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Accelerating Net-Zero:
Critical Opportunities in Asia Pacific's Climate Policy

Policy levers to accelerate the transition

Contents

Foreword: The Defining Decade For Asia Pacific's Climate Ambition

The next decade will define Asia Pacific's climate transition. Asia Pacific has the most to gain from reaching net-zero, and the most to lose from this not happening fast enough.

The region has the natural resources, technology, human and financial capital needed to provide leadership and effect change, but governments, businesses and society at large must act decisively and accelerate the next wave of decarbonisation.

Achieving net-zero ambitions has the potential to grow the Asia Pacific economy by almost US$50 trillion by 2070 but at the same time requires us to scale up emerging technologies, build new industries and unlock US$80 – US$90 trillion in investment by 2050[1].

Government policy will make or break this transition.

Clear direction can facilitate investment through the design of regulatory environments that remove barriers and encourage private capital. In many cases, success will depend on coordinating complex industry and infrastructure shifts – modernising electricity grids to meet growing demand for renewable energy, scaling up charging and future fuel distribution to decarbonise both industry and transport – and supporting difficult industry and workforce transitions. Technologies needed for the transition remain comparatively immature, creating commercial uncertainty with capital not sure where to look, or which technology to back. Most critically, governments must create viable markets and visible demand signals, while also supporting early-stage innovation.

While each nation faces different circumstances, three common imperatives stand out:

- Accelerate, commercialise, and scale up emerging clean energy technologies
- Mobilise private capital for large-scale net-zero investment
- Close the price gaps between low-carbon and conventional options.

Solar and wind are now the lowest cost sources of electricity, so the economics of the transition are already working in its favour. **This paper focuses on the next wave of decarbonisation: future fuels, critical minerals, batteries, and industrial transformation.** These are the building blocks of the future economy.

This next wave of transition will be harder than the last. With increasing interdependence for energy, resources, and technology, governments across Asia Pacific need to balance national interests with greater regional integration. Shared standards, trade, and investment agreements can grow new markets and accelerate change. Facing structural shifts, governments must balance competition with collaboration to secure shared prosperity.

This is our moment to act, and we must accelerate.

Will Symons
Asia Pacific Sustainability Leader

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Asia Pacific Public Policy Leader

Introduction Pathways to net-zero require policy ambition

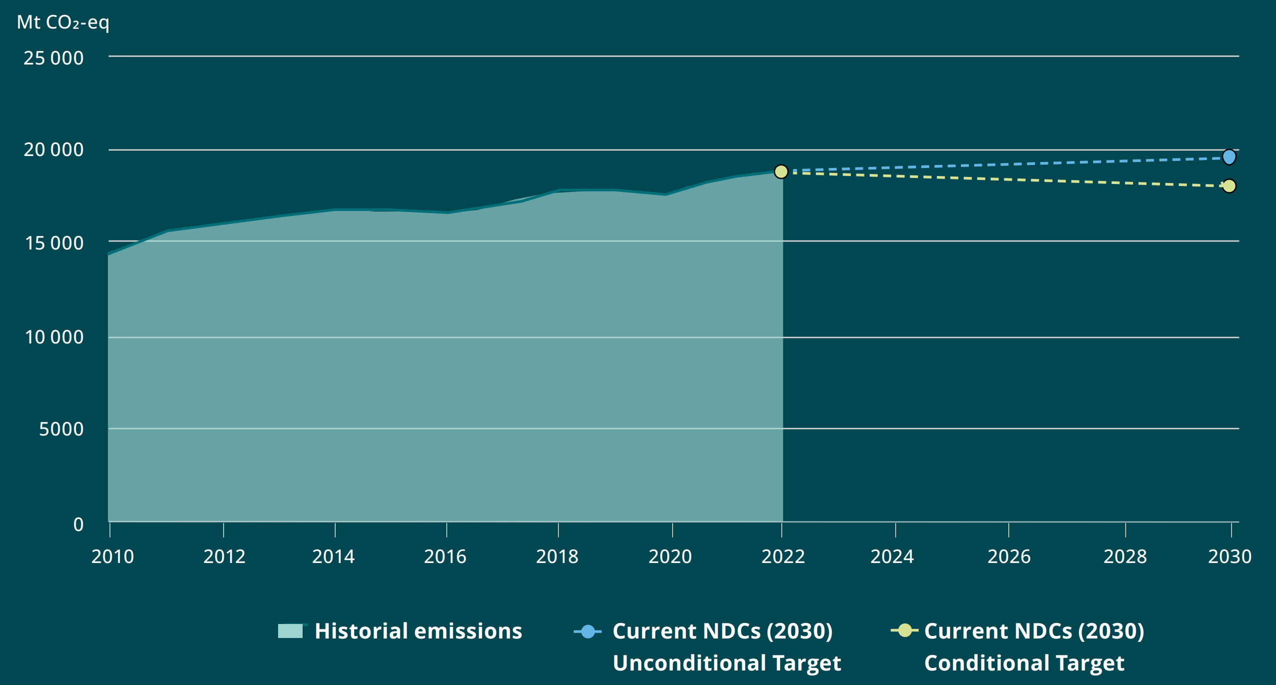
Asia Pacific's Ambition

Economies across Asia Pacific have set ambitious emissions reduction targets through Nationally Determined Contributions (NDCs) under the Paris Agreement and are embedding targets into laws, aligning policy, and mobilising resources to close the gap.

They have launched transition roadmaps and rallied investment. From China's dominance in decarbonisation technologies to Australia's clean energy export potential, the region is positioning itself as a global climate leader.

Yet the Intergovernmental Panel on Climate Change (IPCC) data is clear, and emissions in Asia Pacific, which account for nearly 60% of the global total, continue to rise (see Figure 1). While momentum for change is growing, we are not on track to keep warming within a 1.5°C limit.

Figure 1: Asia Pacific emissions continue to rise
Asia Pacific historical and implied greenhouse gas emissions from energy by NDCs (mid-point projection)



Source: International Energy Agency Climate Pledges Explorer

The current state of play: growing risk of stalemate

Most transition plans rely on a mix of proven solutions and emerging technologies. With rising electricity demand, energy security concerns, hard-to-abate sectors, and challenging investment demands, there is a growing risk of delay or stalemate.

This paper focuses on four critical pillars: **future fuels, critical minerals, batteries, and industrial transformation.** Each pillar must scale up now, reducing emissions or enabling other transition levers, to drive meaningful decarbonisation by 2030 and beyond.

Some areas of transition are accelerating. Renewable energy is scaling as solar photovoltaic (PV) and wind become the least expensive generation sources in almost all markets. Electric vehicle sales (EV) are growing across the region, making up 48% of new car sales in China[2].

Renewables now account for almost 30% of the region's energy generating capacity and are growing faster than fossil fuels. Despite this success, the region's power mix remains reliant on fossil fuels, which still generate 67% of electricity. As energy demand surges and energy security concerns rise, fossil-based generation – and associated emissions – continue to rise.

To meet net-zero commitments decarbonisation must also begin delivering material emissions reductions beyond power generation.

The global energy transition will succeed or fail on Asia Pacific's efforts

The region accounts for 60% of the world's population, nearly 40% of global GDP and around 60% of carbon emissions[3]. Its scale and trajectory of change is pivotal. How Asia Pacific responds will shape the world's net-zero outcome.

The opportunity is historic, and the risks are significant. Asia Pacific can lead a zero-carbon industrial revolution as transformative as its recent decades of economic growth.

