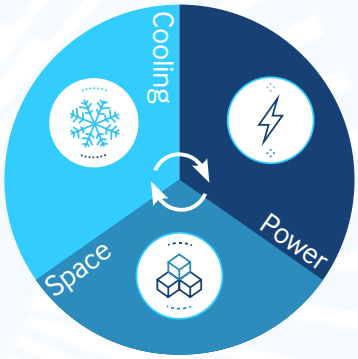
For instance, to reduce their Scope 1 and 2 emissions, China-based VNET and Singapore-based Nxera are investing in photovoltaic systems across their facilities to implement renewable energy into their power mix and so decrease their need for energy from fossil fuel sources. Nxera, in particular, has set an ambitious goal to achieve net zero operational emissions by 2028 through a multi-faceted approach. This includes maximising the deployment of solar photovoltaic systems and partnering with strategic allies like Sembcorp Industries to source renewable energy.

Asian Data Centre Platforms Tackling Emissions

Across Asia, data centre platforms are addressing their emissions by focusing on three key resource spheres: i) power, ii) cooling and iii) space. These strategies are crucial for mitigating the environmental impact of the rapidly growing data centre industry in the region.

i. In the power sphere, the installation of solar photovoltaic (PV) panels is generating electricity directly for data centre operations. China-based VNET has implemented such a project at its Boxing Data Centre in Yizhuang, Beijing, where rooftop PV equipment generated approximately 217,700 kWh in 2023. This initiative reduced CO2 emissions by about 192 tonnes and saved around RMB230,000 in electricity costs for the company.

Fig. 2.33 – The Resource Economy Of AI & Data Centres



Source: BMI

ii. Cooling solutions combine air-based and liquid-based methods to reduce power and water consumption, while ensuring operational continuity. Nxtra, for instance, has implemented hot/cold aisle containment and economisers to enhance cooling efficiency by precisely directing airflow and minimising energy waste. They also employ predictive analytics to forecast cooling demand accurately, enabling pre-emptive adjustments to conserve energy. These efforts have resulted in a reduction of 8,080 MWh in cooling power and prevented 5,786 tCO_2e emissions in FY2023/24.

   Asia is also at the forefront of cutting-edge solutions to reduce energy use for cooling by deploying data centres on the seabed. The first commercial underwater data centre has been developed off Hainan Island, China saving 68,000 sq metres of land, 122 million kilowatt-hours of electricity and 105,000 tons of freshwater per year.

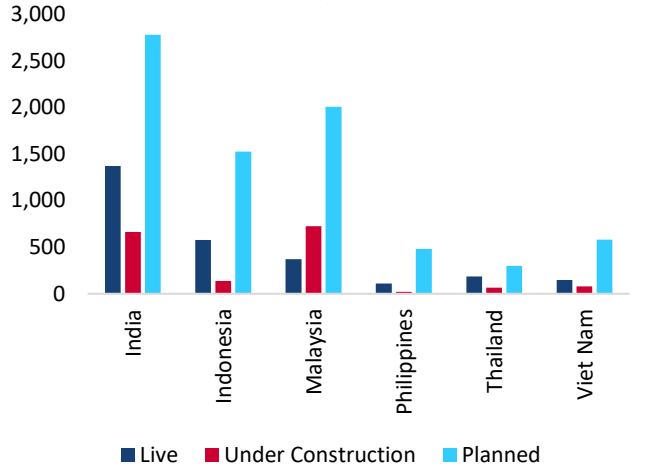
iii. Platforms like VNET and Nxtra are committed to enhancing resource efficiency by integrating more renewable and recyclable materials into their facilities. This includes the use of durable, energy-saving and recyclable materials, such as non-flammable insulation to minimise heat loss and reduce energy consumption, thereby optimising the space and resources used in data centre construction and operation.

Investing In Renewables And New Power Solutions To Support Contribution

The substantial energy requirements of the Technology & Electronics sector, especially with the genesis of AI, are compelling data centre companies and other firms in the technology and electronics ecosystem to become active participants in sourcing their own power and even developing their own renewable energy. Key technology and electronics markets in Asia will need to boost their power supplies, especially to sustain the advent of AI. In India, BMI estimates that there is 662.5 MW of data centre power capacity under construction, with another 2.78 GW planned for development over the decade. Malaysia faces a similar scenario with 724.2 MW under construction and slightly over 2 GW planned for development.

Fig. 2.34: AI Turbo-Charging Power Infrastructure Requirements In Asia

Selected Asian Markets – Data Centre Computing Capacity, MW (2024)



Note: Does not include cloud providers' self-built data centres. Source: National sources, DC Operators, BMI

This power need raises two key challenges for the technology and electronics sector: i) power supply security risks – how will this increased demand be met?; and ii) alignment requirements with the Paris Agreement objectives – how can the sector meet it current and future power needs without expanding its use of energy from fossil fuel sources? In addressing these challenges, Power Purchase Agreements (PPAs) are becoming a crucial tool for Asian data centre companies in their transition to renewable energy. These long-term contracts between energy producers and consumers are enabling data centres to secure a stable supply of clean energy while supporting the development of new renewable projects. A notable example is the recent Memorandum of Understanding (MoU) between Evolution Data Centres and Citicore Renewable Energy Corporation (CREC) in the Philippines in December 2024, which involves a PPA for up to 100MW of clean energy to power a data centre.

The next step for players in the Technology & Electronics sector has been investing in their own power supply, but with a focus on implementing renewable energy so as to contribute to emissions reduction. Pan-Asian platform STT Data Centres (STT), for example, is actively investing in renewable power projects. In India, STT GDC has partnered with leading renewable energy providers to develop new solar and wind farms with a total capacity exceeding 155 MW. This investment is intended to add capacity to the grid and support India's transition to a low-carbon economy while also supporting digital transformation.

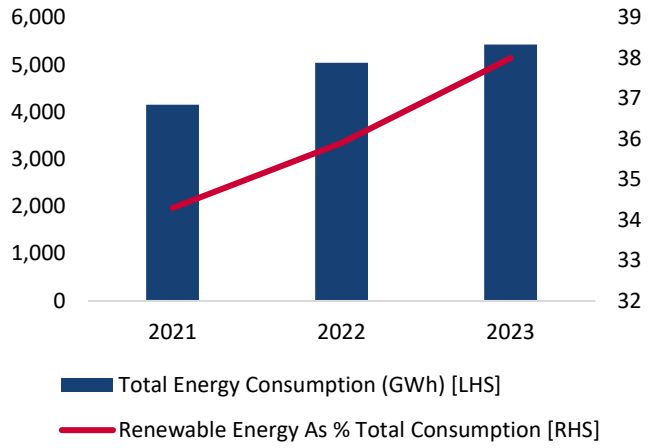
Beyond traditional renewables, data centre companies are also investing in research and development for alternative fuel solutions. These include advanced energy storage systems, hydrogen fuel cells and small modular nuclear reactors. For example, China-based GDS is also exploring advanced technologies such as hydrogen fuel cells. They have partnered with SK ecoplant to pilot hydrogen power generation using Solid Oxide Fuel Cell (SOFC) technology in their Singapore data centre, with the aim to establish Southeast Asia's first data centre fully powered by hydrogen fuel cells.

Some firms are exploring geothermal energy, particularly in regions with suitable geological conditions. Others are investigating biomass and biogas technologies as potential sustainable power sources. Additionally, there is growing interest in ocean energy technologies, such as tidal and wave power, especially for coastal data centres. These diverse investments in emerging power technologies demonstrate the data centre industry's commitment to innovating beyond conventional energy solutions, aiming to create a more resilient and sustainable power infrastructure for the technology and electronics sector, especially the future development of AI and cloud computing.

These contributions to the energy transition mean that data centre platforms in Asia are rapidly increasing the proportion of renewable energy in their overall energy mix, a trend that is expected to continue. This shift is evident across major data centre operators in the region, with many already surpassing their initial targets. For instance, Singapore headquartered STTelemedia (STT) has made considerable progress, with renewable sources accounting for 62.5% of their electricity consumption in 2023, exceeding their 2026 target of 60%. Similarly, Chinese data centre developer and operator GDS has steadily increased its renewable energy consumption, with the proportion of renewable energy to total energy consumption growing from 34.3% in 2021 to 38.0% in 2023 (Fig. 2.35). These examples illustrate the sector's commitment to sustainability and highlight the tangible progress being made in transitioning to cleaner energy sources. As this sector continues to invest in renewable projects and technologies, we expect to see further contributions in the share of renewable energy powering Asia's data centres in the coming years.

Fig. 2.35: Renewables' Contribution Expanding Even As Total Energy Consumption Increases

GDS – Selected Power KPIs (2021-2023)



Source: GDS, BMI

As highlighted, data centres play a key role in the technology and electronics supply chain, and so their investment towards lowering greenhouse gas emissions not only supports their own contribution to the transition, but also that of their clients. According to BMI estimates, Asia's data centre computing capacity being leased out to customers in 2024 hovered around 9GW of power. This figure is projected to grow to 12.8GW by 2028, and data centre providers must ensure that these power needs are increasingly met by low emission energy so as to support and contribute to the emissions reduction strategies of their customers.

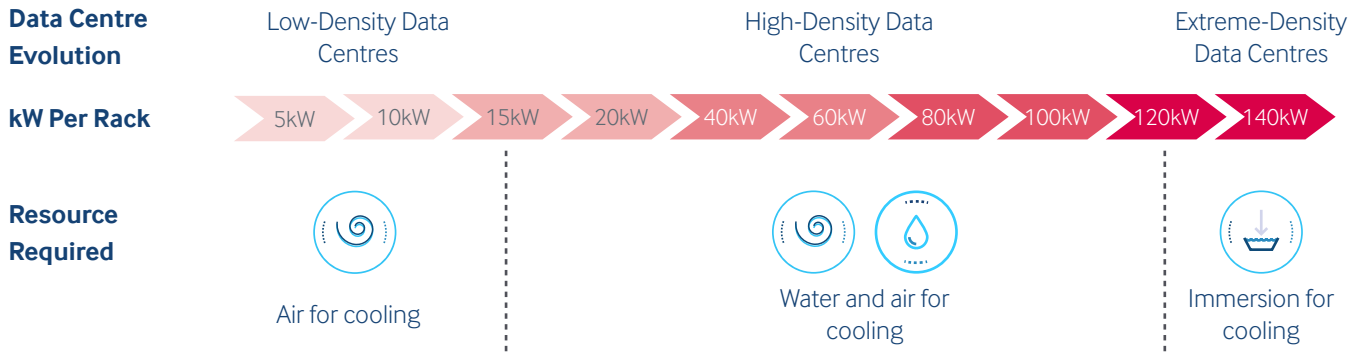
Adaptation Strategies To Focus On Water Access And Conservation

Data centres are one of the segments of the Technology & Electronics sector that are most exposed to climate change risks, with their cooling requirements exposing them to increases in average temperatures, extreme heat events and drought, as well as the damage and operational risks of flooding and storms.

Water scarcity has been, to date, an area of adaptation which data centres have placed the greatest focus on addressing. Reduced rainfall and drying water bodies are compelling firms to improve their water usage efficiency and invest heavily in alternative liquid cooling solutions. While water is not a necessary input for cooling data centres when server racks operate below a certain power threshold (typically 15 kW per rack), the landscape is rapidly changing with the advent of AI-powered digital transformation.

The increasing demand for AI use cases is driving the need for extensive rack capacities, often reaching up to 120 kW per rack. This surge in power density has made water a critical resource for cooling these high-performance systems. As a result, water management has become a key issue for countries and platforms aiming to host AI applications.

Fig. 2.36: Data Centre Cooling Solutions By kW Per Rack



Source: BMI

Governments have a key role to play in this process. Public sector entities such as municipalities and regional governments are often owners of water bodies and resources. As data centres are often connected to local aquifers, government policies and regulations significantly influence how these resources are utilised. Recognising the strategic importance of data centres and the need for sustainable water use means that Asian governments are implementing guidelines and incentives to encourage more efficient and responsible water consumption practices and adaptations by the Technology & Electronics sector. These measures range from mandating water recycling systems and setting strict usage limits to offering tax breaks for companies that implement innovative water-saving technologies.

Asian Governments Shaping Data Centre Water Management

Singapore and Johor (Malaysia) represent some of the largest data centre markets in the world. The rapid growth of data centre capacity has placed considerable strain on local power, land and water resources, thus prompting their respective (local) governments to shape the industry's direction through forward-looking regulation.

The Johor State Data Centre Development Planning Guidelines requires data centres to adhere to Water Usage Effectiveness (WUE) standards. Data centres must incorporate water conservation strategies that align with recognized industry standards for WUE (WUE is interpreted as a measure of how efficiently a data centre uses water in relation to its IT operations, with a lower WUE indicating more efficient water usage). This involves using renewable and energy-efficient technologies such as direct expansion systems, eco-chiller water systems and rainwater harvesting systems.

In Singapore, the Infocomm Media Development Authority (IMDA) has developed a Green Data Centre Roadmap which embeds greater public-private cooperation to develop technologies able to reduce cooling intensities and costs.

A primary focus is on optimising cooling towers, which represent up to 97% of a data center's water usage. This involves recycling blowdown water and increasing Cycles of Concentration through advanced technologies like electrooxidation, as demonstrated by Amazon Web Services in collaboration with Singapore-based startup Hydroleap. Additionally, Singapore's Public Utilities Board (PUB) mandates data centres consuming over 60,000 m^3 of water annually to adhere to stringent water efficiency management practices, including the installation of private water meters and submission of Water Efficiency Plans.

Fig 2.37: Regulatory Approaches To Data Centre Water Management – Singapore And Johor

	Initiative	Singapore Data Centre Roadmap	Johor Data Centre Regulation
	Water Usage Effectiveness (WUE)	Encourages the adoption of WUE metric with a target of 2.0 m3/MWh or lower.	Requires aderence to WUE standards and alignment with recognised industry standards.
	Cooling Tower Optimisation	Focuses on optimising cooling towers, recycling blowdown water and using electrooxidation technology.	Emphasises water conservation strategies through renewable and energy-efficient technologies like eco-ciller systems.
	Water Efficiency Plans	Mandates water efficiency management practices, including private water meters and plans for high water consumers.	Compliance with water supply management requirements is reviewed by authorities such as SPAN and BAKAI.
	Public-Private Cooperation	Involves collaboration with private firms to develop technologies reducing cooling intensities and costs.	Not explicitly mentioned but involves approval by relevant water authorities.
	Innovation And Partnerships	Includes partnerships for developing energy-efficient cooling solutions, such as KoolLogix's collaboration with A*STAR.	Encourages the use of technologies like direct expansion systems and rainwater harvesting.

Source: IMDA, Johor State, BMI

Asian data centre providers are launching their own adaptation initiatives to address water scarcity by implementing innovative strategies to maintain efficient cooling systems while conserving water resources and adhering to government guidelines. We note that Asian platforms are at the forefront of integrating water-free cooling technologies or cutting-edge liquid cooling solutions globally.

Fig 2.38: Selection Of Asian Data Centre Companies' Water Conservation And Adaptation Strategies

Data Centre Company	Headquartered	Water Conservation And Adaptation Insight
VNET	China	Already implemented water-free cooling technologies, rainwater collection and reclaimed water recycling. VNET aims to enhance water-use efficiency across its operations, achieving a WUE of less than one for specific projects in water-deficient regions.
GDS	China	Utilising innovative cooling technologies. The company has achieved a WUE of 1.7 in 2023.
Nxera Singtel	Singapore	Focused on water management technologies and recycling systems. Their data centres, such as DC West and Kim Chuan 2, have achieved WUEs of 1.7 and 2.4 respectively, through initiatives like rainwater recycling and cooling tower water reuse.
CtrlS	India	Launched water recycling, direct-to-chip cooling and liquid cooling. At the end of 2023, CtrlS recycled nearly 10 billion litres of water for its data centre operations.
STT GDC	Singapore	Achieved a 17.9% improvement in WUE in 2023 by utilising air-cooled chiller plants and maximising the use of recycled water.

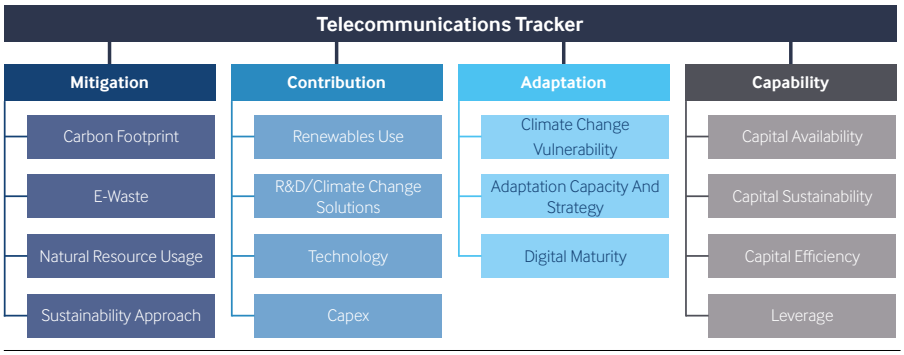
Source: STT GDC, CtrlS, Nxera, GDS, VNET

Sector Tracker: Telecommunications

In the context of this report, telecommunications means telecom-satellite; telecom-wireless; telecom-wireline integrated and services. Using the AIIB-Amundi Climate Change Investment Framework (CCIF), the Telecommunications Sector Tracker aims to capture the extent to which operations, investments and strategies of companies operating in this sector align with the Paris Agreement goals of Mitigation, Adaptation and Contribution to the transition. A fourth dimension, financial Capability, has been added by BMI to assess a company's financial strength and ability to deliver on its climate objectives.

Mitigation

The telecommunications sector has long acknowledged its environmental impacts, yet the absence of standardised key performance indicators (KPIs) hinders accurate comparisons between entities. To address this challenge, our Tracker employs a combination of industry-standard KPIs directly related to environmental impact, alongside subjective assessments of companies' stated intentions and observable actions.



Source: BMI

Mitigation efforts receive the most comprehensive reporting within the Tracker scores, as these initiatives resonate strongly with the sector's key stakeholders: consumers, shareholders, employees and governments. Data demonstrating progressive reductions in carbon emissions and improved energy efficiency are visually impactful and easily understood. However, it is important to note that the methodologies underpinning these indicators may not always be robust.

For instance, apparent decreases in carbon emissions may be achieved through carbon offsets, potentially masking overall increases in emissions when accounting for contributions from third-party assets such as data centres and competitors' infrastructure. This highlights the need for a more comprehensive and transparent approach to environmental impact reporting in the telecommunications industry.

Adaptation

Assessing companies' Adaptation potential is also challenging, given that almost no telecoms company actively tracks this in a meaningful way, even though many do report on projects carried out internally or with third parties to help communities and society at large leverage their digital connectivity and services to adapt to a changing environment.

For this aspect of the Tracker, the focus has been placed on the companies' exposure to physical climate risks in the countries in which they operate and the willingness and ability of these countries to adapt to climate change. The former is proxied by the risk of extreme weather events and natural disasters, while the latter is proxied by a range of social, political, legal, institutional and economic indicators. Domestic digital markets and their maturity are also assessed as it indicates replacement of legacy physical-based systems, which are at higher risk of disruptions through climate disasters compared to less power-intensive digital-first or digital-only solutions.

Contribution To The Transition

Quantitatively assessing the Contribution to the transition process proved challenging for the telecommunications industry. The primary obstacle is the lack of standardised, meaningful data, which hinders a comprehensive understanding of how this objective is being addressed. The Telecommunications Sector Tracker focuses on three trackable aspects of companies' low-carbon transition contribution efforts, utilising a set of operational and financial indicators as proxies.

The Tracker examines the trajectory of capital expenditure per user for each company trying to gauge spending towards new-age, energy-efficient infrastructure and services that are low-carbon alternatives to traditional old-style telecommunication networks. The Tracker also assesses any spending towards research and development of low-carbon energy efficient solutions and its existing subscriber base that is tied to modern digital infrastructure such as 5G and FTTx, compared to older generation of networks. It also tries to examine the companies' use of renewable energy to power its operations, as it indirectly drives cash-flow towards energy technologies that are themselves deemed as solutions to climate change, making them more attractive through economies of scale.

By focusing on these financial and operational indicators, the Tracker aims to provide a proxy measure of telecommunications companies' capacity and commitment to contributing to the low-carbon transition. While this approach has limitations due to the lack of standardised data, it offers valuable insights into the sector's progress and potential in addressing environmental challenges.

Capability

BMI has also added a fourth pillar to consider: financial capability. This fourth pillar has been added to reflect the fact that reducing carbon footprint, protecting against climate change risk and investing in green technologies are all capital-intensive processes and therefore any transition will be partly contingent on a company's financial health and capacity. Those companies in a more financially stable position, with access to capital, are better placed to set meaningful targets and fulfil them with actions.

Sector Tracker Insight: Telecommunications

Telecommunication Majors Have Made Substantial Commitments To Emissions Reduction

The telecommunications (telecoms) industry has made substantial commitments towards reducing its greenhouse gas (GHG) emissions and achieve designated net zero targets. Notably, mobile network operators (MNOs) are at the forefront of this transition and have increased their transparency as well as adjusted their targets to decrease their GHG figures consistently.

For the purpose of this tracker insight, we categorise Scope 1, 2 and 3 emissions following GSM Association's (GSMA), the world's leading non-profit representing MNOs' interests, definitions for the mobile telecoms segment.

- Scope 1 emissions are defined as direct emissions from MNOs that may include, among many other things, on-site power generators (i.e. diesel generators) for tower assets.
- Scope 2 emissions represent indirect emissions from the use of electricity or power purchases that serve for heating and cooling purposes and produced on an MNOs' behalf.
- Scope 3 emissions, the most challenging to frame, are defined as emissions not associated with the MNO itself but rather coming from its value chain, including wireless hardware equipment vendors' emissions to site development.

Scope 3 remains the hardest to define and frame in the industry, mainly due to a series of activities that MNOs can conduct both in-house or outsource. For example, cellular tower sites can be developed by MNOs or delegated to independent towercos, which may have a greater GHG footprint.

On a global level, Scope 1 and 2 emissions have remained the same, in the case of Scope 1, or decreased, in the case of Scope 2 between 2021 and 2022. In 2022, they account for 2% and 23% of MNOs' total emissions respectively. In 2022, MNOs Scope 3 emissions accounted for 75% of total emissions, up from 72% the previous year.

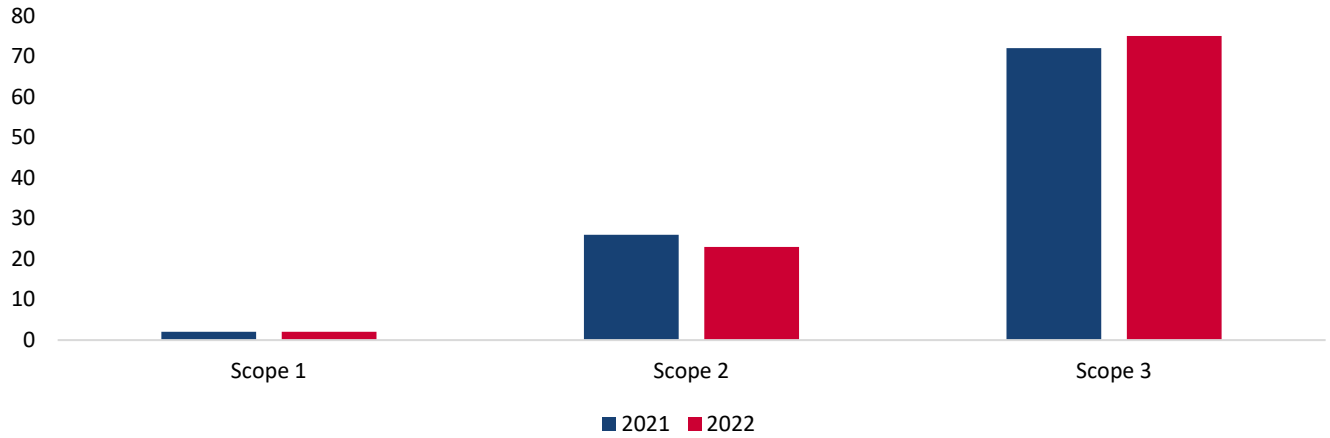
In the Asia-Pacific (APAC) region, according to GSMA, operational emissions per connection increased by approximately 6% from 2019 to 2022. The proportion of purchased renewable energy remains relatively low, at about 10%, primarily because many countries in the region offer limited options for companies to procure renewable energy.

Implementing more ambitious climate and energy policies, along with changes to electricity markets and regulations to boost investment in clean energy, will enable telecoms operators to access renewable energy and lower emissions. Considering the region's critical role in telecom's global supply chains, decarbonising electricity can also help reduce Scope 3 emissions for operators worldwide.

We believe that future efforts from the Asian telecoms industry will continue to focus on the modernisation of their infrastructure stack, from fibre, data centres and wireless networks, to improve electricity and power usage. Latest available data from GSMA highlight that in 2022 MNOs purchased 227 TWh of electricity globally up from 194 TWH in 2021 and 181 TWh in 2020. As networks expand and become more powerful, electricity consumption is set to increase, as evidenced by the almost 12% CAGR registered between 2020-22 for purchased electricity.

Fig 2.39: Network Emissions Pose Challenges To Scope 3 Progress

Global – MNOs' Emissions By Scope As % Of Total (2021-2022)

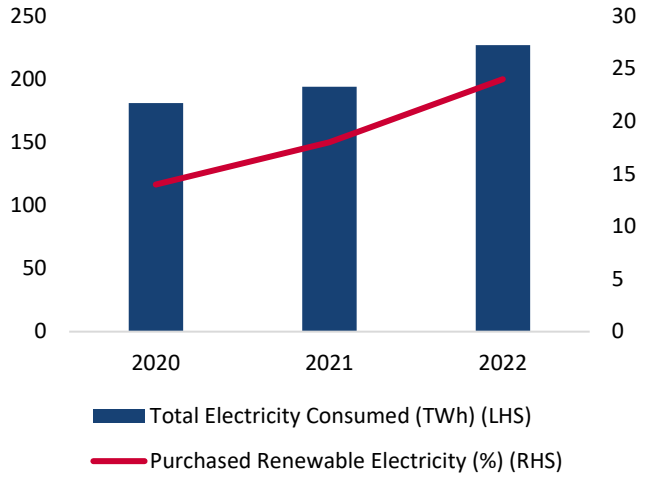


Source: GSMA, BMI

MNOs have become more conscious about this figure and its projected increases and have committed to increasing the share of renewable electricity purchase agreements to power their operations. In 2022, MNOs' electricity purchases globally were made up of 24% of renewable electricity, a double-digital increase on 2020's 14%. In APAC, the average renewable electricity purchased by MNOs reached 7% in 2022, whereas the average renewable electricity already present within national grids in the region is 25%. In China, for example, MNOs purchased on average 4% of renewable electricity during the same year, but where the national grid offers an average of 29% renewable electricity, highlighting the opportunity for MNOs to increase their purchasing of renewable electricity over the medium term.

Fig 2.40: Digital Transformation To Increase Power Consumption, Clean Energy A Priority

Global – MNO Electricity Consumption Data (2020-2022)



Source: GSMA, BMI

Legacy Networks Phase-Outs Drive Progress On Mitigating Scope 1 & 2 Emissions

The Asian Telecoms sector has made considerable progress in the reduction of Scope 1 and 2 emissions. However, such progress has been divergent with some MNOs reporting strong decreases in GHG emissions and others experiencing single-digit increases on an annual basis over the 2021-23 time period. Factors contributing to increases in Scope 1 and 2 emissions vary greatly and may be caused by single events, but on the whole, these emissions are concentrated in wireless networks that support a proliferating number of connected machines, smartphones and their associated data traffic flows. We highlight that MNOs across a variety of markets in Asia have had success in decreasing their emissions through their energy efficiency and increased renewable energy consumption.

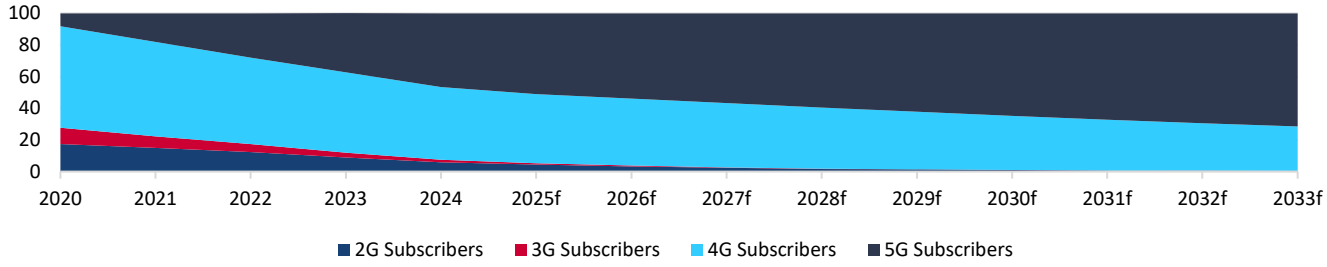
For example, Singapore-based telecoms operator SingTel has significantly invested in making its network infrastructure more sustainable. In the context of Scope 1 and 2 emissions, SingTel has pledged to reduced indirect greenhouse gas emissions group-wide by 55% by 2045. To do so, the telco has prioritised energy consumption reduction, energy efficient network hardware and increased renewable power usage. At the end of FY2024, SingTel reported a net 7.1% reduction in Scope 1 and 2 emissions from the previous year.

The decommissioning of inefficient, low-value legacy cellular networks that provide 2G and 3G services is the most popular lever among Asian MNOs to considerably reduce their controllable emissions. MNOs like SingTel and China Unicom, operating in some of the most digitally mature markets of China and Singapore, have turned off their 2G networks. Gains from shutting down 2G and 3G networks are mainly yielded by improvements in energy efficiency, which in turn has reduced operational emissions. Consequently, energy efficiency improvements from the retirement of older networks have helped reduce electricity use per connection, despite growing demand for data and connectivity as businesses and consumers move onto 4G and 5G networks.

BMI estimates show that 2G and 3G technology usage is set to consistently decline over the medium term (out to 2033) as a result of MNOs' sustainability pledges, the associated economic gains and ICT regulators' stances towards the phase-out of older networks. By the end of 2023, 2G and 3G mobile subscriptions in APAC accounted for 9.0% and 3.1% of the total subscriber base in APAC respectively. By end of 2024, these levels were projected to decrease further to 6.0% and 1.5%, respectively. BMI forecasts the most consistent decline of legacy networks to come from 3G, which will be equivalent to 0.03% of the total mobile subscriber base in 2033. 2G technologies are set to decline much

Fig 2.41: 2G/3G Shutoffs Offer MGOs A Key Mitigation Tool

APAC – Total Mobile Subscribers By Technology, % (2020-2033f)



f = BMI forecast. Source: Local Telecom Regulators, MNOs, BMI

more gradually, hitting 0.5% of the total mobile base in 2033 as 2G supports a number of machine-to-machine (M2M) cellular connections which are embedded in devices that range from electricity, water, gas (EWA) smart metres to slot machines, so MNOs are more reluctant to shut the 2G networks down.

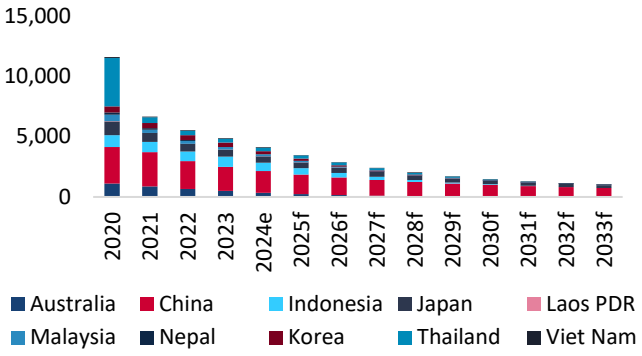
Phasing out legacy infrastructure has therefore become a priority not only for MNOs but also ICT regulators. Some have pursued aggressive and ambitious 2G/3G decommissioning campaigns that will accelerate the transition towards 5G technologies (5G is estimated to account for 46.5% of total mobile subscribers in APAC in 2024 and 71.4% by 2033). One such example is in Viet Nam, which has pursued one of the most fast-paced legacy networks shutoff, with 2G set to shut down by early 2025, thus supporting the decrease in local MNOs' overall Scope 1 and Scope 2 emissions footprint.

Network infrastructure owners, whether MNOs or independents, are also investing in the substitution of older wireline technologies such as Digital Subscriber Lines (DSL) and cable. Phasing out DSL networks will aid in GHG emissions reductions, particularly since newer technologies like fibre-optic wires are less resource-intensive. Namely, legacy wireline technologies like DSL, for example, heavily rely on copper extraction and processing, which is an energy-intensive process.

DSL infrastructure generally features higher power consumption per unit of data transmitted compared to fibre systems due to the nature of its equipment. In the context of Asia, DSL is at the forefront of phase-out efforts. This is a similar initiative to the shutoff of legacy mobile networks, although wireline networks decommissioning is much more resource-intensive and therefore more likely to be initiated by independent infrastructure owners or spin-offs. As a result of legacy wirelines networks' decommissioning efforts, BMI forecasts total broadband subscriptions linked to DSL across Australia, China, Indonesia, Japan, Laos PDR, Malaysia, Nepal, Korea, Thailand and Viet Nam to decrease from 4.1 million in 2024 to slightly over one million in 2033.

Fig 2.42: Retirement Of Copper Networks Expected To Reduce Emissions Across Value Chain

Selected APAC Markets – xDSL Broadband Subscribers By Country, '000 (2020-2033f)



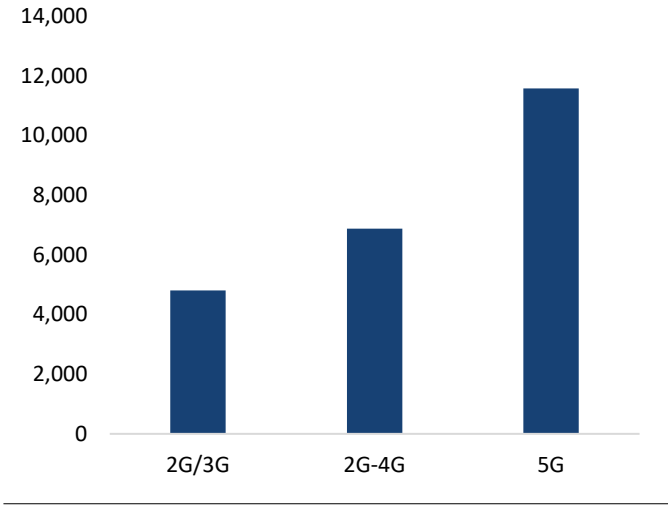
e/f = BMI estimate/forecast. Source: Local Telecom Regulators, Operators, BMI

5G's Power Consumption Impacts Progress On Scope 1 & 2 Emissions Mitigation

While 5G may offer stronger ESG credentials and economic efficiencies when compared to 2G, 3G and to some extent, 4G, the technology's power consumption requirements are higher than its predecessors. A study by Huawei shows that energy consumption per unit of data, measured in W/bit, is considerably lower for 5G over 4G technologies. Overall power output per base station is much higher for 5G. According to Huawei data from 2019, the total power output of a single 5G base station is 11,577W, up 68.3% from 4G's total output and 140.7% from a 2G/3G base station. It must be noted that the latter figures are heavily dependent on the hardware, as well as the technical features such as number of frequencies used by a designated MNO or towerco for their sites, so these may vary greatly.

Fig 2.43: Widespread 5G Deployment Set To Increase Industry's Power Output Figures

Global – Total Energy Footprint Of Base Stations By Technology, W (2019)



Note: BMI compilations based on Huawei data. Source: Huawei, BMI

We believe that 5G infrastructure power output figures will have diverging effects on MNOs' contribution towards net zero. 5G, as noted, consumes more power than the other networks; however, it offers up the opportunity for longer-term energy efficiency. Power remains the key variable to further reduce MNOs emissions. To different extents, MNOs have already started to address this issue by upgrading their sites and thus achieving Scope 1 and Scope 2 progress.

Towercos Contributing To The Reduction Of Overall Emissions For The Wider Industry

Further efforts in this domain are being championed by other firms in the telecoms value chain, in particular network hardware equipment vendors and independent tower companies (towercos). Especially in Asia, the latter hold a key position in the telecom infrastructure market, due to their extensive ownership of energy-intensive assets like tower sites, and are therefore increasingly looking to reduce their emissions through strategies such as the adding solar power facilities to their sites.

Networks increasingly account for the bulk of Scope 3 emissions and because the physical infrastructure has been predominantly outsourced to 'independent' owners of fibre or tower assets, these are becoming crucial actors in wider efforts reduce emissions in the telecoms value chain. As a result, independent towercos in Asia, such as regional player EDOTCO, Indonesia-based Tower Bersama and India-based Indus Towers, have increasingly incorporated sustainability KPIs into their operations. These include the proportion of renewables used as part of a sites' portfolio mix, as well as other indicators such as water usage and biodiversity impact.

With regards to initiatives that are currently under way to reduce emissions, EDOTCO is deploying solar-powered tower solutions to reduce reliance on traditional grid electricity and on-site fuel generators, and more than 2,600 solar sites were active at the end of 2023. Moreover, the towerco is adopting lithium batteries to reduce dependency on grid power and installing multipurpose streetlamp poles or 'smart poles' that integrate energy-saving LED lights and reduce the need to construct separate towers.

Furthermore, grid considerations are fundamental for decarbonisation contribution efforts from towercos. The majority of Asian markets has only less than 1% or between 1-25% of tower sites disconnected from the national grid (off-grid) or on unreliable grid (bad grid). Other markets, however, like Pakistan and Myanmar, have a much larger proportion of sites (25-50%) off-grid or on bad grid.

Historically, towers disconnected from the grid or on an unreliable grid have utilised backup power solutions based on fossil fuels, such as small diesel cells. These remain the most popular source of alternative or backup power for tower sites, but we also note that solar panels are emerging as a renewble alternative. Solar brings several advantages to site owners, including the possibility to lower total cost of ownership (TCO) for tower owners, while also insulating them from shocks associated with rises in fuel prices or national electricity price hikes.

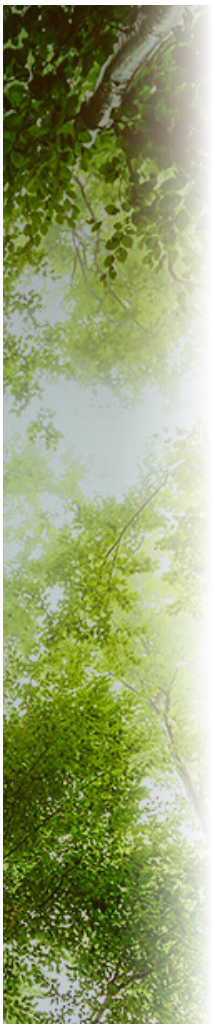
Fig 2.44: Proportion Of Sites Off-Grid/On Bad Grid, % (2022)

<1%	1-25%	25-50%
China	Bangladesh	Myanmar
Indonesia	Cambodia	Pakistan
Korea	India	
Viet Nam	Lao PDR	
	Malaysia	
	Mongolia	
	Nepal	
	Philippines	
	Sri Lanka	
	Thailand	

Note: <1% means low level of offsite/ bad grids. Latest available data (2022).
Source: TowerXchange, BMI

Tower tenants are placing premiums on providers that can offer network reliability with minimal power-induced outages, and so emissions reduction by tower operators is translating into a competitive asset for companies.

However, despite progress in implementing renewable sources, on-site diesel or other fuel generators remain a crucial component in many markets due to their proven reliability, consistency, scalability and ease of maintenance. Towercos are increasingly adopting a hybrid approach, combining diesel fuel cells and solar power to ensure uninterrupted service at their sites. This strategy aims to maximise renewable energy usage while maintaining reliable power backup.



Infrastructure Sharing Offers A Catalyst For Decarbonisation

Another crucial emissions reduction strategy in the Telecoms sector is the growing requirement from telecoms regulation to share network infrastructure between local MNOs. Markets like Bangladesh and Sri Lanka have made considerable progress on this issue in 2024, and are catching up with other leaders in this area, like India and Indonesia, which have introduced mandatory passive telecoms infrastructure regulations respectively in 2021 and 2020.

In Indonesia, the Omnibus Law mandates the sharing of passive telecoms infrastructure for all telecoms operators. Passive infrastructure sharing in telecommunications, including towers, ducts and poles, offers significant efficiencies.