Deloitte's Turning Point analysis shows decarbonising the region could unlock a 7.5% increase in GDP by 2070 – equivalent to a US$9 trillion gain, or US$47 trillion in net present value[3]. That's more than the combined economies of Australia, India, and Japan today.

The economic risks of failing to act are stark. If action is not taken, Asia Pacific's GDP will shrink by 5.5% or by US$3.4 trillion annually by 2050. By 2070, losses could reach 12% of GDP – US$16 trillion per year – or US$96 trillion in net present value.

What comes next is more difficult and requires deep changes in industrial policy, energy systems and technology adoption.

The challenges are complex:

- **Future fuels** are essential for decarbonising transport, heavy industry, and power, but remain costly and in limited supply.
- **Critical minerals** are rising in demand, but supply is geographically concentrated and growth faces environmental constraints.
- **Battery production** must scale up rapidly to meet EV demand and support renewable grids, but faces resource bottlenecks and margin pressures.
- **Industrial transformation** – core to economic growth – must shift away from emissions intensive processes and fuels, but lacks viable, commercially scalable alternatives.

Net-zero is unattainable without policy intervention

The scale, pace and complexity of change is unprecedented. Asia Pacific's current NDCs target a reduction of nearly half a billion mega-tonnes of CO_2-equivalent emissions by 2030, or 3% of total emissions. Reaching net-zero implies cutting emissions by 2.6% per year. And every year of delay requires steeper cuts in future years to meet net-zero by 2050 and decreases the likelihood that we will avoid dangerous climate change.

Across Asia Pacific, the impact and implication vary nation to nation. Developed economies, with greater historic emissions, must make deeper cuts to offset rising emissions from developing countries, as their economies grow.

The logic of transition is conceptually simple: Electrify wherever possible, decarbonise the electricity supply, and tackle residual emissions through efficiency, behaviour change and new technology.

With progress on decarbonised electrification accelerating, focus needs to expand to emissions sources which cannot be electrified. These transitions are more difficult. Heavy transport and industrial production face many entrenched barriers and, while technologies exist in areas like low-temperature industrial heat, many sectors still lack viable, scalable decarbonisation pathways. This is where targeted, creative policy becomes essential.

It is estimated that achieving global net-zero will require between US$150-200 trillion in investment by 2050[4]. Asia Pacific alone will need US$79 - 89 trillion. In 2023, investment in low-carbon technologies across the region hit a record US$840 billion. But this must nearly triple to around US$2.3 trillion per year by 2030 and increase further thereafter.

Capital investment is needed to scale up generation and grid infrastructure, replace transport fleets, transform industrial processes, and build resilient supply chains. And the financing challenge is significant. Many projects are not economically viable under current market conditions. Investors need returns on their investments, and consumers need affordable options.

This is where policy becomes critical – to set direction, offer public funding support, and reduce risks to make transition projects bankable. Targeted policy needs to address bottlenecks in each pillar to unlock private capital and accelerate change.

Five key actions for policy makers stand out:

1. **Accelerate policy and regulation**
   Provide clear, stable frameworks that signal a long-term direction and commitment to industry and reduce risk for investors.
2. **Establish sector strategies and institutions**
   Develop targeted roadmaps that clarify what to build, when and where – and assign institutional responsibility for delivery.
3. **Develop new markets**
   Support research, innovation and early-stage investment – but most importantly, build the market infrastructure that allows industry to scale up.
4. **Remove barriers to growth**
   Address financing gaps, infrastructure bottlenecks and execution risks that are slowing progress.
5. **Foster regional cooperation**
   Collaborate across borders to pool demand, share technology, and attract capital at the scale necessary for net-zero transition.

Across the following chapters these five themes return again and again in offering a roadmap for governments, policy makers, business leaders and regulators across the region to meet their NDCs and accelerate decarbonisation.

01 Future Fuels

Future fuels are critical to the next wave of decarbonisation

Meeting climate targets means shifting away from fossil fuel dependence.

For industrial heating, heavy transport such as aviation and shipping, and certain power generation needs, the opportunity for electrification is limited and new low- and zero-carbon fuels are needed (collectively referred to as 'future fuels' in this paper).

Power generation and industrial processes generate 68% of global energy related CO2 emissions today while transport contributes a further 23% (see Figure 2). Electrification and renewables can reduce emissions from electricity generation, some industrial processes and light road transport. But other sectors, such as heavy industry, aviation and maritime shipping, require fuels with higher energy density or specific properties – and this is where future fuels are critical to the net-zero transition.

Clean hydrogen, synthetic fuels, and biofuels are the primary low-carbon fuel options, but each face technical, economic, and infrastructure hurdles. With current production limited and costly – and future demand projected to rise – the race to scale up is accelerating. Yet high costs constrain demand, and without a clear path to profitability, attracting investment remains a challenge.

Future fuels include clean hydrogen, synthetic fuels and biofuels:

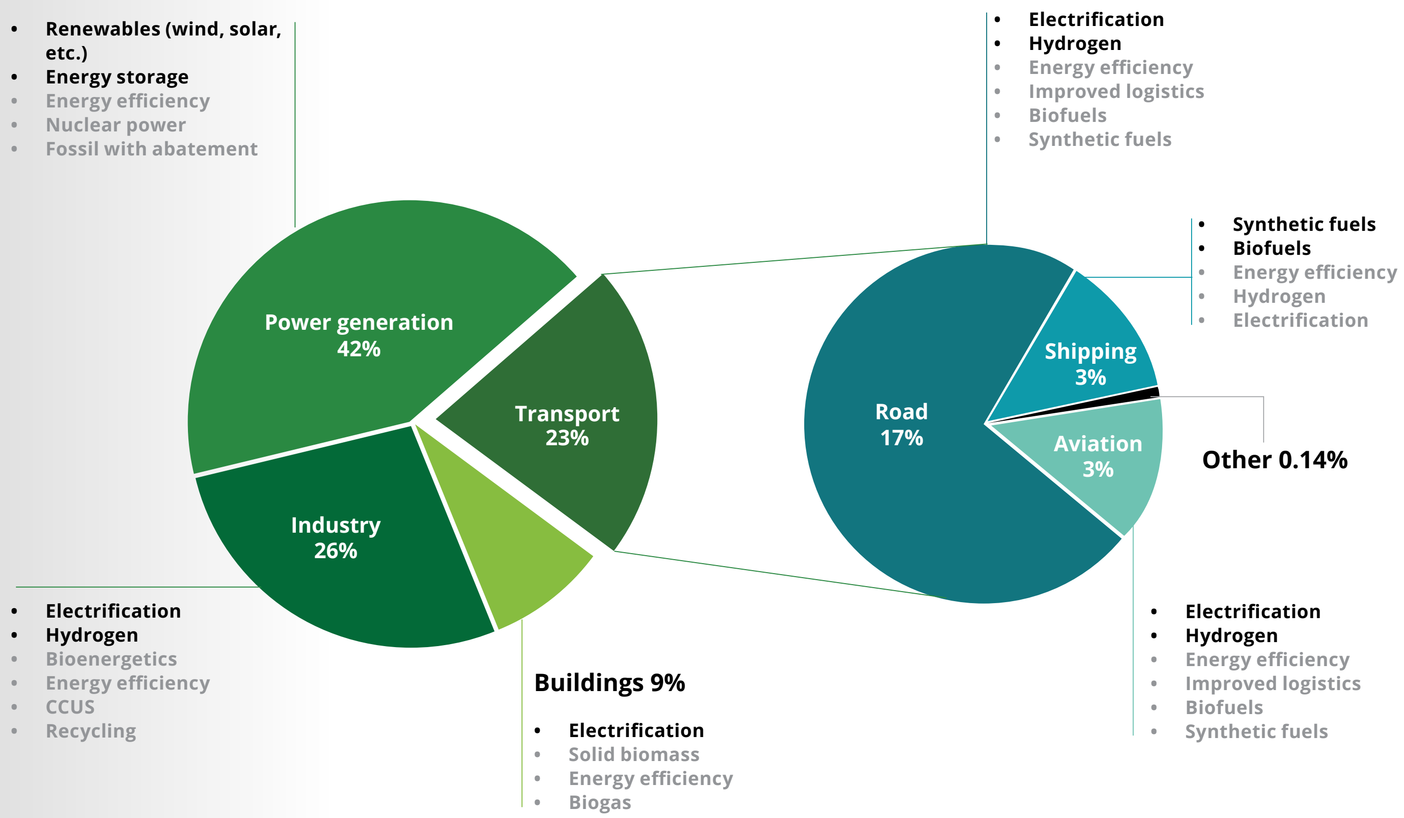
Clean hydrogen is produced by processes with significantly lower emissions than hydrogen produced through traditional approaches – primarily through water electrolysis powered by renewable ('green hydrogen') or nuclear ('pink') sources, or by capturing and storing carbon emissions from traditional hydrogen production ('blue').

For a full explanation of the different methods (and 'colours') of hydrogen production, please see 'Green hydrogen: Energizing the path to net zero' by Deloitte.'

Synthetic fuels, such as kerosene, methanol, and ammonia, are created by further processing hydrogen feedstocks.

Biofuels convert organic matter, such as crops or agricultural waste, into fuels through chemical, thermal or biological methods.

Figure 2: Global CO_2 emissions from energy combustion and the available decarbonisation strategies for each addressable through future fuels technology

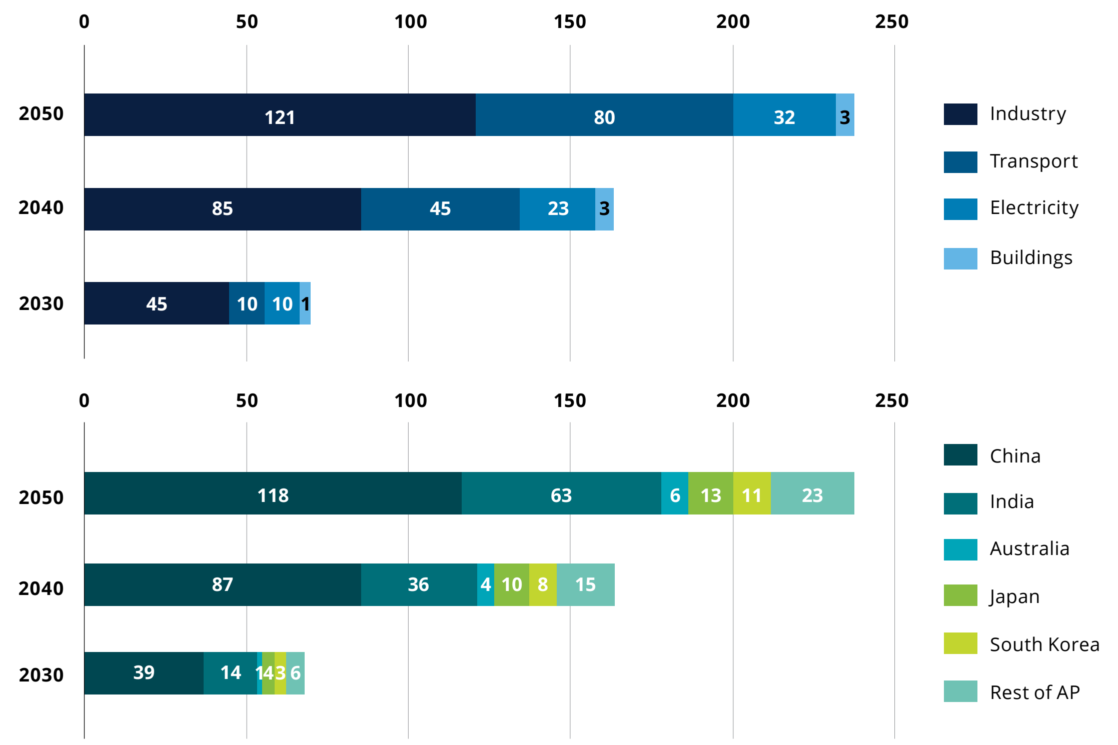


Source: Deloitte analysis based on Deloitte,[3] IEA[9] and Our World in Data[10]

Asia Pacific, with its concentration of heavy industry and rapidly growing air and shipping traffic, faces significant pressure to adopt future fuels. Production, however, remains minimal with biofuels accounting for less than 4% of energy consumption in the transport sector[5], less than 1% hydrogen consumed annually in the region is green[6], and the use of sustainable aviation fuel (SAF) and low-carbon maritime fuels barely registering.

Yet change is anticipated. Focusing specifically on hydrogen, Deloitte forecasts demand will grow to 66 Mt by 2030 and to 236 Mt by 2050 (see Figure 3)[7]. Almost all demand growth is expected to come from clean hydrogen sources. By mid-century, future fuels could meet 77% of aviation fuel needs and 83% for maritime transport[8].

Figure 3: Asia Pacific hydrogen demand by sector and country (in MtH2)



Source: Deloitte analysis adapted from Deloitte's 2023 report 'Green Hydrogen: Energising the path to net zero'. Forecasts are estimated and based on the anticipated projected demand should sufficient action be taken to meet required commitments alongside the ambition to limit warming to 1.5 degrees by 2050.

For Asia Pacific, the value isn't just in decarbonisation – it's the creation of a major new industry.

Deloitte estimates the hydrogen market could grow to US$632 billion annually in Asia Pacific (53% of the global total)[9]. Rich natural resources and renewable energy capacity position the region as both a leading source, and key market for, future fuels. Australia stands out as a primary exporter of clean hydrogen products, while China and India are expected to scale up production for their domestic markets. Meanwhile, Japan and South Korea are set to become major future fuel importers, driving industry and grid decarbonisation. And while earlier in development, with growing aviation and shipping markets – and strong renewable energy and feedstock resources – Asia Pacific can also be a major player in future transport fuels.

Advancing the future fuels industry

Most major economies have hydrogen strategies in place and are beginning to tackle aviation and maritime fuels. Meeting demand, however, requires substantial investment. Developing the region's hydrogen value chain alone needs investments of US$130 billion annually over the next 25 years[9], with further investment in other future fuels[10]. This means not just investing in production facilities, but renewable energy, transport, infrastructure, and even new vessels and engines. By comparison, fossil-fuels industries attracted US$1.1 trillion investment in 2024[11].

Today, clean hydrogen comprises less than 1% of total global hydrogen production, and just 10% of this fraction is green hydrogen[12].

Development is scaling fast: as of May 2024, 1,572 clean hydrogen projects representing US$680 billion investment by 2030 have been announced. Yet, actual investment commitments remain modest, with only 434 projects (representing 4.6 Mt) passing final investment decisions (FID), and only one third of these in Asia Pacific.