Infrastructure sharing contributes to reductions to Scope 2 emissions through more efficient use of energy. For example, shared cooling systems and lighting can reduce the overall electricity consumption per tenant. We believe that the greatest impact is made on Scope 3 emissions owing to the reduced need for equipment and construction materials, minimising upstream emissions associated with the production and transportation of these materials.

Fig 2.45: Infrastructure Sharing Regulations Further Contribute To Decarbonisation Efforts

	Has The Market Got Infrastructure Sharing Regulation?
Bangladesh	✓
Cambodia	✗
China	✓
India	✓
Indonesia	✓
Japan	✓
Lao PDR	✗
Malaysia	✗
Myanmar	✗
Nepal	✓
Pakistan	✓
Philippines	✓
Singapore	✓
Korea	✓
Sri Lanka	✓
Thailand	✗
Viet Nam	✓

Note: Selected APAC Markets – Status On Infrastructure Sharing Regulation By Market (2024). Source: BMI Research

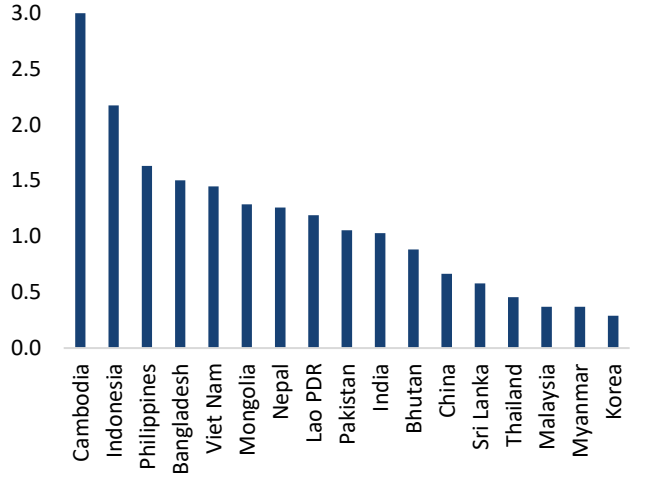
Contributing To Downstream Emissions Reduction: E-Waste Management Efforts A Priority

A crucial part of the telecom industry's Scope 3 emissions emerges from downstream value chain activity, primarily from their customers, and concerns e-waste. There is a significant carbon footprint associated with the production, usage and disposal of electronic devices. The manufacturing of mobile phones, network equipment and related electronics involves energy-intensive processes that contribute to high levels of CO2 emissions. When these devices reach the end of their life, improper disposal can lead to environmental degradation and further emissions from landfill waste and incineration.

The scale of the e-waste problem in Asia underscores the urgency for MNOs to take action and place a greater focus on a solution. According to GSMA data for 2019, China generated 10,129 kilotons (Kt) of e-waste, followed by India with 3,230 Kt and Indonesia with 1,618 Kt. Other countries in the region also contribute significantly to the e-waste burden: Korea (818 Kt), Thailand (621 Kt), Malaysia (364 Kt) and the Philippines (425 Kt). Even smaller nations like Bangladesh (199 Kt) and Pakistan (433 Kt) generate considerable amounts of e-waste.

Fig 2.46: Tackling Mobile E-Waste A Key Contribution Strategy

Selected APAC Markets – Mobile Phone E-Waste As % Of Total E-Waste By Country (2019)



Note: BMI estimates based on GSMA 2019. Source: GSMA, BMI

These data include e-waste from the entire telecoms value chain, including devices, network equipment and other electronic components, but mobile phones account for a substantial proportion of total e-waste generated. In China, for instance, mobile phone e-waste amounted to 67.5 kilotons (Kt) in 2019, making up 0.7% of the country's total e-waste. India generated 33.3 Kt of mobile phone e-waste, which constituted 1.0% of its total e-waste. Indonesia followed with 35.2 Kt, accounting for 2.2% of its total e-waste. Although smaller in absolute terms, countries like Cambodia (0.6 Kt, 3%) and Mongolia (0.2 Kt, 1.3%) generate proportionally high percentages of mobile phone e-waste, highlighting a widespread issue across the region.

Regulatory pressure and consumer expectations are also driving MNOs to adopt practices which will decrease e-waste. Governments and international bodies are implementing regulations that mandate responsible e-waste management and reporting of emissions. Approaches to e-waste regulation diverge in scope and size. First, it must be noted that not all APAC markets have a legally binding e-waste policy framework and some markets only feature e-waste management initiatives or regulations that affect electronics outside the telecoms value chain.

Some markets, like Malaysia and Singapore, feature much stricter telecoms e-waste management regulations, whereas others like the Philippines are looking to develop a stronger and more targeted e-waste framework. In Malaysia, e-waste, including mobile phones, is classified as scheduled waste under the Environmental Quality (Scheduled Wastes) Regulations 2005. Malaysia has implemented EPR principles, making manufacturers and importers responsible for the collection and recycling of their products, including mobile phones. More specifically, in 2021, Malaysia introduced new regulations specifically addressing household e-waste, which includes mobile phones. This was an extension of previous regulations that primarily focused on industrial e-waste.

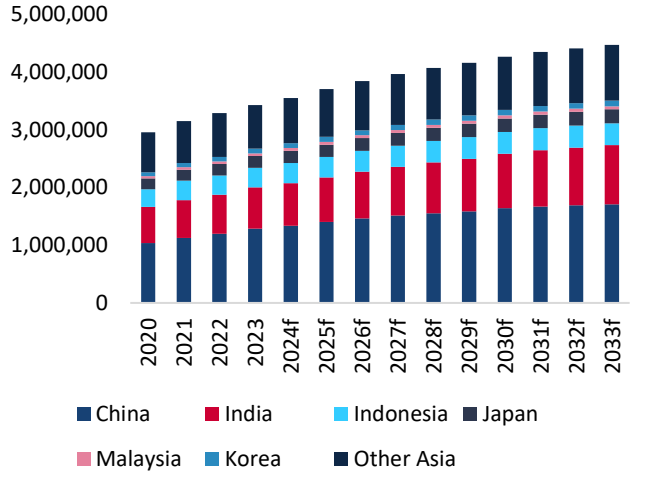
Similarly, in 2021, Singapore implemented a regulated e-waste management system under the Resource Sustainability Act. This system follows the EPR approach, making producers responsible for the collection and proper treatment of e-waste. The regulation specifically includes mobile phones as one of the regulated products. Such regulations have allowed MNOs to set up more thorough and transparent e-waste reduction strategies. Notably, Singapore-based MNO SingTel aims to retrieve at least 20% of the total number of new mobile devices distributed directly to customers through various recycling schemes by 2030. The company also forged partnerships with other stakeholders in the value chain, such as Sweden-based Ericsson, to optimise the handling, collection and recycling of e-waste. These initiatives ultimately help not only decrease the volume of e-waste, but also reduce the need for new device production, which is one of the most carbon-intensive stages in the lifecycle of electronic products.

Contribution by MNOs to e-waste reduction and tackling the wider telecoms industry's Scope 3 emissions is needed now, with projections for the growth in devices rapidly expanding. Using smartphones as an example, due to them being the most immediately identifiable source of e-waste in the telecoms value chain, as well as the most widespread communications consumer electronic, BMI projects the total number of smartphones owned

by mobile subscribers in APAC to grow from an estimated 3.5 billion in 2024 to 4.5 billion in 2033. Much of the growth in the APAC smartphone segment has to date been driven by the digital powerhouses of China, Japan and Korea. While demand in these markets will continue to expand over the medium term, we believe that future growth in smartphone demand will also be driven by rapidly digitalising economies in South, Southeast Asia and Central Asia, placing further pressure on markets in these sub-regions to develop e-waste regulations.

Fig 2.47: Greater Contribution To e-Waste Measures Required As Volumes Of Smartphones Continue To Expand

APAC – Total Smartphones Owned Forecasts, '000 (2020-2033)



f = BMI forecast. Source: National sources, BMI

We note that the most challenging element in the reduction of emissions through lower e-waste will be in the context of upstream and midstream e-waste. This is because of complex supply chain arrangements, technological constraints, low levels of oversight by suppliers and a lack of defined practices to reduce e-waste. The global nature of supply chains for electronic devices such as smartphones means that components are often sourced from multiple countries, each with different regulations and practices. For instance, a mobile phone might have components manufactured in China, assembled in Viet Nam and sold in India.

The design and manufacturing processes of electronic devices are often not optimised for easy recycling or refurbishment. Many devices are built with components that are difficult to disassemble or contain mixed materials that complicate recycling efforts. For example, mobile phones often contain tiny amounts of precious metals like gold and rare earth elements embedded within complex assemblies.

MNOs often have limited control over their upstream suppliers and the environmental practices they adopt. Many components are sourced from third-party manufacturers who may not prioritise or have the capability to implement effective e-waste management practices. Encouraging or enforcing sustainable practices among these suppliers requires leverage that MNOs may not always possess.

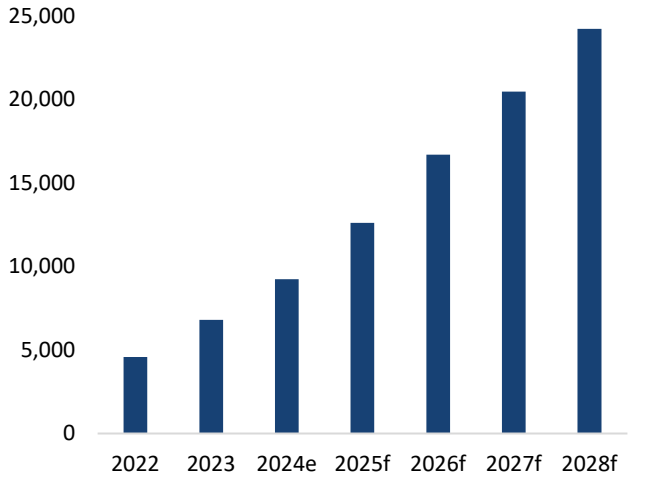
Adaptation Strategies Looking To Space To Protect Digital Infrastructure From Climate Change Risks

The telecommunications industry is adapting to modern climate catastrophes by focusing on mitigating physical risks associated with digital infrastructure such as towers, fibre optic networks and data centres. The primary adaptation strategy being pursued by the industry involves initiatives for digital infrastructure resilience. This approach primarily consists of relocating physical telecommunications assets to 'safer' areas to ensure their protection and continued operation in the face of climate-related threats.

Space has emerged as a new frontier for telecommunications resilience due to its inherent protection against a variety of hazards, including natural catastrophes. Space-based telecommunications assets, particularly satellites, have long served as backup solutions for customers during terrestrial network outages. Recent advancements and greater economies of scale in satellite manufacturing and launch services have significantly reduced the cost of delivering services such as satellite broadband or direct-to-device communication, making these options more affordable and accessible. We project that there will be over 24,230 connectivity satellites in orbit by the end of 2028.

Fig 2.48: Space As An Opportunity To Reduce Telecom Industry Emissions

Global – Cumulative Number Of Connectivity Satellites In Orbit (2022-2028)



e/f = BMI estimate/forecast. Source: National sources, Satellite Operators, BMI

The APAC region is at the forefront of this trend, with digitally mature markets like China driving world-leading sector innovation through the deployment of low-earth-orbit (LEO) satellite constellations, such as G60 to deliver enhanced connectivity services. Asian telecom operators are key champions in these adaptation strategies,

increasingly partnering with satellite operators to bolster their infrastructure resilience and expand into new consumer areas previously unreachable via terrestrial networks. For instance, India-based operator Reliance Jio is collaborating with Luxembourg-based SES to deliver its Jio Space Fiber service using SES's O3b mPower MEO constellation. This service promises to offer ultra-fast broadband to household and retail customers in India, regardless of their geographical proximity to active terrestrial networks.

US-based satellite service providers are also expanding their presence in the APAC region. Starlink, for example, entered the Indonesian market in 2024 and was reportedly considering a USD1.5 billion investment in Viet Nam to penetrate its satellite communications market. Satellite telecom solutions are particularly popular in island nations within the APAC region, such as Fiji, Vanuatu, Tonga and the Cook Islands, where climate threats remain elevated and ground-based connectivity infrastructure is scarce.

While space offers a relatively more resilient environment compared to areas exposed to high climate risks on Earth, it is not without its challenges. Natural hazards in orbit, such as extreme radiation or adverse phenomena, pose fundamental risks that threaten this strategy. Additionally, the growing issue of orbital debris presents a significant concern for space-based telecommunications infrastructure.

The scale of the orbital debris problem is evident in recent statistics. In 2023, according to data from the US Space Force, the number of total rogue elements tracked in space across various categories reached 23,109 objects, representing a staggering 111.5% increase over the previous year. This figure is nearly equivalent to the projected number of connectivity satellites expected to be in orbit by 2028, estimated to be slightly over 24,000. As the telecommunications industry continues to leverage space-based solutions for climate resilience, addressing these orbital challenges will be crucial to ensure the long-term viability and safety of this adaptation strategy.

Network Deployments In Space Aiding Adaptation And Mitigation

The advantage of space telecoms infrastructure, also defined as non-terrestrial networks (NTNs), is that operators can minimise their physical footprint on Earth to deploy tower or wireline networks. This is a considerable advantage for adaptation to climate change risks, but also the reduction of the industry's emissions.

Satellite reduces the incentive for MNOs to build towers or expand fibre optic networks in rural areas where terrestrial network connectivity is still deliverable. This greatly reduces the CO2 emission profiles of network expansion, especially since satellite maintenance is less frequent and more predictable. Other direct contributions towards wider sustainability goals include reduced deforestation or direct environmental impact associated to terrestrial network deployment and upkeep.

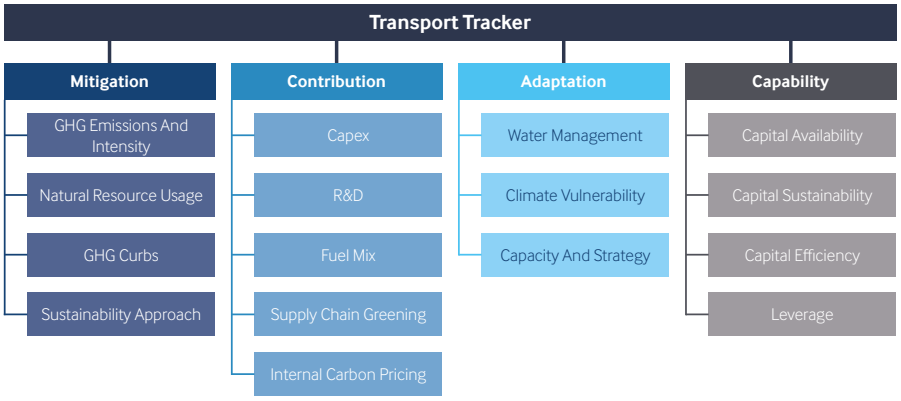
Asian MNOs are increasingly attracted to NTN to reduce their emissions and gain a competitive edge. US-based direct-to-device satellite operator AST SpaceMobile (AST) has partnered with over 10 Asian MNOs (including Rakuten, Globe Telecom and Smart Communications) to deliver space-based 5G cellular broadband to their mobile subscribers' smartphones.

Sector Tracker: Transport

In the context of this report, transport means rail, transport infrastructure services, trucking and delivery. Using the AIIB-Amundi Climate Change Investment Framework (CCIF), the Automotive Sector Tracker aims to capture the extent to which operations, investments and strategies of companies operating in this sector align with the Paris Agreement goals of Mitigation, Adaptation and Contribution to the transition. A fourth dimension, financial Capability, has been added by BMI to assess a company's financial strength and ability to deliver on its climate objectives.

Mitigation

For our Mitigation pillar, there are four elements. The initial element focuses on a company's greenhouse gas (GHG) emissions intensity and its growth pattern. In this segment, the Index evaluates the percentage shift in emissions for each company over the period from 2018 up to 2023. Companies are then assigned a ranked score in relation to their peers within the Index. This ranking is subsequently merged with a carbon intensity score, which calculates the ratio of total emissions to the company's overall sales volume.



Source: BMI

Secondly, we look at a company's natural resource use through total energy use and rank them on energy intensity per sales volume.

The third element in our Index analyses the sustainability approach by companies. It looks at whether companies adopt recommendations by the Task Force on Climate-related Financial Disclosures (TCFD) and The Taskforce on Nature-related Financial Disclosures (TNFD). It also ranks companies on whether they have different initiatives and policies relating to energy efficiency, emissions reduction, waste reduction and climate change.

The final element uses a qualitative approach by examining efforts by companies to curb GHG emissions. Through analysis of various company documents such as annual reports and sustainability reports, the Index evaluates each company's efforts in mitigation. These factors include:

- Does the company have a net zero target?
- How soon does it aim to reach this target?
- Does the company have emissions reduction initiatives in place?
- How much toxic waste does the company produce per annum?

Adaptation

For the Adaptation portion of our Index, three areas are analysed. Firstly, we assess the overall vulnerability of a company to different effects of climate change such as flooding risk, exposure to tropical cyclones and drought. This is then also assessed in light of overall infrastructure, communication access and overall healthcare in the areas companies operate.

Secondly, we compare total water withdrawal and overall water intensity between companies. A company is also assigned a score based on how much of its water use is recycled.

Lastly, we assign a subjective score to companies based on their overall adaptation capacity and strategy published in company reports.

Contribution

Our Index for contribution is divided into four categories. The first category looks at the fuel mix used by companies to determine efforts at reducing emissions and moving towards less carbon-intensive operations.

The second category analyses efforts at supply chain greening. This ranks companies based on environmental supply chain management and efforts to incorporate sustainable packaging. The share of renewable energy in total energy use is also considered in the ranking.

For the third element, we analyse research and development (R&D) efforts. A company's total revenue as well as capital expenditure (capex) is compared to R&D spend to determine the total effort into investing in new sustainable initiatives. Total sustainable capex is also tracked across 2022, 2023 and 2024, and companies are scored accordingly.

Lastly, companies are assigned a score based on if they have internal carbon pricing mechanisms as well as if they are investing specifically in new sustainable products to help lower their contributions to climate change.

Capability

BMI has also added a fourth pillar to consider: financial capability. This fourth pillar has been added to reflect the fact that reducing carbon footprint, protecting against climate change risk and investing in green technologies are all capital-intensive processes, and therefore any transition will be partly contingent on a company's financial health and capacity. Those companies in a more financially stable position, with access to capital, are better placed to set meaningful targets and fulfil them with actions.

Sector Tracker Insight: Transport

Transport Sector Must Ramp Up Mitigation Efforts To Support Scope 3 Reduction

Asia is a major player in global trade, with the region boasting the largest container port in the world by throughput (port of Shanghai, China), the largest airport by cargo volumes (Hong Kong International Airport, Hong Kong, China) and the second longest railway in the world (China), and an extensive road network functioning to support global, regional and domestic freight requirements. The region's continued strong economic growth and expansion of tourism is also driving passenger transport demand (commuting, business travel and tourism). It is therefore unsurprising that the transport industry in Asia is a significant carbon emitter.

The transport sector is the third largest contributor to greenhouse gas emissions in the region (as shown in figure 2.49), accounting for 14.3% of total emissions as of 2021 (latest available reading). From 2000 to 2021, total CO2 emissions from Asia's transport sector have increased from 938.3 Mt to 3,006.3 Mt, as the region's economies expand. In 2000, Asia accounted for 22.1% of global transport emissions and this has increased to 34.9% as of 2021.

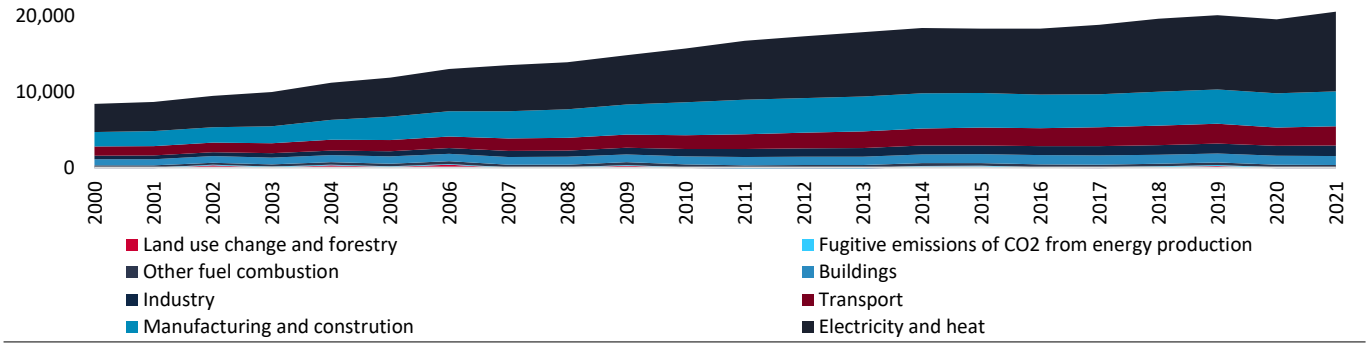
The Transport sector therefore has a considerable task ahead if it is to reduce its emissions and support the Paris Agreement objective of Mitigation. As noted, transport emissions are increasing and this is understandable with the rapid economic expansion and trade growth being undertaken in the region. Progress on emissions reduction within the sector is being made, with our Transport Tracker showing a growing volume of companies operating in the industry now tracking their emissions and firms placing reduction strategies and targets in place.

This finding is also echoed in the responses to the BMI Companies and Climate Change Survey, May 2024, with 60.9% of transport companies surveyed stating they have set a target to reach net zero between 2030-2040. Of some concern though and highlighting the challenges this sector faces in reducing its emissions, 17.4% of transport respondents stated that they have yet to set a net zero target date. Transport respondents recorded the highest level of not setting a net zero date out of the respondents across the eight industries surveyed. Major players in the Transport sector in Asia-Pacific (APAC) are, however, outlining their reduction pledges. COSCO Shipping Holdings (COSCO), China's largest container shipping line (the fourth largest in the world) and also a terminal port operator with operations in China and globally, has set a goal of carbon neutrality by 2060. Indian Railways, which is the world's fourth longest railway network in the world and the third busiest, has pledged to reach net zero by 2030.

One of the primary obstacles facing the transport sector when reducing emissions within their operations is technological limitations, with the development and adoption of new fuel technologies both slow and costly. Transport firms looking to replace their use of diesel or similar petroleum derivatives face challenges in sourcing alternative fuels that are cost-competitive, energy-dense and readily available through existing infrastructure. Progress is being made and is explored in greater depth in our contribution analysis of the Transport sector.

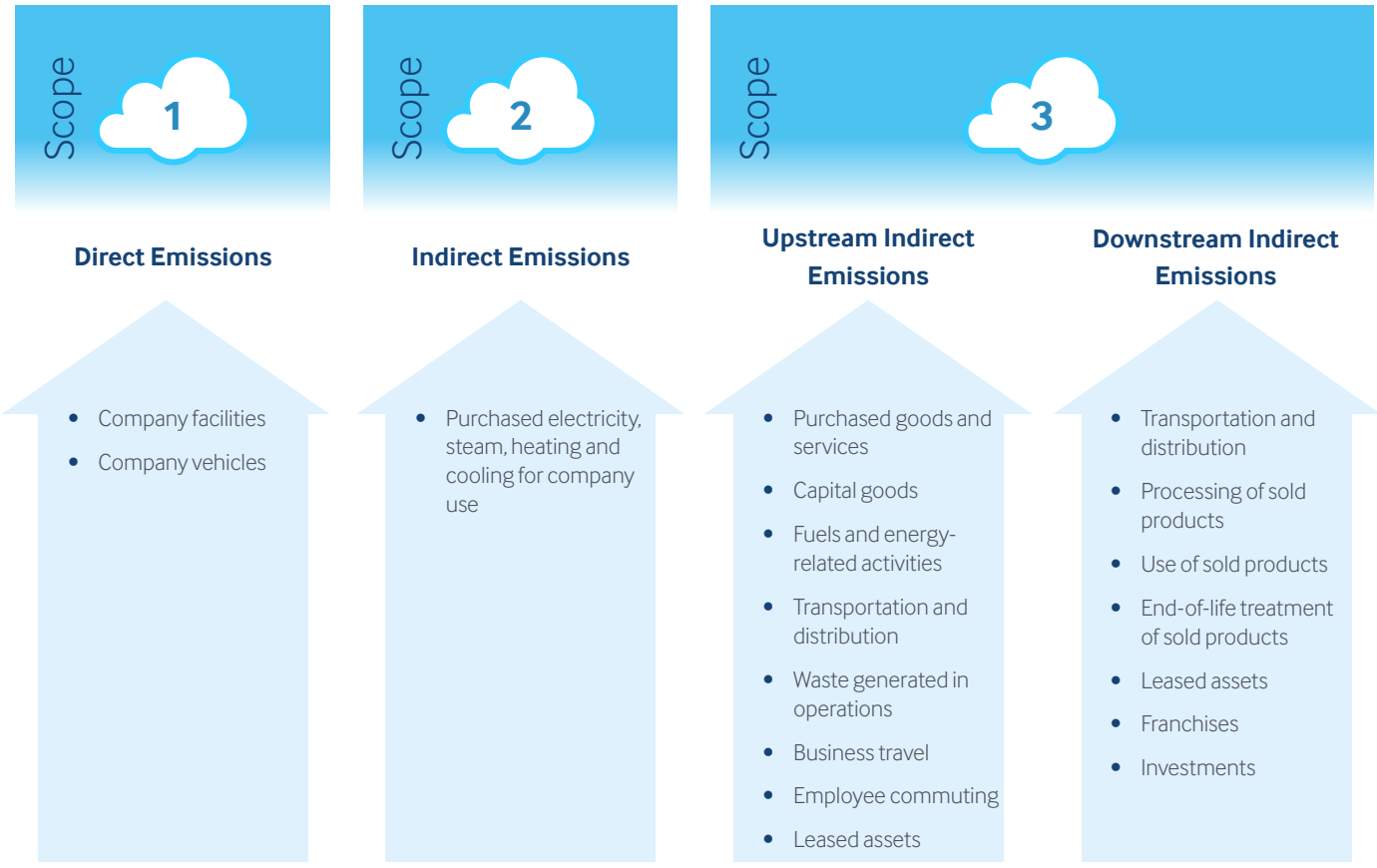
A key driver behind the Transport sector's pledges on emissions reduction stems from their clients. These companies utilise transport firms as their second- and third-party logistics providers and so the Transport sector is part of their Scope 3 emissions. To date, emissions reduction strategies by companies have focused on Scope 1 (emissions from a company's facilities and vehicles) and Scope 2 (purchased power), but for companies to achieve Scope 3 (upstream and downstream emissions) and so net zero, one of the areas which they must measure and reduce is within the transport and distribution elements of their supply chain. Wider industry is therefore requiring greater transparency from the transport sector on their emissions and reduction plans. For transport companies, mitigation strategies are imperative as without them they risk losing market share to competitors that have developed more sustainable climate strategies.

Fig 2.49: Asia CO2 Emissions By Sector, Mt CO2



Source: Climate Watch, BMI

Fig 2.50: GHG Protocol Scopes Across Value Chains



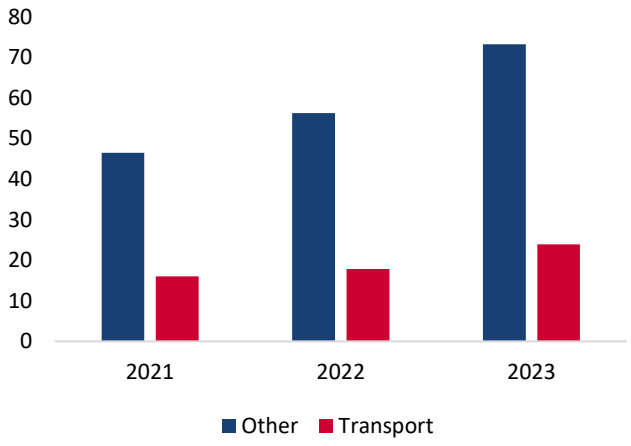
Source: Greenhouse Gas Protocol

The transport sector is receiving support from governments and financial institutions to implement emissions mitigation strategies. Although to date the majority of government-led policies have been aimed towards supporting the electric light-duty vehicle (LDV) segment, we are now noting a shift towards a policy focus on the heavy-duty vehicles (HDV), which includes medium freight trucks, heavy freight trucks and buses. Almost 70% of global HDV sales are now covered by electric vehicle (EV) policies. Markets are ramping up funding, committing to zero-emission vehicle (ZEV) deployment targets, and several are enacting HDV-specific policies for the first time. As of Q4 2024, 30 markets had signed the Global Memorandum of Understanding (MoU) on Zero-Emission Medium- and Heavy-Duty Vehicles, including two Asian signatories, New Zealand and Papua New Guinea. These countries aim for 100% zero-emission new truck and bus sales by 2040. In New Zealand, the aim is to reduce emissions from freight transport by 35% by 2035.

Policies in major markets such as China and India are also shifting towards boosting the development of EV manufacturing in addition to EV deployment and increasing electric charging infrastructure. Tianjin (China) aims to have 80% NEVs in public transport, rental, logistics and delivery vehicle sales by 2025, while Viet Nam's net zero transport by 2050 goal includes HDVs. Japan aims to introduce 5,000 electric HDVs by 2030.

Support offered from development banks worldwide will also help to drive transportation decarbonisation, especially given the costs involved in lowering emissions through the development, procurement and use of new technologies and fuel types. According to a Joint Report on Multilateral Development Banks' Climate Finance financing provided to the transportation sector globally for mitigation reached 24.0% of total mitigation financing in 2023 and stood at USD23.3 billion, up by 30.5% y-o-y.

Fig 2.51: Multilateral Development Bank Mitigation Financing With A Transport Focus, USDbn (2021-2023)



Source: Joint Report on Multilateral Development Banks' Climate Finance (2021, 2022, 2023), BMI

Transportation Embracing Alternative Fuels To Contribute To Emissions Reduction

A key contribution that the transportation sector can make towards the Paris Agreement objectives is the move towards alternative fuels. These will not only decrease the sector's emissions but will also serve to reduce the emissions of multiple industries, which rely on varying transportation modes and transport infrastructure for their operations. As noted above, the move towards lower/zero emissions fuels is challenging, but steady progress is being made.

The adoption of biodiesel, as a transitional fuel option, highlights a first step which is being used by the trucking sector to reduce their emissions. Biodiesel is mixed with petroleum diesel, which decreases its emissions and can be used in trucks with diesel engines without modifications being needed. McDonald's, the US fast-food chain, is utilising recycled cooking oil from its restaurants to create biodiesel which it then uses in its supply trucks globally, including in its operations in India.

Biofuels are a logical next step in the transition and offer a viable replacement for diesel and heavy fuel oils across various transport sectors (trucking, aviation, railways and shipping), but global (and regional) production will take years to achieve the necessary scale to replace conventional fossil fuels. Progress in some markets is, however, being made. China's Farizon Auto, Geely Group's commercial vehicle brand, has been developing methanol-powered vehicles and launched its Homtruck in December 2023. The Homtruck utilises methanol-hydrogen and electric technology for its powertrain, and transport and logistics companies are already exploring it as an option to add to their operations. In September 2024, German transport and logistics provider The Duvenbeck Group signed a strategic partnership with Farizon Auto to include the Homtruck within its fleet, with the first 50 Homtrucks due to be delivered to the logistics company in 2025. We expect to see greater utilisation of methanol within the trucking sector in China, with over 60% of the world's methanol produced in the market. China has also implemented methanol-fuelled vehicle pilot areas, where methanol refuelling infrastructure has been developed. The vehicles utilised in these pilot areas have focused on public transport (buses and taxis), but they showcase how methanol refuelling infrastructure can be developed and scaled, and so could be utilised and replicated by the trucking sector.

Fig 2.52: Methanol Vehicle Operations In China

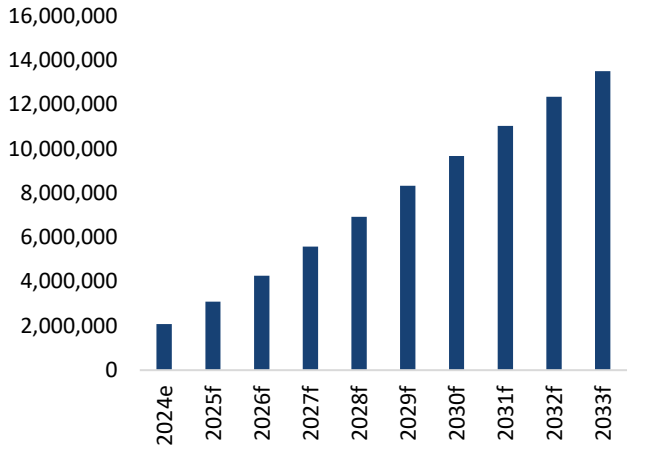
Province	City/Cities	Vehicle Type
Shanxi	Jinzhong and Chanzhi	Taxi and HD Bus
Shanghai	Minhang	Taxi
Shaanxi	Xi'An, Baoji, Yulin and Hanzhong	Taxi, Mini MPV and Self-Dumping Truck
Guizhou	Guiyang	Taxi
Gansu	Lanzhou, Pingliang	Taxi

Source: Methanol Institute, 2019

Electrification is also seen as a solution to decarbonising the transport sector, but it is currently best suited for short-haul freight flows. Geely's Farizon Auto is playing a key role in driving progress and is the world's largest producer of electric commercial vehicles. Its recently launched SuperVAN, which offers swappable batteries and an optional methanol range extender, is available on the Chinese market and will also be made available in Singapore, the UAE and a selection of European markets. Battery-powered long-haul trucking has been harder to develop due to the size and weight of the required batteries, which limits cargo capacity. Innovation in this segment is, however, starting to emerge; Volvo (part of China's Geely Group) is due to launch the long-range version of its FH Electric for sale in H225. The FH Electric is able to travel for up to 600 km on one charge and so offers trucking and logistics companies an option for their inter-regional and long-distance routes.

In Asia, electrification of the vehicle sector is gaining momentum. For instance, in the Asia-Pacific (APAC) region, electric vehicle (EV) stock is expected to grow at an annual average rate of 26.3%, increasing from 39.4 million in 2024 to 131.1 million in 2030. Over this period, China will account for 92% of the total EV fleet in the APAC region. While still limited in its share of overall electric vehicles, the total electric commercial vehicle fleet in Asia (10 key markets) will grow by an annual average of 27.0% during this same period, increasing from over two million in 2024 to over 13.5 million by 2030. As of 2023, China accounts for three of the world's largest 10 electric vehicle manufacturers, namely BYD (the world's largest), Geely Auto Group and GAC. This growth has been driven by favourable government policies and significant investments in the production of alternative fuel-powered vehicles.

Fig 2.53: APAC* Commercial Electric Vehicle Fleets



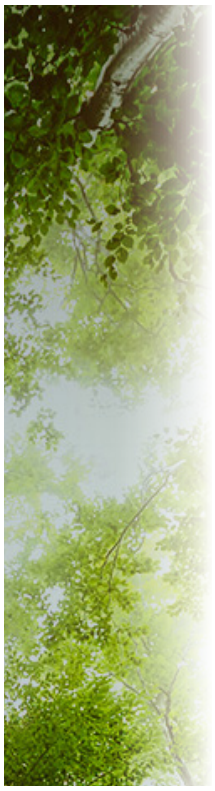
*Note: *Total calculated from 10 key APAC EV markets: Australia, China; Hong Kong, China; India, Japan, Macao, New Zealand, Singapore, Korea and Viet Nam. The total number of officially registered road motor vehicles, propelled by both an internal combustion engine (ICE) and at least one electric motor using rechargeable batteries that can be charged from an external plug-in source, with at least four-wheels designed for carrying goods (commercial vehicles). The vehicle may solely use the electric motor, the ICE or use a combination of the two simultaneously. Vehicles must be officially registered with national traffic authorities. e/f = BMI estimate/forecast. Source: FCAI, CAAM, Hong Kong Department of Transport, FADA, JAMA, DSEC, MIA, LTA, Ministry of Environment, Yonhap, VAMA, BMI*

The railway segment of transportation offers lower levels of emissions for freight and passenger transport, when compared to road, and many markets and companies are exploring a model-shift, at least for their longer-haul operations overland. In India, for example, the National Rail Plan highlights a goal of increasing the share of freight by rail from 27% in 2022 to 45% by 2030. A continued electrification of railway networks and a move away from diesel (although not complete removal, as diesel traction offers a key climate change adaptation strategy for rail, as it can still operate during floods and extreme heat conditions) will further reduce rail's emissions. This also applies to the exploration of new power sources as the electrification of railways is in many cases still being powered by fossil fuels, and a power shift to renewable options is also required.

Hydrogen trains also offer a route to decarbonising the railway sector further, though this will still require the scaling of relevant infrastructure to power these trains. Developments such as the unveiling in June 2023 of the China Railway Rolling Stock Corporation (CRRC) Ningdong, a hydrogen-powered locomotive, show that progress is being made. The Ningdong engine reportedly has a 270 kg capacity of liquefied hydrogen and can run for up to 190 hours. CRRC estimates that hydrogen trains could replace up to 90% of the 7,800 diesel locomotives operating in China, which accounts for 36% of the country's fleet.

In the Transport Infrastructure Services sector, ports and airports are investing to provide the alternative fuels to support the transition of the Maritime and Aviation sectors. In 2023, the International Maritime Organization (IMO) pledged its intention to have zero and near-zero fuels in use by 2030, with the aim to fully achieve net zero emissions from shipping by 2050. This target has been signed by over 200 companies in the maritime industry. To date, the majority of the global shipping fleet – around 99% – relies on diesel engines and marine fuel oils, but with new vessels entering service yearly, a shift in fuel is becoming more apparent. Det Norske Veritas (DNV) data showcases that as of end-July 2024, 15.7% of vessels on order would be powered by alternative fuels. Ports must therefore invest in alternative fuel infrastructure to support this transition and progress is already being made. In March 2024, Shanghai's Yangshan port undertook China's first ship-to-ship green methanol bunkering, supplying the 16,000 TEU Astrid Maersk. Shanghai is set to expand its green shipping fuel position and has set a target to develop a shipping fuel 'filling centre' by 2030 that has a capacity of one million tonnes of green methanol and green ammonia per annum.

In the Aviation sector, a move to alternative fuels is also under way, but according to IATA, as of 2023, sustainable aviation fuel production accounted for only 0.2% of total demand. Airlines are, however, investing in the transition to alternative fuels. Hainan Airlines, for example, became China's first passenger flight to use aviation biofuel in 2015 and other airlines have followed. A major boost to the transition of the Aviation sector to more sustainable fuel options came in September 2024 with the launch of China's sustainable aviation fuel (SAF) pilot programme. Air China, China Eastern and China Southern are all participating in the pilot across 12 commercial flights, with the programme expected to be expanded in 2025. Key to the development of this programme is the transport infrastructure (airports) investment that has taken place to be able to provide SAF with the airports of Beijing Daxing, Chengdu Shuangliu, Zhengzhou Xinzheng and Ningbo Lishe all participating in the pilot programme.



Alternative Fuel Options Developing

Cost and complexity are the key challenges facing the Transport sector in their transition to lower- or zero-emitting fuel types. All transport modes face the issues of the ability and speed with which they can transition their fleets, as well as whether the alternative fuel option is scalable and readily available (infrastructure has been developed for refuelling and there are high levels of availability). For some transport segments (specifically maritime and aviation), the ability of alternative fuels to power these modes over the long distances they must travel is a further challenge that must be overcome. In figure 2.54, we highlight the suitability of different fuel options for decarbonising the transport sector.