In aviation, the story is similar. SAF production reached just 0.2% of global fuel use in 2023, primarily from US and European facilities. Despite this, momentum is building, with 85 producers announcing 130 SAF projects across 30 countries[13].

Less than 1% of global shipping fuel is estimated to come from future fuels, with ships capable of taking these inputs a key constraint. As of July 2024, just 297 of the global fleet of 109,000 were operating with future fuels[14].

Early movers face major hurdles, including limited domestic supply chains and distribution infrastructure, and – most critically – uncertain demand for costly new fuels.

High future fuel costs are holding back the transition

Direct price comparisons are difficult. Energy prices are volatile, end-uses differ, and regional costs vary, but most future fuels typically cost three to ten times more than conventional fuels. The gap is widest for the synthetic fuels that are essential to decarbonise aviation and shipping.

While innovation, scale and efficiency gains will reduce costs, future fuels are likely to remain more expensive than fossil fuels in the medium and longer term. This is driven by renewable energy inputs, new infrastructure requirements, and entrenched fossil fuel subsidies (see chapter 5).

This is the core challenge policymakers face – new technology, market structures, and demand signals are necessary. But without addressing the price gap, progress will be slower and more expensive.

High production costs, price volatility, poor transparency, and limited low-carbon premiums for downstream products lower returns and create financial risk – complicating project investment.

Incentives matter, but the key issue is cost allocation and determining who pays. Policy must decide where costs fall between producers, consumers, and government. Fossil fuels will remain cheaper unless climate impact, air quality and other externalities are priced in. Carbon pricing, whether through tax, trading, or direct levies, won't solve everything, but it can go a long way towards closing the cost gap and funding early-stage scale up.

Key issues for policymakers

1) Set the policy roadmap and sequencing

Future fuel strategies need to be developed into national and sector-level roadmaps, policy action and funding. What's needed now is clear, coordinated policy and regulation that aligns fuel pathways, infrastructure and incentives across supply and demand, and across borders. This will give industry and investors the confidence to make long-term commitments.

Policymakers must also make pragmatic choices based on fuel readiness and cost. For example, blue hydrogen can accelerate early market and infrastructure development due to its lower cost, while production of clean hydrogen scales. Similarly, biofuels and methanol will likely play a more important role in the near-term decarbonisation of aviation and shipping before synthetic kerosene and ammonia become viable.

Given the significant investments required for transition fuels, policymakers must evaluate options to ensure that they do not lock-in technologies that are not viable in the long-term due to their higher carbon intensity.

Australia's hydrogen strategy: turning vision into investment

Australia is leveraging its strong resources base and proximity to growing Asian demand to become a global hydrogen leader. The 2024 National Hydrogen Strategy aims to build a substantial clean hydrogen industry and unlock over AUD$50 billion in private sector investment and create up to 16,000 new jobs by 2030[15].

With an AUD$225 billion project pipeline, Australia is now focused on delivery and key initiatives include:

- **Hydrogen Production Tax Incentive:** AUD$7 billion over 10 years to close the production cost gap.
- **Hydrogen Headstart:** AUD$4 billion to support large-scale clean hydrogen projects.
- **Regional hydrogen hubs:** co-investment in shared infrastructure across seven locations.
- **Project funding** from the Clean Energy Finance Corporation and National Reconstruction Fund.
- **Research and development (R&D) and innovation:** led by ARENA[16], alongside regulatory reform at state and federal levels.

In 2024, ARENA awarded AUD$814 million to the Murchison Green Hydrogen Project. The project will generate 3.7GW of renewable power for hydrogen and ammonia production, backed by federal and state support to streamline planning and approvals.

While momentum is building, the question remains whether the extensive policy support will be enough to break through the technical and financial challenges for this industry to reach scale.

2) Address technology readiness

Many of the technologies behind future fuels are in early development (see Figure 4). Challenges extend beyond production to fuel certification, infrastructure and downstream use. These issues increase the risk of project delay, cost overruns and underperformance – impacting investment decisions and cost.

Governments must help close the gap. Targeted support through R&D funding, tax incentives, venture capital and concessional finance can reduce risk for first movers and accelerate commercialisation.

Figure 4: Future fuel technology readiness, not including biofuels

Category	Sub-Category	Main Solutions	Technology Readiness Level (TRL)*	Comment
Fuel production	Synthetic fuel production	Synthetic kerosene production	6	Produced by Fischer-Tropsch synthesis (using H_2 and CO_2)
		Methanol production	7	Produced using H_2 and CO_2
		Ammonia production	8	Produced by Haber-Bosch (using H_2 and Nitrogen)
Feedstock	H_2 production	Electrolysis	9	Green hydrogen - electrolysis using renewable energy
	CO_2 capture	Solid direct air capture	7	Direct air capture based on solid adsordents (at low temperature)
		Liquid direct air capture	6	Direct air capture using aqueous solutionn (at high temperature)
		Sustainable biogenic CO_2	11	Sustainable CO_2 from point capture (concentrated sources)
Engine technology	Aviation	Electric aircraft	5	Battery or Hybrid electric plane
		Hydrogen-fueled	6-7	Fuel cell or direct hydrogen combustion
		Kerosene-fueled aircraft	11	Commercial engines
	Maritime	Hydrogen-fueled ship	4-5	Combustion engines fuelled with hydrogen
		Ammonia-fueled ship	6	Combustion engines fuelled with ammonia
		Methanol-fueled ship	9	Combustion engines fuelled with liquid methanol
		Biogas-fueled ship	9-10	Combustion engines fuelled with liquified biogas
		Electric ship	9	On-board battery electric ships

Source: Deloitte analysis based on International Energy Agency (IEA) Technology Readiness Database[63]

**The International Energy Agency (IEA) utilises a Technology Readiness Level (TRL) scale to assess the maturity of energy technologies. This scale, ranging from 1 to 11, helps evaluate a technology's development stage and its readiness for practical application.*

3) Manage demand for renewable electricity

Future fuel production is energy intensive and relies on access to low-cost renewable energy. Electricity accounts for up to half the cost of green hydrogen.

From a transition perspective – direct electrification is more efficient than converting electricity into future fuels – policymakers must weigh up where renewable capacity delivers he greatest emissions reduction impact.

For economies with abundant, low-cost renewable electricity supply, future fuel production is viable. Other nations may need to prioritise domestic electrification and rely on importing low-carbon fuels to meet demand. Reliable access to zero-carbon energy is a critical decision point for project viability.

4) Build market infrastructure

Inconsistent standards and weak price signals are two significant barriers for future fuel markets. Definitions of future fuels vary by producer and country. Policymakers must set consistent standards that support ease of doing business and trade whilst ensuring certainty about fuel emissions intensity.

Price discovery is equally problematic. Conventional energy prices are distorted by subsidies, and there are no established low-carbon fuel premiums.

Governments can bridge the price gap through pricing support – such as production incentives in India or Australia, or auctions in the UK and Japan.

Some governments go further and act as market-makers. Germany's H2Global, acts as a market intermediary (see box). South Korea has pioneered auctions that can set a benchmark price, which included a 2024 round to secure 6,500GWh of long-term hydrogen supply for power generation[16].

Forging cross-border trade

H2Global is a cornerstone of Germany's strategy for energy independence and industrial decarbonisation. It bridges the cost gap between clean hydrogen producers and buyers. Through its intermediary, Hintco, it contracts long-term supply through competitive tenders and then resells to buyers via short-term auctions. The government covers the price difference, de-risking trade.