Fig 2.54: Fuel Options Matrix For All Transport Modes Globally

	Fuel/Engine Tech Readiness	Scalability	Energy Density (volume)	Energy Density (weight)	GHG Reduction
Ammonia*	Strong	Moderate but strengthening	Moderate	Moderate	Strong
Hydrogen	Moderate but strengthening	Moderate but strengthening	Weak	Strong	Strong
Liquified Natural Gas (LNG)	Moderate but strengthening	Strong	Moderate	Strong	Moderate
Nuclear*	Moderate	Weak	Strong	Strong	Strong
Biofuels/ Methanol	Strong	Moderate but strengthening	Moderate	Weak	Moderate but strengthening
Battery Storage	Moderate	Moderate but strengthening	Weak	Weak	Strong

*Note: * Ammonia & Nuclear options apply exclusively to shipping. Source: BMI*

Adaptation Remains Critical Investment For Reducing Risks, International Cooperation Needed

Companies are placing greater scrutiny on supply chain security and with that the risks that climate change can have on their operations, including within transportation. An increase in climate events and their severity from typhoons, flooding and extreme heat are damaging transport infrastructure and the sector's ability to service passengers and freight. Within transport infrastructure, ports and airports are exposed, with damage to ports globally from climate-related events estimated by Oxford University's Environmental Change Institute to be USD7.5 billion per year, impacting more than USD100 billion worth of trade. Multinational insurance provider Allianz estimates that in 2023, ports globally faced 117 days of downtime due to tropical cyclones. According to the Airports Council International and OpenFlights, 25 of the world's top 100 busiest airports are 10 metres below sea level, leaving them exposed to flood risk. Climate events can also disrupt and destroy road and rail networks. In India, for example, in 2023 multiple landslides resulted in over 1,300 road closures. In July 2024, a landslide on the Bengaluru-Mangaluru line led to train cancellations for more than 10 days.

Three forms of adaptation by the transport industry's clients are emerging and so the sector must not only build its own resilience to climate change events but must also adjust to the climate risk mitigation being undertaken through the full supply chain. The hub plus one strategy is being embraced specifically by manufacturers who create more than one hub of production, so that if one of their manufacturing hubs or its respective transport network is disrupted they can still continue to manufacture in another area and transport the products to market, albeit at a lower volume. ii) Model switch offers companies the ability to diversify their supply chains, so that if a climate event impacts one transport mode, they can shift to another (e.g. railways to road or shipping to aviation). iii) For some industries, initiating these adaptation measures within their supply chains is not possible. They are restricted in terms of where they can locate (e.g. the mining sector must mine where the commodity has been discovered) and their transport needs cannot be switched to other modes (e.g. due to weight/volume a product must be shipped and cannot be transferred to air). Therefore, the transport sector must develop measures in the face of climate change risks.

The instances of climate-related events are projected to increase, and the transport sector must build resilience and develop navigational tools to adapt their operations for them. Different transport modes will require different strategies, but examples are already emerging. In the Transport Infrastructure sector, airports are initiating flood and extreme heat measures. Singapore's Changi Airport (CAG), for example, faces flooding (from increased rainfall, storms and rising sea levels) and higher temperatures, which are existing risks being exacerbated by climate change. The airport is initiating immediate and longer-term strategies, as well as tactics to address varying levels of risk severity from climate events. To tackle flood risk, all three of the airport's runways have been grooved to drain surface water and the airfields drainage capacity has been expanded. Technology is also being used to monitor climate-related risks to CAG's operations, with the airport

one of the first in the world to introduce a runway condition reporting system, which alerts air traffic controllers and pilots to changing conditions. Longer-term CAG's climate change resilience will benefit from the construction of the Long Island reclamation project, which aims to create a buffer from rising sea levels on Singapore's East Coast.

Building Road Resilience: Madhya Pradesh Rural Connectivity Road Project (MPRCP)

The MPRCP highlights how incremental steps can be rapidly implemented to develop climate resilience within a road network and better prepare it for greater levels and more regularity in flooding and extreme heat so that the trucking and delivery segment of transportation can continue to operate, or that delays caused are reduced.

Challenge: Impact risk on road network from climate change, with Madhya Pradesh State's predicting that precipitation during the monsoon season will increase by 1.3 times over a 30-50-year period, and that the average temperature in the state will rise by between 1.8 and 2.0 degrees in the 2030s.

MPRCP Risks And Initiatives

	Flood Events: Surface sealing, embankment pitching and expansion of culverts.
	Higher Intensity And Frequency Of Rainfall: Designed camber of road surface to ensure water did not accumulate on the road and run off with road drainage capacity expanded.
	Landslides: Soil slope protection measures including dry stone walls and the planting of grass.
	Extreme Temperature: Utilised asphalt binder standard VG-30, which withstands ambient temperature up to 48°C.

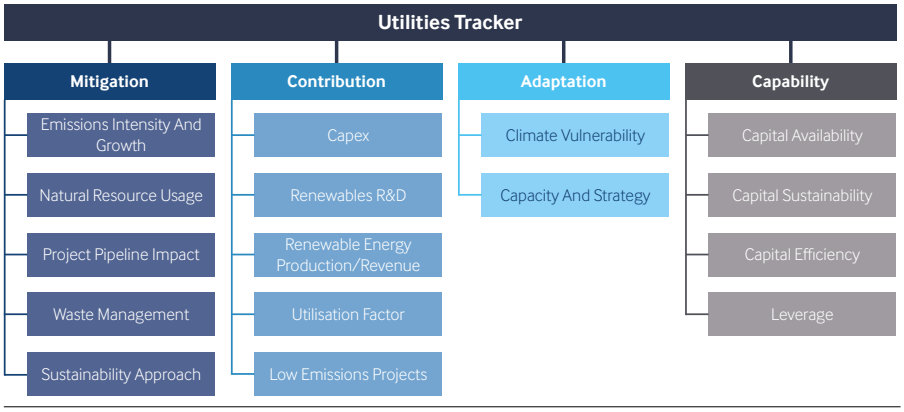
Source: AIIB

Sector Tracker: Utilities

In the context of this report, utilities means electric generation/distribution and electric-integrated. Using the AIIB-Amundi Climate Change Investment Framework (CCIF), the Utilities Sector Tracker aims to capture the extent to which operations, investments and strategies of companies operating in this sector align with the Paris Agreement goals of Mitigation, Adaptation and Contribution to the transition. A fourth dimension, financial Capability, was added to the CCIF to assess a company's financial strength and ability to deliver on its climate objectives.

Mitigation

The score for Mitigation comprises five segments. The first is based on the utility's carbon footprint whereby the Tracker assesses each utility's percentage change in emissions between 2018 and its most recent levels (2023) and gives a ranked score relative to the other utilities in the Tracker. This score is combined with a carbon intensity score, which measures the total emissions per unit of generation for power generators or per unit of total sales for power transmission utilities. These two data points are combined and weighted equally to give an average.



Source: BMI

By researching and analysing each utility's annual reports, sustainability reports, websites and other official documentation, three of the Mitigation scores are given for the utility's Sustainability Approach, Natural Resource Usage and Waste Management. Scoring considered aspects such as the presence of dedicated committees, internal policy formation, resource consumption including fossil fuels, waste creation, recycling, mitigation commitments and plans in place to achieve these targets. The final segment measures utilities' project pipeline impact through measuring the size of companies' highly emissive projects in BMI's Key Projects Data.

Adaptation

This score for Adaptation takes two variables into account. Climate Vulnerability is a function of the utility's exposure to climate change risks based on its operating location. Here, large multinational corporations achieve strong scores, as their geographical dispersion mitigates the risk of localised changes in the climate impacting negatively on their operations. This score is particularly pertinent for utilities maintaining a heavy hydroelectric asset base due to its vulnerability to drought. Similarly, Adaptation Capacity and Strategy scores utilities based on their location, and denotes the level of preparation for natural disasters in each market by measuring the capability of the infrastructure and institutions in place to cope with shocks.

Contribution To The Transition

The score for Contribution is derived from five indicators. Capex forms the base of this pillar as it is an indication of the overall investment undertaken by the utility over the most recent reporting year. The Utilisation factor score denotes a ranking of the overall generating efficiency of a utility's power plants, and is calculated by dividing total power generated in 2023 by the total operation capacity owned by the utility. The Renewables R&D score is derived by the analysis of each utility's R&D spending on deploying new renewable power technologies and its percentage share on the company's revenue to determine the utility's contribution towards innovation and improvement in the industry. The score also considers Renewables Energy Revenue, which calculates a utility's revenue and the percentage share of a utility's total revenue. Finally, Low Emissions Projects Pipeline includes the total project pipeline of low-carbon projects in BMI's Key Projects Data.

Capability

BMI has also added a fourth pillar to consider financial capability. This fourth pillar has been added to reflect the fact that reducing carbon footprint, protecting against climate change risk and investing in green technologies are all capital-intensive processes, and therefore any transition will be partly contingent on a company's financial health and capacity. Those companies in a more financially stable position, with access to capital, are better placed to set meaningful targets and fulfil them with actions.

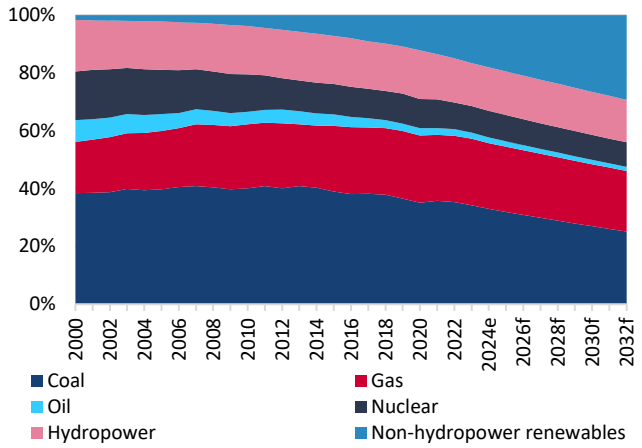
Sector Tracker Insight: Utilities

Mitigation Efforts Hampered By High Emissions In The Power Generation Sector

In the Utilities Sector Tracker, we measure mitigation through several indicators, including but not limited to emissions intensity and growth, company sustainability approach, and natural resource use. Although power companies are accelerating mitigation through net zero targets and emissions reduction strategies that raise the sustainability approach score, we note that high company emissions are weighing on the average score for emissions intensity and growth. In particular, Scope 1 and 3 emissions, which encompass direct emissions from utilities such as from fuel combustion and indirect emissions from the value chain, are weighing on mitigation scores. In this deep dive, we analyse the drivers behind high sector emissions but also discuss falling future emissions as utilities adopt technologies and measures to reduce their emissions.

Fig 2.55: Global – Total Generation Share By Source, % (2000-2032)

Utilities Power Progress Slow But Steady Due To Reliance On Fossil Fuels



Note: BMI estimates based on GSMA 2019. e/f = BMI estimate/forecast. Source: GSMA, BMI

Fossil Fuels Dominate Power Supply But Set To Be Overtaken By Renewables

Power utilities firms face high Scope 1 emissions due to their continued reliance on fossil fuel power plants, particularly highly emissive coal-fired power generation. In 2024, BMI forecasts that fossil fuels will continue to dominate the global electricity mix, accounting for 57.7% of total power generation. Within this, coal is projected to contribute 32.9% of the world's electricity generation, as illustrated in the chart in figure 2.55. Despite these challenges, the Utilities sector is making notable strides in replacing dirty fuels with clean alternatives to meet company and country decarbonisation targets. Combined low-carbon hydro, non-hydropower renewable and nuclear sources are estimated to supply 42.2% of global electricity in 2024 according to BMI estimates and are forecast to grow to over half of the power mix by 2033. This reflects the utility sector's growing commitment to renewable energy solutions, which we will discuss further in the contribution section of this report.

Asian-Pacific Utilities To Retain Coal-Fired Power Plants To Ensure Energy Security

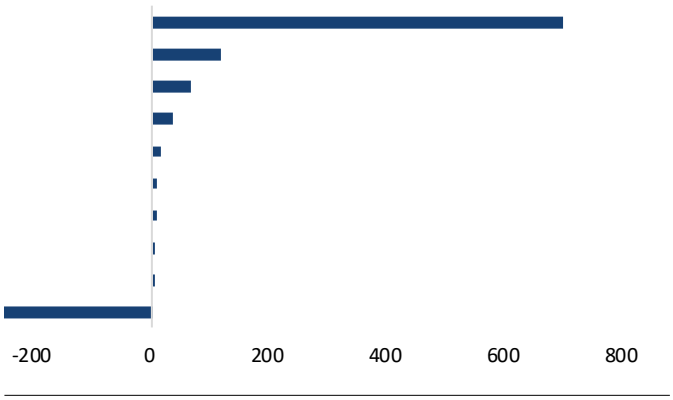
Despite renewables growing to make low-carbon electricity the largest segment of the global power mix over this decade, fossil fuels will remain a key source of power with the Asia-Pacific (APAC) markets as shown in the chart in figure 2.56, meaning that the region will still rely on fossil fuels until the end of the decade, holding a 52.1% share in 2033. Utilities companies across the region are showing commitment to diversifying their power supply and expanding their renewables supply, with a few announcing a moving away from coal. For example, China Light and Power Holdings in Hong Kong, China has committed to phasing out coal, as the Chinese special administrative region's climate strategy is to replace coal with cleaner fuels such as gas and renewables to cut carbon intensity by 65-70% by 2030 (compared to 2005 levels).

However, many utilities firms are planning to retain significant shares of coal-fired power in their energy mix over the medium term owing to their already installed capacity and the need to retain coal for energy security. For example, in China BMI projects that coal will remain at a significant 36.4% share of total generation in our forecast for 2033, albeit a decline in its share versus 2024 owing to its huge renewables buildout. This high retention of coal for electricity generation is, in part, due to a short-term buildout following heatwaves fuelling power supply issues in the market. In 2022, China expanded its coal-fired power and added 114 GW in 2023, with the market leading the global buildout of coal for that year. The state-owned company State Grid Corporation of China (SGCC) signalled that China could be building up to 150 GW of new coal-fired power capacity from 2022 to end-2025. Therefore, despite coal's long-term importance declining, it will remain a power generation component in the APAC region, as a means of securing power generation, and will have an impact on the Utilities sectors' mitigation efforts.

Indonesia's state-owned energy company PT PLN is expected to remain highly reliant on coal-fired power as the utility capitalises on the country's domestic coal resources and the high demand from the industrial sector, such as from the country's large nickel industry. After signing a Just Energy Transition Partnership (JETP) in 2022 to transition away from coal with USD20 billion committed from international partners, the government has set a limited phase-out target of 1.7 GW, with the country's current power generation from coal estimated to reach 224.9 TWh in 2024 and accounting for 67.2% of Indonesia's total power generation. This highlights that the country's transition from coal, while under way, will require more funding and support.

Fig 2.56: India To Add The Most Coal Over The Next Decade

Selected APAC Markets – Coal Generation Net Change, TWh (2023e-2033f)



e/f = BMI estimate/forecast. Source: Local sources, EIA, BMI

High transitioning costs and the need for secure baseload supply are why Indonesia, China, India and other major economies in the region retain and are forecast to retain a significant share of coal in their power mix. The chart in figure 2.56 illustrates how major APAC markets are leading the coal buildout, with India projected to add 696.7 TWh over our forecast period. India's coal fleet will keep expanding in response to growing demand, electrification, and its expanding economy, resulting in coal-fired power comprising a majority 66.6% of the power mix in 2033. Similarly, Viet Nam is expected to remain a leading coal market, experiencing a smaller increase of 65.1 TWh in generation growth but continuing to rely on coal for 39.7% of its power mix in 2033.

Financing Constraints In Emerging Markets Compromise Utilities' Mitigation Efforts

In emerging markets, financing risks are high, which is a problem for attracting capital investment for the buildout of renewables. For example, financing problems in countries like Bangladesh where the government is struggling to pay for power supply, lead to unpaid bills as high as USD800 million to the Indian conglomerate Adani. Moreover, Bangladesh has over USD1 billion in debts to Indian power companies, exacerbated by a dollar shortage. This raises concerns given the significant level of investment required to transition to net zero. In Bangladesh, the International Monetary Fund (IMF) estimates the country needs up to USD1.7 billion annually until 2041 to meet its clean energy targets, necessitating overseas aid since domestic financing is insufficient.

Coal continues to attract the most investment in Bangladesh, raising concerns about future stranded assets and growing debt, especially as coal prices soar internationally. Fiscal pressures and declining foreign currency reserves suggest that cost-effective renewable options, like rooftop and utility-scale solar, would better serve Bangladesh's energy security and affordability needs. However, limited access to finance is curtailing their expansion. High borrowing costs also elevate the weighted average cost of capital (WACC), making renewable energy projects less financially viable. We expect that this, as well as the prohibitive cost of technologies such as carbon capture and storage (CCS) and hydrogen, will heavily weigh on the ability of Bangladesh to achieve its emission reduction target of 5% between 2011 and 2030 unless drastic international and regional funding and support is implemented in a very short timeframe.

Utilities Seek Solutions To Reduce Coal Emissions Rather Than Decommission Plants

As many utilities will continue to rely on their coal-fired power generation but need to ramp up decarbonisation efforts, there is an increasing need to reduce emissions from coal combustion. We see several ways that companies are reducing their Scope 1 emissions. For example, one growing technology is combined heat and power plants that utilise heat energy to generate electricity that would otherwise be wasted in conventional power plants. In addition, emerging clean solutions are gaining traction, such as CCS, as well as hydrogen, which can help reduce coal carbon intensities. Although the latter technologies are key solutions to reduce carbon emissions in the power sector, we highlight that these are yet to be deployed at scale and so do not yet have a significant impact on utility company emissions.

Co-Firing As A Leading Mitigation Solution

Biomass co-firing has become a leading climate solution among utilities in the APAC region. By blending biomass pellets with coal, utilities can significantly lower greenhouse gas emissions, mitigate reliance on coal and utilise agricultural residues that would otherwise contribute to pollution. India's National Thermal Power Corporation (NTPC) has been at the forefront of this initiative, blending biomass pellets with coal to reduce pollution and dependency on fossil fuels. In 2021, NTPC placed a substantial order for 930,000 tonnes of biomass pellets, underscoring the Indian government's commitment to leveraging agricultural residues in power generation. This effort not only addresses the climate impacts of utilities but also mitigates the environmental impact of crop residue burning, that raises emissions in agricultural regions, which is why governments, such as India's, are actively promoting co-firing.

The adoption of biomass for power generation in Asia has surged over the past decade, tripling to 62.8 GW in 2024 from 21.9 GW in 2014, according to BMI data. China leads the region with a capacity of 32.7 GW, followed by India with 11.0 GW and Japan with 6.6 GW in BMI's 2024 estimates. Government mandates have played a crucial role in this increase. In India, the government requires all coal-fired power plants to co-fire with biomass at a ratio of around 5-7%. Similar mandates have been issued in China, while Japan and Korea have incentivised biomass co-firing through feed-in tariffs and renewable certificates. In Viet Nam, the newly approved (April2024) Power Development Plan requires coal plants to begin using biomass and ammonia fuels after 20 years of operation.

Contribution To Depend On Grid Investments

The Utilities Sector Tracker's contribution score is derived from the level of company investment in low-carbon power through project pipeline and renewable energy revenue indicators. We highlight that investment in renewables such as solar photovoltaic (PV) and wind are raising utilities' contribution to the energy transition. However, not all utilities' strategies are focused on clean energy investment, particularly grid operators, weighing on the average contribution score. This, along with low utilisation factors, which measure operational efficiency of a company, make the contribution score the lowest score for Utilities across the four pillars. This shows that despite the sector playing a significant role in speeding up the energy transition, investing in clean energy is not uniform across the sector. Investment in renewables depends on local drivers, especially government regulation and support for clean technology, which is why the utilities leading our solar PV project pipeline come from countries that are actively promoting decarbonisation, as seen in the table in figure 2.57. We also highlight that this table shows why our Utilities Sector Tracker is being led by companies such as Engie and RWEgiven their large low-carbon emissions pipelines reducing their contribution scores.

Fig 2.57: APAC And NAWE Utilities Lead BMI Key Utility-Scale Solar PV Project Pipelines

Utility	Country	No Of Solar Projects
EDF Renewables	France	39
NextEra Energy Resources	USA	34
Engie	France	33
PowerChina	China	30
RWE Group	Germany	24
Satluj Jal Vidyut Nigam Limited	India	21
Solar Energy Corporation	India	19
Iberdrola	Spain	19
National Thermal Power Corporation (NTPC)	India	17
National Hydro-electric Power Corporation (NHPC)	India	15
State Power Investment Corporation	China	15
Statkraft	Norway	15
Orsted A/S	Denmark	15
Enel Green Power SpA	Italy	14
Tata Power	India	14
China Three Gorges Corporation (CTGC)	China	13
China General Nuclear Power Corporation (CGN)	China	12
China Resources Power	China	11
Gujarat Urja Vikas Nigam Ltd (GUVNL)	India	10

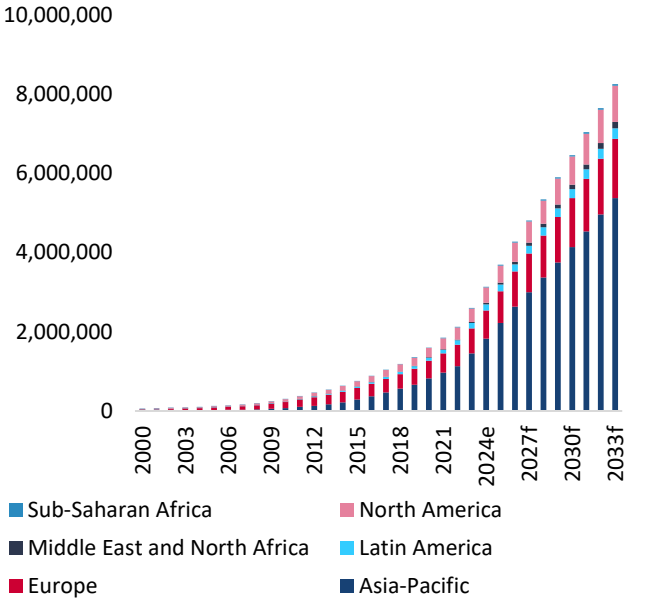
Source: BMI Key Projects Data

Global Renewables Accelerate

Despite contribution levels varying across utilities companies, significant investment in renewables has led to global renewables generation capacity growing by almost five-fold over the last decade and is projected to grow three-fold over the next decade, according to BMI forecasts. This will mean that renewables will help reduce global energy emissions by 129% between 1990 and BMI's last forecast year of 2033. The chart in figure 2.58 shows that APAC is leading renewables generation capacity growth, demonstrating that the region will offer the biggest contribution to reducing carbon emissions over the medium and longer term.

Fig 2.58: Global – Non-Hydropower Renewables Capacity, MW (2000-2033)

APAC Leads Non-Hydropower Renewables Growth



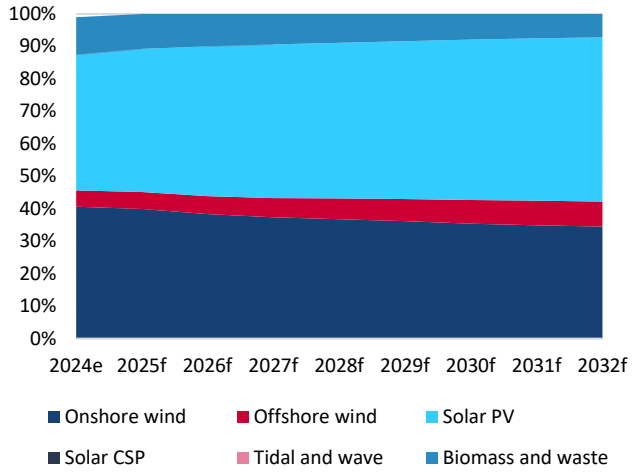
e/f = BMI estimate/forecast. Source: Local sources, EIA, BMI

Solar PV Leads Renewable Technologies Deployed In APAC

Solar PV remains the biggest contributor to emissions reduction from the power sector as the technology is the cheapest form of clean energy with strong global availability and scalability. The chart in figure 2.58 shows how solar PV is leading in APAC, accounting for roughly 50.3% of renewable power generated in 2033. Several major utilities have been expanding solar PV across the region to boost their renewable capacity, diversify their power supply and reduce carbon emissions. The table in figure 2.57 illustrates that just over half the companies leading BMI's Key Projects Data solar PV pipeline are in APAC, and specifically India and China, given these Asian heavyweights are spearheading renewables growth.

Fig 2.59: Solar PV To Remain Leading Contributor To APAC's Energy Transition

APAC – Total Non-Hydropower Renewables Generation Share By Technology, % (2024-2032)



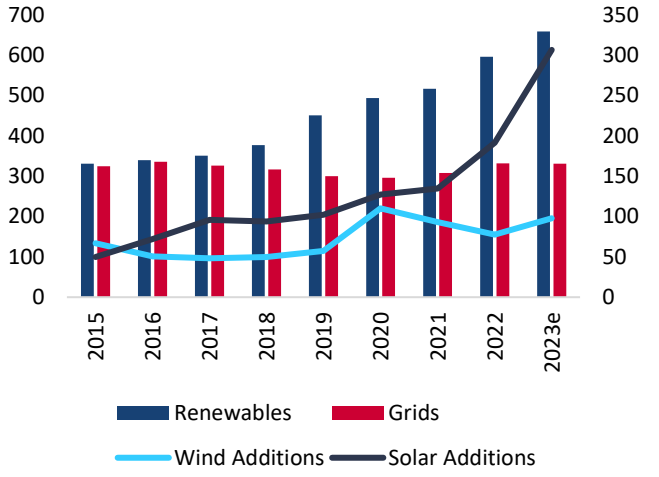
e/f = BMI estimate/forecast. Source: Local sources, EIA, BMI

Contribution Risks From Underinvestment In Grid Infrastructure

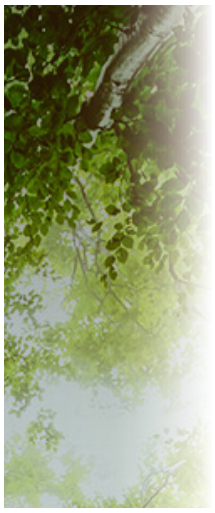
A significant risk to the energy transition is the underinvestment in grid network infrastructure, which is becoming more unreliable, inefficient and insufficient to keep pace with the rapid growth of renewables. This is driving up curtailment risks, escalating costs, and diminishing the attractiveness of renewable energy, risking the continued contribution of the sector. Despite China providing a leading example for grid investment globally, the rest of APAC is lagging. This is owing to utilities favouring renewables investment over grid investment. Since 2018, renewables investment has outpaced grid spending by an average of nearly USD200 billion according to the IEA, with the gap reaching USD328 billion in 2023. High costs and long lead times are undermining the expansion of transmission grids, with South Asian grids experiencing particularly high losses from old and inefficient grids. Grid investment will be a key focus for financing as curtailment costs increase and slow the pace of renewable deployment.

Fig 2.60: Renewables Investment Outpacing Grid Spending

Global – Annual Grid & Renewables Investment, USDbn & Wind & Solar Capacity Additions, GW (2015-2023)



e = BMI estimate. Source: Local sources, EIA, BMI



Digitalisation Of Grids Supports Transition

Digitalisation of grids will be crucial for integrating low-carbon energy sources, as well as to improving grid resiliency and lowering the cost of the energy transition. For example, the IEA estimates that digital technologies would help improve the management of grid assets, improving the lifespan of the infrastructure and reducing costs by USD1.8 trillion in grid investment until 2050. Therefore, digital grid solutions such as smart metering, grid management systems and AI grid optimisation technologies, will become key growth areas for the sector. Grid efficiency through smart technology can help companies reduce their emissions, increase renewable integration, as well as adapt to growing climate risks, making it a three-pronged approach to the energy transition.

China is a global leader in smart grid technology, with massive investments already under way in smart meters, and advanced grid infrastructure that is supporting its leading renewable integration and reducing curtailment risks. The State Grid Corporation of China (SGCC) has been instrumental in these developments, deploying millions of smart meters and enhancing grid resilience through advanced monitoring and control systems.

Adaptation Will Drive Increasing Distributed Energy

Adaptation is the Utilities Sector Tracker's highest performing component. We measure adaptation by looking at utilities' climate change vulnerability and companies' adaptation capacity and strategy. These scores are raised by companies' geographical locations given several of the utilities in the tracker operate in low-risk countries where infrastructure has limited exposure to climate change risks. For example, utility companies that are based and operate in Singapore benefit from the country having resilient infrastructure, as well as being less at risk to natural disasters located near the equator.

Climate Risks Require Resiliency Solutions, Increasing Digitilisation

Despite strong sector tracker performance, climate change risks are expected to have implications across all aspects of the utilities sector from increasing physical impacts on infrastructure to growing stress on the grid from erratic demand patterns caused by extreme weather. Utilities must therefore adapt through building more resilient power systems. One method that we have already discussed is through increased digitalisation of systems. In terms of adaptation, this would mean increasing the planning of systems and climate data to better cope with climate risks. This can be done using big data analytics, artificial intelligence or through rolling out a smart grid. Smart meters, for example, provide real-time data on energy consumption, enabling better efficiencies and demand response. As climate change disasters such as hurricanes and floods grow which can cut supply, smart meter data can help identify affected areas and speed up recovery. Since 2018, TNB (Malaysia) has implemented a strategy called 'Grid Digital Transformation' that is working towards a digital grid to improve not only security but sustainability and affordability. This has resulted in the deployment of smart meters,

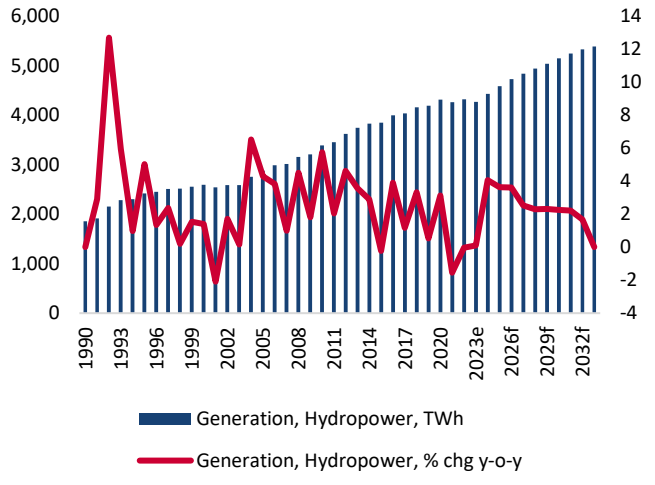
which has helped support the adoption of roughly 2.3 million units in the country. This means that Malaysia has a smart meter penetration rate of around 6%. TNB plans to deploy 9.1 million smart meters that would make smart meter penetration 26.2%, further indicating the company's commitment to increasing digitalisation.

Hydropower's Exposure To Climate Change Requires Better Water Management

Extreme weather events are increasingly impacting energy security, necessitating robust adaptation strategies. These events result in lower efficiency, higher operational costs and more frequent power outages, and become increasingly problematic as energy demand continues to rise. Droughts have severely affected hydropower output across various regions. To mitigate drought risks, utilities are diversifying their energy portfolios by investing in other renewable power sources, battery storage and other technologies. According to the World Meteorological Organization (WMO), drought conditions significantly reduced hydropower output during 2022, exacerbated by increasing water demand and diminishing supply from rivers, lakes and reservoirs. The chart in figure 2.61 shows the global hydropower output decline during this period. During the drought period in 2022, China's reliance on hydropower resulted in mandated power cuts and reduced manufacturing operations to manage lower electricity supply, which has ramped up the need to improve hydropower management, as well as the diversification of energy supply. Utility companies like China Three Gorges Corporation (CTGC) and Electricity Generating Authority of Thailand (EGAT) are addressing these risks by improving climate resiliency through advanced water management systems, real-time monitoring and predictive analytics.

Fig 2.61: Increasing Drought Probability To Weigh On Hydropower Reliance

Global – Hydropower Generation, TWh (LHS) & Hydropower Generation Growth y-o-y, % (LHS)



e/f = BMI estimate/forecast. Source: Local sources, EIA, BMI

Distributed Solar Coupled With Energy Storage To Grow As Solution To Climate Risks And Grid Shortcomings

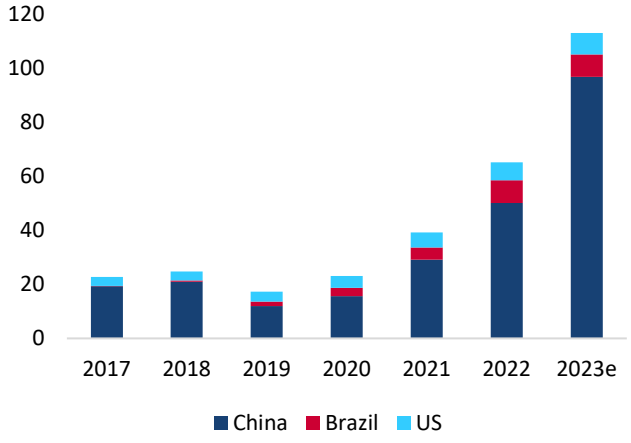
As climate risks rise, decentralisation, led by solar PV coupled with battery storage, is increasingly being adopted by utilities providers to enhance resilience, as well as to address grid bottlenecks. Decentralised energy systems disperse power supply across multiple smaller systems rather than relying on a few large, centralised plants. This approach helps utilities mitigate the impacts of extreme weather events and reduce reliance on centralised infrastructure. For instance, globally E.ON and Enel are investing heavily in microgrids and distributed renewable energy systems, while Engie is deploying battery storage solutions to support decentralised power. Tenaga Nasional Berhad and China Light And Power are also focusing on community-based solar projects.

Government policies and market trends are accelerating this shift. The Chinese government, for example, has incentivised distributed solar by allowing the sale of rooftop solar electricity and increasing grid electricity prices, leading to significant capacity additions. In 2021, 29.3 GW of distributed solar capacity was added in China, surpassing large-scale solar's 25.6 GW. Japan is similarly pushing for rooftop solar mandates to also mitigate limited land resources, while Indonesia is issuing rooftop solar quotas to its state-owned utility PLN to address grid expansion challenges.

These initiatives demonstrate a collective shift towards decentralised energy systems, bolstering grid resilience and sustainability. With policies such as China's 14th Five Year Plan, which aims to reduce battery energy storage system costs by 30% by 2025 and mandate energy storage installations for new solar and wind projects, the integration of solar PV and storage is set to grow rapidly. This momentum is essential for utilities overcoming grid barriers and adapting to growing climate risks, making decentralised solar coupled with battery storage a leading solution in the energy transition.

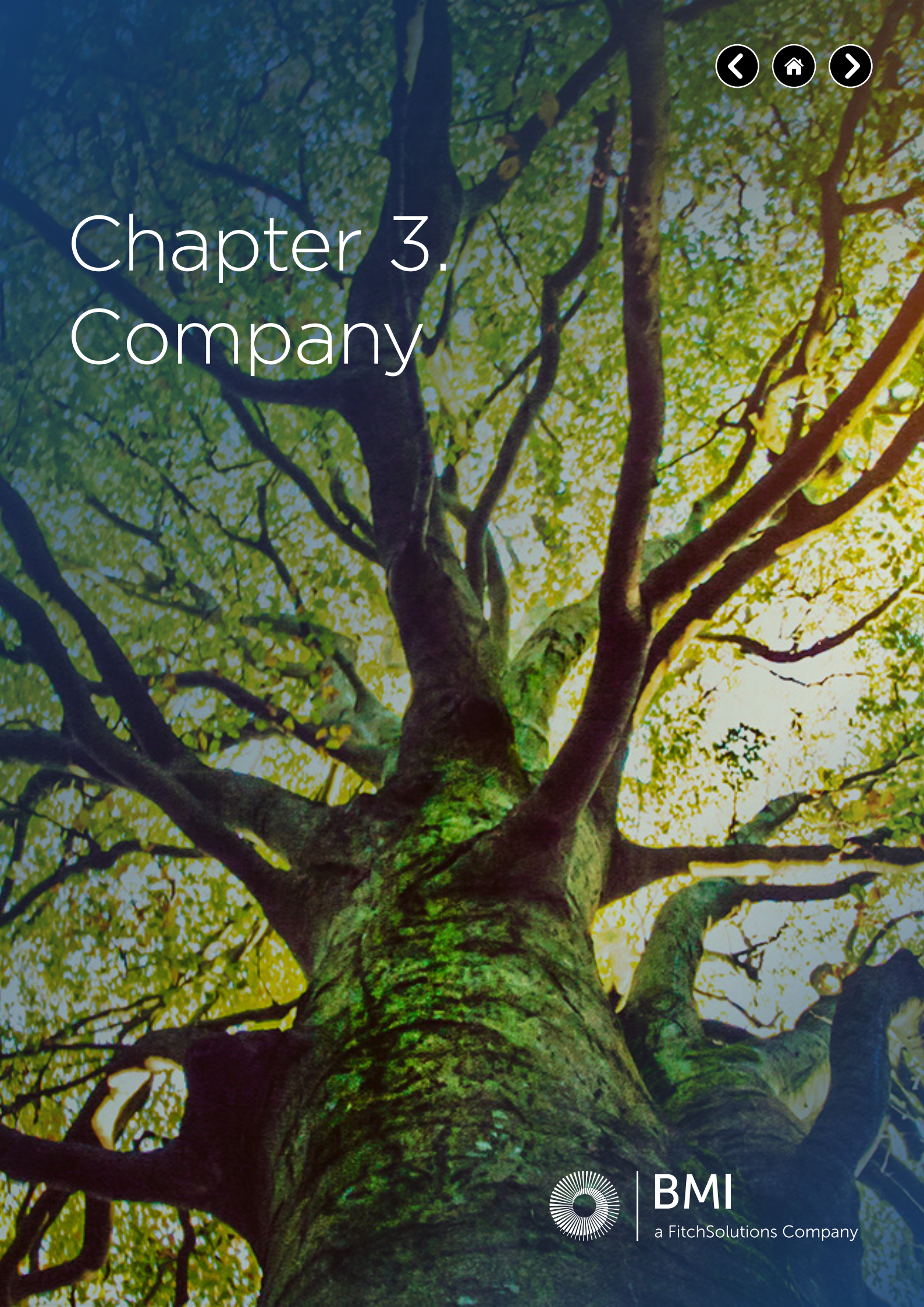
Fig 2.62: Utilities Adapting Through Growing Distributed Energy Resources On Grid Networks

Select Markets – Distributed Solar Additions, GW



e = BMI estimate. Source: ABsolar, EIA, NEA, BMI

Chapter 3. Company



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Company Insights Overview

The company insight chapter builds on the sector analysis undertaken from the Trackers and offers an opportunity to hear more directly the 'insight from industry' via B2B survey analysis (sector comparisons and industry specific reviews of survey responses) and company specific case studies. Companies from across the eight sectors outline the challenges they have faced, as they have made progress on implementing the Paris Agreement objectives (PAO) via:

- the solutions they are launching;
- their successes to date;
- where greater focus is required for the advancement of climate change mitigation;
- the development of adaptation measures to build resilience against the risks associated with climate change;
- and the expansion of contribution to the transition efforts.

The Paris Agreement Objectives Through A Company Lens

Climate Change Mitigation: Company specific targets and pledges to reduce emissions and firm's wider strategies to 'hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels'.

Climate Change Adaptation: Company level assessments of their operational and value chain exposure to the adverse impacts of climate change and the adaptations they are already making and planning to foster climate resilience.

Contribution To The Transition: Company-led investment (including into sustainable R&D products and services) and the creation and evolution of a company's green activities and its contribution to the firm's revenue, which will ensure investment 'flows are consistent with a pathway towards low greenhouse gas emissions and climate resilient development'. Also reviewed within this section is the role a company can play in supporting emission mitigation efforts and adaptation strategies through its value chain and how a company's contribution is aligning with country-level and international goals.

To assess the 'insight of industry' BMI conducted a B2B survey and hosted interviews, along with research into specific firms to create Case Studies of companies that are developing innovative solutions within energy transition, emissions reduction and developing climate resilience.

B2B Survey: BMI surveyed 200 senior executives in May 2024. The survey respondents sit on sustainability committees for APAC-based companies within the eight sectors included in this report. We thank them for sharing their time and perspective on their company and sector's energy transition plans, giving us a view on their strategies, challenges and aims for climate change mitigation and adaptation, and their contributions to the transition.

Case Studies: To offer deeper and direct insight into company specific initiatives that align with the Paris Agreement objectives, BMI undertook interviews with Heads of Sustainability and Chief ESG Officers, as well as researching company specific ESG and Sustainability reports, disclosures and announcements on sustainability initiatives. We thank the interviewees for their time. The choice of companies was guided by firms' carbon neutral and net zero pledges, their engagement in setting commitments and targets via Science Based Targets initiative (SBTi) and in engagement with BMI's Industry and ESG teams, which research and analyse sustainability developments and so are well placed to advise on companies that are undertaking new and significant strategies which support the Paris Agreement objectives. Five Case Studies have been developed from these interviews and research.

Key Takeaways

Survey Insights

Momentum on meeting the Paris Agreement objectives must be maintained, the progress to date is encouraging, with more companies making clearer commitments on net zero and reporting their measures to implement climate change resilience.