H2Global is supporting global hydrogen supply chains. In 2024, Germany and Australia deepened co-operation through an Energy and Climate Partnership. Cooperation covers R&D support and technology transfer and underpins trade between the two nations. The agreement included a joint €400m H2 Global-linked fund to support Australian hydrogen exports to Germany and Europe[17].

5) Stimulate new fuel demand

Without early buyers, projects struggle to secure financing. The absence of tradable markets and demand signals slows development, even where the long-term trend is clear.

Governments are helping to close this gap through mandates and quotas, shifting the cost burden to industry. Examples include the EU's ReFuelEU regulation which mandates 1.2% of aviation fuel be from sustainable sources by 2030, or India extending biofuel blending targets to aviation. However, without pricing support, the impact of mandates on end-consumer costs needs to be carefully managed.

The private sector is also stepping in. Large buyers are using bilateral offtake agreements – often in response to mandates or supported by incentives – to create demand, invest in supply and de-risk production. In aviation and shipping, these are being coordinated by the International Air Transport Association (IATA) and the International Maritime Organisation (IMO).

6) Coordinate industry infrastructure

Fuel supply chains need investment in distribution and infrastructure. While some fuels, like synthetic kerosene and biofuels, can use existing systems, others require purpose-built assets. Hydrogen, for example, needs dedicated pipelines, terminals and storage facilities due to its volatility and low density.

The policy challenge is aligning infrastructure with production. The EU's hydrogen plan regulates fuel transport and streamlines permitting, supported by national initiatives and investment to build distribution networks (see box). Fuel hubs offer a solution by co-locating R&D, production and demand to accelerate deployment. This is particularly important for air and port infrastructure.

The EU's hydrogen development policy: a potential case study for the region

The EU's comprehensive mix of regulatory, financial and industrial policy aims to build a clean hydrogen economy as a core part of its net-zero goal. Key regulatory measures include the Hydrogen and Decarbonised Gas package, Renewable Energy Directive III, Fit for 55 package, and Net-Zero Industry Act. These set binding targets, govern hydrogen infrastructure, define clean hydrogen and future fuels, and integrate these into energy and industry supply chains.

Financial support is provided through the European Hydrogen Bank, Innovation Fund, Important Projects of Common European Interest (IPCEI) and national schemes. These target production scale-up, cost-gap reduction and risk sharing for early stage projects. Infrastructure is supported through specific funds and mandates, including Hy2Infra for pipelines and storage. Certification frameworks are being developed to define clean future fuels and underpin cross-border trade.

Demand creation is driven by mandates and targets in industry and transport (e.g. ReFuelEU Aviation) and carbon pricing (through the EU Emissions Trading Scheme (ETS). However, delays in certification, slow permitting, high prices and offtake uncertainty continue to hold back final investment decisions. Despite strong policy architecture and rising investment, few projects have progressed. Demand-side policy implementation and infrastructure build-out remain critical gaps to address[18].

7) Align with global industry transitions

Aviation and maritime shipping are global industries with concentrated and mature supply chains. National roadmaps need to align across airlines and shipping firms, fuel suppliers, ports and global engine, ship and aircraft manufacturers.

For drop-in fuels like biofuels, mandates and subsidies must match realistic demand and supply forecasts. But transitions involving hydrogen, ammonia or methanol require new infrastructure, craft and engines. Policy must reflect the readiness of end-use technologies – underscored by Airbus's recent delay of hydrogen aircraft, citing slower market development[19].

Accelerating the future fuel industry across Asia Pacific

With a diverse mix of resource-rich producers and a growing need for alternative fuels across the region, there is opportunity for Asia Pacific nations to work together to accelerate the future fuel economy.

Coordinate policy frameworks

The region should agree on standards, definitions, and carbon pricing to enable certification, transparency, and ease of trade. Latin America offers a model where 14 nations developed a common certifications scheme for clean hydrogen, CertHiLac, to support regional integration[20]. Progress may also come through sectoral agreements, such as the IMO's recent global marine fuel standard and emissions pricing framework.

Supply chain and trade partnerships

Deepening trade relationships means aligning incentives, supporting cross-border investment and co-investing in trade infrastructure to enable long-term fuel flows.

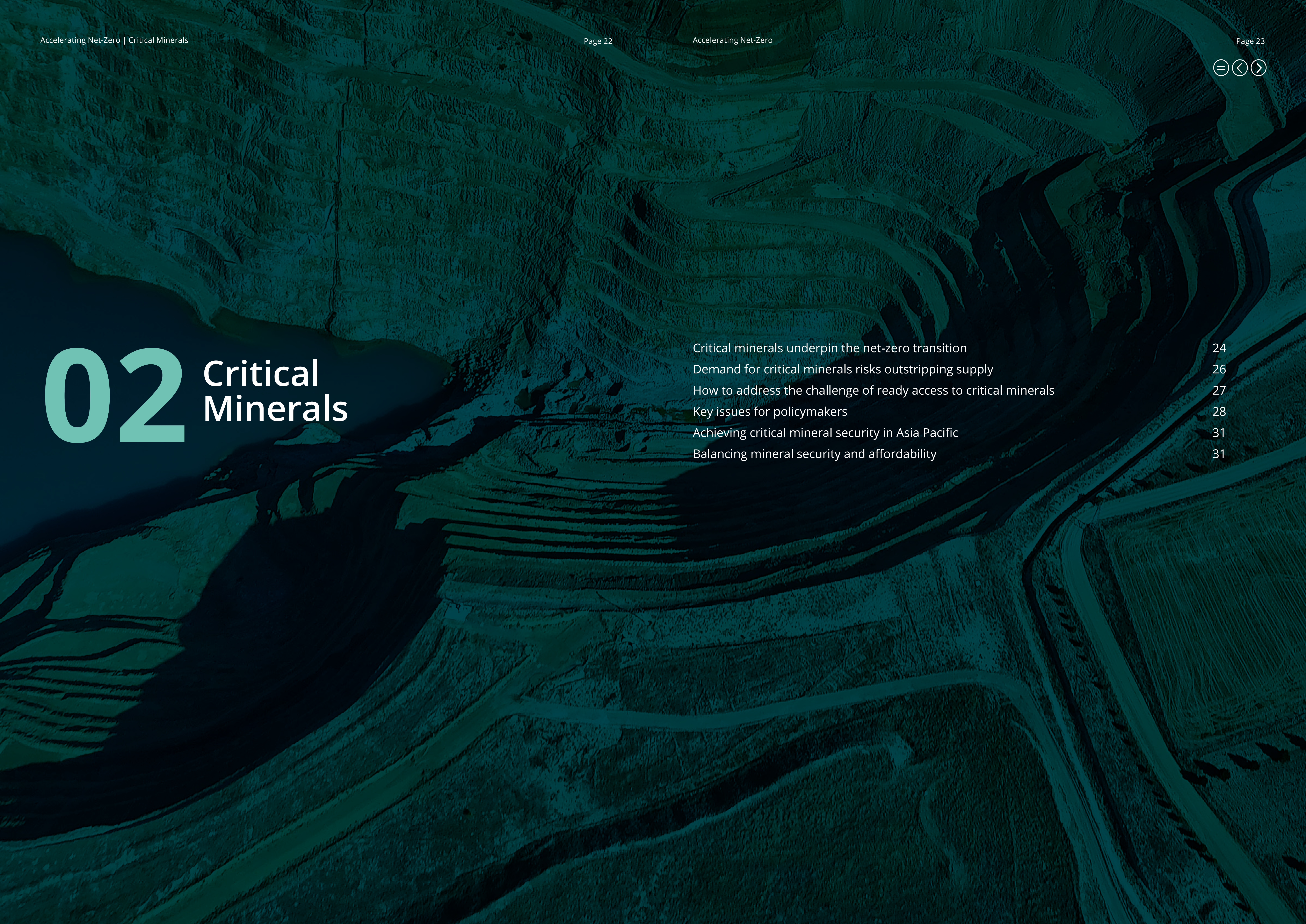
Finance and technology transfer

Finance needs to flow into projects and partnerships. Development finance, joint ventures and technology transfer can accelerate local production, export readiness and regional transition to future fuels.