To realise greater emissions reductions, companies must invest and adopt new technologies and practices such as decreasing their use of fossil fuels and embracing renewable energy, transitioning from utilising gasoline powered vehicles to electric vehicles and implementing smart metres to track power use and adopt energy efficiency measures.

To develop greater climate change resilience, companies must first expand their assessments to review their full value chains, evaluate financial impact implications and undertake scenario analysis.

Frameworks need to be developed to offer all stakeholders full transparency on company pathways to net zero and greater climate resilience.

A transformative approach to meeting the Paris Agreement objectives is needed to drive greater development of low-carbon and climate-resilient products and services.

Sector Specific Survey And Case Study Snapshot	
Automotive	One in four automotive company survey respondents have made significant progress in low-carbon product/service creation.
Basic Industries	Greater levels of R&D spend on contribution initiatives are needed, with 60% of Basic Industry respondents allocating 10-20% of R&D budgets to carbon emission reduction strategies. Gamuda, the case study for this industry, displays how the sector can lead contribution efforts. The company is already using sustainable materials within its construction projects and vitally, within its engineering initiatives, is creating solutions to contribute to developing climate change resilience, such as their Stormwater Management and Road Tunnel (SMART).
Energy	The energy sector is funnelling investment towards lower emissions, with 75% of energy companies surveyed allocating 20% or over of their R&D spend on carbon emission reduction strategy. Beijing Gas, the case study within the energy analysis segment, showcases the progress on transition already being made. The company, through its natural gas offering, has enabled the city of Beijing to diversify its energy mix and the company is targeting a reduction in its methane emissions to near zero by 2030.
Healthcare	Climate change will place greater stress on health services and facilities, drive up demand for healthcare and pharmaceutical products, and put pressure on pharmaceutical product manufacturing and distribution. In preparation for greater stress on health services and facilities, 47% of survey respondents have stated that they are reviewing the location of their existing operations and assets.
Technology & Electronics	The sector is exploring new technologies when it comes to their energy needs, with 40% of Technology & Electronics respondents stating that they have already implemented hydrogen. Tencent, the case study for the Technology & Electronics segment, is utilising its CarbonX vehicle to advance low-carbon technologies and contribute towards the Paris Agreement targets.
Telecommunications	Strong progress on emissions reduction and a focus on achieving net zero showcase telecoms as an early adopter in the transition to a low-carbon economy. Telecoms companies lead the other sectors, with over 78% pledging a net zero target of 2040 or before, and over 40% aiming to reach net zero by 2030.
Transport	While transport companies' mitigation efforts may lag other industries, this is a sector that is making strong progress in preparing for climate change risks, with transport firms placing specific adaptation focus on extreme weather events. Indian Railways, the case study within the Transportation segment, has considerable experience in preparing for and operating during extreme weather events, with the action plan implemented in the lead up to and during Cyclone Dana 2024 an example.
Utilities	Outages in the Utilities sector will increase as climate change risks become more acute. Over 40% of utility company survey respondents have made progress on implementing physical risk assessments to pinpoint their exposures, and as a first step have increased their insurance coverage. The next step for the sector will be investing in further adaptation measures to actively protect their operations.

Survey Insights: Transformation And Innovation Ensure Low-Carbon Transition

Survey Objective

In May 2024, BMI conducted a B2B survey of 200 companies across the Asia-Pacific (APAC) region. The purpose of the survey was to track company progress on meeting the Paris Agreement objectives and specifically to assess:

i. the successful strategies that businesses have implemented;

ii. the challenges companies face in mitigating emissions, building resilience and adapting to climate change impacts; and

iii. how corporates are contributing by supporting their value chain's mitigation and adaptation efforts.

The survey is a helpful tool for the research as it investigates the following:

- How are companies tracking and reporting emissions reduction and assessing climate change risk?
- What progress are companies making on setting net zero target dates?
- What benefits are companies realising from developing clear and focused policies on meeting the Paris Agreement objectives?
- What strategies and solutions are being implemented by companies to conduct net zero business operations and to develop climate change resilience?
- To what extent are businesses investing in and applying renewable energy technologies?
- How much are companies prepared to invest in R&D that could help to develop a low-carbon economy?
- How can technology improve climate-related business strategies?

Maintaining Paris Agreement Momentum

Disclosure And Reporting Become Part Of Regular Workflow

*Over **80%** of respondents graded their reporting on emissions reduction and adaptation to climate change as being good or very good. This strength in companies' reporting has enabled firms to offer regular disclosures with annual ESG reports now a standard publication and part of corporates' regular workflow.*

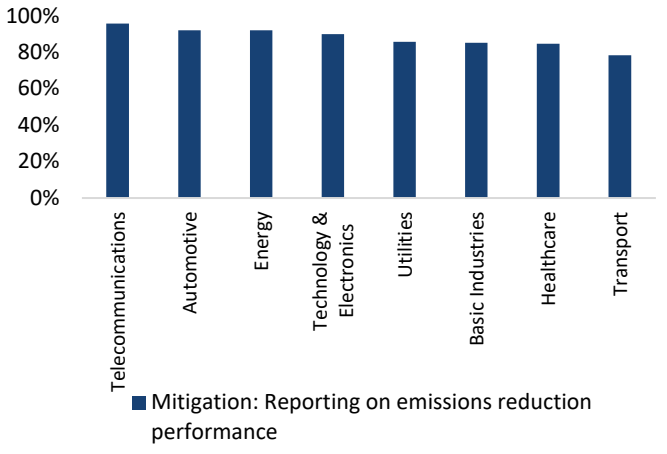
Almost 10 years on from the Paris Agreement, which laid out the climate change objectives of Mitigation, Adaptation and Contribution, BMI conducted a survey of 200 companies in the APAC region to understand the progress that has been made and the challenges that are yet to be overcome.

Nine in 10 respondents grade their reporting standards for emissions reduction performance as good or very good. Over 80% grade their reporting on climate change adaptation at this level.

Sustainability reports have become a standard annual offering for companies, cementing commitments to regular updates on their progress on the Paris Agreement objectives. The tracking and reporting of data around emissions mitigation, climate change adaptation have become standardised. Firms have also become more confident in their measuring and reporting procedures.

Fig 3.0: Improvements In Transport Sector Reporting Would Support Progress On Supply Chain Emissions Transparency

% Of Respondents That Graded Their Reporting On Mitigation & Adaptation As Good Or Very Good



Source: BMI Companies and Climate Change Survey, May 2024

The sectors where respondents show the greatest confidence in their progress on reporting around emissions reduction are Telecommunication, Automotive, Energy and Technology & Electronics. The Transport sector lags behind other industries, but 78% still ranked their reporting on emissions reductions as good or very good. This survey finding could highlight that while all sectors face data collection and reporting challenges, Transport plays a role in multiple sectors' supply chains and so their tracking of Scope 3 emissions in particular are complex.

The volume of reporting by companies on their adaptation to climate change resilience is slightly lower than that of their reporting on emissions and shows how the global movement towards a low-carbon economy and the setting of net zero targets has driven an initial company focus on mitigation reporting. However, the reporting by companies on the development of climate change resilience within their operations is becoming more standardised. Firms are moving beyond just focusing on mitigation to also include insight into their adaptation assessments and strategies. The industries that lead in terms of grading their adaptation reporting as good or very good are Utilities and Energy.

Fig 3.1: Focus On Companies' Net Zero Plans

Almost 1/3 of surveyed companies have set a net zero taget of 2030.

78% of telecommunications companies surveyed are aiming for an early net zero target of betwen 2030-2040.

1/5 of transport firms surveyed have a net zero pledge beyond 2050, or have not even set a date yet.

Just 9% of firms surveyed have yet to reach the stage of commiting to a net zero target.

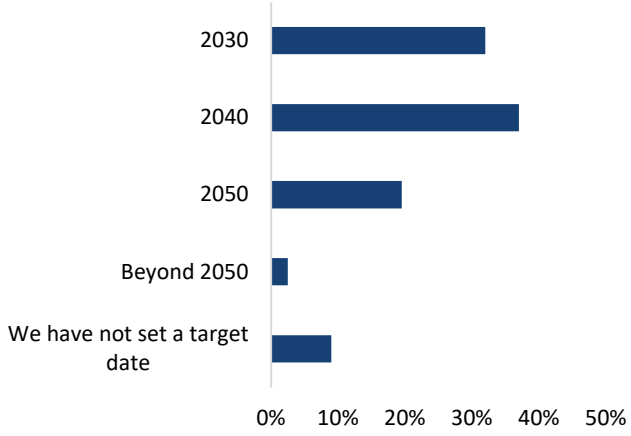
These companies play a key role in the infrastructure of a country and its economic security. Their progress to date on tracking and reporting adaptation to climate change impacts benefits from national climate change adaptation strategies and programmes (NAPs) which have developed to protect the vital sectors and infrastructure of economies.

In China for example, the National Climate Change Adaptation Strategy 2035 was launched in May 2022 with a shifted objective towards proactive adaptation, where previous editions of the NAP focused on a response to the impact of climate change. A greater focus on monitoring and prediction of extreme weather in the 2035 iteration will better enable companies to prepare for climate change events and support their adaptation-focused investment decisions. China's latest national adaptation strategy also expands its sector coverage, with food security receiving greater focus along with supply chains, the financial sector and energy supply.

The progress on tracking and reporting emissions reduction is enabling APAC companies to set relatively early net zero targets of between 2030-2040 and assess their climate change exposure in order to start developing risk mitigation measures.

Fig 3.2: Companies Aiming For Net Zero

Q. Which Year Has Your Company Set As The Year It Will Reach Net Zero?



Source: BMI Companies and Climate Change Survey, May 2024

As many as seven in 10 companies have set a target to reach net zero between 2030-2040. Industry outperformers for 'early' net zero commitments tend to be in the Telecommunications, Basic Industries and Technology & Electronics sectors. Meanwhile, Utilities and Transport companies are lagging other industries with regards their commitment to net zero. As many as 20% of transport companies have set a net zero pledge of later than 2050, or are yet to set a date. This is an important finding as companies in the Utilities and Transport sectors play a significant role in the Scope 2 and Scope 3 emissions of other companies. Therefore, the ability of utility and transport firms to reduce their emissions will be key for other industries to meet their net zero pledges.

Reduce, Adopt, Invest, Disrupt: Creating The Low-Carbon Economy

What is driving the progress of companies towards a low-carbon economy? What strategies have they been implementing to decrease their emissions levels?

Six in 10 respondents state that their company has implemented an energy efficiency policy and waste reduction initiative, with just under half outlining that they have put a renewable power policy in place. This focus on reduction is an understandable first step, with over 70% of respondents listing significant, or very significant progress on the internal reduction strategies of a switch to LED lighting, decreasing waste and optimising water use. These emission reduction solutions have enabled many companies to begin their emissions reduction journey, but firms must now start to move in greater numbers to the next stage, that of adoption.

According to the survey findings, we can see some signs of companies adopting practices, such as:

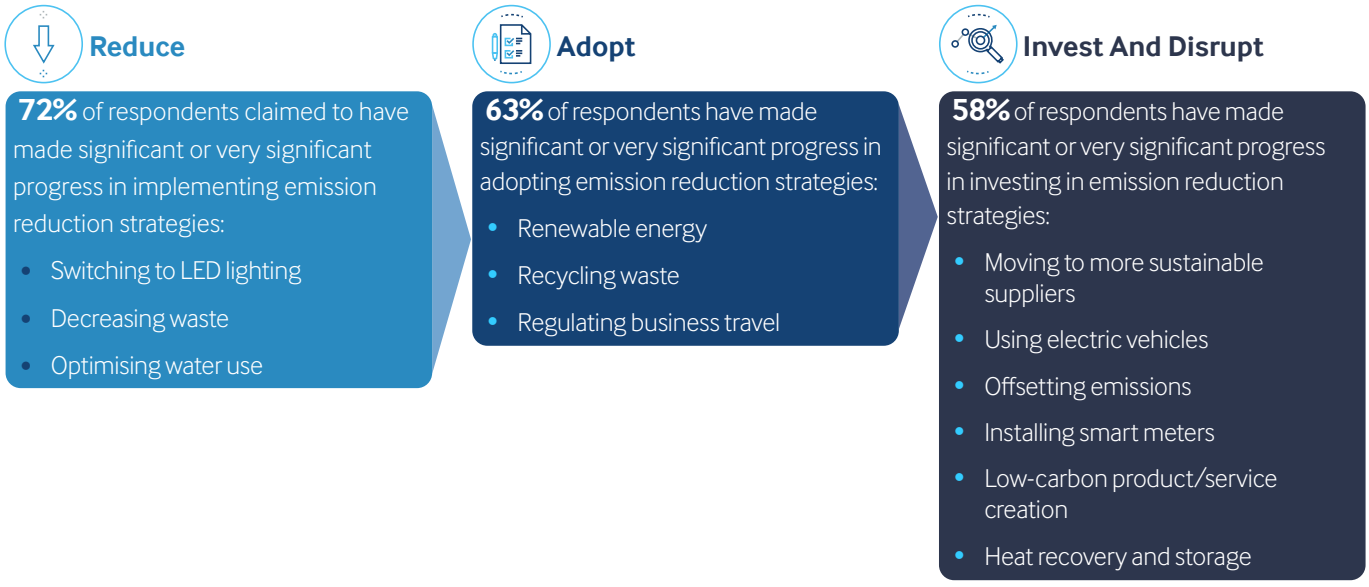
- embracing renewable energy;
- using electric vehicles;
- installing smart meters;
- investing in heat recovery and storage;
- working with more sustainable suppliers;
- recycling waste;
- regulating business travel; and
- creating low-carbon products/services.

These solutions have the potential for disruption. Many will require shifts in decade-long business practices and considerable investment. Some of these required investments, which will support mitigation efforts, will also help companies in their journey towards contributing to a low-carbon economy.

Addressing electricity and heat production with a shift to renewable energy sources is going to be key in order to meet the Paris Agreement's long-term goal of holding the rise in global surface temperature to below 1.5-2 degrees centigrade above pre-industrial levels. Two thirds of respondents state that they have made significant or very significant progress on embedding the use of renewable energy into their operations. What is more encouraging is that industries beyond the Energy and Utilities sectors are taking ownership of their power needs and investing in their own renewable power initiatives, such as investing in solar panels at their facilities, and are not wholly reliant on the power industry to make the switch on their behalf.

Almost half (47.5%) have already implemented their own green power (e.g. investing in their own solar panels), with the rest stating that they are in the planning phase to do so. Not a single respondent stated that they have 'not yet considered' the strategy of implementing their own renewable power. The Basic Industries and Healthcare sectors are non-power sectors that are showing encouraging signs of embracing and implementing their own green power projects.

Fig 3.3: Mitigation Strategies
Respondents Ranked Progress On Emissions Reduction Solutions As Significant Or Very Significant Progress

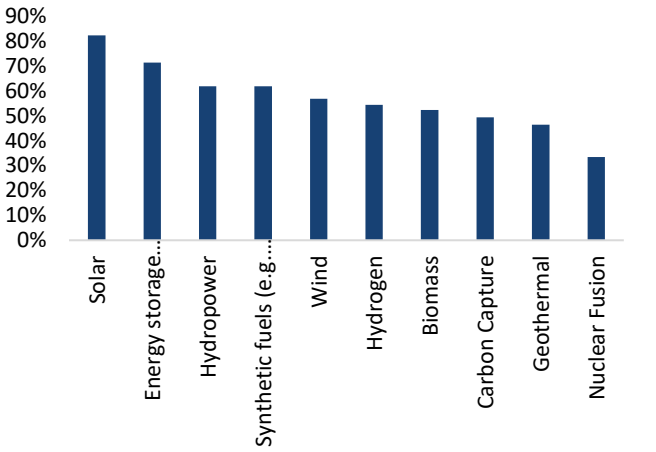


Source: BMI Companies and Climate Change Survey, May 2024

The greater participation of non-power companies in controlling their switch to more renewable energy sources is driving the green power preferences of many companies. Over 80% of respondents stated they are making solar a priority or strong priority as their low-carbon emissions technology of choice, with six in 10 firms already implementing solar strategies to power their operations. While power generating sectors are able to implement multiple types of renewable energy, as it is a core focus of their business, sectors that have a manufacturing focus, such as Healthcare must consider the cost and space available to them for the implementation of low-carbon emission technology. Solar panels are a relatively low-cost and can be fixed to facilities' roof space. One such example is IHH Healthcare Malaysia, which in June 2024 launched an initiative that will run into 2025 to install solar panels across its entire network of hospitals.

Fig 3.4: Solar, A Power Priority

Q: Rank The Extent To Which Your Company Is Prioritising Low-Carbon Emission Technologies (Chart Represents Priority Or Strong Priority Responses)



Source: BMI Companies and Climate Change Survey, May 2024

Cover, Adapt And Optimise, Futureproof: Building Climate Change Resilience

The Paris Agreement objective on adaptation has led to a greater focus on building climate change resilience at a company level, as opposed to just at a country level. Businesses are increasingly witnessing the impact of climate change risk on their own operations and are reacting. For example, the 2023 floods in China are estimated to have cost the economy more than USD13.2 billion and negatively impacted the market's agribusiness sector.

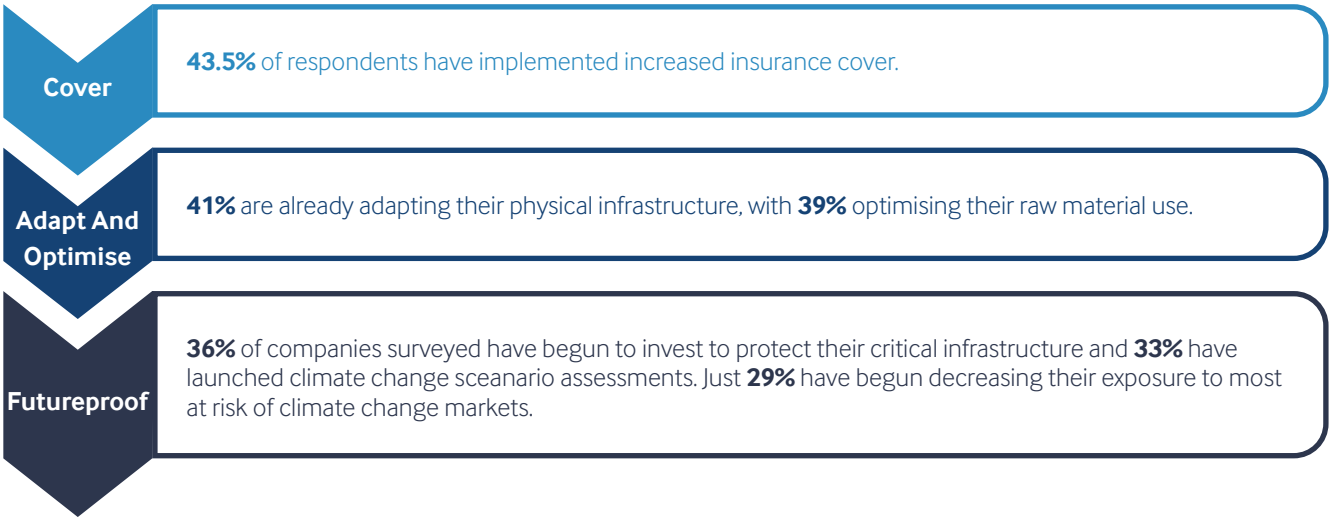
The survey indicates that progress is being made by companies to address the impact of climate change, but still many firms are reviewing and planning ways to build resilience. Six in 10 respondents are at the planning/reviewing stage of their adaptation strategies and just 37% of companies have implemented at least one of the strategies (outlined in Fig 3.5) in developing climate change risk resilience.

Those companies under way in developing their climate change risk resilience measures have placed their initial focus on seeking protection through increased insurance cover; there has been a global rise in insurance product offerings related to climate change risks. Businesses are also telling us that they are prioritising investment in the protection of their workforce and physical infrastructure, and in optimising the use of raw materials to decrease their exposure levels against a deficit in core materials caused by climate change or disruptions to their supply chains.

Futureproofing is under way for some companies but many remain at the planning stage. Further progress will not only ensure greater protection of assets and a reduction in risk exposure, but will also offer opportunities of sustainable revenue generation and perpetration for potential regulation. Considerable costs are associated with futureproofing a company's operations as it requires scenario planning and risk impact assessment, investment in protecting critical infrastructure and potentially the reduction of a company's exposure to its most at-risk markets.

Business location decisions need to include climate change risk assessments and for many sectors, location is partly determined by energy reserves as well as access to water and transport links. There is more flexibility in location for manufacturing companies with several markets in APAC acting as potential production hub options. Climate change risk is therefore not just an immediate risk to company operations but is a risk to economies, with firms assessing their exposure levels to specific at-risk areas within countries and considering their adaptation strategies or diversification options.

Fig 3.5: Implementing Climate Change Resilience Strategies



Source: BMI Companies and Climate Change Survey, May 2024

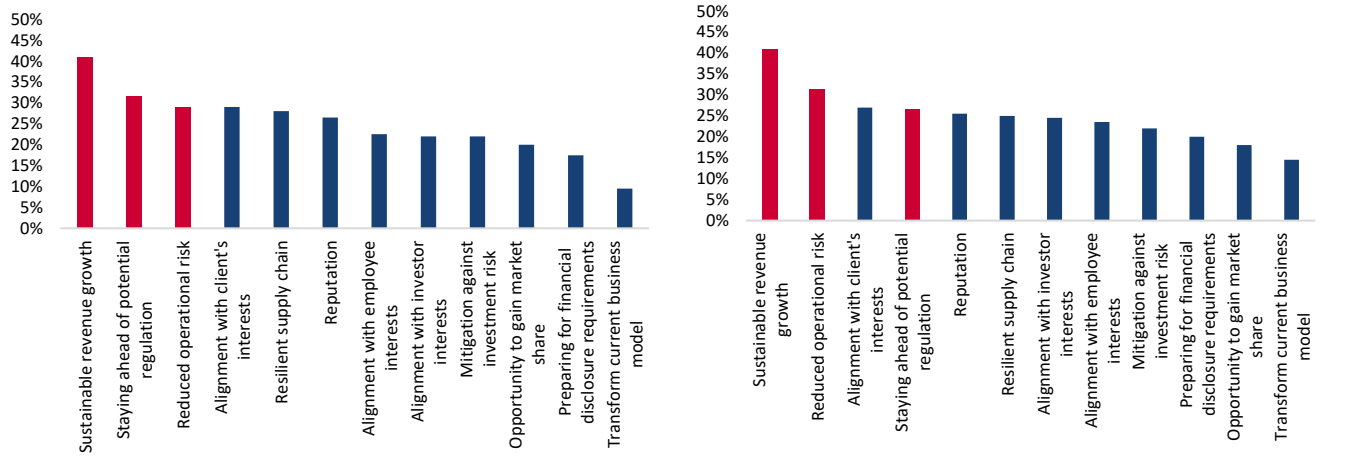
Revenue, Regulation And Risk: Focusing On Benefits Of Transition To Low-Carbon Economy

As companies enter a phase of greater disruption to existing business practices and increased investment to achieve the Paris Agreement objectives, the benefits of the transition to a low-carbon economy must be apparent if momentum is to be maintained.

Respondents told us that the three main benefits of having clear and focused emissions reduction and climate change resilience policies are (i) sustainable revenue growth, (ii) staying ahead of potential regulation and (iii) reduced operational risk. Alignment with client, investor and employee interests and corporate reputation also ranked highly, but the three 'R' focus of revenue, regulation and risk was what emerged most clearly as companies plan their low-carbon journey.

Fig 3.6: Three 'R' Benefits: Revenue, Regulation And Risk

Q. What Are The Three Most Important Benefits To Your Company In Having A Clear And Focused Emissions Reduction Policy (LHC), Climate Change Resilience Policy? (RHC)



Note: LHC = Left-hand chart; RHC = Right-hand chart. Source: BMI Companies and Climate Change Survey, May 2024

Revenue: In meeting the Paris Agreement objectives, companies need to create ways to reduce their emissions, develop climate change resilience and contribute to the low-carbon economy. Increasingly more focus is being placed on contribution and how companies can shift their operations to ensure they are contributing to emissions reduction and the development of climate change resilience. How can companies produce goods and services that are more sustainable and provide solutions to carbon reduction and building climate resilience?

Companies are developing products and services that are sustainable and can support a green economy. This could include offerings to aid emissions reduction and support climate resilience measures.

Eight in 10 companies surveyed are currently working towards achieving between 10-40% of Green Revenues[1] from their revenues stemming from more sustainable product and services offerings by 2030. The most ambitious firms are utilities and autos companies, with 20% and 10% respectively aiming for reporting 60% green revenues by the end of the decade. For this to happen, there will need to be greater levels of innovation in the creation of greener products and services, but the expansion of renewable energy and electric vehicles highlights the progress being made within these two sectors as they move away from traditional fuel and energy sources.

Regulation: The Paris Agreement objective on emissions mitigation is leading companies and countries to set themselves carbon neutral and net zero targets. Greater regulation will be an important tool to help both to achieve their pledges.

1 *Green revenue is a classification system from FTSE Russell which identifies company revenue from products and services contributing to a global green economy.*

Fig 3.7: Countries Emission Pledges A Key Driver of Regulation - Overview Of Emission Targets – Select APAC Markets

Country	Emissions Targets and Pledges Insight
Australia	Commitment to reduce greenhouse gas emissions to 43% below 2005 levels by 2030. Plans to achieve net zero[2] emissions by 2050
Cambodia	Goal of net zero by 2050
China	Planning to reach its carbon emissions peak before 2030 and become 'carbon neutral[3]' before 2060
India	Plans to reduce carbon emissions by 50% by 2030 and pledged to reach net zero by 2070
Indonesia	Targeting net zero emissions by 2060
Korea	Committed to carbon neutrality by 2050
Malaysia	Seeking to achieve net zero carbon emissions by 2050.
Nepal	Commitment to carbon neutrality by or before 2045 and negative carbon emissions by 2050
Singapore	Committed to achieving net zero emissions by 2050
Viet Nam	Planning to achieve net zero by 2050

Source: Climate Action Tracker, Climate Change Authority, national sources, BMI

To date, regulation has focused most on those sectors with the highest emissions and that has meant the greatest focus on the power sector. In China, for example, the market's emissions trading system (ETS) was initially launched in 2021 to cover the power sector but has the potential to be expanded to cover Basic Industries segments such as cement, aluminium, iron and steel. The Basic Industries sector is also being regulated in the EU through the the Cross-border adjustment mechanism (CBAM), a carbon tariff on imported aluminium, iron and steel.

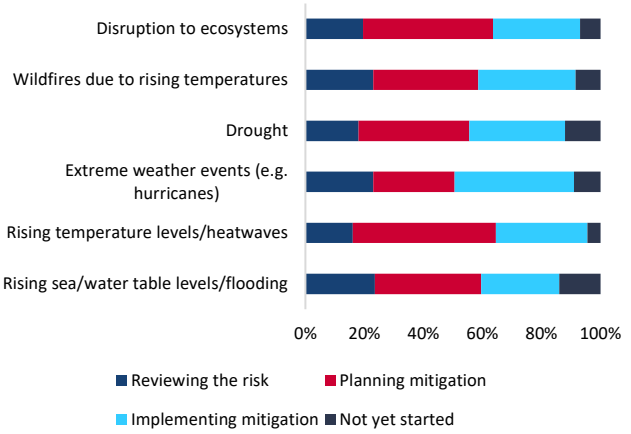
There is the potential of regulations to expand over a greater number of sectors and for regulation to be aligned between markets and so spread globally. The UK for example is due launch its own CBAM by 2027.

2 *Net Zero: Reduction in absolute emissions to support the target to limit global temperature increases to 1.5 degrees Celsius, as agreed in the 2015 Paris climate summit.*
3 *Carbon Neutral: Finding ways to reduce CO2 emissions or removing an equal amount of CO2 from the atmosphere. Focuses on CO2 emissions, as opposed to wider greenhouse gases.*

Risk: Climate change risks differ by country and sector, and companies will face differing levels of exposure due to where they are located and the nature of their operations. Fewer than half the respondents are already taking actions to address extreme weather events (e.g. hurricanes), with planning more likely to be under way for building resilience against a wide array of climate change risks ranging from drought and wild fires to rising sea/water table levels.

Fig 3.8: Further Progress On Climate Change Resilience Needed

Respondents' Preparation Levels For Risks Associated With Climate Change



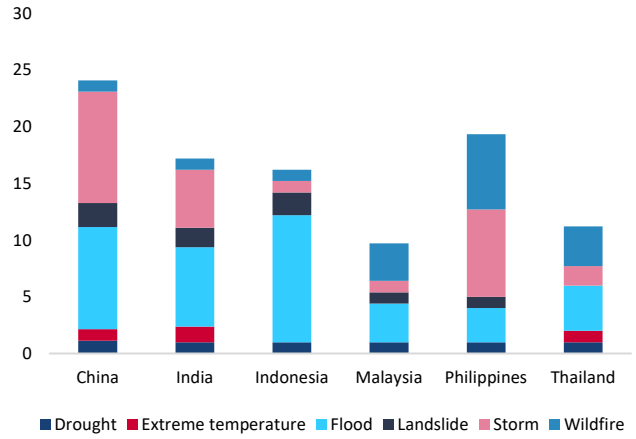
Source: BMI Companies and Climate Change Survey, May 2024

The multiple risks across the APAC region are highlighted by climate data from the IMF (see Fig 3.9), which showcases the operational exposure that companies are most likely to have to navigate.

Companies need to be aware of multiple risks across their operations and value chains, with each country in the APAC region facing a varying degree of climate change risk. Assessing the specific exposure and developing policies that align with the Paris Agreement objectives will enable firms to better adapt to their environment.

Fig 3.9: Assessments Across Operations And Value Chains Needed To Map Differing Climate Risk Exposures

Average Number Of Disasters (2013-2022)



Source: EM-DAT, CRED / UCLouvain, Brussels, Belgium, IMF Climate Data, BMI

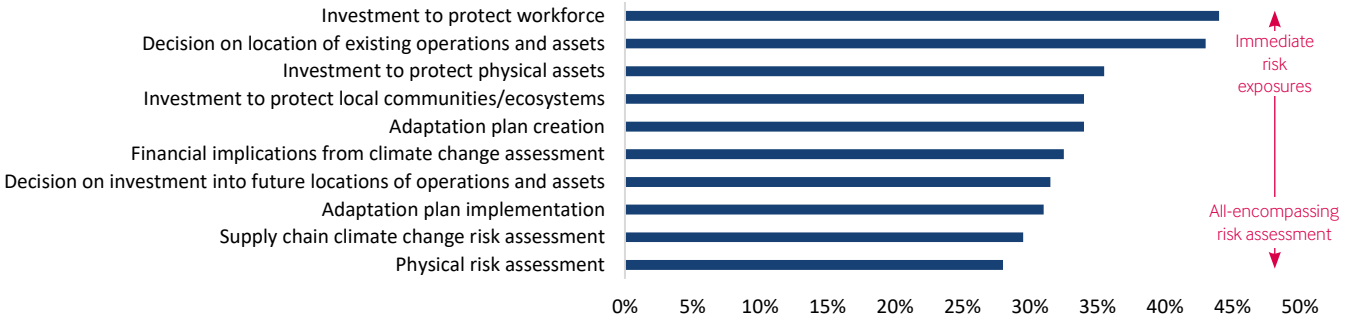
Assessment, Supply Chains And Frameworks: Prepare Now For The Longer Term

How can companies best prepare as emission reduction deadlines loom and climate change risks become more frequent and impact more severely on business operations?

Three themes emerged from the survey responses: (i) the need for greater levels of assessment; (ii) focusing on supply chain challenges; and (iii) the need to develop frameworks to ensure the stages a company needs to take on its emissions reduction journey, and for it to develop climate resilience, are structured and highlighted throughout its business and value chain.

Assessment: Industries must assess the challenges they face. For example, when companies build climate change resilience, they must address the immediate exposures they face and plan for their operational environments to worsen. The progress to date has been focused on addressing immediate risk exposures and investment has been channelled towards protecting workforces and physical assets, as well as decisions on the location of existing operations. Companies must move beyond their current immediate risk exposure strategies and begin to assess the all-encompassing risks they face. An all-encompassing internal operation risk evaluation, such as a physical risk assessment, followed by a review of a company's supply chain, should enable businesses to gain greater insight and transparency across their business units so that they can pinpoint where the greatest climate risk exposures lie, adapt strategies and make the necessary investment. It will also allow companies to identify risks in the longer term. However, only a third of companies have completed a physical climate risk assessment.

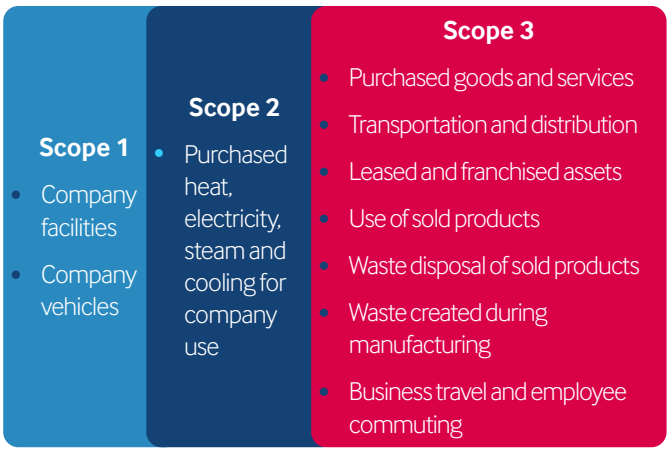
Fig 3.10: Moving Beyond Immediate Risk To Assess Full Risk Profile
Implemented Climate Change Risk Strategies



Source: BMI Companies and Climate Change Survey, May 2024

Supply Chains: A lack of transparency across supply chains is another area that respondents consider a major challenge to their progress on meeting the Paris Agreement objectives. Climate change risk planning and emissions reduction becomes much harder beyond the immediate operations of a company. The fact, as noted above, that transport companies are less advanced in their reporting of emissions reduction is troubling given the extent of the role these companies play in their partners' Scope 2 and 3 emissions. Companies must encourage all suppliers – transport companies especially – to improve the transparency and standardisation of their reporting. Progress will also be made as more companies implement supply chain climate risk assessments; only three in 10 companies surveyed have competed such an assessment, although more than half of the survey's respondents state that they are planning to do so.

Fig 3.11: Transparency Across Supply Chains Will Improve As Firms Make Progress On Tracking Scope 3 Emissions
Scopes 1-3



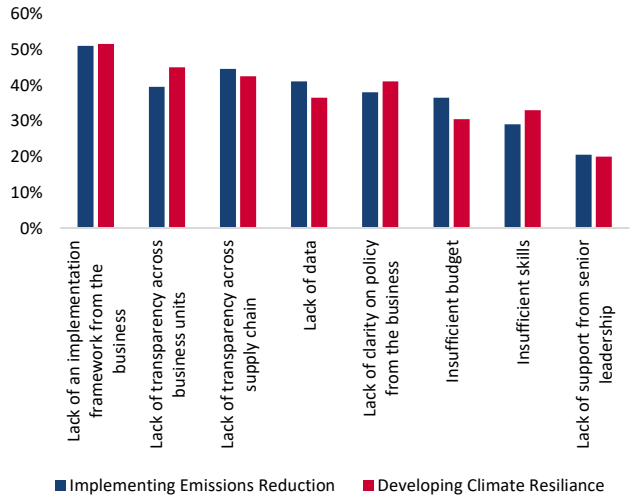
Source: GHG Protocol, BMI

Frameworks: The survey asked companies to rank their three greatest challenges for emissions reductions and developing climate change resilience.

- **Challenge 1:** Lack of implementation framework
- **Challenge 2:** Lack of transparency across business units
- **Challenge 3:** Lack of transparency across supply chains

Fig 3.12: Business Processes And Frameworks Are Key Challenges

Q. Select The Three Greatest Challenges Your Company Faces In Implementing Emissions Reduction & Developing Climate Change Resilience



Source: BMI Companies and Climate Change Survey, May 2024

Over half the respondents listed a lack of implementation framework as one of their top three challenges when implementing emissions reduction and developing climate change resilience. They can ensure better business processes and planning in creating commitments and for businesses to improve the way in which they work more closely within business units and with partners and suppliers. This offers the potential for the two challenges of a lack of transparency across business units and supply chains to also be addressed. Frameworks offer structure and clarity.

Companies have focused on setting emission reduction targets for themselves and addressing immediate climate change risks to their operations. While considerable progress has been made in reporting and disclosing data, with annual sustainability reports becoming a standard offering, a more structured approach needs to develop. Early achievements must now merge into longer-term plans to show how companies will reach carbon neutral and net zero, with milestones along the implementation journey. These frameworks must be outlined internally and externally, so that all stakeholders, from employees, vendors and customers can understand the planned implementation outlook.

These implementation frameworks can form an important record on how companies plan to meet the Paris Agreement objectives in alignment with science-based targets, reporting standards and a structure to outline a company's progress and its plans towards reaching specific pledges. Figure 3.13 outlines options that can support the development of implementation frameworks.

Fig 3.13: Frameworks Will Ensure Continued Progress On Paris Agreement Objectives

Example Eight Stage Framework

Source: BMI

Transformative Approach Needed For Low-Carbon Economy To Become Reality

One of the most surprising results of the survey is the fact that too few companies are using the Paris Agreement objectives as a means to 'transform current business models.' Just one in 10 respondents say that transforming their business model is an important benefit of meeting the needs of the objectives. However, the risks associated with climate change, the need to reduce emissions reduction and the drive for companies to lead contribution efforts are an important business focus and require a form of transformational behaviour.

Because progress to date has been achieved through reduction, optimisation and adaption within existing business practices and models, the opportunity for a more transformative approach to company operations is yet to fully emerge.

The embracing of a more transformative mentality is going to be required for the transition to a low-carbon economy and for companies to develop their resilience to climate change. Some innovation associated with addressing climate change and emissions reduction is emerging. For example, in the Automotive sector, EVs have shifted the fuel dynamics of a whole industry. Within basic industries, a sector where innovation is slower to develop, companies are evolving traditional materials, such as concrete into green concrete in order to decrease their emissions and are creating new working practices to develop climate change resilience in the next generation of buildings.

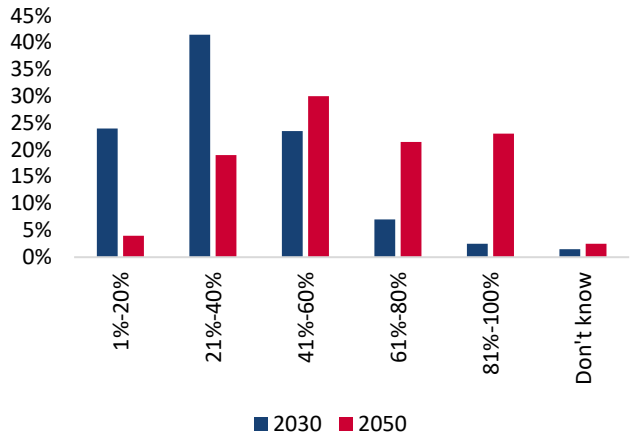
Four in 10 respondents stated that their companies are targeting revenues derived from environmentally sustainable economic activities and products of between 21-40% by 2030. By 2050, almost half plan to lift these revenues to over 60%. To accomplish such targets companies will need to create new product lines and services and new business practices, and business models will evolve driving the emergence of the low-carbon and climate-resilient economy. The research and development (R&D) committed by companies towards carbon emission reduction strategies will also need to grow; just one in 10 of respondents are committing over 41% of their R&D budget towards developing a low-carbon economy.

Innovation to support and drive energy transition to a more sustainable future will emerge internally within companies but will also be supported by evolution in the technology space. The potential of Artificial Intelligence (AI) is steadily becoming apparent, across multiple industries and multiple processes and work practices, and is being explored as a support in helping to achieve the Paris Agreement objectives. 40% of respondents stated that they have already implemented AI to support their company's emission reduction and climate change resilience strategies.

To date, the focus has been on implementing AI to boost optimisation or as a risk reduction solution. The technology has the potential, however, to be a key tool to fast track the development of transformative solutions, especially around predictive applications, such as early warning systems (EWS). The World Meteorological Organisation (WMO) is already exploring AI as it develops EWS, which will support climate risk mitigation efforts and which are going to become even more important for companies as they prepare for climate change impacts and develop resilience strategies.

Fig 3.14: Business Models Need To Transform To Drive Sustainable Revenue

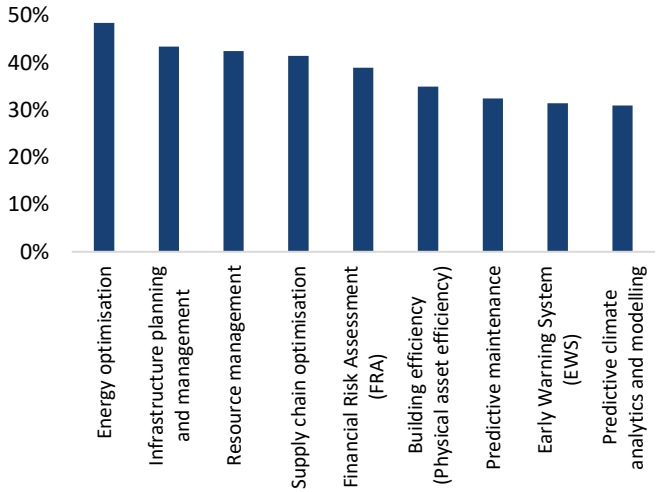
Q. What Is The Percentage Of Revenues Derived From Environmentally Sustainable Economic Activities & Products That Your Company Seeks To Achieve By 2030 & 2050?



Source: BMI Companies and Climate Change Survey, May 2024

Fig 3.15: AI Offers To Fast Track Solutions To Climate Resilience And Emissions Reduction Challenges

Implementation Of AI As A Solution To Support Your Company's Emission Reduction & Climate Change Resilience Strategies

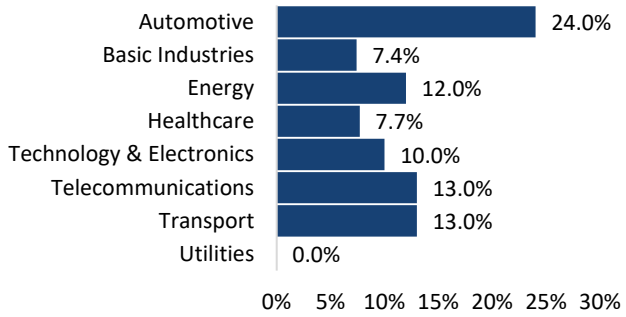


Source: BMI Companies and Climate Change Survey, May 2024

Survey Analysis: Automotive Companies Insight

1. If a transition to a carbon-neutral economy is to be achieved, companies must create low- or no-carbon products and services. One in four automotive companies stated that they have made significant progress in low-carbon product/service creation, outpacing the other sectors, with electronic vehicles revolutionising the automotive sector. This level of progression is enabling a third of automotive firms to project green revenues of over 80% in 2050, ranking it fourth in comparison with the eight sectors.

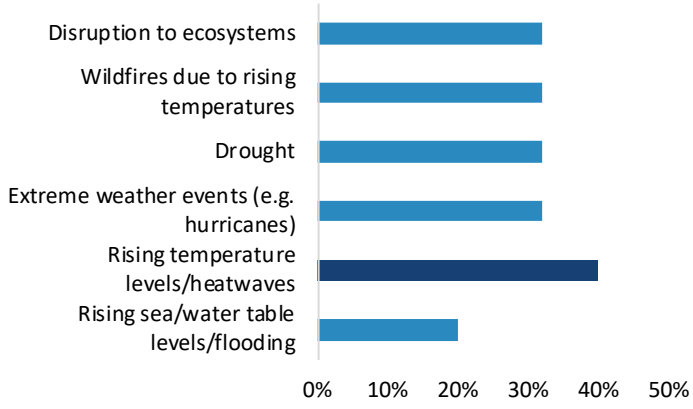
Fig 3.16: % Of Companies To Have Made Very Significant Progress On Low-Carbon Product/Service Creation



Source: BMI Companies and Climate Change Survey, May 2024

2. 40% of automotive companies have completed some form of adaptation strategy to develop climate change risk resilience. Four in 10 companies have already implemented mitigation strategies to address rising temperature levels/heatwaves. This particular focus is understandable, with the manufacturing sector of automotives heavily exposed to extreme heat, causing a threat to workforce health, productivity levels (machinery must be kept cool to operate effectively) and access to continuous power to ensure that operations are not interrupted. The negative impact of extreme heat on automotive operations was displayed in 2022 when factories, including electric vehicle battery manufactures, were forced to shutdown for six days in China's Sichuan province due to a heatwave-related power shortage.

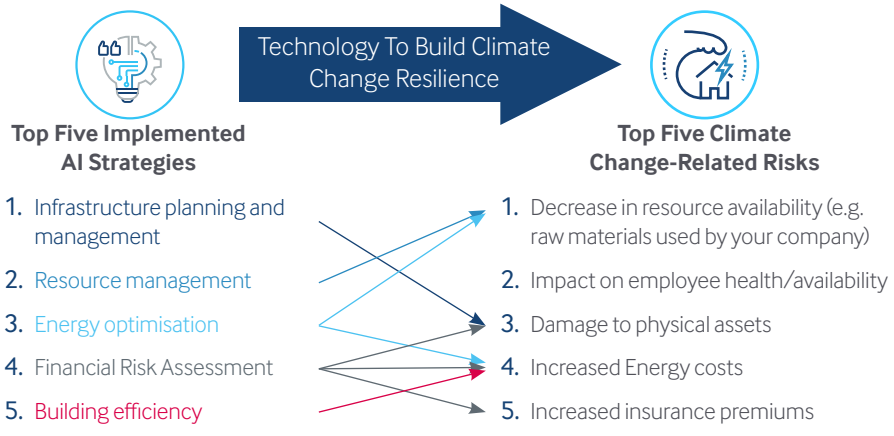
Fig 3.17: % Of Automotive Companies That Have Implemented Mitigation Strategies For Risks Associated With Climate Change



Source: BMI Companies and Climate Change Survey, May 2024

3. Emerging AI technology offers solutions that will fast-track emissions reduction and climate change resilience, with automotives companies acting as early adopters in implementing AI in their operations to aid their progression on the Paris Agreement objectives. Over half of automotive firms have already implemented AI into their resource management strategy, an area of great concern to the sector, with two in three ranking a decrease in raw materials used by the sector as their greatest risk of exposure from climate change.

Fig 3.18: Automotive Companies Top Five Implemented AI Strategies And How They Are Addressing Automotives' Top Five Climate Change-Related Risks

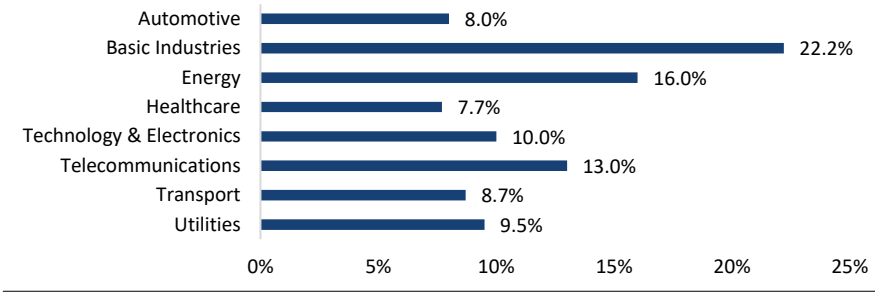


Source: BMI Companies and Climate Change Survey, May 2024

Survey Analysis: Basic Industries Companies Insight

1. One in five companies think that a lack of transparency across their supply chain is the single biggest challenge it faces in implementing an effective emissions reduction strategy. This is an important finding given that Scope 3 emissions in the basic industries sector are so wide-ranging and may explain why more companies in this sector are concerned by their supply chain than companies from other industries.

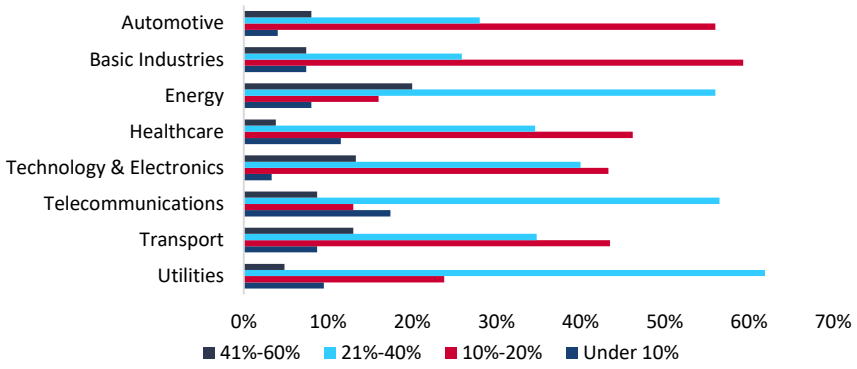
Fig 3.19: % of companies saying a lack of transparency across their supply chain was the single biggest challenge they face in terms of implementing an effective emissions reduction strategy



Source: BMI

2. If companies are to commit to contributing to a low-carbon economy, it is important that they are prepared to spend on investment in exploring low-emission business models. 60%of basic industries companies spend 10-20% of R&D on carbon emission reduction strategies. This makes construction companies among the lowest spenders; they are investing less than energy, technology and transport businesses.

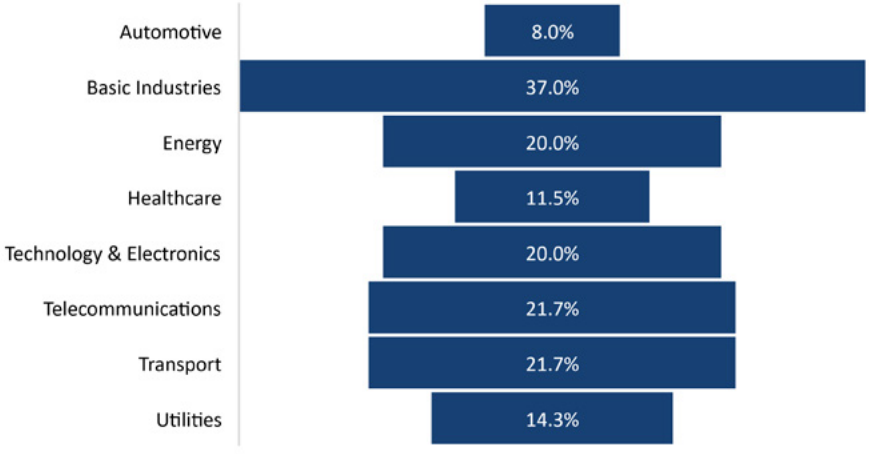
Fig 3.20: R&D spend on carbon emission reduction strategies, by sector



Source: BMI

3. When it comes to implementation of actual commitments, two in three basic industry companies have implemented a green building policy and 80% have implemented a waste reduction policy: these are the two emission reduction commitments basic industry companies are most likely to have implemented. It is important to note that basic industry companies are more likely to have made very significant progress in creating a renewable energy strategy (37%) than businesses from other sectors. The next closest are transport and telecoms companies (22%), decreasing to automotive (8%)..

Fig 3.21: % Of Companies To Have Made Very Significant Progress In Implementing A Renewable Energy Policy As A Carbon Emissions Solution



Source: BMI

Gamuda Berhad Case Study

'Decarbonisation remains a top priority, and we expand our investments in renewable energy sources like solar, hydropower and wind. More importantly, we continue incorporating climate resilience and adaptation designs. This includes implementing greenhouse gases reduction measures, such as embodied carbon calculation, from construction to operation, while ensuring our assets are protected against specific climate challenges.'

Gamuda Berhad ESG Impact Report, 2024

Gamuda Berhad (Gamuda) is an engineering, property and infrastructure company, based and operating in Malaysia, as well as in markets throughout Asia and in the UK. The company is in a unique position to support the Paris Agreement Objectives via its:

- emission reduction targets (mitigation);
- focus on developing resilience against climate change within its own operations, but vitally as an engineering and construction company building in climate resilience measures into its projects (adaptation); and
- supporting emissions reduction in countries, where it operates, through multi-regional engineering, property and infrastructure projects and contributing to the global Basic Industries sector's emission reduction focus. The company's projects which build climate change resilience, such as its Stormwater Management and Road Tunnel (SMART), showcase Gamuda's commitment to supporting the development of climate resilient infrastructure (contribution).

Placing a spotlight on Gamuda's adaptation solutions and progress highlights the company's important role, which goes beyond protecting its own operations from climate change risk, in building climate change resilience for the end users of its infrastructure and property developments.

The company launched its Gamuda Green Plan 2025 in 2021, with this plan and targets now extending to 2030 and beyond. The Plan consists of four pillars which cover the Paris Agreement Objectives, as well as wider sustainability and ESG commitments.

Fig 3.22: Gamuda Green Plan

Pillar 1:	Pillar 2:	Pillar 3:	Pillar 4:
Sustainable Planning And Design For Construction	Our Community In Our Business	Environmental And Biodiversity Conservation	Enhancing Sustainability Via Digitalisation

Source: Gamuda Green Plan, BMI

Mitigation

Gamuda's group emissions across the three scopes stand at: Scope 1: 31,224 tonnes CO2e; Scope 2: 36,699 tonnes CO2e; and Scope 3: 398,606 tonnes CO2e. Gamuda has committed to achieve net zero carbon emissions by 2050 and is making considerable progress already within Scope 1 and 2 emissions reduction.

The company has set reduction targets across its construction and operations for Scopes 1 and 2 of 30% by 2025 and 45% by 2030. In terms of Scope 3 progress, Gamuda has implemented ESG evaluation within its procurement since 2011 and is planning to set Scope 3 targets from 2026.

Gamuda is already ahead of its 2025 target, having achieved a 32% Scope 1&2 emission intensity reduction in FY2024, building on the FY2023 reduction of 23%. This emissions reduction is being achieved through Gamuda's commitment to enabling the supply of renewable energy for the company's offices and project sites, transitioning the company's vehicle fleet to low carbon, as well as creating operational efficiencies.

The total energy that the company sources from renewables reached 43% in 2024, up from 4% in 2022. This is in part being driven by the installation of solar panels at its sites. 4,615 solar panels were installed and active at five of Gamuda's sites in 2022, and have since expanded to 11,252 panels across 17 sites in 2024.

Resource efficiencies are also supporting Gamuda's emissions reduction drive, with the company aiming for a 40% reduction in its carbon emissions across its developments and townships by 2030. By utilising technology (Next-Gen Digital Industrial Building System – NGDIBS) the manufacturing of pre-cast concrete elements and the implementation of sustainable materials is helping to reduce emissions within the construction process. Gamuda is utilising this within its Gamuda Garden Valeria Phase 5A housing project, in Malaysia, with an estimated emission reduction at product stage of 41% and 53% at the construction stage.

Adaptation

Gamuda's role within infrastructure construction has required it to develop a two-pronged strategy towards adaptation, not only assessing and planning for climate change risks to its construction operations but also developing and contributing to buildings and infrastructure that are climate change resilient.

1. **Adaptation In Operations:** Gamuda monitors climate-related risks and has undertaken physical risk assessments. In 2024, it highlighted that its current most relevant risk is that of flooding, with the subsequent operational impact being operational disruptions and increases to maintenance costs. The company estimates approximately MYR6.7 million (USD1.5 million) plant and equipment is in flood risk areas. To reduce its climate-related risks, Gamuda is focusing innovation within its engineering design to reduce the company's exposure and develop greater resilience.
2. **Building In Resilience:** The company is embedding climate change resilience into its projects and has allocated the third pillar, Environmental and Biodiversity Conservation, of its Green Plan 2025 towards this. Through its Gamuda Parks project the company is developing 2,000 acres of green space and waterscapes within its townships, in Malaysia. These will provide cooling measures and sponge rainwater run off to address climate change risks such as increasing temperature and flooding. Gamuda's Pillar 4, Enhancing Sustainability via Digitalisation, is supporting the utilisation of AI in the company's operations enabling the development of climate-resilient designs.

Contribution

Three contribution strategies are emerging within Gamuda's wider sustainability plans: contribution through the construction of renewable infrastructure, contribution towards support and education on emissions within the company's value chain and contributing to longer term emissions reduction at its final product stage.

i. **Contributing To Renewable Power:** Gamuda's involvement in renewable power projects will aid in reducing emissions, with the company supporting developments within solar and wind. For example, the Goulburn River Solar Farm project in New South Wales, Australia, has a planned 585 MWp capacity, which will enable the powering of approximately 225,000 homes and is projected to cut carbon emissions by 910,000 tonnes per annum, supporting the Australian government's target of achieving 82% renewable energy in the nation's electricity grids by 2030.

ii. **Contributing To Sustainable Infrastructure:** Sustainable infrastructure, which features ways to mitigate emissions and ensures climate resilience measures are built in, is another area where Gamuda is contributing to the Paris Agreement objectives. One of the company's projects to develop sustainable infrastructure is Malaysia's Penang Silicon Island (PSI), a land reclamation project which will have the multipurpose use of attracting investment and developing as a tourism destination. To support mitigation, PSA's creation will ensure that 20% of the island is reserved for greening (green parks) and bluing (mangroves, canals and wetlands) initiatives, a strategy to cool the environment by 1-2°C. The Green Tech Park, which will be developed on the island, will be powered by 100% renewable power. The project is also building in climate change risk adaptation, with the minimum platform level set at 3 m above mean sea level to offer resilience against flooding.

iii. **Contributing To The Longer Term:** The installation of solar panels and EV charging points within Gamuda's developments do not only mitigate emissions in the short term but will ensure the longer-term contribution by tenants of these properties to emissions reduction. In 2024, 77% of Gamuda's owned property or investment properties are equipped with renewable energy sources and green facilities.

Spotlight On Adaptation

Constructing And Contributing To Adaptation Solutions

Gamuda's multi-market operations requires the company to navigate numerous climate change risks from extreme heat to flooding. Using data for three of the markets which Gamuda operates in (Figure: 3.23), the variety of risks and their frequency becomes apparent.

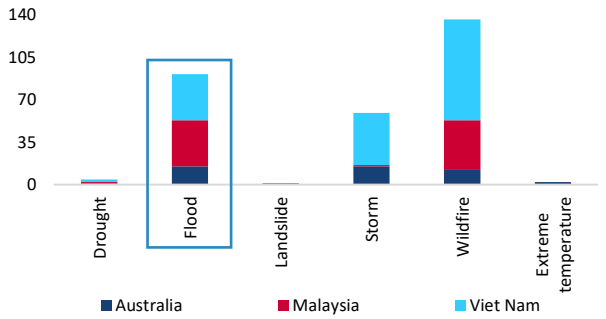
Gamuda has completed its assessment of the potential risks and opportunities of climate change, and this study included the effects of global temperature increases and rising sea levels. This has enabled Gamuda to incorporate adaptations to its project planning and design, as well as assessing climate change risk across the lifecycle of its projects, within construction and demolition. This has ensured that Gamuda is able to identify vulnerable climate risk areas and critical infrastructure and develop a strategy. For example, the company has undertaken flood preparedness and has a response plan in place across all its locations. Gamuda has incorporated its wider ESG risks into its corporate risk register.

'At Gamuda, addressing climate change is both an environmental responsibility and a strategic imperative. As a multi-regional organisation, we face disruptions from extreme weather and shifting climate patterns, necessitating the integration of climate resilience into our business practices. We prioritise resilience and adaptation in our design processes, evaluating climate adaptability to ensure our infrastructure can withstand changing conditions.'

Gamuda Berhad ESG Impact Report, 2024

Fig 3.23: Climate-Related Disasters Frequency

Total Number Of Disasters (2013-2023)



Source: The Emergency Events Database (EM-DAT), Centre for Research on the Epidemiology of Disasters (CRED) / Université catholique de Louvain (UCLouvain), Brussels, Belgium – www.emdat.be.

Fig 3.24: Gamuda's Climate-Related Risk Assessment

Climate Condition	• Increased severity of extreme weather such as floods, water pollution and drought can cause disruptions to the entire business operation • Changes in precipitation patterns and extreme variability in weather patterns • Rising ambient temperatures • Rising sea levels
Potential Financial Impacts	• Reduced revenue from decreased production capacity • Reduced revenue from higher costs due to negative impacts on workforce • Write-offs and early retirement of existing assets • Increased operating and capital costs • Reduced revenues from lower sales/output • Increased insurance premiums and potential for reduced availability of insurance on assets in 'high-risk' locations

Source: Gamuda Climate-related Risks and Opportunities

Gamuda has considerable experience in developing flood adaptation solutions in multiple markets. These include its river restoration and the reduction in riverbank erosion in the Clarence River area as part of its Coffs Harbour Bypass Project in Australia, and the creation of the Wetlands Arboretum within the Gamuda Cove development in Malaysia, which are aiding flood mitigation and shoreline erosion control. Perhaps the most well-known project to date and the one which showcases a flooding adaptation solution is Gamuda's Smart Tunnel in Kuala Lumpur, Malaysia.

Stormwater Management And Road Tunnel (SMART)

Over the last decade (2013-2023), the Emergency Events Database (EM-DAT) has recorded 82 instances of climate-related disasters in Malaysia and 46% of these were flooding events. Under the 12th Malaysia Plan, MNR15 billion (USD3.4 billion) has been allocated for the flood mitigation projects in the country between 2023-2030.

The Department of Statistics of Malaysia (DOSM) estimated that the December 2021-January 2022 floods caused approximately MYR6.1 billion (USD1.4 billion) of losses. The statistics agency's Special Report on the Impact of Floods in Malaysia 2021 outlines the impact across the different segments of the country's economy and highlights that the state of Selangor was hardest hit during these floods, with an estimated loss of MNR3.1 billion (USD700 million).

'Gamuda's success lies in its ability to create advanced solutions and technological innovations to the challenges encountered in all its projects. For example, the SMART project is the world's first infrastructure concept to solve two critical urban challenges: traffic congestion and flooding. It is an early example of critical climate mitigation infrastructure'.

Reaping Rewards From Continuous Innovation, Forbes, 20th June 2024

Fig 3.25: Malaysia December 2021-January 2022 Floods Losses

Malaysia December 2021-January 2022 Floods Overall And Selangor State Losses

Flood Impact Categories	Overall Loses (MYR)	Selangor State Loses (MYR)
Public Assets And Infrastructure	2bn	na
Living Quarters	1.6bn	1bn
Vehicles	1bn	855mn
Manufacturing	900mn	884.5mn
Business Premises	500mn	396.4mn
Agriculture	90.6mn	na

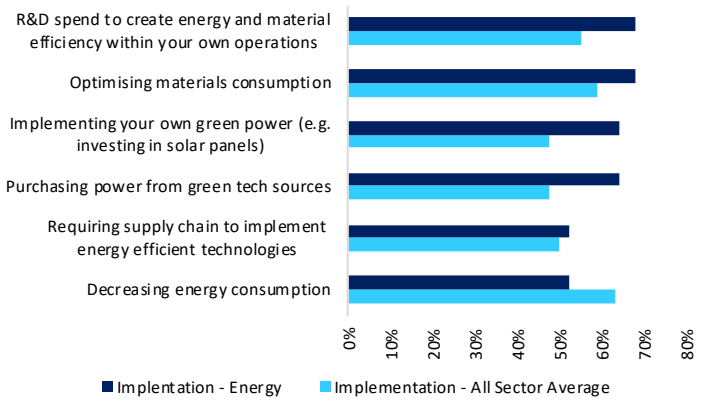
na = not available/applicable. Source: DOSM, BMI

Gamuda has proven its adaptation credentials in offering flooding solutions. In May 2007, the company's Stormwater Management and Road Tunnel (SMART) was launched in Kuala Lumpur, Malaysia. The 9.7 km tunnel functions as both a stormwater bypass tunnel and a tunnel for traffic. It operates a system of 'divert, store and release' and in February 2022 had been activited on 40 occasions, averting an estimated MNR1.4 billion (USD316 million) in damage. On December 18th 2021, during the December 2021-January 2022 floods, SMART diverted five million cubic metres of water. Gamuda's SMART solution showcases how basic industry companies can develop climate change adapatation solutions that benefit cities and their communities.

Survey Analysis: Energy Companies Insight

1. Three in five companies have implemented at least one emission reduction strategy, with the energy sector outpacing the other industries surveyed. Energy has one of the most complex transition journeys and companies must also navigate the growing cost of emissions (via Emissions Trading Schemes – ETS), as well as demand from their customers to provide clean energy. 44% of energy firms highlight one of the three key benefits of having a clear and focused emissions reduction policy is a subsequent alignment with their client's interests. Energy companies have so far focused their implementation on R&D spend to create energy and material efficiencies, optimising materials consumption, purchasing power from green sources and implementing their own green power as strategies to reduce their emissions.

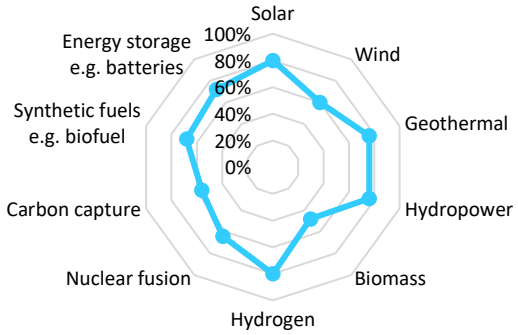
Fig 3.26: % Of Implementation Of Emission Reduction Strategies



Note: All sectors – Automotive, Basic Industries, Energy, Healthcare, Technology & Electronics, Telecommunications, Transport, Utilities. Source: BMI Companies and Climate Change Survey, May 2024

2. Moving beyond optimising operations and towards investment in new lower emission energy sources will be vital for the sector and will drive the wider transition to a low-carbon economy. Companies are investing to revolutionise the Energy sector, with eight in 10 firms ranking the development of the new energy technology, hydrogen, as a priority/strong priority. The opportunities from hydrogen are already starting to be realised in Asia. In 2023, Japan's 'hydrogen town' of Kitakyushu launched its first 100% H2 water heaters. The transition and implementation of new green energy sources requires considerable investment and the energy industry is outspending other sectors, with 75% of energy companies allocating over 20% of their R&D spend on carbon emission reduction strategies. In comparison, only 40% of companies in the segments of automotives and basic industries are committing R&D spend on carbon emission reduction at this level.

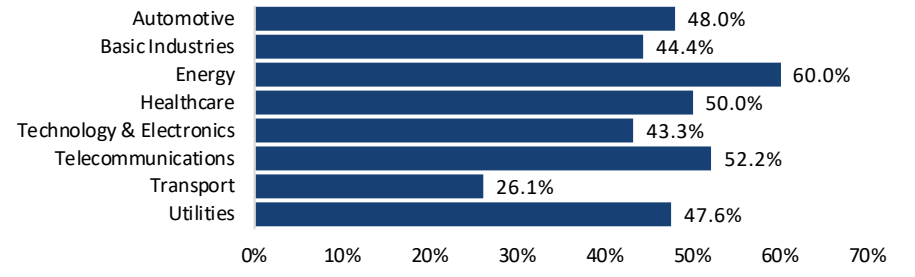
Fig 3.27: % Of Energy Companies Ranking A Selection Of Low-Carbon Emissions Technology As A Priority/ Strong Priority



Source: BMI Companies and Climate Change Survey, May 2024

3. 60% of energy companies list a decreased demand outlook from clients as a great or very great risk to their operations, as other sectors seek to optimise their own energy use and so cutback, as well as seek the lowest emission energy providers to decrease their Scope 2 emissions. The energy companies that transition the quickest by increasing their renewable energy output will mitigate this risk and retain and gain market share.

Fig 3.28: % Of Companies Ranking Decreased Demand Outlook From Consumer/ End User As A Great Risk/Very Great Risk To Their Operations From Climate Change



Source: BMI Companies and Climate Change Survey, May 2024

Beijing Gas Case Study

'BEHL has formulated a climate response strategy featuring proactive strides, forward-looking planning, win-win collaboration and low-carbon operations, which will serve China's carbon peaking and carbon neutrality initiatives and promote the sustainable development of BEHL.'

BEHL 2023 Climate Action Progress Report

Beijing Gas, part of Beijing Enterprises Holdings Limited (BEHL), is the largest single city gas supplier in China's city gas industry, supplying 95% of Beijing's gas usage in 2022. The company plays a key role in the climate transition process and is supporting the Paris Agreement objectives through its:

- target to reduce methane emission intensity to near zero and its evolution towards renewable energy solutions (mitigation);
- rollout of its five stage Climate-related Risk Management System, which has enabled the company to pinpoint its exposure to climate change risk and to develop resilience strategies. (adaptation); and
- investing in natural gas as a transition energy source, expanding into renewable energy and funding the exploration of new energy options such as hydrogen-enriched natural gas (contribution).

Placing a spotlight on Beijing Gas' adaptation strategy showcases the depth of the company's physical risk assessment and how scenario analysis has enabled it to build resilience and be prepared to rapidly react to climate events, such as the severe rainstorm in North China in July 2023.

BEHL is made up of Beijing Gas, BE Water (water), EEW GmbH (energy from waste) and Yanjing Brewery (Beer). BEHL measured its total greenhouse gas (GHG) emissions (Scope 1 and 2) in 2023 (latest available reading) at 2.4 million tonnes of CO2 equivalent. Of this, Beijing Gas accounted for 17%. BEHL has committed to achieve carbon peaking by 2030. BEHL's Climate Action Progress Report primarily focuses on the climate assessment work of Beijing Gas, as a pilot assessment for the wider group.

Mitigation

Natural gas functions as a transition energy source between fossil fuels and renewable energy options. Beijing Gas therefore is already operating within the energy transition segment, producing less carbon dioxide emissions than coal and oil-fired power operations. Beijing Gas is BEHL's second lowest CO2 emitter after the company's energy to waste unit. Of greater emissions focus for Beijing Gas is its methane emissions, as it is BEHL's major methane emitter and methane is the second biggest GHG contributor to global warming. Beijing Gas has a target of retaining its methane emission intensity below 0.1% by 2025, and is targeting its methane emission intensity to be reduced to near zero by 2030.

The next stage of evolution for Beijing Gas is moving beyond supplying transition energy (natural gas) to offering renewable power. The first stage of Beijing Gas' strategy is to support the development of solar and wind power generation in the Beijing-Tianjin-Hebei region and surrounding areas. Over the longer term, the company is looking to also explore geothermal and hydrogen power options. At the end of 2023, Beijing Gas had a contracted volume of distributed photovoltaics of approximately 6.5 MW. Between 2019-2023, the company has undertaken hydrogen research projects and has submitted a construction application for a demonstrative hydrogen refueling station.

Adaptation

In 2023, Beijing Gas put in place its five stage Climate-Related Risk Management System, with the company functioning as a pilot for BEHL's wider climate risk assessments. This specialised risk management process starts with identification, with Beijing Gas collecting climate releated risks internally and across its value chain and then allocating them across a short-, medium- and long-term risk horizon. The next stage of assessments enables the company to view these risks in terms of their liklihood and the extent of their impact on Beijing Gas' operations and assests. The third stage reviews the company's existing measures and their effectiveness, and where required, the formulating/revision of countermeasures. The fourth stage, an assessment of financial impact analysis, evaluates both the impact cost and the cost of adaptation measures. The fifth and final stage, metric and target setting, tracks the implementation and management of climate change adaptation measures.

The identification and assessment reviews within Beijing Gas' Climate-Related Risk Management System has enabled the company to assess and measure the potential impact to its operations and assets from extreme precipitation, extreme heat, extreme cold, typoons, sea level rise and global warming. Beijing Gas' physical risk assessment has pinpointed the company's three greatest risks as extreme heat, extreme cold and extreme precipitation.

Contribution

China has a target of peak carbon emissions before 2030 and achieving carbon neutrality before 2060. Beijing Gas is a major supplier of energy to the Beijing Municipality and is contributing to the administration's transition to carbon neutrality. In 2022, the company supplied 95% of the city's gas usage, with gas accounting for over 35% of the municipal's primary energy consumption. The company has provided research into energy development pathways for the Beijing government by 2025, 2035 and 2050. Beijing Gas' proposals to support Beijing Municipality's strategy towards carbon neutrality are:

- renewable power resources to be coupled with natural gas to ensure energy stability and security.
- reduction in the proportion of coal-fired power from outside Beijing, with Beijing increasing local power generation through natural gas.
- over the long term, implementing carbon capture, utilisation and storage (CCUS) in natural gas-fired power generation and heating to achieve local carbon neutrality.

Beijing Gas is also driving contribution through innovation, exploring new energy options. In 2022, its research project on Adaptation Evaluation and Demonstrative Verification for Hydrogen-enriched Natural Gas, which it undertook with SPIC Hydrogen Energy and Beijing Gas and Thermal Engineering Design Institute, was accepted by the Beijing Municipal Science & Technology Commission.

Spotlight On Adaptation

Risks, Resilience And Reaction

'Beijing Gas is well aware that the impact of climate change on enterprises cannot be taken lightly. Climate change itself is a risk that can directly impact enterprises, and it can trigger other major risks through different ripple effects. Therefore, Beijing Gas has incorporated climate-related risks into its comprehensive risk management framework for review and supervision to rein in the risks.'

BEHL 2023 Climate Action Progress Report

Building on the Climate-Related Risk Management System, Beijing Gas has developed a physical risk assessment. This enables the company to take acute risks (extreme heat, cold and precipitation) and chronic risks (sea level rise and global warming), and review their exposure and outline potential impacts on equipment and operations. Beijing Gas has developed a physical risk assessment process to measure and create sceanario analysis for each of these climate-related risks:

1. Operating region analysis
2. Creation of physical climate risk model (including meteological data and climate simulation)
3. Analysis of physical risk likelihood and impact
4. Analysis of material physical risks (based on exposure)
5. Adaptation analysis

This process has enabled Beijing Gas to map risks by impact location and impact on operations.

Fig 3.29: Beijing Gas Physical Risk Assessment – Risk By Type, Location And Impact

Physical Risk	Operating Regions Impacted	Impact On Operations
Extreme precipitation	All operating regions	• Gas supply facilities, storage tanks, regulation stations and other equipment at risk of flooding (a secondary disaster caused by extreme precipitation), leading to equipment failure, corrosion and damage. • Standing water around LNG receiving terminals may affect their normal operations, leading to equipment damage, power outages and supply chain disruptions. • Employees are unable to safely operate and maintain equipment and are exposed to greater safety risks.
Extreme heat	All operating regions except Hainan province	• Increased demand for gas (e.g. for air conditioning and refrigeration, etc.) puts the gas supply system under stress. • The evaporation rate of LNG increases due to temperature changes, affecting the replenishment rate of storage facilities. • Expansion and deformation of gas pipelines caused by long periods of high temperatures increase the risk of leaks and ruptures, and loosened pipe connections increase the risk of leakage. • Maintenance costs for gas supply equipment and operating costs for site ventilation equipment at risk of increasing.
Extreme cold	All the operating regions except Hainan and Guangxi	• Increased demand for gas (for heating, etc.) puts the gas supply system under stress. • Reduced road transportation and logistics capacity due to extreme cold impact gas supply chains and LNG transportation, increasing the risk of gas delivery delays and supply instability. • Freezing and rupturing of pipelines and valves and damage to gas supply facilities increase safety risks for outdoor workers.
Typhoon	Coastal areas such as Tianjin and Hainan	• Equipment damage and increased safety risks for customers, employees and the public.
Sea level rise	Tianjin	• Due to rising sea levels, seawater will more easily come into contact with infrastructure at receiving terminals, such as pipelines, pump stations and storage tanks. Corrosion by seawater can damage equipment, leading to malfunctions, leaks and losses, increasing operational risks and asset maintenance costs for coastal operating regions of Beijing Gas.

Source: BEHL 2023 Climate Action Progress Report

The development of climate-related risk management systems and physical risk assessments support companies in developing resilience measures, but already Beijing Gas is having to use these processes and findings to adapt and respond. The July 2023 rainstorms in North China were an example for the company of how to react to a natural disaster.

Adaptation In Action: Reacting To Extreme Precipitation

On July 2023, a severe rainstorm in North China led to accumulated rainfall exceeding 400 mm and levels reaching 1,000 mm. Beijing Gas' operations in western Beijing and central and southwesten Hebei were exposed, and the company therefore implemented a natural disaster response:

Coordination: Organising meetings with government bodies to update on impact and outages and cordinate response

Protection: Setting up flood guard booths equipped with personnel and vehicles

Suspension: Suspending construction projects and production operations

Inspection: Inspecting and assessing its pipeline network

Support: Customer service response to residents reports of gas-related issues triggered by the rainstorm and flooding

Service: Investment in post-disaster reconstruction of CNY7.2 million to repair pipelines and install emergency gas supply facilities. Ensuring that by the end of 2023 all gas users had their supply fully restored

Survey Analysis: Healthcare Companies Insight

1. Climate change is a pressing risk for healthcare: the World Health Organisation (WHO) estimates that climate change will cause approximately 250,000 additional deaths per year between 2030-2050, with direct damage costs to health estimated at between USD2-4 billion per annum by 2030. Climate change will place greater stress on health services and facilities, drive up demand for healthcare and pharmaceutical products and put pressure on pharmaceutical product manufacturing and distribution. In preparation for greater stress on health services and facilities survey respondents have outlined where they are currently placing their resources to build resilience. When respondents were asked to note which climate change risk strategy they already had in place, the greatest focus - at over 46% - of healthcare companies listed that, as part of their climate change risk strategy, they have completed making decisions on the location of their existing operations and assets. This focus is understandable as the healthcare sector is on the frontline of responding to climate-related disasters. It is imperative that its operations are not located in high-risk disaster zones and that it has multiple backup operations..

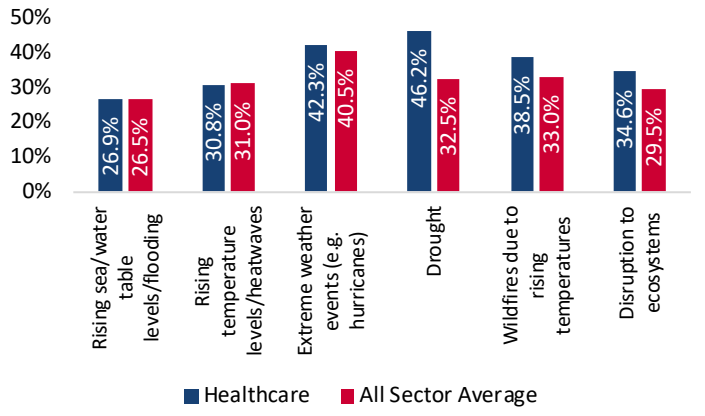
Fig 3.30: % Of Healthcare Companies Ranking Their Top Three Benefits Of Having A Clear Climate Resilience Policy

Source: BMI Companies and Climate Change Survey, May 2024

Increasing healthcare risks from climate change will drive demand within the sector. 50% of healthcare companies acknowledge that one of the three main benefits of having a clear climate resilience policy is sustainable revenue growth.

2. Implementation of climate resilience policies are already needed, with climate change exacerbating risks to healthcare from extreme weather events such as typhoons, heatwaves and droughts. Climate change is already placing pressure on the healthcare sector across the APAC region. Healthcare companies are outperforming firms in other sectors in preparing for climate change risks. Four in 10 have implemented strategies across one or multiple risks associated with climate change. Drought and extreme weather events are risks where healthcare companies have so far focused their mitigation efforts. Flooding, rising temperature levels and heatwaves are areas where the healthcare sector will need to move beyond planning and start implementing greater levels of risk mitigation.

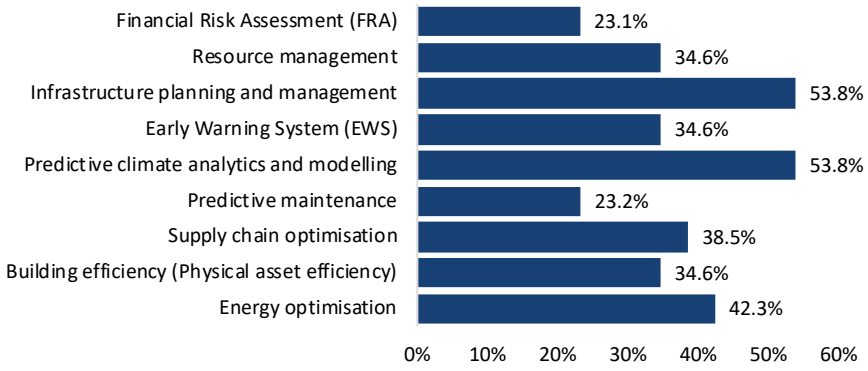
Fig 3.31: % Of Companies Implementing Mitigation For Risks Associated With Climate Change



Note: All Sectors – Automotive, Basic Industries, Energy, Healthcare, Technology & Electronics, Telecommunications, Transport, Utilities. Source: BMI Companies and Climate Change Survey, May 2024

3. AI is one of the emerging technologies that promises to support healthcare companies' emissions reduction and climate change risk mitigation efforts. Multiple AI options are emerging from energy and physical asset optimisation to the development of Early Warning Systems. Healthcare companies are using various AI offerings to support their operations, but their strongest focus, with over 50% of companies having already implemented these AI solutions, is for infrastructure planning and management and predictive climate analytics and modelling. Healthcare infrastructure is at risk from climate change events that might lead to a degradation, or even the complete shuttering of services. At the same time when their services are potentially most at risk from a climate change event is also when healthcare services will see massive demand to the point of being overwhelmed. Scenario analysis and preparing their infrastructure for such events is therefore vital. Equally, utilising predictive climate analytics and modelling via AI will better enable healthcare companies to prepare for such scenarios, enabling them to pinpoint where they will be most exposed and developing procedures and resilience measures before these events unfold.