Bridging the future fuels cost gap

Future fuels offer two major benefits: they cut emissions from hard-to-abate sectors and create a new low-emissions industry than enhances energy security.

To reap these benefits, governments face the complex problem of closing the price gap with fossil fuels, and managing competing energy uses to maximise emissions reduction.



02 Critical Minerals

Critical minerals underpin the net-zero transition

Critical minerals underpin the net-zero transition.

Demand is accelerating across renewable energy, grid infrastructure, EVs, batteries, and future fuels, making access to raw materials both a strategic enabler and a supply risk.

Production is highly concentrated with two or three countries controlling most of the mining and processing for most critical mineral supply chains – and China dominates in nearly every category. With rising demand, trade tensions and the essential role of critical minerals in clean energy technologies – securing supply has become a strategic imperative.

Figure 5: Critical mineral needs for clean energy technology

	Copper	Cobalt	Nickel	Lithium	Rare Earth Elements (REEs)	Chromium	Zinc	Platinum Group Metals (PGMs)	Aluminium
Solar PV	High	Low	Low	Low	Low	Low	Low	Low	High
Wind	High	Low	Moderate	Low	High	Moderate	High	Low	Moderate
Hydro	Moderate	Low	Low	Low	Low	Moderate	Moderate	Low	Moderate
Concentrated solar power (CSP)	Moderate	Low	Moderate	Low	Low	High	Moderate	Low	High
Bioenergy	High	Low	Low	Low	Low	Low	Moderate	Low	Moderate
Geothermal	Low	Low	High	Low	Low	High	Moderate	Low	Low
Nuclear	Moderate	Low	Moderate	Low	Low	Moderate	Moderate	Low	Low
Electricity networks	High	Low	Low	Low	Low	Low	Moderate	Low	High
EVs and battery storage	High	High	High	High	High	Low	Moderate	Low	High
Hydrogen	Low	Low	High	Low	Moderate	Low	Moderate	High	Moderate

Importance: High ● Moderate ● Low ●

Source: International Energy Agency (IEA)

What are critical minerals?

These minerals including copper, nickel, cobalt, lithium, graphite, and rare earth elements are essential for the manufacturing of batteries, magnets, turbines, electrolysers, motors, and solar panels that drive clean energy technologies. In addition, massive volumes of copper and aluminium are needed to meet the world's electrification demand.

Many countries have their own definitions of critical minerals with minor differences in which elements are included. What is common however, is that critical minerals are vital for decarbonisation, advanced industry, and increasingly, national security.

Demand for critical minerals risks outstripping supply

The scale of the global net-zero transition is unprecedented and cannot happen without a reliable supply of critical minerals.

As an example, the EV fleet in Asia Pacific is projected to reach 671 million vehicles by 2050 – each requiring, on average, 53kg of copper, 40kg of nickel, 13kg of cobalt and 9kg of lithium. Over the same period, the region's power grid will double in size, expanding by 53 million kilometres[21].

According to the International Energy Agency (IEA), critical mineral demand could double by 2030 based on the announced NDC pledges or more than triple under the Net-Zero scenario – then continue rising to 2050[22]. Demand patterns vary by material: copper could increase 154%, nickel by 226%, and lithium by almost 9-fold by 2050, with nearly all growth coming from clean technologies (Figure 6).

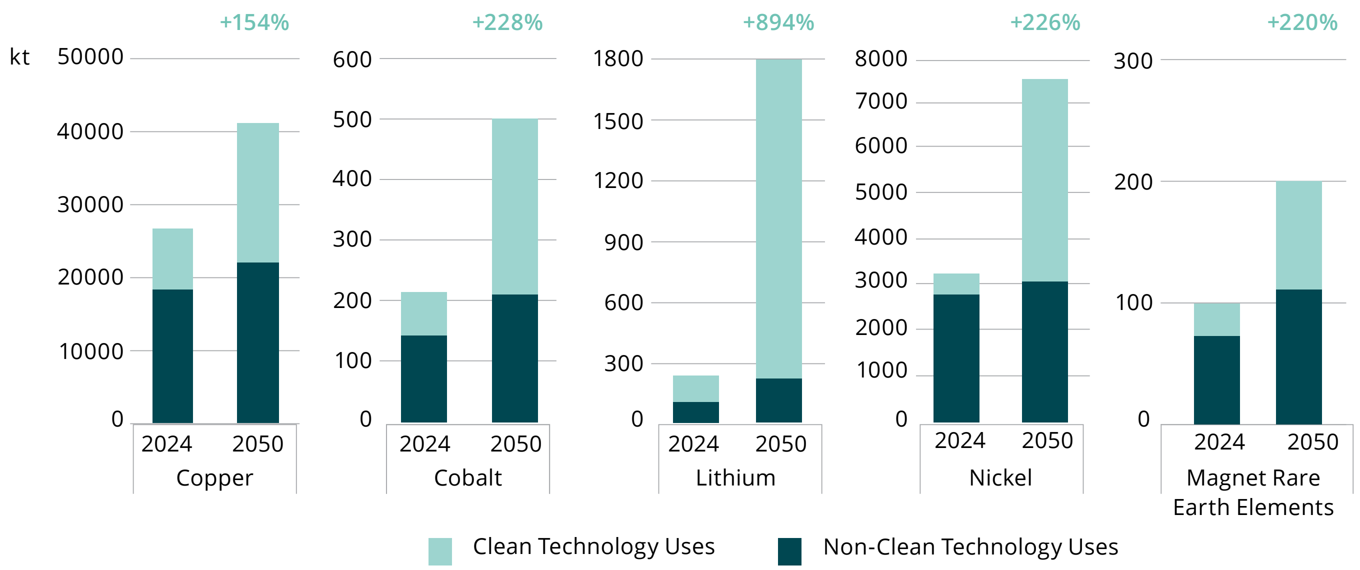
To meet this rising demand new sources are required. However, building new capacity, including refining and processing, and supply chains is not straight forward.

Mining projects are capital intensive, slow to develop and often rely on complex trade agreements and foreign investments. Prices are volatile and opaque, and in some mineral markets, low-cost suppliers with weak environmental and labour standards are leading to the curtailment of production elsewhere.

Governments and policy need to bridge the gap between demand and reliable, affordable and diversified supply.

The value of the global critical minerals market reached US$320 billion in 2022, with mining capex for nonferrous metals rising 30% to US$40 billion, and exploration spend up 20% to US$6 billion[23]. But investment remains far below what is needed. Meeting net-zero demand would require US$360 - US$450 billion in cumulative investment by 2050 and current forecasts fall short by at least US$140 billion. Furthermore, supply gaps across a range of minerals are forecast from 10% for cobalt to as much as 35% for lithium.