Fig 3.32: % Healthcare Companies Implementing AI To Support Their Emissions Reduction And Climate Change Resilience Strategies

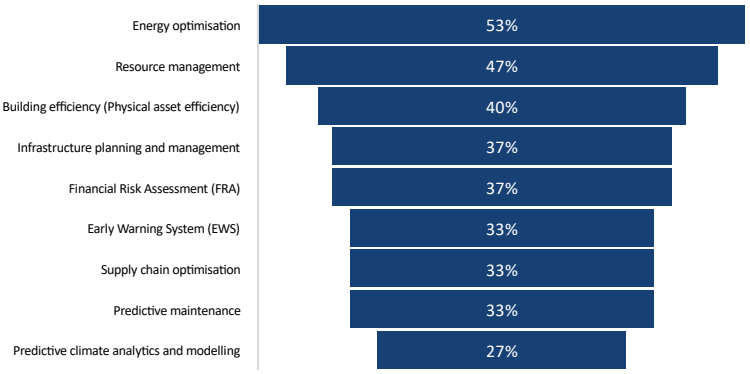


Source: BMI Companies and Climate Change Survey, May 2024

Survey Analysis: Technology & Electronics Companies Insight

1. The high electricity demand associated with the technology and electronics sector makes energy optimisation a priority for the industry to tackle if it is to reduce its emissions. In 2021, Singapore's more than 70 data centres, for example, were accounting for approximately 7% of the country's electricity consumption. Technology and electronic companies are using emerging technology to make these savings, with over half of companies using AI to drive energy optimisation; this is also the AI focus of other energy-intensive sectors such as basic industries, automotives and utilities. A switch to renewable electricity is a next step in the transition journey, with seven in 10 companies already implementing a renewable electricity policy.

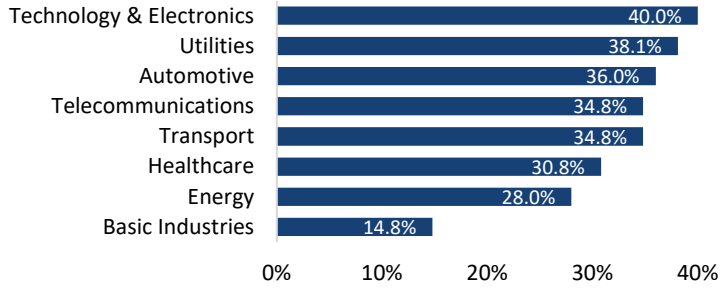
Fig 3.33: % Of Technology And Electronics Companies Implementing Artificial Intelligence (AI) To Support Emission Reduction And Climate Change Resilience Strategies



Source: BMI Companies and Climate Change Survey, May 2024

2. Multiple renewable electricity options are being utilised, with technology and electronics companies placing a strong focus on the development or purchasing of electricity generated from solar and energy storage. Technology companies are making considerable progress in using hydrogen, with 40% saying that they have already implemented hydrogen, with APAC emerging as a test bed for this new technology. Pilot projects for hydrogen to power data centres in Singapore have already been launched.

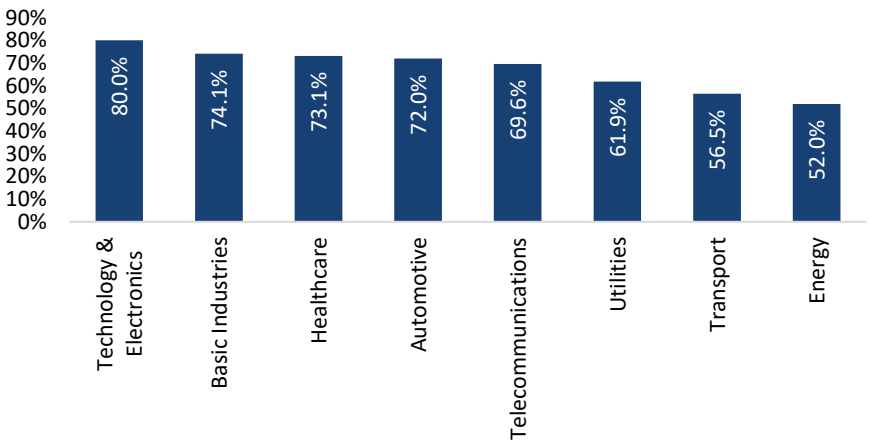
Fig 3.34: % Of Companies That Have Implemented Hydrogen As A Low-Carbon Emissions Technology



Source: BMI Companies and Climate Change Survey, May 2024

3. Rising temperatures, heatwaves and droughts stemming from climate change are a major risk to the technology and electronic industry. Over half the companies from our survey have implemented strategies to start mitigating their exposure to this risk. Extreme heat events create water stress, with water a key component of cooling, especially for data centres. To address this climate change risk, 80% of technology and electronics companies have already made significant, or very significant, progress on water optimisation.

Fig 3.35: % Of Companies That Have Implemented Optimising Water Use



Source: BMI Companies and Climate Change Survey, May 2024

Tencent Case Study

'We believe that digitalization and reducing carbon emissions are the twin wheels driving China's economic development forward. In the future, Tencent will use digital technologies and platforms to promote and facilitate a new low-carbon lifestyle and encourage more users to seriously consider carbon consumption when making choices.'

MA Huateng (Pony Ma), Co-Founder, Chairman of the Board and Chief Executive Officer, Tencent Carbon Neutrality Target and Roadmap Report, February 2022

Tencent, a world-leading internet and technology company, has the opportunity to leverage its position as a digital innovator and via its global reach to support the Paris Agreement Objectives. It is already making considerable progress across:

- reducing emissions, as it implements renewable power to achieve carbon neutrality (mitigation);
- assessing climate change risks to the company's operations and preparing responses (adaptation); and
- designing digital solutions to support its clients' emission tracking and initiate warnings during climate change events. The company is also financing climate innovation via its CarbonX programme to support initiatives that focus on carbon capture, utilisation and storage (CCUS) and technology-based carbon removal (contribution).

Placing a spotlight on Tencent's contribution to date highlights how the company is investing in digital solutions and technology to mitigate emissions and create adaptation solutions to climate change risk. There is a specific focus on Tencent's CarbonX, a pioneering programme, which showcases how companies can invest in tackling climate change beyond their immediate operations.

Mitigation

Tencent has pledged to achieve carbon neutrality in its own operations and supply chain, and to use green power for 100% of all electricity consumed by 2030.

It released its Carbon Neutrality Target and Roadmap Report in 2022, following a year-long GHG emissions assessment and exploration into how the company can achieve carbon neutrality. It has developed three pillars of Carbon Neutrality Initiatives:

i. Energy Efficiency: Energy consumption management and reduction in owned and rented offices, development of heat recovery and cooling systems within data centres, and T-Block data centres have been developed to achieve ultra-low energy consumption.

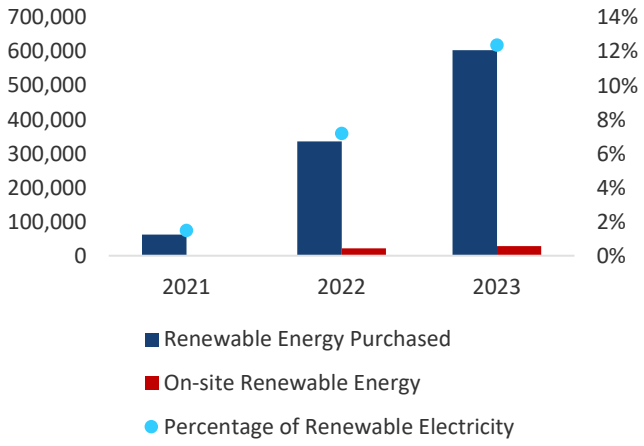
ii. Renewable Energy: Procurement and support of centralised renewable energy power plants (wind and solar).

iii. Carbon Offsets: Supporting emerging as well as carbon-offset technologies.

In 2023, the company's green power purchase avoided >300k tonnes of emissions and its solar PV capacity was up by 166%. Tencent has achieved this through a mixture of expanding its renewable energy purchased and on-site renewable energy. In 2023, the company's renewable energy purchased increased by 79.6% to 604,277 MWh, with its on-site renewable energy growing by 29.5% y-o-y to 28,311 MWh. By the end of 2023, the percentage of Tencent's electricity provided by renewable electricity had expanded to 12.4%.

Fig 3.36: Tencent Rapidly Expanding Its Use Of Renewable Energy

Tencent Renewable Energy Purchased & On-Site Renewable Energy, MWh, Percentage Of Renewable Electricity, %



Source: Tencent Environmental, Social and Governance Report 2023

Adaptation

Tencent has undertaken an in-depth assessment of its climate risks, run scenarios and developed a management framework. The company has assessed its key climate change risks as extreme heat, flooding and tropical cyclones, water stress and drought, and has reviewed the potential impact on Tencent operations. It has also detailed ways in which it is and will respond to these risks, building further resilience into its operations. Tencent's adaptation focus has included the assessment of data centres' response measures.

Climate risk and opportunity are overseen by Tencent's Carbon Neutrality Joint Project Group and the ESG Working Group. Their responsibilities towards climate adaptation include identifying climate-related risks and opportunities, developing a climate response plan, and implementing mitigation measures and investigating opportunities.

Fig 3.37: Adapting To The Climate Risk Reality – Tencent Climate-Related Risks Assessment And Response

Climate Risk	Impact Assessment	Response
Extreme heat	• Higher cooling demand from facilities • Disruption to power supply	• Factor climate into site selection of data centres and use natural conditions to cool equipment • Improve energy efficiency • Strengthen heat resistance and resilience
Flooding and tropical cyclones	• Health and safety risks to employees • Damage to infrastructure and equipment • Temporary suspension of operations	• Factor flooding and water location into site selection (data centres and offices) • Invest in flood gates, secondary drainage, sealed power and fibre ducts in exposed areas • Install equipment that meet requirements for flood and wind resistance grades
Water stress and drought	• Lack of water for cooling data centres will disrupt operations • Increased costs associated with procurement of water during a shortage	• Factor water source and availability into site selection (data centres and offices) • Implement water recycling • Install back-up water facilities, including water trucks

Source: Tencent Environmental, Social and Governance Report 2023

Contribution

Tencent aspires to be a leader in supporting and encouraging society and industries to embrace and transform towards lower-carbon consumption.

The company is investing in three areas to support its end users to reach net zero:

i. Promote low-carbon lifestyles: Educate and guide consumer lifestyle choices via internet products and games e.g. Carbon Island.

ii. Facilitate a low-carbon transformation for the industrial sector: utilising technology to optimise energy efficiency and savings and support businesses low-carbon digital infrastructure.

iii. Support the innovation for sustainable social value: Aid the development of innovative technologies and social value (e.g. emergency response and educational equality).

Spotlight On Contribution

Investing In Digital Solutions And Technology

The digitalisation of the global economy means that companies such as Tencent play a key role in the contribution to a lower-carbon economy, not only through investments and progress within their own operations, but in supporting the transition progress of other sectors. The move to paperless and a reduction in the need for travel (both commuting and business travel) highlight greater levels of digital connectivity and are just some of the early and most obvious ways that the technology sector is contributing to the global economy's optimisation of resources and reduction in emissions. Tencent estimates that its launch of Tencent/Voov Meeting, a video conferencing product (December 2019), has led to a cumulative reduction of more than 15 million tons of carbon emissions by decreasing the need for travel and thus reducing the use of the high carbon-emitting transport sector. Emission reduction and building resilience to climate change risks offer technology companies a unique opportunity to invest in and develop measurement and reporting, management and waste reduction, rapid reaction and optimisation tools to meet the climate challenges the world faces. Tencent is already starting to implement and develop these types of contribution offerings:

'We aim to act as a helper and connector by taking the initiative in assisting the low-carbon transformation of society and supporting low-carbon technologies.'

Tencent Carbon Neutrality Target and Roadmap Report, February 2022

Measurement And Reporting: The digilitalisation of measurements, reporting and verification (MRV) is going to be key to enable companies to track, report and meet data disclosure requirements on mitigation and adaptation, and Tencent is already looking at the next steps to support industries in their tracking and measurement needs by exploring blockchain initiatives.

Management And Reduction: Tencent's Smart Building Management Platform via an Internet of Things solution enables resource management and the potential for reduction (emissions and waste) and has already been implemented by the China Power Investment Corp (CPI).

Rapid Reaction: Social networks have the potential to play a key role in rapid reaction during emergencies, with Tencent's Weixin already utilised to push out emergency government alerts for risks such as earthquakes. This connectivity to large percentages of the population also offers social media platforms the potential to play a role in contributing to adaptation efforts through alerts and guidance during climate change events (e.g. flashfloods and wildfires).

Optimisation: AI is a relatively new technology, but companies such as Tencent are already exploring offering optimisation solutions across multiple industries, both for emissions reduction and building resilience to climate change. Tencent's AI for FEW initiative is seeking to tackle the global challenges of sustainability within food, energy and water.

Innovation, an attribute associated with the technology sector, will be key for the realisation of the Paris Agreement objectives. The technology sector is making considerable progress on innovative solutions towards emissions reduction and developing climate change resilience. In the BMI B2B survey, technology companies came second to only energy sector respondents in terms of the number of companies that were investing over 40% of their R&D budget on carbon emission reduction strategies.

This innovative, solution-led approach to tackling emissions and climate change is on display within Tencent's CarbonX initiative and is an example of how technology companies can support, foster and drive transition contribution.

CarbonX Programme: Investing Beyond Conventional Green Technology

CarbonX, Tencent's vehicle to advance low-carbon technologies, contributes towards the Paris Agreement targets and in supporting global progress for a net zero world by 2050. It was launched in March 2023. The programme aims to target technology at its early-stage development, with investment and guidance enabling the transition from laboratory to industrial use, thereby offering support at one of the hardest stages in a company's development. Tencent has committed CNY200 million (USD28 million) to the programme over a three-year period.

'We must rapidly explore new technologies that can reduce carbon emissions in many industries for which there is no cheap or easy path to decarbonization.'

Dr. Hao Xu, Tencent Vice President of Sustainable Social Value and Head of Tencent's Carbon Neutrality Lab.
CarbonX: Supporting the Next Generation of Climate Technologies.

In May 2023 Tencent awarded its first tranche of investment, at approximately CNY100 million (USD14 million), to initiatives that focus on carbon capture, utilisation and storage (CCUS) and technology-based carbon removal. Three initiative tracks were created:

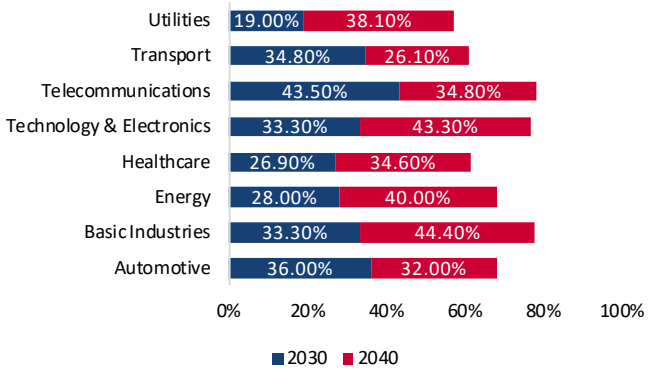
- CarbonX Lab: Designed to incubate research institutions, universities or labs that bring in game-changing climate solutions
- CarbonX Accelerator: Designed to accelerate the growth of climate-tech startups that exhibit commercialisation potential
- CarbonX Infrastructure: Designed to support capacity building to facilitate industry development

From 300 applications, 13 teams won investment, with solutions such as using steel slag to capture and store carbon from furnace exhaust, converting CO2 aviation fuel and employing new approaches to capture CO2 from the atmosphere. It is estimated that, once commercialised, these technologies will have the potential to eradicate 100 million metric tons of CO2 per annum.

Survey Analysis: Telecommunications Companies Insight

1. Strong progress on emissions reduction and a focus on achieving net zero rapidly make telecoms an early adopter in the transition to a low-carbon economy. Compared to the other sectors, telecoms companies tend to have a lower emissions footprint, but this does not detract from the success that telecoms companies in APAC are making to reduce their emissions. Over 95% of telecoms companies rank the reporting of their emissions reduction performance as good or very good; the majority have in place tracking and reporting tools by which to measure their progress in reducing emissions and are making firm net zero pledges. Telecoms companies lead the other sectors, with over 78% pledging a net zero target of 2040 or before, and over 40% aiming to reach net zero by 2030.

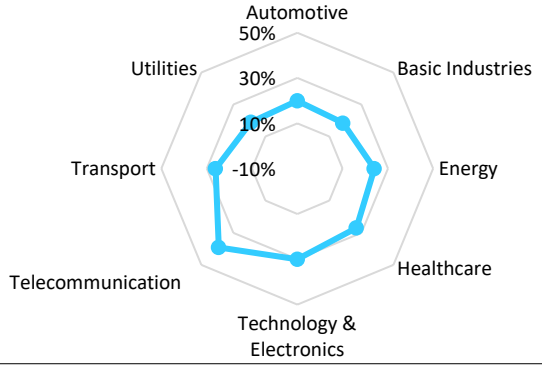
Fig 3.38: % Of Companies' Net Zero Target Dates



Source: BMI Companies and Climate Change Survey, May 2024

2. While the optimisation of resources and power use play a role in the progress of telecom companies in their emissions reduction, switching to greener power will ensure the sector meets its targets. Telecoms companies are focusing on investing in energy storage and wind, with 61% and 48% of firms utilising these technologies to support their emissions reduction strategies to date. Four in 10 telecoms companies are implementing geothermal technologies, more than all other sectors. For example, PLDT of the Philippines and its wireless unit Smart Communication Inc signed a deal in May 2023 with Philippine-based geothermal provider Energy Development Corporation (EDC), which is projected to reduce PLDT and Smart's CO2 emissions by 16,000 tons per annum.

Fig 3.39: % Of Companies Implementing Geothermal As A Low-Carbon Emissions Strategy

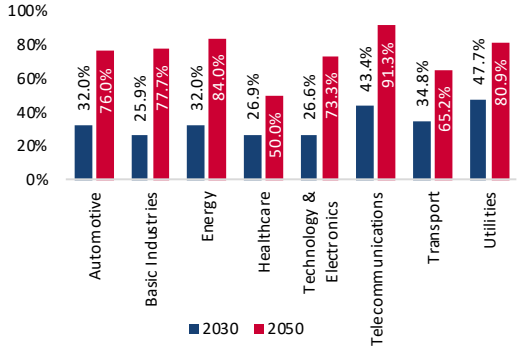


Source: BMI Companies and Climate Change Survey, May 2024

3. Four in 10 telecoms companies are planning for green revenues to account for over 40% of their operations in 2030, and this is projected to rise to over 90% of companies achieving this level of green revenues by 2050. It is, however, not enough to create low-carbon products and services that will drive green revenue generation – the sector must also make greater progress at the end of its value chain.

   Waste disposal and recycling are the areas telecoms companies are pinpointing in terms of their most significant emission reduction challenges. Solutions to reduce emissions in these segments of the telecoms life cycle are being implemented and include recyclable/ biodegradable packaging associated with the telecoms sector, a reduction in SIM card sizes to reduce plastic waste and buy-back/ recycling schemes for telecoms products.

Fig 3.40: % Of Companies Planning For Green Revenues Of 41% Or Higher

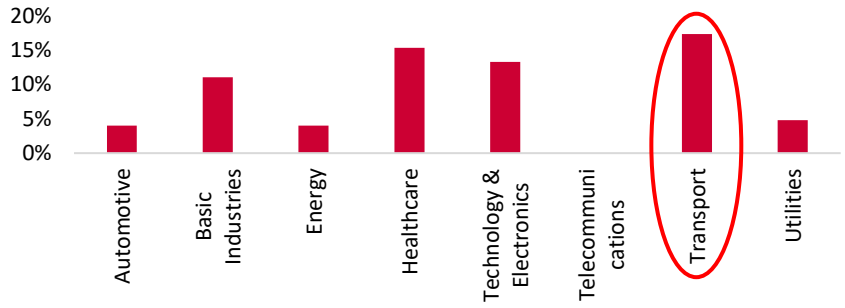


Source: BMI Companies and Climate Change Survey, May 2024

Survey Analysis: Transport Companies Insight

1. Transport companies point to a lack of data and a lack of clarity from within the business as a key challenge they face in implementing emissions reduction. A net zero target is vital in terms of setting emissions reduction policies; however, the Transport sector lags others in terms of setting net zero timeframes. Nearly one in five transport companies have not yet set a net zero date.

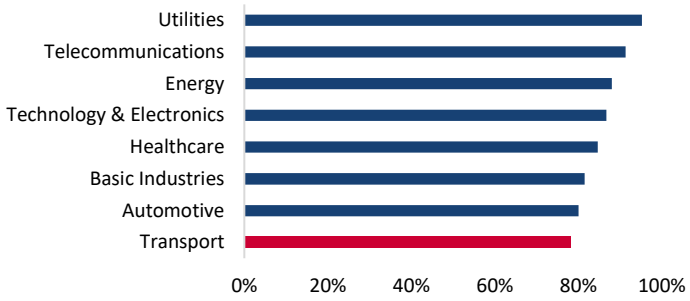
Fig 3.41: Not Yet Set A Net Zero Target Date



Source: BMI Companies and Climate Change Survey, May 2024

2. A lack of data is impeding the Transport sector's ability to report its emissions reduction performance with confidence. Although 78% of respondents rank their emissions reduction reporting level as good or very good, this lags other sectors, where over 85% of respondents rank their standards of reporting at this level. The benefits of making progress on emissions reduction polices and reporting are well understood. It seems that transport companies understand this as they grade the benefit of gaining market share from a clear and focused emissions reduction policy more highly than other sectors, as their clients require this information to address their Scope 3 emissions.

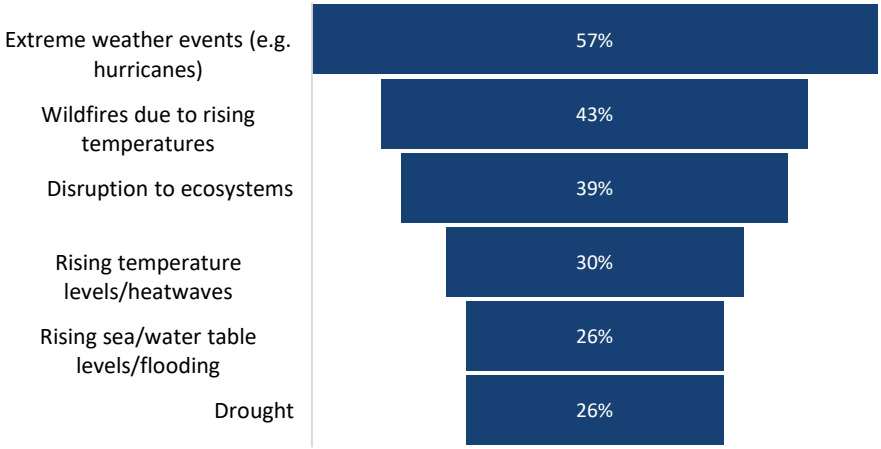
Fig 3.42: % Of Transport Companies Ranking The Reporting Of Emissions Reduction Performance As Good/Very Good



Source: BMI Companies and Climate Change Survey, May 2024

3. Transport firms are making strong progress in preparing for climate change risks. Transport and healthcare companies are ahead of the other sectors in terms of implementing risk mitigation for climate change. Multiple climate change risks threaten transport operations, but the greatest focus to date has been on extreme weather events, with over half the transport companies implementing mitigation measures against extreme weather events, which can have a major impact on wider supply chains with potential disruptions on rail and road networks, ports and aviation.

Fig 3.43: % Of Transport Companies Which Have Implemented Mitigation For Climate Change Risks



Source: BMI Companies and Climate Change Survey, May 2024

Indian Railways Case Study

'We need to take care of the environmental concerns along with the economic development to ensure sustainability. Indian Railways has embarked on a mission to improve energy efficiency and replace fossil fuel sources with renewable energy sources like solar and wind to achieve net zero carbon emissions by 2030.'

Vinod Kumar Yadav, Chairman of the Railways Board, UN Environment Programme

Indian Railways, India's national railway system operator and the fourth largest railway network in the world is making considerable progress in supporting the Paris Agreement Objectives via its:

- emissions reduction, with a specific focus on its electrification programme (mitigation);
- assessing climate change risks to the company's operations and preparing responses, especially in relation to preparing for and reacting to cyclones and flooding (adaptation); and
- investing in expansions and upgrades, so that the company can ensure greater volumes of freight are carried by rail, instead of on India's road network, and so support the market's wider emission reduction strategies (contribution).

Placing a spotlight on Indian Railways' mitigation efforts to date showcases the company's short-, medium- and long-term emissions reduction strategies. Indian Railways electrification programme is almost complete and has enabled the company to decrease its use of higher emitting diesel traction. The implementation of company sponsored renewable power over the medium term will further reduce emissions, as will Indian Railways' innovative approach to exploring new traction power options (e.g. hydrogen).

Mitigation

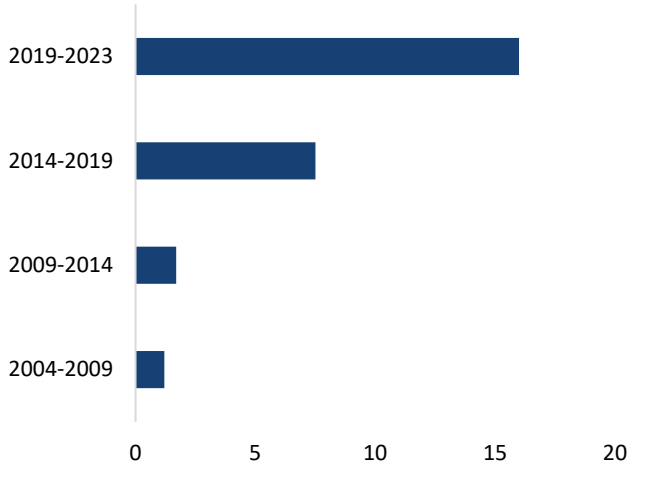
Indian Railways, India's national rail system operator, announced its target to reach net zero by 2030 in June 2021. The railway, which is the fourth largest in the world, plays a key role for both passenger and freight transport in India. Over the last decades, however, the national highway network has started to play a greater role. In 2021-2022, the railways carried 26% of India's freight traffic, down from 63% in 1990-1991.

Dedicated Freight Corridors (DFCs) seek to address the balance. The DFCs are part of a strategy to increase the share of rail in freight loadings to 45% by 2050 and decrease road freight. Known as the Indian Railways' Golden Quadrilateral, the DFCs link the four metropolitan cities of Delhi, Mumbai, Chennai and Howrah, and two diagonals (Delhi-Chennai and Mumbai-Howrah). The total lengths of Eastern & Western DFCs have a completion target of December 2025. The Dedicated Freight Corridor Corporation of India Ltd (DFCCIL) has noted that this modal shift will aid in the reduction of greenhouse gas (GHG emissions) from India's transport sector, with an Ernst & Young study assessing that the DFCs will save more than 450 million tonnes of CO2 in their first 30 years of operation.

Indian Railway's electrification drive is another element of the company's emission mitigation efforts. In 2015, 45% of the railway network was electrified. By January 2024, this had reached 94% of lines, and India's Prime Minister Narendra Modi pledged at this time that Indian Railways would achieve 100% electrification within 'a few months'. Indian Railways is expanding its electric locomotives fleet, with 10,238 electric locomotives in service as of December 2023, compared to 4,543 diesel locomotives. To reduce emissions even within its diesel fleet, the company is using a 5% blending of biofuels in traction diesel fuel.

Fig 3.44: Indian Railways Network Electrification

Average Route Kilometres (rkm) Of Electric Railway Installed In India (rkm/day)



Source: Indian Railways, Energy Monitor

Adaptation

India faces multiple natural disaster threats and Indian Railways has a long operational history of navigating them and building in resilience measures. Climate change means, however, that these risks of flooding, storms (cyclones) and extreme heat are likely to become more prevalent and severe, requiring the company to develop new and longer-term adaptation strategies.

According to climate-related disasters frequency data from the IMF, over the last decade (2013-2023), India's greatest risk stems from flooding, followed by storms and then extreme temperatures. Flooding and storms, such as cyclones, can cripple railway operations by flooding tracks, damaging rail-related infrastructure and causing landslides that can block lines and disrupt operations for weeks/months.

Indian Railways has considerable experience in adapting to flood and storm risks and has well-tested strategies in place. In some instances, rail operations must be halted, with trains cancelled, and that is the safest course of short-term risk mitigation. It is imperative how Indian Railways is able to restart operations and decrease the impact of flooding and storms on its lines and infrastructure. Indian Railway's preparation for Cyclone Dana in October 2024 highlights how the company is able to put its adaptation strategy into action during a live climate risk event. Preparing for the worst and having backup options has proven key for the company. In planning for Cyclone Dana, Indian Railway's East Coast Railway (ECoR) zone took the following actions:

- Operated a disaster management cell to monitor Dana's impact on railway operations;
- Put specialised teams in place to restore tracks and signalling systems;
- Placed diesel locomotives on standby (should the electric network be knocked out);
- Located equipment for restoration work near vulnerable locations; and
- Cleared silt near lines to decrease the risk from landslides.

The company's monitoring of its infrastructure to build a vulnerability picture is another element of its adaptation strategy. In October 2024, it was reported that Indian Railway's South-Central Railway (SCR) had undertaken a review of hydraulic data of its bridge network in flood-prone areas in order to assess their operations and decrease rail traffic disruption.

Indian Railways is also utilising vacant land next to its railways for afforestation, a measure which can build support against landslides. It is also planting trees to deliver green cover and shade around its railway stations, an adaptation measure to offer protection to passengers and railway workers from extreme heat.

Contribution

Indian Railways plays a vital role in India's transport network and economy, carrying over eight billion passengers and over 1.4 billion tons of freight per annum. As part of India's net zero plans, the railway is set to play an even greater role as the nation seeks a modal shift from road to rail, with plans for Indian Railways to expand its role in the national freight mix to 45% by 2030.

The railway operator's progress on mitigation and adaptation will therefore contribute to India's emissions reduction and climate change resilience strategies. It is estimated that India's transport sector contributes 12% of the country's GHG emissions, with railways making up 4%. Indian Railway's plan to be a net zero carbon emitter by 2030 would eliminate 7.5 million tonnes of CO2 equivalent per annum for India and will support the country in its target of reaching net zero by 2070.

At over 42,000 miles in length and the fourth largest national railway network in the world, Indian Railways emissions reduction will contribute to the decrease in global emissions. The railway company's mitigation strategies will also serve as a case study for other railway operators globally to review and potentially utilise. Indian Railways achieved 45% electrification of its network in a five-year period and the share of electrified lines across its total network is now higher than the EU, UK and US.

Indian Railways' expertise could also help contribute to other markets' railway development and modal shifts from road to rail, which would decrease their emissions. An example of this is Indian Railways joint venture, announced in September 2024, with Wabtec to manufacture Indian-made locomotives at the Marhowra plant for export to Africa. The Evolution Series ES43ACmi locomotives feature a diesel-electric engine, with plans for export to commence in 2025.

Spotlight On Mitigation

Implementing Renewable Energy To Support Electrification

'We need to invest more in renewables to meet the energy requirements of Indian Railways and to realise its climate change commitments."

Dr D Dhanuraj, chairman of the Kerala-based Centre for Public Policy Research, Energy Monitor

Indian Railways' emissions reduction strategy can be divided into three time periods. Over the short term, the company has reduced its emissions through its development of DFCs and the electrification of the lines and traction. Over the medium and longer term, Indian Railways looks set to focus on renewable energy (both through purchasing agreements, but also through the development of its own solar and wind generation).

Fig 3.45: Indian Railways Emissions Reduction Strategy - Timeframe Of Emissions Reduction Strategy

Short Term	
	Expansion Of DFCs: Facilitating modal shift from road to rail.
	Electrification Of Lines And Traction: Decreasing emissions through the reduction in diesel-powered locomotives.
Medium Term	
	Investment In Solar Power: Utilising vacant land and station roofs for solar plants and panel to generate electricity for traction and station facilities.
	Investment In Wind Power: Increasing wind power plants within its power portfolio.
Long Term	
	Exploring New Traction Power Options: Hydrogen for heritage lines.

Source: News articles, BMI

Via its electrification of its lines and locomotive fleet, Indian Railways has displayed its transition credentials. The next step for the company is playing a role in expanding India's use of renewable sources for electricity generation. In 2024, BMI estimates that India's electricity generation from coal power will account for just over 70% of the market's total electricity generation. Coal powered electricity generation is a high CO2 emitter, and while coal remains a dominate fuel in India's electricity generation mix, its role is decreasing, BMI highlights that coal accounted for over 77% of electricity generation in the county in 2015. During this period (2015-2024), India's use of solar power to generate electricity has expanded from 0.5% in 2015 to an estimated 6% in 2024, making it now India's third largest power source for electricity generation after coal and hydropower, having overtaken natural gas in 2022.

India's renewable power push will support in providing cleaner electricity to Indian Railways, but the company itself is also implementing its own role in the transition from fossil fuels to renewable energy. The railway firm has installed wind energy production and its capacity exceeded 103 MW as of June 2024. By utilising its vacant land, Indian Railways has also developed solar energy production and it has added solar panels onto its station roofs and administrative buildings. As of June 2023, the company's solar production capacity had exceeded 238 MW and was being used to operate trains, as well as powering Indian Railways' railway stations and buildings. Indian Railways will continue to expand its renewable generation capacity, with reports estimating the company has 51,000 hectares of vacant land that has the potential to be utilised for solar generation. The company is also starting to explore other renewable energy sources to support its operations, with the company trialling the use of hydrogen for traction.

Exploring Hydrogen For Heritage Lines

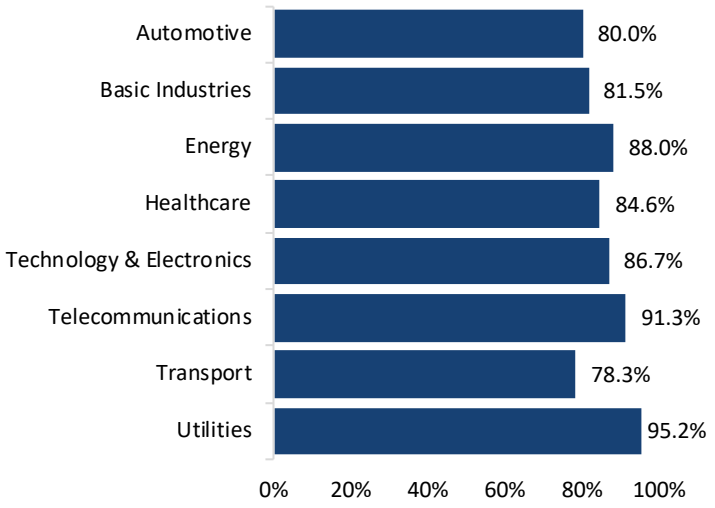
Steam, diesel and now increasingly electric, Indian Railway's traction fleet has utilised multiple power options, and its current electrification push is part of the company's emissions reduction strategy and transition to low- or zero-emission fuel. The increased use of electricity will, in the short term, still create emissions due to India's power mix, but Indian Railways is investing in its own renewable power through solar and wind projects. A subsequent step, which the company is already starting to explore, is next-generation clean power.

Indian Railways has already investigated using solar to power a train. In 2017, a train with 16 solar panels producing 300 Wp was trialled from Sarai Rohilla in Delhi to Farukh Nagar in Haryana. The trial has moved no further, but the company is exploring another low emission power source: green hydrogen. The 'Hydrogen for Heritage' project, which was expected to commence in late 2024, is a pilot project running between the Jind-Sonipat section of Northern Railway, using a Hydrogen Fuel cell on an existing Diesel Electric Multiple Unit (DEMU). The plan is that 35 hydrogen trains will be developed for Indian Railways and will be used on the company's heritage/hill routes, such as the Darjeeling Himalayan Railway and Nilgiri Mountain Railway.

Survey Analysis: Utilities Companies Insight

1. Nine in 10 companies think that they are tracking their emissions reduction performance well or very well, with the sector outperforming other industries. Over 80% of companies measure their reporting of emissions reduction performance at this level. The implementation of tracking and reporting procedures has enabled the sector to understand its emissions footprint and start planning for mitigation. It has also ensured companies can provide data to their vendors and clients, with utility providers featuring within Scope 2 emissions of multiple industry supply chains. The outcome of tracking and reporting emissions has highlighted the scale of the challenge for this sector to rapidly decrease its emissions and achieve net zero. Under 20% of utility companies are aiming to reach net zero by 2030, with longer lead times required to make the transition. Meanwhile, 76% of companies are aiming for net zero by 2050. Utilities companies recognise that they need to make greater progress on their transition journey, but they must do so in balance with ensuring power system security.

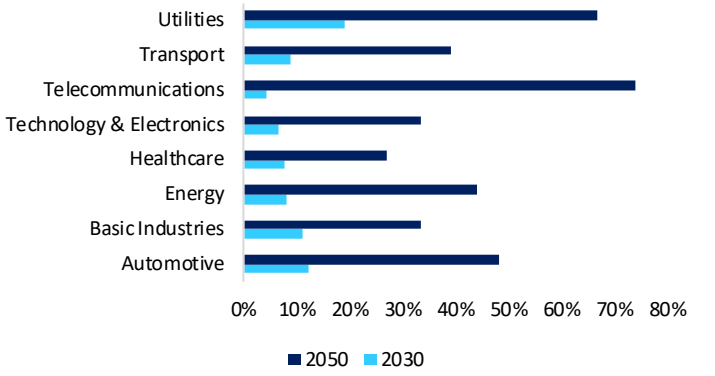
Fig 3.46: % Of Companies Measuring Their Tracking Of Emissions Reduction Performance As Well And Very Well



Source: BMI Companies and Climate Change Survey, May 2024

2. Progress on emission reduction by utility companies is being made, with many firms embracing renewable power options, the key mechanism by which electric generation and distribution firms can contribute to the Paris Agreement. While only 20% of companies are planning for green revenue contribution to exceed 60% in 2030, the number of companies pledging to meet this green revenue bracket is set to increase to six in 10 companies by 2050. To expand their green generation capacities, utility firms are focusing on traditional renewable power technologies, showcasing this sector's need to balance sustainability with power system security and provide a mix of power generation options. Seven in 10 companies have already implemented solar strategies, and over 50% are implementing hydropower strategies to support carbon emission reductions.

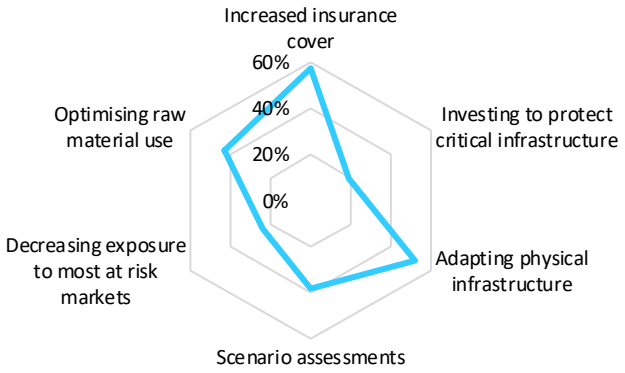
Fig 3.47: % Of Companies Seeking To Achieve Green Revenues Of 61% And Over In 2030 And 2050



Source: BMI Companies and Climate Change Survey, May 2024

3. Strong progress in assessing climate change risks, with the focus now shifting to addressing and implementing strategies to combat climate change risk, is vital for a core infrastructure sector such as Utilities. Power outages will increase on the back of climate change, and companies must invest to build resilience and power system security. Compared with the other sectors, utility companies have made greater progress in implementing physical risk assessments (over 40%) as they seek to ascertain their risk exposures and start planning how to mitigate them. Over half of companies pinpoint their greatest climate change risk as stemming from extreme weather events. The most immediate solution utility firms have been implementing is increasing their insurance cover (57% of respondents have already done so), followed by adapting their physical infrastructure. The next stage will be for companies to invest in protecting their critical infrastructure. Only two in 10 companies have so far implemented this strategy, with the industry underperforming the other sectors. The benefits of investing and building climate change resilience will ensure the power generation sector can perform its key role of ensuring power system security. Companies also note that those that make the greatest progress now will also be the ones that can benefit from greater levels of market share as 76% of respondents highlight the opportunity to gain market share and sustainable revenue growth as being key benefits to having a clear climate resilience policy.

Fig 3.48: % Of Utility Companies That Have Implemented Climate Change Resilience Strategies



Source: BMI Companies and Climate Change Survey, May 2024

Chapter 4. Countries

BMI
a FitchSolutions Company

BMI APAC Low-Carbon & Climate-Resilient Transition Index

The Index is a benchmarking tool measuring the progress of 15 markets in APAC in their journey towards a clean energy future. The assessment is rooted in four main pillars, three which measure the Paris Agreement objectives (Mitigation, Adaptation and Contribution) and a final pillar, Investment Risks, to provide insight into the investment environment that a country's energy transition is facilitated by, while also informing stakeholders on the opportunities and risks in the region's energy markets:

Mitigation encompasses strategies to reduce emissions, such as phasing out fossil fuels, promoting the adoption of renewables and reducing energy intensity.

Adaptation includes a market's ability to reduce exposure to climate risks such as drought and rising temperatures, as well as the capacity to manage growing intermittency.

Contribution to the transition is an assessment of the existence and effectiveness of market policies and regulations in promoting emission-reduction technologies.

Investment Risks considers the investment environment of a country by measuring hurdles, such as legal or logistical risks. This component also measures how effectively a country can capitalise on energy transition investment or how investment risks could slow the transition.

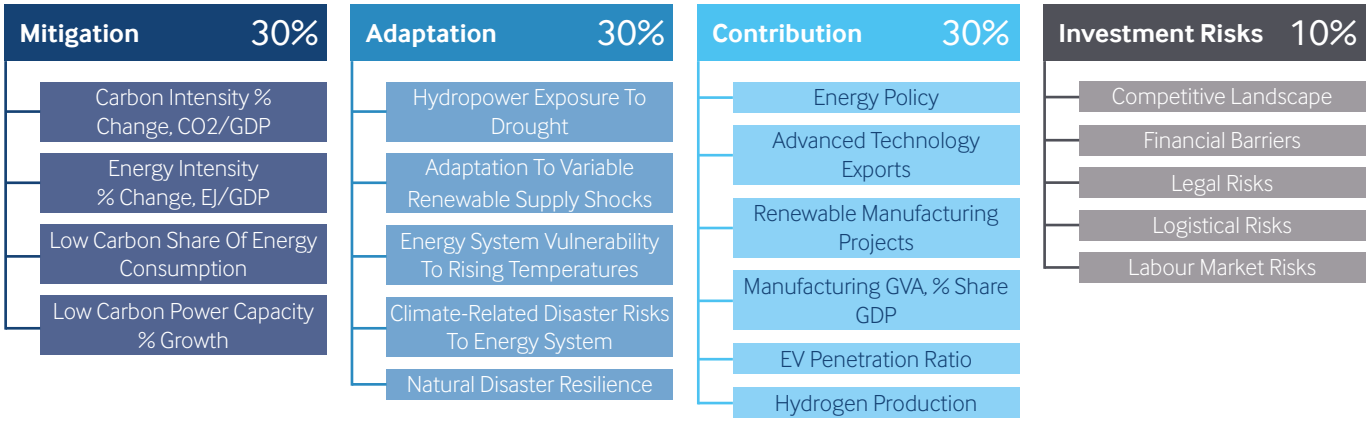
The Index Framework closely aligns with that of the Basic Industries Tracker. However, where the Basic Industries Tracker measures a company's capability to invest in the energy transition, the LCCRT Index Framework measures the investment risks within a country to measure how attractive a country is to investors, which determines the level of funding a country may have in the energy transition.

The realisation of the Paris Agreement objectives (Mitigation, Adaptation and Contribution) will only be accomplished through greater commitments and progress at the industry, company and country level. This report has so far showcased the progress to date and the development trajectories of industries and companies. We now turn the focus to countries. Specifically, we look at their progress in transitioning to low-carbon energy through the lens of the Paris Agreement.

Shifting to low-carbon energy is essential for limiting global temperature increases to below 2°C compared to pre-industrial levels, while also striving to achieve the 1.5°C target. For this, emissions reduction must be realised, with the largest sectoral emitter being the energy sector. The UN reports that the energy supply sector (electricity, heat and other energy) is responsible for approximately 35% of total global emissions. Considerable progress towards lower- or low-emitting energy is steadily being achieved, while energy companies are setting their emissions reduction targets and installing growing levels of renewable energy. Wider industry is taking ownership of a portion of their energy needs, with the B2B survey in this report noting that 47.5% of respondents across eight industries have already implemented their own renewable energy within their operations (e.g. investing in solar panel installation). A greater focus on energy security is emerging, not only the need for a diverse mix of energy solutions to exist, but also how the sector can prepare and build resilience to address the risks of climate change.

The energy sector of a country is critical infrastructure, and the government retains a level of oversight, often with state-owned energy entities playing a key role, or a sole role in the segment. Countries are key drivers in determining the direction and pace of the transition to a low-carbon economy. They can, and are, implementing emissions reduction policies, climate change adaptation measures and contribution standards in the energy transition. Countries across APAC are demonstrating their commitment by setting carbon neutral, Net Zero and decarbonisation targets at a national level.

Fig 4.0: BMI APAC Low-Carbon & Climate-Resilient Transition Index Structure



Note: The 2024 LCCRT Index Framework has been updated since 2023 to more closely align the pillars with the Paris Agreement objectives. Source: BMI APAC Low-Carbon & Climate-Resilient Transition Index

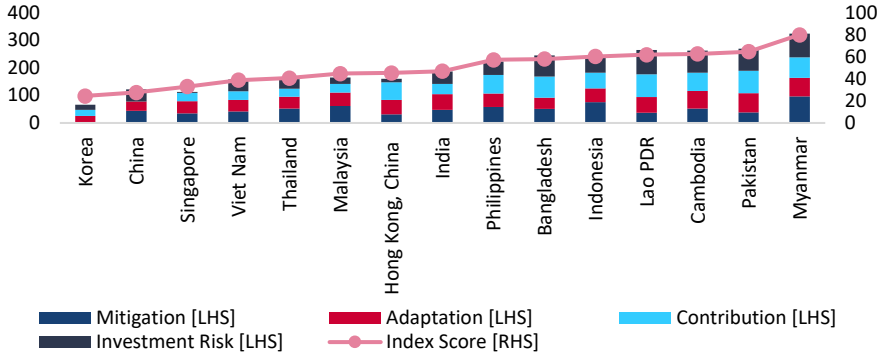
To assess and acknowledge country progress and the challenges being faced and to overcome within energy transition, BMI has created the BMI APAC Low-Carbon & Climate-Resilient Transition Index, which maps country energy transition progress across the Paris Agreement objectives. In addition, the analysis provided in this chapter will highlight potential investment opportunities in the energy space.

The Index uses a range of indicators to offer a detailed analysis of each market's progress under the three Paris Agreement objective pillars (displayed above). These include, for example, measures such as the carbon intensity of an economy (Mitigation pillar), a market's vulnerability to rising temperatures (Adaptation pillar), as well as a market's electric vehicle penetration ratio (Contribution), which shows how supportive a government has been to its EV sector. All the indicators that are included within each pillar of the Index are displayed in Fig 4.0. The Index is developed from BMI data, as well as data from the EIA, World Bank and national statistics between 2013 and 2023. This provides a snapshot of a country's progress for each year. A scoring system between 0 and 100 has been developed, where 100 reflects a slower transition with strong challenges and 0 represents a faster transition with weaker challenges. A lower score, therefore, shows greater progress within the Index components and fewer challenges being faced in transitioning towards a clean energy system and climate-resilient economy.

Key Takeaways

In this section of the report, we will highlight the key takeaways from each section of the Index. The report will then take a deeper dive into some of the mitigation, adaptation, contribution and investment risk trends across the APAC region to highlight progress, challenges and investment opportunities. This section of the report will provide analysis on Index scores, as well as draw from historical data that serves as inputs into the Index. It also includes forward-looking BMI forecasts to support the discussion on energy transition progress of the 15 markets now and over the next decade.

Fig 4.1: Korea And China Lead APAC's Low-Carbon Energy Transition
APAC – Low-Carbon & Climate-Resilient Transition Index By Pillar (2023)

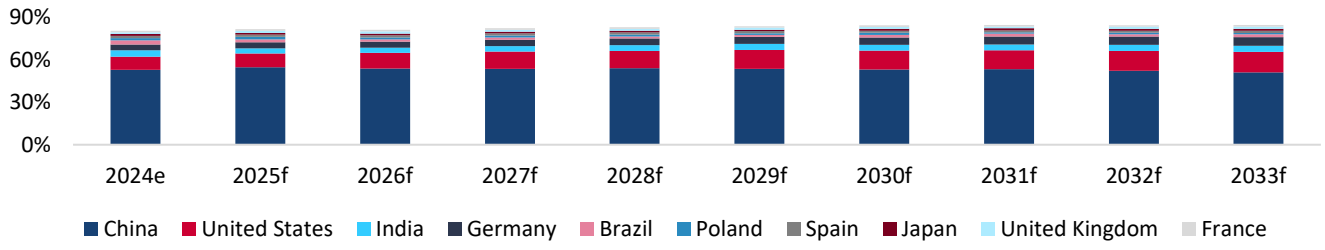


Note: Lower score = greater transition progress and fewer challenges in a market's transition. Source: BMI APAC Low-Carbon & Climate-Resilient Transition Index

Mitigation

Energy security is a priority in the region and a key driver behind fossil fuel dominance owing to the secure baseload power supply thermals provide. BMI projects fossil fuels to hold a 70% share of the power mix in the APAC region in 2023, falling to 66.9% in 2033; this is despite the country-specific targets for emissions reductions in the region. We highlight this trend as a key challenge to the region's progress in mitigating climate change. We note markets, such as Indonesia, Viet Nam, India and China that rely on energy-intensive industries for economic growth will retain significant fossil fuels in their energy mix, while ramping up the installation of renewables to reduce carbon emissions. Fig 4.2 highlights that China is a global leader in installing renewables, accounting for over 50% of the world's capacity additions between 2024 and 2033. We expect further technological development for clean fuels to present opportunities to replace coal, oil and gas in the long term.

Fig 4.2: China To Dominate Renewable Growth With Over 50% Of Additions
Global – Top 10 Markets By Share Of Annual Renewable Capacity Growth, % (2024-2033)



e/f = BMI estimate/forecast. Source: EIA, national sources, BMI

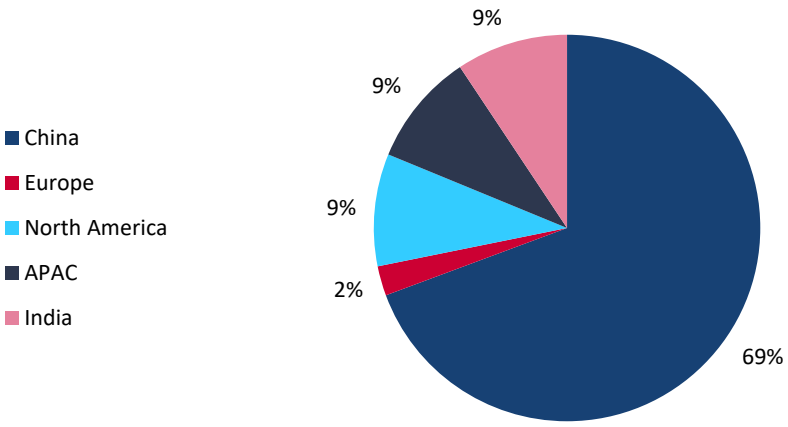
Adaptation

We highlight hydropower drought risks in Pakistan, China and Southeast Asia owing to climate change-induced changes to rainfall, which reduces the reliability of hydropower output, as well as excessive damming on the Mekong River, which is disrupting the natural flow. This is reducing the attractiveness of hydropower, but also exacerbating drought risks in highly exposed markets. Despite this, Pakistan is expected to grow its hydropower fleet from a 20.2% share in 2023 to 34.6% in 2033, owing to limited and unstable power generation from other sources. We expect this to increase supply risks, but also present opportunities for greater exploration and investment into other sources such as solar and nuclear, which would offer stability and reserve supply as a backup to hydropower.

Contribution

China leads the Contribution pillar, with a score of 0 (lower score = higher contribution) owing to the market's huge manufacturing base that is integral to the global energy transition. Showcasing China's vital role as a renewable manufacturing hot spot is Figure 4.17, which details the 2021 global solar equipment manufacturing production according to IEA data. Figure 4.3 details the projected manufacturing production in 2027 and shows China's continued key role in the global renewable supply chain.This is owing to China's considerable manufacturing subsidy support. We highlight the huge benefit of China's renewable supply chains that are accelerating the global transition, but caveat that the world's over reliance adds risks to future supply.

Fig 4.3: China Expected To Remain A Hotspot For Renewable Manufacturing
Global - Solar PV Manufacturing Production Capacity Estimate (2027)



Source: IEA, BMI

Investment Risks

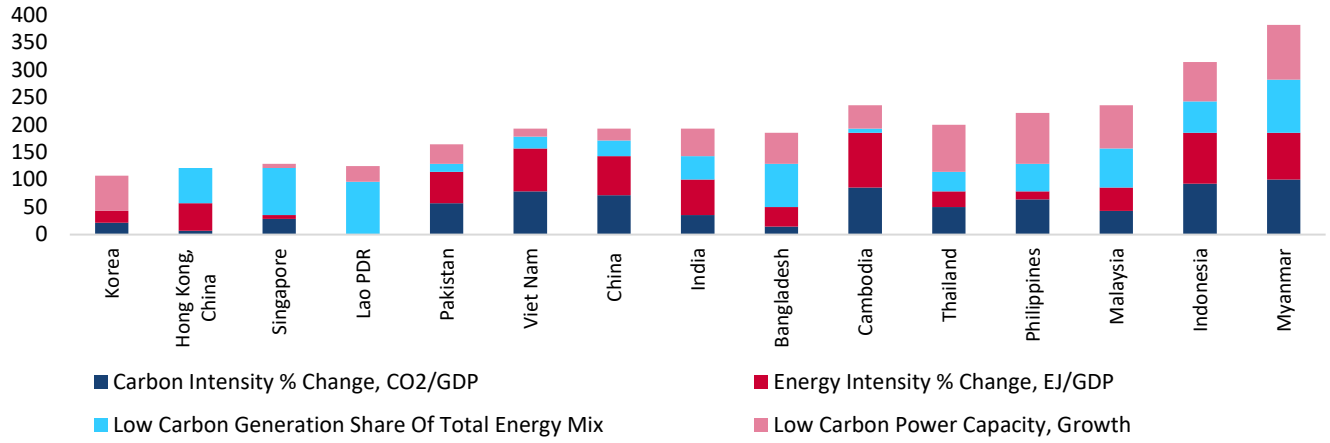
The Investment Risks pillar is a measure of how capable a market is at absorbing and utilising climate funding. We highlight those markets with stronger challenges (with scores closer to 100 in the Index) will be less effective at utilising the international funding available. We also expect that growing international investment is not only increasing the energy financing availability, but also reducing the investment risks in emerging markets through lowering financial barriers, as well as increasing transparency and openness. We highlight Lao PDR and Indonesia as key beneficiaries of this international investment towards their low-carbon energy transition.

Mitigation

The chart in Fig 4.4 presents country scores for the Mitigation pillar of the BMI APAC Low-Carbon & Climate-Resilient Transition Index in 2023, scores which have been calculated using indicators that measure emissions reduction progress and the progress of low-carbon energy deployment. We highlight that for some markets, such as Korea and Pakistan, scores are bolstered by the deployment of low carbon technology, such as solar PV and hydropower. Markets such as Lao PDR, Hong Kong, China; and Bangladesh benefit from their efforts in decreasing economic carbon intensity via energy-efficient technologies, such as high-efficiency motors, as well as by reducing grid losses through microgrids. This pillar accounts for the multiple mitigation strategies employed by markets.

Fig 4.4: Low-Carbon & Energy Intensity Boosts Korea's Energy Transition Outlook

APAC – Mitigation Pillar Index Score By Component (2023)



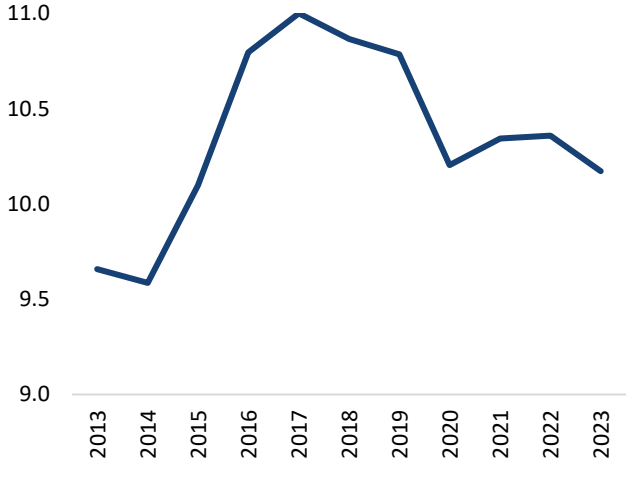
Note: Lower score = greater progress and fewer challenges in a market's transition. Source: BMI APAC Low-Carbon & Climate-Resilient Transition Index

High Economic Carbon Intensity Over Past Decade Weakens Mitigation Scores

The APAC region continues to face challenges in reducing its carbon intensity because economic growth continues to drive up energy demand. Renewable power options are being installed but the rapid pace of economic growth, the need for energy security from a diversified power mix and the stability of supply that coal, oil and gas can offer mean that carbon-intensive power options remain key for a market's growth and development. The carbon intensity, measured as carbon emissions per economic output (GDP), has been rising in several markets, particularly those experiencing rapid economic expansion such as Indonesia, Viet Nam and the Philippines. This has resulted in rising regional carbon intensity from 9.7 MMtonnes CO2/GDP in 2013 to 11.0 MMtonnes CO2/GDP in 2017. Between 2017 and 2020, we observed a decline in carbon intensity as the region's carbon emissions grew at a slower rate due to the acceleration of renewables and the steep decline in economic activity, particularly energy-intensive output, during the COVID-19 pandemic. This reduction in activity contributed to lowering the region's carbon intensity. However, despite this period of decline, overall carbon intensity has increased between 2013 and 2023, as economic growth remains reliant on carbon-intensive fuels.

Fig 4.5: Economic Growth Drives Energy Consumption And Carbon Intensity To Increase

APAC – Economic Carbon Intensity, MMtonnes CO2/GDP (2013-2023)



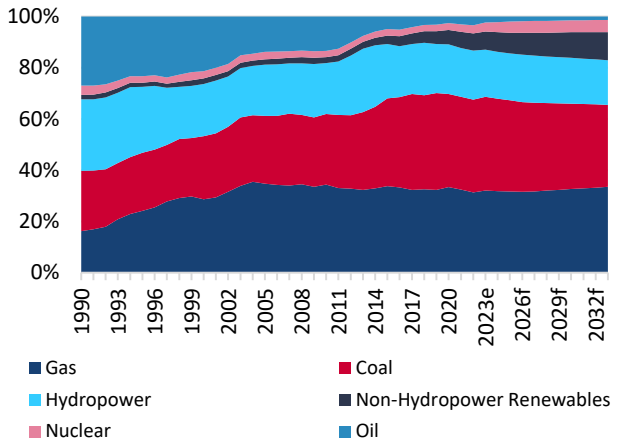
Source: EIA, local sources, BMI

Carbon Intensity Raised By Continued Reliance On Fossil Fuels

Moreover, continued reliance on coal for economic growth and energy security continues to foster fossil fuel growth in APAC markets, including the Philippines, Viet Nam, Indonesia and India. Despite climate commitments, fossil fuels will, according to BMI forecasts, maintain more than 60% share of the APAC region's power mix over the next decade. Gas will hold the largest share of the power mix towards the end of the decade, as developed markets rely heavily on natural gas as a transitional fuel to compliment intermittent renewable supply. This indicates slow regional transition to clean fuels, hindering efforts to reduce carbon emissions.

Fig 4.6: Gas To Become Largest Power Source, Coal To Hold Firm Second

Asia – Share Of Power Mix, % (1990-2032)



Note: This chart is created from BMI's Asian regional data. e/f = BMI estimate/forecast. Source: EIA, national sources, BMI

Although Energy Efficiency Gains Are Expected Over The Coming Decade, Growth In Fossil Fuels Will Raise Absolute Emissions

Total carbon emissions for 11 of the 15 APAC markets is expected to grow by 5% between 2023 and 2033, as illustrated in chart in Fig 4.7, which maps how regional carbon emissions will continue growing into the next decade. This shows how reliance on fossil fuels is slowing country transitions. While the growth trend continues, we highlight that carbon emissions growth is slowing, with increasing efficiency efforts reducing the growth trajectory. Average carbon emissions growth, from the selected markets in Fig 4.7, drops from 3.7% between 2014 and 2023 to 1.8% for 2024 to 2033.

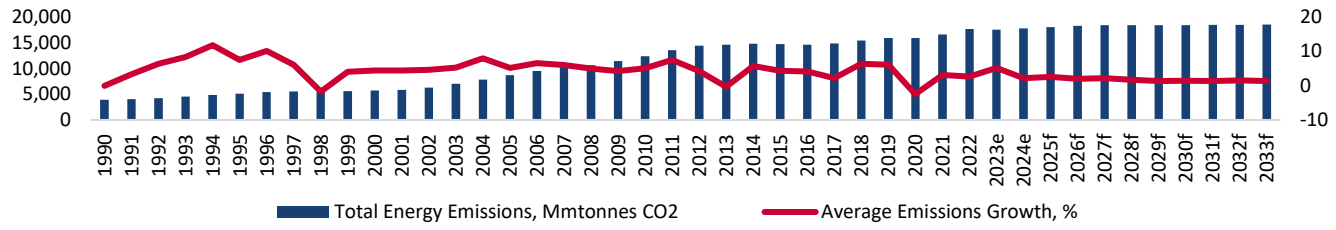
For example, carbon intensity per GDP is forecasted to decline gradually in the Philippines between 2025 and 2033, due to the implementation of energy efficiency measures and a shift towards renewable energy. However, coal remains a dominant source of energy in the market due to its availability and affordability. The country's coal-based energy generation is expected to increase, with carbon emissions projected to rise from 198 MMtonnes CO2 in 2024 to 285 MMtonnes CO2 by 2033. This increase is driven by the expansion of the downstream metals processing industry, which relies heavily on coal. Despite this, the forecasted emissions expansion of 44% between 2024 and 2033 is much smaller than the historical expansion of 107% between 2014 and 2024.

This slowdown in growth is due to the market quickly expanding its renewable power that will almost double in capacity between 2023 and 2033, supported by the market's ambitious target of reaching 35% renewable energy in its energy mix by 2030. BMI does not expect this target to be met, but the fact that such a pledge has been made is acting as impetus for the expansion of renewable power in the country.

Thailand has also made progress in improving its energy efficiency, particularly in the industrial and commercial sectors, through various energy-saving measures and strategies such as mandatory energy audits, energy codes and energy management systems. The market's Energy Efficiency Plan (EEP) 2018-2037 aims to reduce energy intensity by 36% by 2037, compared to 2010 levels. However, the country will continue to see growing carbon emissions into the next decade, due to its reliance on energy-intensive industries such as petrochemicals and heavy manufacturing. BMI forecasts total energy emissions for Thailand to increase by 16.4% from the end of 2023 until 2033. This growth will happen despite Thailand's ambitious energy intensity savings target, as well as its emissions reduction target of 20-25% (below the business-as-usual levels by 2030) owing to the growth of hard-to-abate sectors. However, we expect the ambitious targets and policies to reach them will facilitate a deeper slowdown in emissions growth beyond 2033.

Fig 4.7: Regional Carbon Emissions Expected To Continue Rising, Although Growth Rates Slow

Selected APAC Markets – Energy Emissions, MMtonnes CO2 (LHS) & Total Emissions Growth, y-o-y, % (RHS)



Note: Data built from Bangladesh, China, India, Indonesia, Malaysia, Pakistan, Philippines, Singapore, Korea, Thailand & Viet Nam only. e/f = BMI estimate/forecast. Source: EIA, national sources, BMI

APAC Climate Targets A Challenge Despite China Holding Its Position As Global Renewables Leader

China has established itself as a global leader in renewable energy, particularly in solar PV and wind power, supported by substantial state investments and incentives. In 2023, China added over 200 GW of new solar capacity and 76 GW of new wind capacity to its domestic power mix, making it the largest renewable energy market globally. The chart in Fig 4.8 shows that this will mean China's non-hydropower renewables is projected to grow from an 18.3% share in 2023 to 37.9% in 2033. The country's aggressive expansion in these sectors is vitally supported by its dominance in renewables manufacturing, which will be discussed in the contribution section of this chapter.

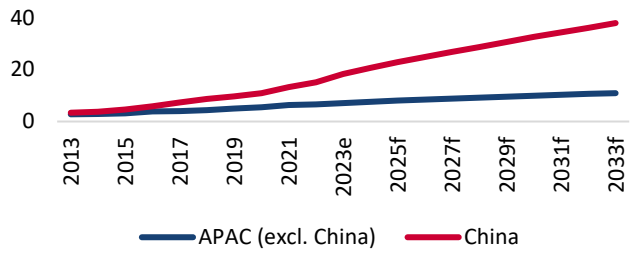
Despite this, the rest of the APAC region risks falling behind on its low-carbon energy transition due to a lack of momentum for renewables growth and continued reliance on fossil fuels, with renewables projected to account for an average 8% share of APAC's power mix in 2024, according to BMI projections. Renewable power projects across APAC have been experiencing delays due to grid connection bottlenecks and lacking policy support. For example, the average delay for commissioning renewable projects in APAC for the solar PV and offshore wind sectors has increased by three-to-four months between October 2023 and April 2024.

Grid connection bottlenecks are becoming a key barrier to the global energy transition. In APAC, grid risks are exacerbated in the region by suitable land for large-scale renewable power projects being far from key demand centres, necessitating an extensive and efficient grid network. However, the expansion of grid networks has been slow, especially in developing markets in the region, causing further delays to the commissioning of renewable power projects.

The region's climate targets, with markets pledging country specific dates to reach carbon neutral and Net Zero will offer the impetus and focus for investment into grid solutions. We expect that after 2033, growth in the renewables space will accelerate and that many governments will support renewable capacity build out to achieve long-term targets of carbon neutrality. This will present opportunities for renewables, particularly solar and wind, as well as support demand-side management and storage solutions to resolve grid issues.

Fig 4.8: China's Non-Hydropower Renewables Generation Share To Reach Almost 40% In 2033

APAC – Non-Hydropower Renewables Share Of Power Mix, % (2013-2033)



e/f = BMI estimate/forecast. Source: EIA, national sources, BMI

China's Renewables Buildout Reduces Carbon Intensity, Although Coal Reliance Raises Short-Term Carbon Intensity

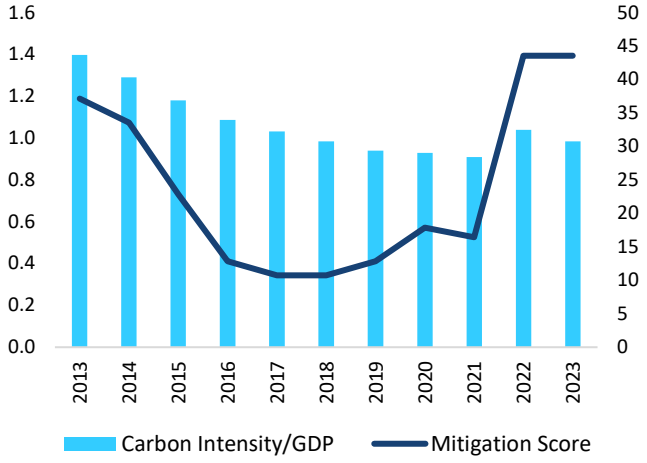
China's aggressive buildout of renewable energy infrastructure has contributed to a significant reduction in the country's carbon intensity levels, dropping from 1.4 MMtonnes CO2/GDP to 0.9 MMtonnes CO2/GDP over the last 10 years (2013-2023), as shown in Fig 4.9. The government has set ambitious targets, such as reducing the cost of Battery Energy Storage Systems (BESS) by 30% by 2025 and achieving 100 GW of storage capacity by 2030. In 2023, China's installed BESS capacity more than tripled from 8.7 GW to 31.4 GW, and this growth trend is expected to continue, reaching roughly 174.0 GW by 2030.

Despite these gains, China's short-term carbon intensity rose between 2021 and 2022 due to coal-fired power being ramped up to support the post-COVID economic recovery. The 2024 National People's Congress emphasised coal's critical role in ensuring stable electricity supply, with Premier Li Qiang underscoring coal's importance for economic and social stability. This reliance on coal poses a challenge to reducing the market's long-term carbon intensity, particularly as coal is used to fuel industry and manufacturing, key pillars of China's economic growth. Moreover, like the rest of the APAC region, China's renewable sector faces grid stability challenges.

Therefore, despite China's strides in progress in mitigating carbon emissions, economic growth, energy security concerns and infrastructure bottlenecks continue to drive reliance on fossil fuels, particularly coal, posing challenges to mitigation efforts.

Fig 4.9: China's Mitigation Progress Sees Risk Spike During Post-COVID Recovery

China – Economic Carbon Intensity, MMtonnes CO2/GDP (LHS) & Mitigation Pillar Score (RHS) (2013-2023)



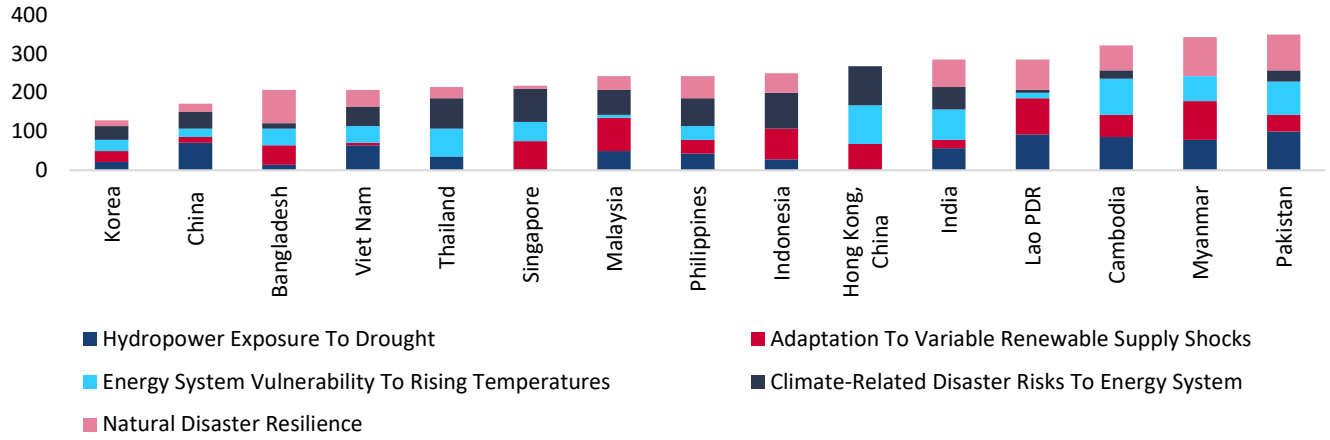
Note: Lower score = greater transition progress and fewer challenges in a market's transition. Source: EIA, World Bank, local sources, BMI APAC Low-Carbon & Climate-Resilient Transition Index

Adaptation

In this section of the chapter, we discuss adaptation to climate risks and the changing energy system. We include a range of adaptation measures, such as exposure to drought risks, temperature increases, as well as growing intermittency to account for the diversity of climate and system challenges to markets. The chart in Fig 4.10 indicates how markets such as China and Pakistan are heavily exposed to drought, whilst other markets such as Hong Kong, China; and Cambodia are vulnerable to rising temperatures. BMI's Adaptation pillar indicators, which are made up of a composition of data points that measure both the risks from climate change, and also market capability to manage these risks provides insight into the challenges and a country's progress in adapting. For example, BMI's adaptation to variable renewable supply shocks indicator, measured by the BMI Power Storage Index, includes an intermittency vulnerability score, as well as a stability score derived from the level of baseload power supply.

Fig 4.10: Hong Kong, China Has High Adaptation Challenges But Low Hydropower And Servicing Risks

APAC – Adaptation Pillar Index Score By Component (2023)



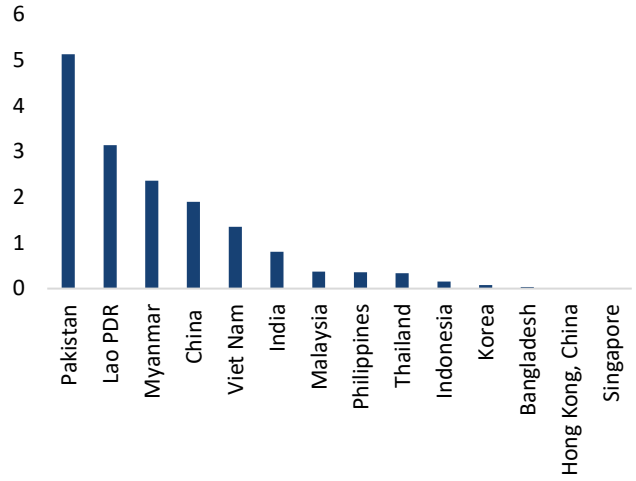
Note: Lower score = greater transition progress and fewer challenges in a market's transition. Source: BMI APAC Low-Carbon & Climate-Resilient Transition Index

Drought Exposure Risks Raise Adaptation Challenges For Southeast Asian Markets

Hydropower has historically played an important role in APAC in providing clean baseload power supply, and hydropower continues to play a role in the region's power mix, accounting for a 12.7% share (all BMI Asian markets) in 2023, only slightly down from its 14.1% share in 2013. Despite the vital role that hydropower plays in providing clean reliable power supply, the increasing drought risks associated with climate change are raising adaptation challenges for countries relying on this source of power. Fig 4.11 demonstrates the elevated hydropower drought risks in Southeast Asia, as well as China and Pakistan. BMI's hydropower drought risk indicator assesses the risk of drought to energy supply based on the proportion of hydropower in the power mix, the efficiency of hydropower output, as well as annual rainfall.

Fig 4.11: Pakistan And Southeast Asia Most Exposed to Drought Risks

APAC – Hydropower Drought Exposure Composite Measure (2023)



Note: Lower score = lower exposure to drought risks. Source: EIA, World Bank, local sources, BMI

Pakistan's Drought Risks To Continue As Hydropower Reliance Grows With Imported Energy Security Concerns

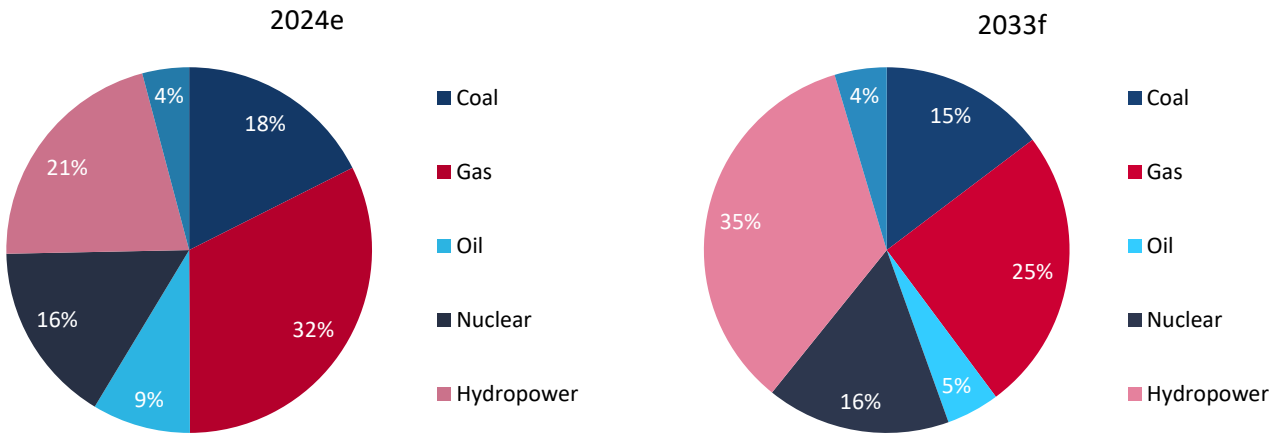
The map in Fig 4.11 shows Pakistan as the market in the region with the highest drought risks. Despite the country reducing its reliance on hydropower from 30.4% in 2013 to 20.2% in 2023, we highlight that hydropower risks will remain elevated in the market. This is owing to very low rainfall levels, as well as a falling capacity factor that indicates hydropower infrastructure will remain but generate less electricity, increasing curtailment and costs to suppliers.

Over the next decade, we forecast Pakistan's hydropower share to expand further to reach 34.6% in 2033 owing to the market's efforts to reduce energy security concerns and a desire to reduce its reliance on imported fuels, such as gas. In 2024, BMI estimates that gas will dominate, with a 32.4% share, which is estimated to decline to 25.1% in 2033, shown by the charts in Fig 4.12. As domestic production is insufficient to meet the market's demand, Pakistan is a net importer of natural gas through pipelines and liquified natural gas (LNG) shipments. As a result, Pakistan, is highly exposed to elevated spot LNG prices on the international market, especially since the Russia-Ukraine war, creating energy security concerns and weighing on the country's economic growth.

To further aid its energy security, the market is looking to increase greater diversity to its power mix by increasing the role that coal, nuclear and hydropower play to replace oil and gas. Renewables growth in Pakistan's power mix will also be supported by policies such as the Alternative and Renewable Energy Policy and Integrated Energy Plan, with a target of Pakistan increasing renewable energy production to a 30% share by 2030, and hydropower to 40%.

Pakistan will face challenges in hitting these targets. The market will see much slower growth in its wider renewables and nuclear segment when compared to hydropower, owing to the larger hydropower resources that increase opportunities. We expect coal to become a key fuel in Pakistan's diversification efforts, as the market explores greater utilisation of its domestic resources. This will weigh on Pakistan's ability to reduce its emissions levels and showcases the difficult journey developing markets must navigate when seeking to address climate change, reduce their emissions, build energy security and ensure the power required to drive economic development and growth.