Figure 6: Demand growth for select critical minerals, net-zero scenario



Source: International Energy Agency (IEA)

How to address the challenge of ready access to critical minerals

Ready access to affordable raw materials is essential to scale up clean energy technology. Governments must align their transition strategies to a reliable supply chain – clarifying where and how they will obtain the necessary critical minerals.

In Asia Pacific, three broad economic groupings are emerging. Resource-rich markets, like Indonesia, Vietnam, Malaysia, and Australia, are seeking to grow exports and move up the extraction and processing value chain.

Import-dependent economies, like Japan and South Korea, are focused on long-term supply security. And China, which dominates mineral processing and clean energy technology manufacturing, aims to retain market access while assuring trading partners it will remain a dependable supplier.

Two core tensions between growth and security are shaping policymaking:

Cost vs resilience

Governments face pressure to keep material costs low while also securing supply. But building resilient supply chains – through domestic development, diversification of trade partners, or stockpiling – comes at a cost premium. Governments need to bridge this gap.

Growth vs responsibility

Sourcing low-cost supplies or expanding local extraction and processing carry environmental and social risks. Many developed countries are reluctant to onshore resource-intensive industries, yet offshoring raises its own challenges. Relying on others to shoulder environmental burdens is no longer an option – and neither is limiting the development of value-add industries in partner countries. Policymakers must share value creation without shifting harm.

The mining and processing industry is mature, but project viability hinges more on price and demand certainty, and less on access to capital. Governments can act to de-risk supply chain development through incentives or underwriting demand and offtake agreements to reduce investment risk.

Increased collaboration across Asia Pacific offers a way forward. The diversity of resource needs and concentration of supply necessitate interdependence. Governments must build stronger trade and investment partnerships to support the growth of this broader industry.

Key issues for policymakers

1) Build stable trade partnerships

Mining depends on stable, long-term trade relationships – but these need to go beyond commodity transactions. Future focused partnerships must include investment, joint-ventures, and technology transfer that supports upstream mining and development of processing industries.

These efforts are no longer just bilateral. Initiatives like the Minerals Security Partnership (MSP) (see box) bring together like-minded nations to align strategy and pool resources. Effective execution often relies on coordinating institutions, such as the Japan Organisation for Metals and Energy Security (JOGMEC), that can bridge public policy and private sector investment (see box).

Minerals Security Partnership

The Minerals Security Partnership (MSP) is a US-led initiative focused on building diversified supply chains for critical minerals and reducing overreliance on any single economy. It brings together governments including Australia, Canada, Japan, South Korea, the UK, and European Union to coordinate private investment across the mineral value chain.

The MSP facilitates collaboration among regulators and financiers to accelerate minerals projects. Its Finance Network aligns government funding, funding agencies and private capital to expand investment in critical minerals projects. The MSP Forum connects its members with mineral producing nations to support resource development.

As of September 2024, the MSP had supported 32 projects globally[24], including:

- Electra Battery Materials: North America's first cobalt sulphate refinery, backed by US$20 million under the US Defense Production Act and $3m from Natural Resources Canada, sourcing cobalt from the Democratic Republic of Congo.
- Mingomba Copper Project: A US$2 billion joint investment by US KoBold Metals and Zambia's ZCCM-IG, is significantly expanding Zambia's copper production and export.

Implementing the Australia/Japan minerals partnership

The Japan Organisation for Metals and Energy Security (JOGMEC) is the coordinating agency for Japan's strategy to secure minerals for its advanced manufacturing and clean energy technology sectors. It plays a key role in trade agreements, manages Japan's critical mineral stockpile, and is instrumental in efforts to diversify chains.

A cornerstone of its strategy is the relationship with Australia. In 2011, JOGMEC and Sojitz Corporation co-founded the Japan Australia Rare Earths (JARE) joint venture, investing AUD$250 million in Lynas Rare Earths to secure long-term supply and bolster the company's future[25]. The partnership expanded in 2022, with an additional AUD$200 million investment, securing access to up to 65% of Lynas's heavy rare earth output.

This also aligns with Australia's ambition of increasing domestic mineral processing, and the Australian Federal Government backed Lynas's expansion with an AUD$1 billion loan to Iluka Resources to develop the country's first integrated rare earth refinery.

2) Shorten the development cycle

New mines take an average of 15 years to reach commercial production[26], leaving projects vulnerable to changes in policy, demand and prices. A key lever to accelerate critical minerals production is to streamline the permitting process and ease regulatory hurdles. This doesn't mean compromising environmental or community standards, but rather creating integrated systems that enable faster, well-informed decisions.

Canada is aiming for a five-year permitting target for critical mineral development through inter-agency alignment. By focusing on designated development zones, new projects can share or develop infrastructure more expeditiously. In developing countries, strengthening regulatory frameworks, building institutional capacity and other practical measures, like conducting targeted geological surveys, can boost investor confidence and accelerate progress.

3) Establish market infrastructure

Markets for low-volume, specialised minerals remain immature compared to bulk commodities. Limited scale reduces price transparency and increases volatility. While organisations like the IEA and London Metals Exchange are working to improve market data, policymakers have an important role to play. Long-term offtake agreements and production incentives can stabilise prices and provide certainty to miners and investors. Strategic stockpiles – such as those in Japan, South Korea, and recently announced by Australia – not only secure supply but can also buffer against price shocks, particularly when co-ordinated internationally[27].

A further priority is strengthening Environmental, Social and Governance (ESG) standards standards and mineral traceability. The EU's Carbon Border Adjustment Mechanism (CBAM), battery passports and local content rules are pushing markets towards greater transparency and differentiation by the source of input materials. These efforts highlight the tension: sourcing responsibly versus sourcing cheaply. Aligning standards is key to balancing both.

4) Align economic and environmental development

For resource-rich countries, building value-added capability is central to their economic development. Malaysia's New Industrial Master Plan[28] targets developing downstream processing of critical minerals – particularly rare earth elements and advanced materials manufacturing aligned to its growing solar PV sector. Policy support includes regulatory reform, R&D funding and financial incentives, which have attracted investments from companies like Lynas Rare Earths – now operating the largest, rare earth processing facility outside of China.

Indonesia, the world's top nickel producer, has restricted its raw material exports to promote domestic refining and establish an end-to-end EV and battery supply chain (see Chapter 3: Batteries). Australia's critical minerals strategy and Future Made in Australia Plan aim to increase domestic refining and processing by supporting local and foreign investment, and secure international trade partnerships across the value chain.

A key question is where to build or invest in the different stages of mineral development. High-cost countries have often offshored resource-intensive extraction and processing while retaining high-value refining and manufacturing. But this model is under pressure. ESG expectations, emission targets, and new processing technologies are pushing countries to co-locate extraction, renewables, and processing to create cleaner and more integrated supply chains.

5) Integrate supply chains

Access to minerals and economic development goals are also driving deeper supply chain integration. Technology companies are securing supply through direct partnerships and investment in upstream facilities. BHP has signed long-term nickel supply deals with Tesla, Ford and Prime Planet Energy Solutions (a Toyota and Panasonic JV) for its Nickel West operations[29].

Tesla has also built its own lithium refining facility in Texas, using US sourced lithium[30].

For resource-rich countries, these partnerships play a role in developing domestic refining and processing industries – and not just for accessing finance, but technology and know-how as well. And when structured around long-term relationships and supply, these deals can create significant mutual benefit – such as the global expansion of South Korea's POSCO (see box).