Fig 4.12: Pakistan's Reliance On Gas To Shrink, Replaced With Hydropower
Pakistan – Generation Share Of Power Mix By Power Type, %



e/f = BMI estimate/forecast. Source: EIA, local sources, BMI

Droughts Along The Mekong River Elevating Drought Risks To Southeast Asian Markets

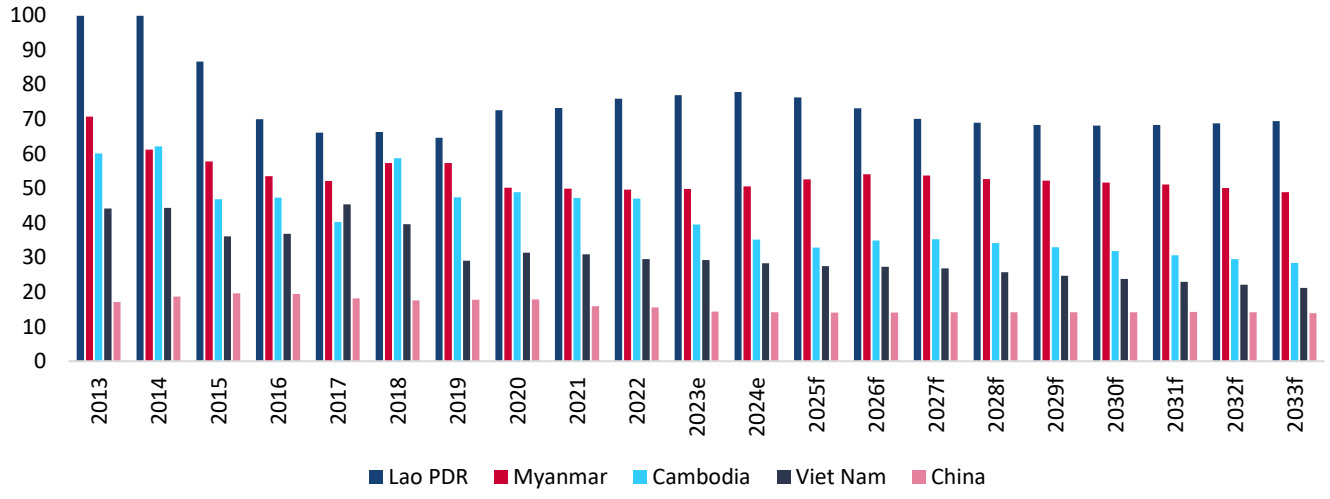
The Mekong River flows through six markets including China, Myanmar, Thailand, Lao PDR, Cambodia and Viet Nam. Damming has altered the natural flow of the river, reducing water availability downstream. This has been exacerbated by increasingly erratic weather patterns placing stress on water resources along the Mekong River.

Drought over 2021 and 2022 reduced hydropower generation in China, and therefore the availability of low-carbon power supply, increasing coal consumption. BMI recorded a drop of hydropower's share from 17.9% in 2020 to 15.6% in 2023. Owing to the drought risk, which disrupts the reliability of the hydropower to generate at capacity, we forecast China to reduce its long-term hydropower generation from 17.2% in 2013 to 13.9% in 2033. Moreover, dam building along the Mekong River is highly controversial with international opposition given the severe impacts, spreading across the Southeastern region. We highlight in the map in Fig 4.11 that Myanmar, Lao PDR, Cambodia and Viet Nam are also exposed to these drought-related hydropower risks. They will also need to explore other renewable power options beyond hydropower to decrease their emissions, while building resilience into their power mixes.

The chart in Fig 4.13 shows that all Southeast Asian markets with elevated drought risks will see declines in their hydropower shares between 2013 and 2033. Lao PDR and Myanmar will still hold larger shares of hydropower in their power mix at well over 40% until 2033, meaning high exposure is expected to continue. Viet Nam and Cambodia will significantly reduce their reliance from 44% and 60% shares in 2013, respectively, to 21% and 14% in 2033, and build thermal power plants and renewables to provide more reliable supply. Cambodia has placed a ban on new hydropower developments on the river until 2030. Moreover, Cambodia has raised targets to 2.0GW in 2030 and to 3.1GW by 2040, partly driven by the move away from hydropower. In Lao PDR, solar will grow from 0.3TWh in 2024 to reach 0.7TWh by 2033 to replace hydropower.

Fig 4.13: Lao PDR And Myanmar To See Declining Hydropower, But Remain Exposed To Rising Drought Risks Over Next Decade

Selected APAC Markets – Hydropower Share Of Power Mix, % (2013-2033)



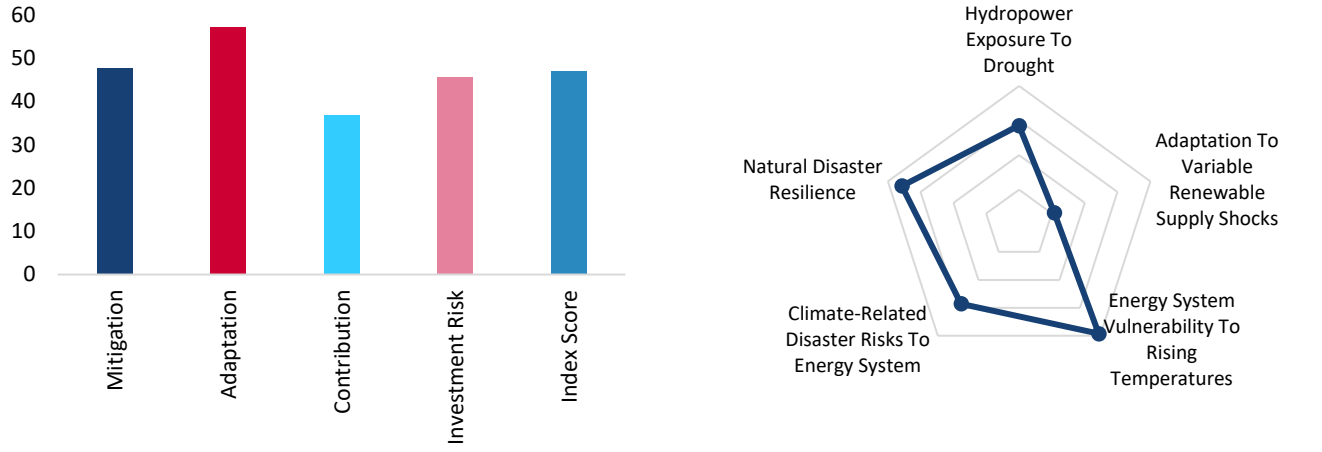
e/f = BMI estimate/forecast. Source: EIA, national sources, BMI

India's High Annual Temperatures And Grid Instability Raise Adaptation Risks, But Offer Opportunity From Consumption Growth

India also experiences high adaptation challenges, which is highlighted in Fig 4.14 owing to vulnerabilities to rising temperatures. This makes Adaptation India's worst performing segment within the BMI APAC Low-Carbon & Climate-Resilient Transition Index. BMI's energy system vulnerability score, which is a component within the Adaptation pillar of the Index, is a composite measure of higher temperatures and the market's capacity to meet rising demand for power. India has some of the highest regional temperatures, second to Pakistan, which is displayed in Fig 4.15. It also has a very strong power demand outlook, as its economy continues to expand. BMI forecasts that India's economy will grow by an average 6.6% per annum between 2023 and 2033. This will result in significant growth in energy consumption with electricity consumption forecasted to grow by an annual average of 5.4% per annum from an estimated 1,551 TWh in 2023 to a forecast 2,591 TWh in 2033.

Fig 4.14: India's Adaptation Challenges Raised By Vulnerability To Rising Temperatures

India – BMI APAC Low-Carbon & Climate-Resilient Transition Index By Pillar (LHS) & Adaptation Pillar By Component (RHS)

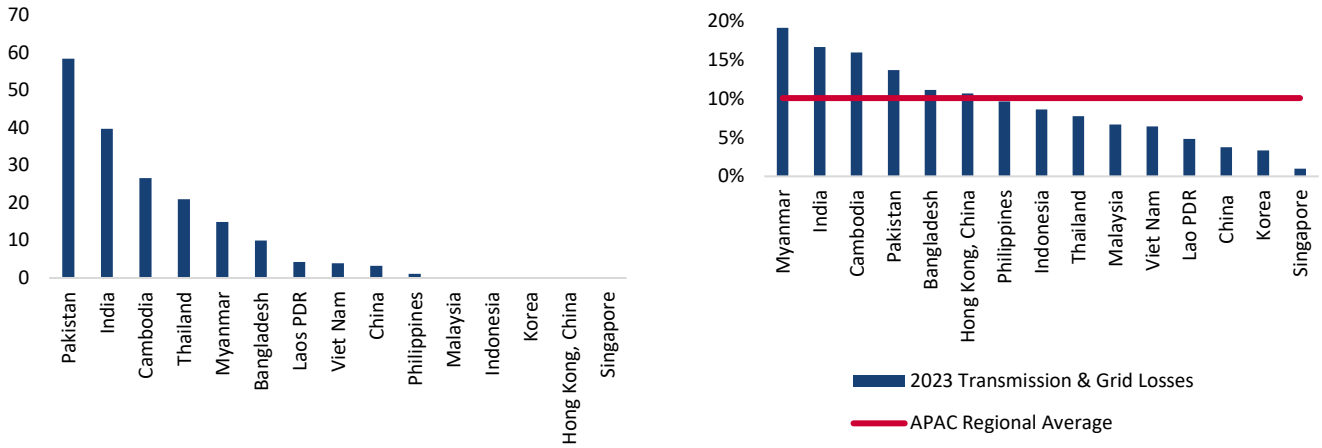


Note: Lower score = greater transition progress and fewer challenges in a market's transition. Source: BMI APAC Low-Carbon & Climate-Resilient Transition Index

Fig 4.15 shows that India has some of the highest transmission and distribution losses in the APAC region, which in 2023 reached 17% of total generation. High losses on India's grid are a result of an ageing and inefficient grid as companies are faced with the challenges of upgrading grids, which need to be extensive and are expensive to improve. India's inefficient grid means the market is more vulnerable to power shortages during spikes in demand from higher temperatures that are increasing because of climate change. Additionally, during heat waves, grid infrastructure can overheat, driving further inefficiencies and potential supply risks. Ageing grid infrastructure is also a barrier to renewables integration on the grid, thereby reducing India's capacity to manage rising demand and lower its emissions.

Fig 4.15: India's High Temperatures And Grid Losses Exacerbate Rising Consumption Risks

APAC – Heat Index Days > 35 Degrees Celsius 2024 (LHS) & Transmission & Grid Losses, % (RHS) (2023)



Note: LHS - Higher figure = higher exposure to drought risks. RHS: Higher % = Greater Transmission & Grid Losses, % Source: EIA, World Bank, local sources, BMI

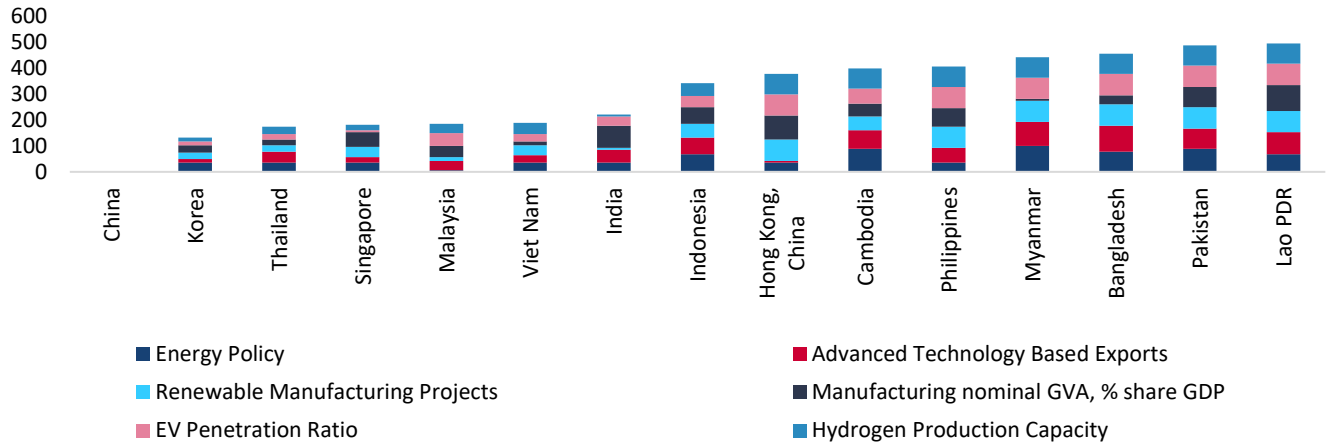
India's government is looking to increase grid investment through privatising distribution companies. This has so far happened with limited success, given that inefficient and ageing grids are expensive and not very profitable, reducing attractiveness to private investors. We expect that the combined risks to security and clean energy will provide impetus to develop grid solutions such as demand management that can help the market alleviate supply stresses. The government has earmarked energy storage and decentralised solar PV as potential solutions to manage the grid.

Contribution

The Contribution pillar considers the level of support to the energy transition, which we measure through BMI's energy policy score; size and potential of domestic energy supply chains; as well as the size of hydrogen and EV sectors that can only exist with active government policy and funding support. For example, numerous renewable manufacturing projects demonstrate that governments are prioritising building renewables manufacturing, whilst a large manufacturing share of GDP shows the potential for producing renewables equipment. The chart in Fig 4.16 shows Thailand outperforming in both indicators, highlighting the market's strong contribution to the energy transition. The Contribution pillar analysis of the Index draws on examples of how APAC markets are developing their supply chains, whilst facilitating new technology growth. We also highlight the importance of this, which is demonstrated by China's role as the global leader for manufacturing renewables equipment.

Fig 4.16: India's Large Hydrogen Base And Renewables Manufacturing Projects Raise Its Score

APAC – Contribution Pillar Index Score By Component (2023)



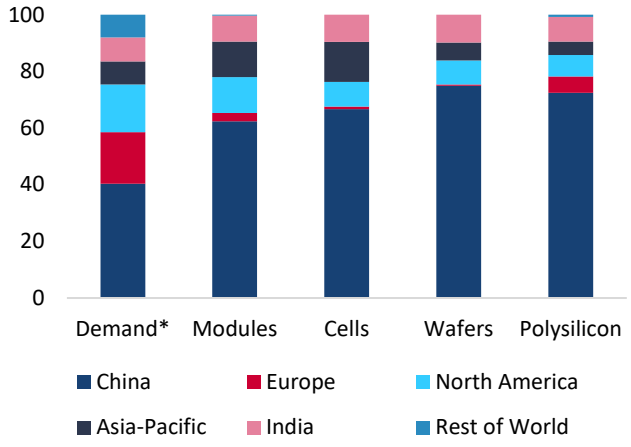
Note: Lower score = greater transition progress and fewer challenges in a market's transition. Source: BMI APAC Low-Carbon & Climate-Resilient Transition Index

China Making Strong Contribution To The Global Energy Transition Due To Investment In Its Low-Carbon Manufacturing Supply Chain

One of the main reasons behind China's fast-paced transition is its very large manufacturing base, which has supported its development as a key manufacturer of renewable power components. BMI estimates manufacturing accounted for almost a third of China's GDP in 2023. Within that large manufacturing base, clean energy manufacturing is significant, making it the largest globally. The development of this manufacturing segment has been facilitated by state support, low labour costs and economies of scale, and has resulted in China supplying most of the globe's renewables equipment. Fig 4.17 displays China's share of solar equipment across the value chain, with China accounting for the majority share of global manufacturing.

Fig 4.17: China Dominates Entire Solar Supply Chain

Global – Global Solar Equipment Manufacturing Production & Demand, % of total

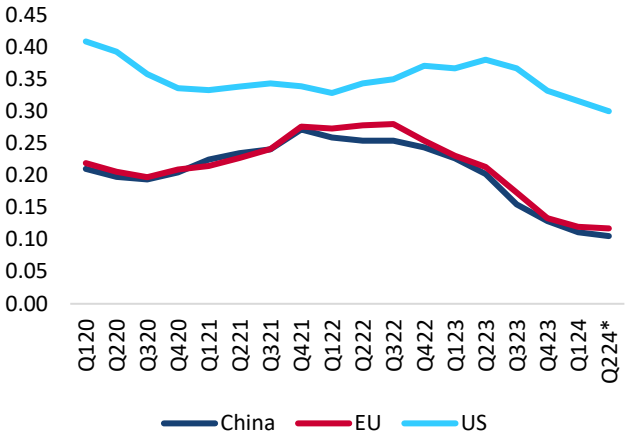


*Note: *Measured as % of global demand of solar PV manufacturing capacity by country and region (2021).*
Source: IEA, Bloomberg, BMI

This not only indicates strong contribution from China to its domestic energy transition but also its key role in global decarbonisation efforts. The chart in Figure 4.18 shows solar PV module prices dropping significantly over the last year from USD0.23/kWh to USD0.1/kWh. China's significant role across the whole value chain from raw materials to the end product enables the country to reduce prices through economies of scale. This has reduced global energy transition costs. Despite this, markets such as the US and India are reshoring and diversifying energy supply chains to reduce their reliance on China for low-carbon technology growth and vulnerability to changes in supply.

Fig 4.18: Low-Cost Chinese Solar Modules Reduce Cost Of Global Transition

China, EU & US – Solar Module Spot Price, USD/W



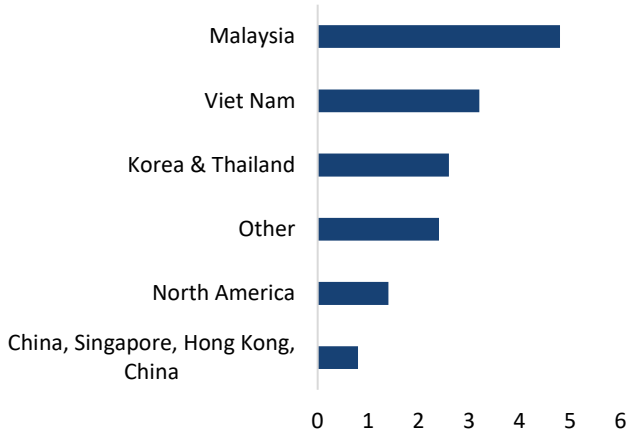
Up to June 12th 2024. Source: IEA, Bloomberg, PV InfoLink, BMI

Global Manufacturing Reshoring To Benefit Regional Peers

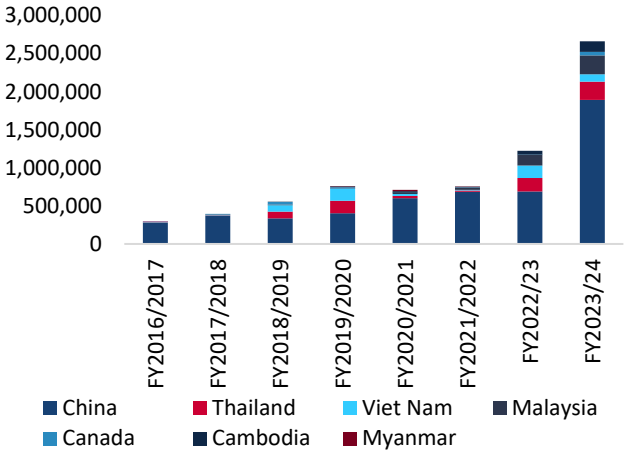
Fig 4.19 displays markets including Malaysia, Viet Nam, Korea and Thailand which are all witnessing higher solar PV exports to the US, as the US seeks to diversify its renewable energy supply chain. The chart on the right shows a similar picture with Indian import duties (2018-2020 & 2022) on solar cells from China raising imports from other markets including Thailand, Viet Nam and Malaysia, as India seeks to diversify its import sources. A pause on restrictive import policies caused a spike in Chinese imports over the FY2023/24 period as the market saw slow growth of its domestic manufacturing sector. These policies have since been reinstated and we expect these will continue to accelerate the role of regional players. Despite this, China will continue to play a significant role given its dominance of the supply chain and the shortfall in Indian manufacturing capacities to meet solar PV targets.

Fig 4.19: Southeast Asia To Experience Benefits From Import Diversification Efforts

US – Solar PV Import Shipments By Market, GW



India – Imports Of Solar Cells To India By Selected Markets, '000



April 2023 to October 2023. Source: Ministry of Commerce, EIA, BMI

Growing Manufacturing Sectors Raise Contribution Scores

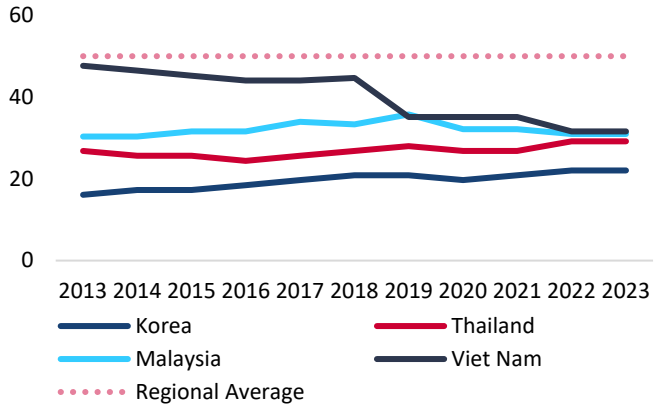
Growing manufacturing bases in markets such as Malaysia, Thailand and Viet Nam have meant better performance in the Contribution pillar as they are playing an increasing role in the global renewable energy supply chain, shown in Fig 4.20. Korea, Thailand and Malaysia all have average Contribution pillar scores under 35, which is well below the APAC regional average of 50 (lower scores = better performance). These low market scores are a result of growth in renewables manufacturing, bolstered by growing hydrogen capacity and electric vehicle fleets.

Viet Nam's Manufacturing Sector Expansion As A Result Of International Investment

Viet Nam's Contribution pillar score has seen significant improvement from 2013, which is as a result of the market's strong manufacturing potential attracting investors. Strong human capital and growth prospects are key factors behind the market's attractiveness. Moreover, as markets diversify energy suppliers, China has also expressed interest in investing in Viet Nam's manufacturing sector to retain dominance in clean energy equipment. We expect that growth in Viet Nam's renewables manufacturing base will increase the market's contribution, but also reduce renewable energy costs, facilitating a faster energy transition for the country. BMI forecasts Viet Nam to grow its renewables share of its total energy generated from 14.9% in 2023 to 17.8% in 2033. We expect a larger renewables manufacturing base will further promote growth in Viet Nam's renewables space, improving mitigation efforts.

Figure 4.20: Viet Nam Emergent As Beneficiary For Energy Sector Manufacturing

Selected APAC Markets – Contribution Pillar Index Score (2013-2023)



Note: Lower score = greater transition progress and fewer challenges in a market's transition. Source: BMI APAC Low-Carbon & Climate-Resilient Transition Index

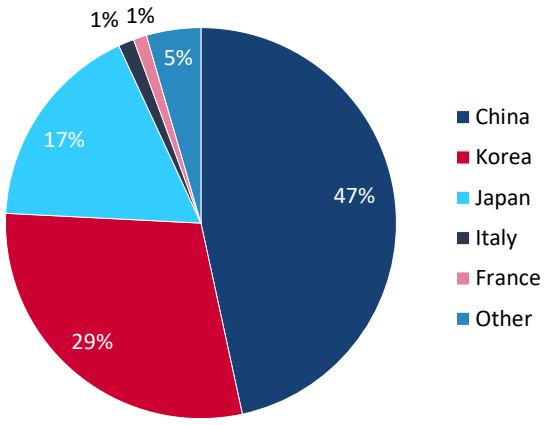
APAC's Dominant Role In Hydrogen Shipbuilding Will Facilitate Regional Growth

APAC's Contribution pillar includes a measure of the hydrogen pipeline. The region has the second largest pipeline behind North America and Western Europe, with 6.1GW of clean hydrogen capacity in BMI's Key Projects Data for the 15 APAC markets. We expect this pipeline to grow as the region relies heavily on fossil fuels for industrial sectors that can only be replaced with sustainable fuels, such as green hydrogen.

In addition, APAC's dominance in the shipbuilding industry significantly benefits the region's potential for hydrogen growth. The high density of shipbuilding expertise and infrastructure in countries like China, Japan and Korea positions APAC at the forefront of developing hydrogen-capable vessels. These ships are critical for the burgeoning global network of green shipping corridors, which will underpin long-distance maritime transportation and large-scale adoption of green hydrogen over the coming decade. The engineering challenges associated with hydrogen transport, such as cryogenic storage and material durability, necessitate innovative solutions that APAC shipyards are well equipped to address. As Europe and North America seek to revitalise their shipbuilding sectors, APAC's established capabilities offer a competitive advantage. This concentration of shipbuilding activity will be crucial in supporting the APAC region's hydrogen economy, facilitating the export and import of green hydrogen and its derivatives, and reinforcing APAC's position in developing the global hydrogen economy.

Fig 4.21: APAC Markets Dominate Shipbuilding And Will Drive Hydrogen Transport Innovation

Total Number Of Ships Built By Country, % share (2022)



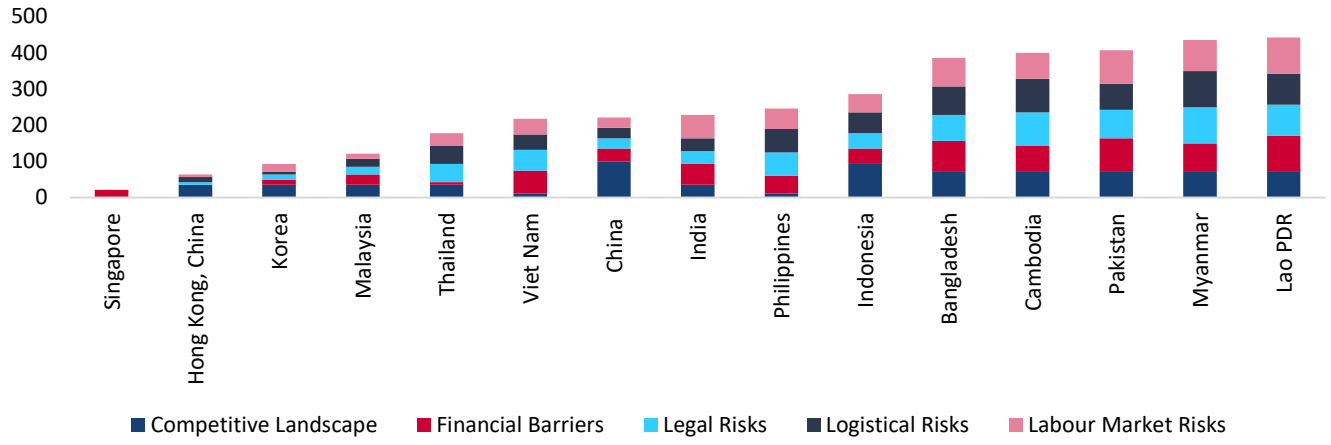
Source: UNCTAD, BMI

Investment Risk

The Investment Risk pillar is built from indicators that measure the risk for investors or stakeholders operating in a market. These are outlined in Fig 4.22 and indicate each market's ability to attract and absorb international funding, and effectively capitalise on it to build low-carbon technology.

Fig 4.22: Emerging Markets Tend To Score Higher On Investment Risks

APAC – Investment Risk Pillar Index Score By Component (2023)



Note: Lower score = greater transition progress and fewer challenges in a market's transition. Source: BMI APAC Low-Carbon & Climate-Resilient Transition Index

Rising International Funding Success Depends On Investment Risks

The availability of climate finance to facilitate the energy transition continues to expand. However, we expect the utilisation of this funding to be exposed to investment risks. The Investment Risk pillar is a measure of how well a market can absorb funding to effectively progress its climate and energy goals.

One area of growth for energy finance is through international funding schemes such as Just Energy Transition Partnerships (JETP) and the Belt and Road Initiative, which are both financing mechanisms being implemented by countries to increase investment in clean energy projects. They present opportunities for renewable developers in these markets to gain access to financing, which becomes increasingly important for emerging markets in decreasing their emissions. At COP28, financing schemes were added to the USD100bn agreed to be mobilised every year at COP15 (hosted in 2020). Although these financing agreements are insufficient to meet the USD2 trillion needed by 2030 to align with the Paris Agreement target and have also not always been provided on time, we highlight how important international financing is for emerging market energy transitions, and the role they can play in reducing investment risks. The table below shows the increasing amount of low-carbon financing that multilateral development banks are providing, which is essential for the global energy transition that relies on high-risk and expensive technologies.

Fig 4.23: COP28 Pledges Grow International Funding Available For Emerging Markets

Funding Mechanism	Amount (USDbn)	Private Vs. Public	Location	Timeframe
Emerging Market Climate Action Fund (EMCAF)	0.011 (UK FCDO) 0.036 (Germany KfW)	Public	Global	na
Energy Transition Accelerator Finance Platform	4.05	Mix	Global	na
Least Developed Countries Fund And Special Climate Change Fund	0.174	Public	Global	na
World Bank	9	Public	Global	na
Development Bank Of Latin America And The Caribbean (CAF)	2 (annual), 15 (total)	Public	Latin America	2030
The Asian Development Bank (ADB)	10	Public	Philippines	2024-2029
Copenhagen Infrastructure Partners	3	Private	Global (mainly Asia-Pacific & Latin America)	na
IEA-Estimated Annual Finance	1,784-2,222 (annual)	na	Global	2026-2030
IEA-Estimated Annual Finance	2,219-2,805	na	Global	2031-2035

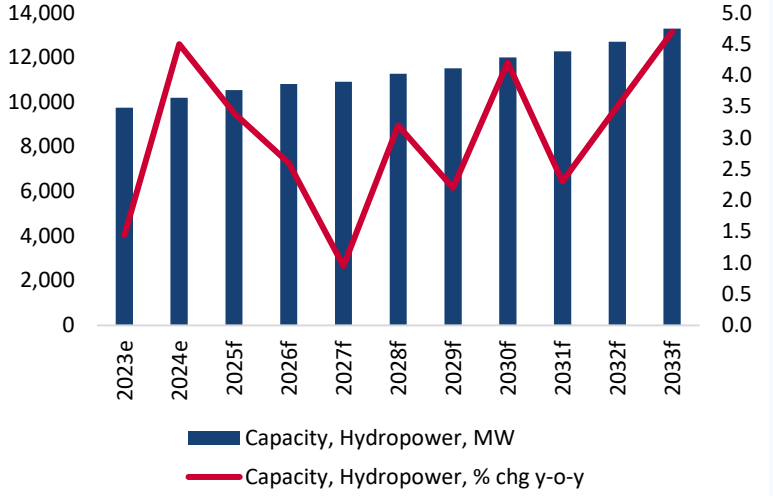
Na = not available/applicable. Source: IEA, BMI

Investment Case Studies:

Lao PDR's Expansionary Foreign Policy Strategy To Reduce Legal And Financial Barriers

Despite Lao PDR underperforming in the Investment Risks pillar, Lao PDR's strategic location and opportunities in the power sector are increasingly attracting international investors notably under China's Belt and Road Initiative (BRI). This growth of investment has boosted hydropower development, and BMI notes that hydropower generation in Lao PDR has expanded from 2.9 GW in 2013 to an estimated 10.2 GW in 2024, and BMI projects it to expand by a further 36% by 2033. To build on the investment to date and further enhance investor confidence, Lao PDR is adopting a multilateral foreign policy strategy aimed at opening its market to a broader range of international investors.

Fig 4.24: BRI Supporting Hydropower Development In Lao PDR
Lao PDR – Hydropower Power Capacity, MW (LHS) & Hydropower Growth, y-o-y, % (RHS)

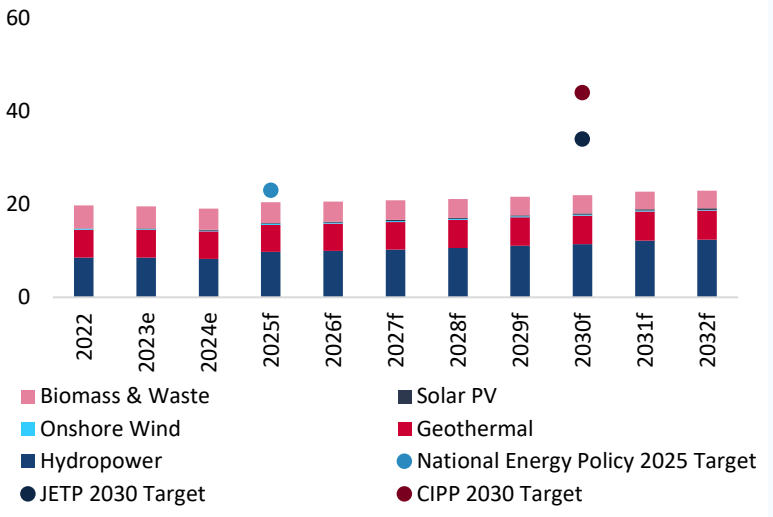


e/f = BMI estimate/forecast. Source: EIA, local sources, BMI

Indonesia's JETP To Increase Mitigation And Lower Investment Risks

Indonesia's Just Energy Transition Partnership has been critical to raising the market's renewables targets. In November 2023, the market announced higher renewables targets from 34% to 44% by 2030, as well as reduced the peak carbon emissions target to 250 MMtonnes CO2 rather than 290 MMtonnes CO2 for the same year. Although Fig 4.25 highlights that BMI believes Indonesia will struggle to reach this target, these targets will provide impetus for faster renewables growth, helping improve Indonesia's Mitigation score. In addition, under the JETP, the market plans to organise funding so that public capital can be mobilised to support projects that are unviable for private sector investment. These include grid investments and coal retiring projects that are high risk and more costly. This will reduce financial barriers for private investors both through higher capital being deployed, as well as through the investment in power infrastructure that would otherwise not exist. This will make renewables investment more attractive.

Fig 4.25: Targets To Offer Impetus For Indonesia's Renewable Power Growth
Indonesia – Total Renewable Power Generation By Type & Target, % of power mix (2022-2033)



e/f = BMI estimate/forecast. Source: EIA, local sources, BMI

Appendix

BMI
a FitchSolutions Company

Appendix

Survey Respondents

In May 2024, BMI sent out online questionnaires to 200 senior executives in the Asia-Pacific (APAC) region, which was represented by respondents from China, India, Malaysia, Korea, the Philippines and Indonesia. Each executive worked at a company across one of eight sectors, namely Automotive, Basic Industries, Energy, Healthcare, Technology & Electronics, Telecommunications, Transport and Utilities.

Respondents all hold the position of owner/partner, CEO, MD, Divisional Head or Director and play a role within their company's environment or energy transition strategy. The size of the companies ranged from 250 employees to over 10,000 employees.

B2B Survey Respondents By Market And Industry

	Total	Automotive	Basic Industries	Energy	Healthcare	Technology & Electronics	Tele-communications	Transport	Utilities
China	20%	16%	15%	24%	8%	12%	30%	22%	38%
India	20%	24%	4%	12%	27%	17%	22%	22%	38%
Malaysia	15%	8%	26%	20%	19%	17%	4%	13%	9.5%
Korea	15%	24%	22%	12%	19%	20%	9%	9%	0%
Philippines	15%	12%	22%	8%	23%	17%	13%	17%	50%
Indonesia	15%	16%	11%	24%	4%	17%	22%	17%	9.5%

Source: BMI Companies and Climate Change Survey, May 2024

In order to qualify for the survey, respondents needed to go through the following questions and respond Yes to at least one of them:

- Are you part of a committee within your company that covers environment or energy transition policy as part of its remit?
- Are you part of an executive or leadership team that discusses environment or energy transition policy issues and policy as part of its remit?
- Do you have a specific environment or energy transition policy role within your company?
- Within your role, are you involved at all in environment or energy transition policy regulations?
- Do you feel you understand how your company views and implements its environment or energy transition policies?

BMI APAC Low-Carbon & Climate-Resilient Transition Index

The BMI APAC Low-Carbon & Climate-Resilient Transition Index measures the progress of 15 APAC markets in the energy transition. The markets included in this report are listed below. The report assesses the progress of these markets and the region's energy transition under four pillars:

- Mitigation
- Adaptation
- Contribution
- Investment Risk

Mitigation is highlighted by the extent a market is lowering emissions and energy consumption; Adaptation is shown by the exposure to climate and energy risks and the capability to reduce this exposure; Contribution measures the extent policy and regulation brings about the energy transition; and Investment Risk measures the operational risks for businesses investing in clean energy.

The overall Index score is made up of all four pillars. These pillars are weighted so that Mitigation, Adaptation and Contribution account for 30% of the final score. This is because the main purpose of this report is to measure country progress against the Paris Agreement objectives, from which these pillars are based. Investment Risk scores will be weighted at a smaller 10%, as this provides important background but is a lower priority for the assessment.

The structure of the Index and indicators, which feature as inputs into the separate pillars, are detailed in the table below. We highlight that the Index provides a static view on a country's energy transition, using historical data from 2013 to 2023 to take a snapshot of a country's progress for each year. For the analysis of the Index (p19-33 of the Report), we draw from BMI's forecasted data to infer future trends in the energy transition.

BMI APAC Low-Carbon Energy Transition Structure And Indicator Inputs

Indicator	Source	Rationale
Mitigation		
Carbon Intensity, % Change, CO2/GDP	BMI Energy Transition Data	Measures five-year % change in CO2 emissions per unit of economic output (GDP) to measure market efforts in reducing economic carbon intensity.
Energy Intensity, % Change, EJ/GDP	BMI Energy Transition Data	Measures five-year % change in energy consumed per unit of economic output (GDP) to measure market efforts in reducing energy consumption.
Low Carbon Generation Share Of Total Energy Mix	BMI Energy Transition Data	Calculates the share of low carbon energy (including solar, wind, biomass, hydropower and nuclear) out of the total energy consumed to show the proportion of clean energy.
Low Carbon Power Capacity Growth	BMI Power Data	Measures year-on-year capacity growth of low carbon power (including solar, wind, biomass, hydropower and nuclear) to indicate low-carbon growth trajectories.
Adaptation		
Hydropower Exposure To Drought	BMI Power Data, World Bank	Measures a country's exposure to drought reducing its hydropower supply. Higher hydropower share means higher risk. Lower annual rainfall and capacity factor also indicate higher risk.
Adaptation To Variable Renewable Supply Shocks	BMI Power Storage Index	Measures a market's capacity to manage intermittent renewables by their need for power storage, which is measured by BMI's power storage index score.
Energy System Vulnerability To Rising Temperature	BMI Power Data, World Bank	Measures a market's capacity to cope with rising temperatures increasing consumption. The electricity production ratio measures the reliability of domestic supply and market capability to manage growing demand. Higher temperatures and higher losses reflect higher supply risks.
Climate-Related Disaster Risks	BMI ESG Country Index, BMI Power Forecast	Measures a market's climate risks and energy system resilience. Higher frequency of climate-related disasters implies higher risks. Newer electricity systems reflect higher climate resilience.
Natural Disaster Resilience	BMI ESG Country Index	Measures a market's capability to respond to and repair damage caused by climate-related events. Higher natural disaster resilience indicates better resilience and adaptation.
Contribution		
Energy Policy	BMI Power RRI Indicator	Scores are driven by data such as a market's access to electricity, electricity pricing tariffs, export capacity and the existence of clean energy targets.
Advanced Technology-Based Exports	BMI Country Risk Data	Measures the value of complex manufacturing and machinery exported from the country to demonstrate a country's technological development that also indicates policy support.
Renewable Manufacturing Projects	BMI Key Projects Data	Measures the quantity of renewable manufacturing projects in the country to indicate the level of government support for domestic renewable supply chains.

BMI APAC Low-Carbon Energy Transition Structure And Indicator Inputs		
Indicator	**Source**	**Rationale**
Manufacturing Nominal GVA, % GDP	BMI Country Risk Data	Measures the proportion of a country's GDP that is generated from manufacturing in nominal terms that demonstrates how large a country's industrial base is to support development of new clean technologies.
EV Penetration Ratio	BMI Autos Data	Calculates the share of electric vehicles (EVs) in the total vehicle fleet to provide a measure of progress of a market's clean transport sector. This shows how effective government policy is at promoting the adoption of EVs.
Hydrogen Production Capacity	BMI Hydrogen Index	Measures hydrogen production per day (kg/day) to measure the level of government support for the nascent sector that would not exist without a facilitative policy.
Investment Risk		
Competitive Landscape	BMI Power RRI Indicator	Assesses the openness of the power and renewables competitive landscape. This is measured by a grade score, driven by data on the number of companies of the market, the state-owned company's share of the market and the existence of fair tenders.
Financial Barriers	BMI Power RRI Indicator	The lower the barriers, the more accessible energy finance is through a number of indicators such as the lending rate, financial services stability and bank density.
Legal Risks	BMI Operational Risk Indicator	Measures risks of operations through a number of indicators such as regulatory quality and rule of law to assess a market's bureaucratic environment and legal environment. The higher the legal risks, the more difficult it is for businesses to operate in.
Logistics Risks	BMI Operational Risk Indicator	Evaluation of the quality and coverage of the utilities, transport and trade infrastructure, including the costs and potential obstacles to business activities. This is driven by a number of data points, such as electricity costs, transport network quality, road density and freight volumes. It also incorporates metrics from the World Bank Logistics Performance index.
Labour Market Risk	BMI Operational Risk Indicator	Evaluation of the risks surrounding employing workers, which is measured by data on the education level of the labour force, availability of suitable workers and indirect employment costs.

Country List

**Note this report refers to the region as the sum of the below countries*

- Bangladesh
- Cambodia
- China
- Hong Kong, China
- India
- Indonesia
- Lao PDR
- Malaysia
- Myanmar
- Pakistan
- Philippines
- Singapore
- Korea
- Thailand
- Viet Nam

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