POSCO's global minerals expansion

A longstanding player in South Korea-Australia resource cooperation, POSCO acquired a stake in Pilbara Minerals in 2018, securing long-term lithium offtake.

Together, the companies have developed downstream lithium processing facilities, making POSCO one of the few lithium chemical producers for batteries outside China[31].

These investments have been supported by Australia's federal and state governments, as well as low-cost financing from state-sponsored Korea Eximbank and Korea Development Bank. POSCO's global approach involves investment and development of raw materials and processing, such as its MSP-backed stake in Black Rock Mining's Mahenge graphite project in Tanzania[32]. In Vietnam, it has announced a US$1.2 billion investment program, including rare earths processing[33].

6) Increase circularity

Recycling is one of the most promising ways to strengthen critical mineral supply chains. With high recovery potential for many materials, the IEA estimates that recycling alone could meet 10-20% of mineral demand by 2030[34]. As available ore quality declines and processing new materials becomes more energy-intensive, the case for recycling grows stronger.

However, recovery rates remain low, and processes are often costly and labour-intensive. Despite this, recycling is essential for reducing waste and emissions, and for improving security of supply. The EU's Critical Raw Materials Act targets 25% of critical mineral demand to be met through recycling by 2030. South Korea plans to increase its recycling rate from 2% to 20%. These plans are typically supported by local content requirements and incentives, and in the EU, by take-back and circularity requirements.

Momentum is growing across the full spectrum of minerals – from established recycling of nickel and aluminium to newer efforts like battery recycling and e-waste recovery. Policy support for R&D, recycling targets and facilities, and product design standards will be key to accelerating circularity at scale. While new business models that could significantly increase efficiency, such as shared ownership, or leasing equipment or components, will likely require regulatory support and sponsorship.

7) Identify alternative materials and supply

With no easy fixes to the underlying supply and demand risks, attention is shifting to alternatives. This includes two key strategies: advancing materials science to improve materials efficiency or developing substitutes and expanding the scope of exploration to identify new reserves.

Governments play a vital role in supporting both strategies: funding research, facilitating early-stage development, and ensuring regulatory clarity. However, caution is needed in more controversial areas, such as deep-sea mining, where environmental impacts remain uncertain.

Achieving critical mineral security in Asia Pacific

Critical mineral security is often framed as a national interest issue, but with increasingly interconnected supply chains, regional cooperation is essential.

There are several actions for policymakers to consider.

Coordinate regional policy

Addressing supply concentration requires an integrated strategy. Policymakers can align incentives, cooperate on infrastructure programs, and codesign development plans across the full value chain, from exploration to processing and trade.

Build regional markets

Beyond bilateral trade agreements, governments need to support growth of tradeable markets. This includes improving transparency around production, pricing, and supply – and establishing consistent ESG and emissions standards.

Support resource-driven development

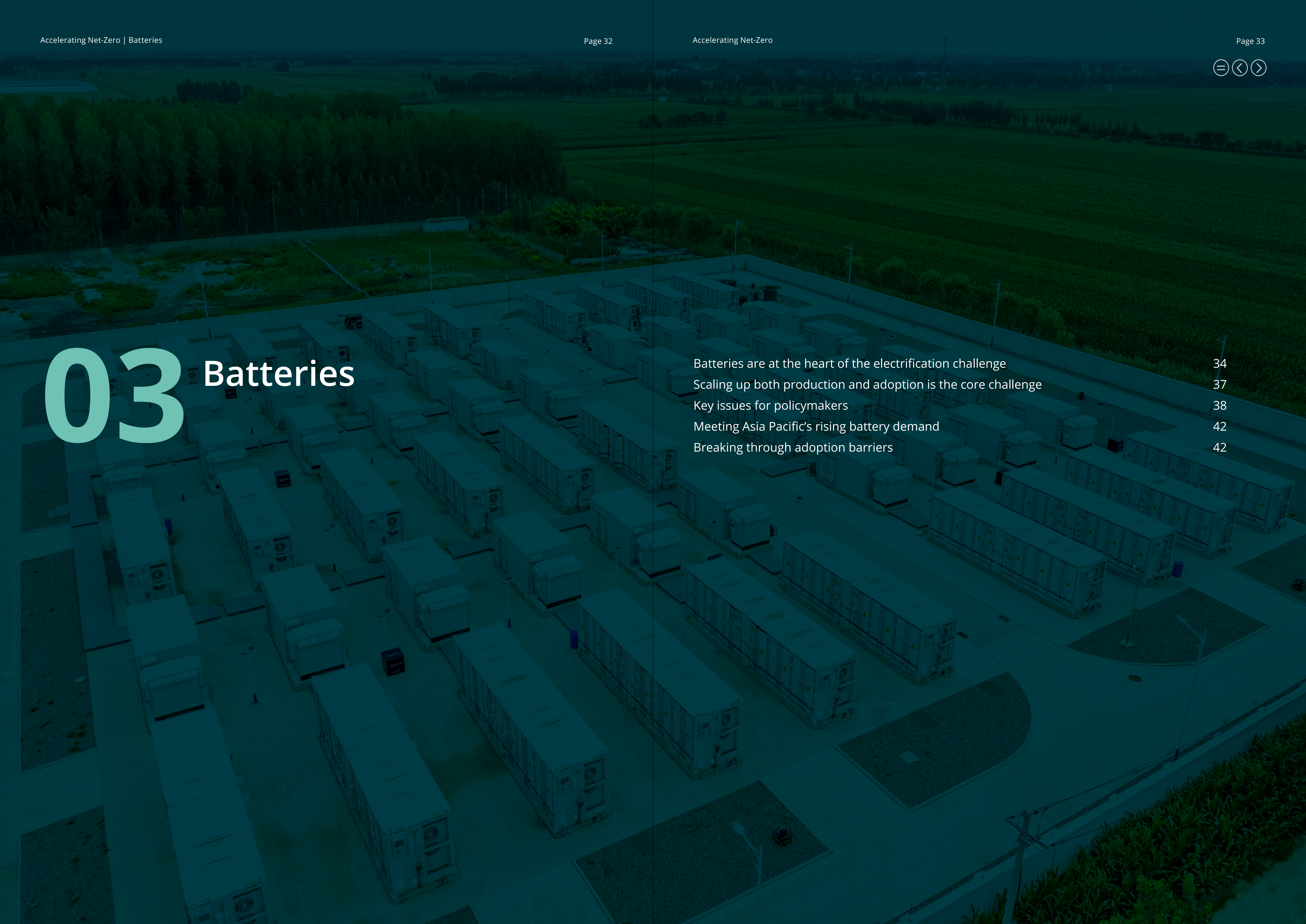
Asia Pacific's resource-rich economies can drive regional prosperity by co-locating extraction, processing, and renewable energy – shifting trade from raw commodities to processed materials. A coordinated approach can boost local development while increasing the region's economic and climate resilience.

Balancing mineral security and affordability

At the heart of the challenge is balancing low-cost access to the critical minerals essential for competitive and affordable clean energy industries, with the need for secure, resilient supply chains.

Developing new supply and strengthening domestic capacity is expensive and can come with environmental costs. Governments need to play an active role in de-risking projects and creating the conditions to attract investment.

In parallel, they need to lead open public dialogue about the trade-offs of resource development to ensure long-term social licence. There is a high cost, but a necessary one to build confidence and momentum in the net-zero transition.



03 Batteries

Batteries are at the heart of the electrification challenge

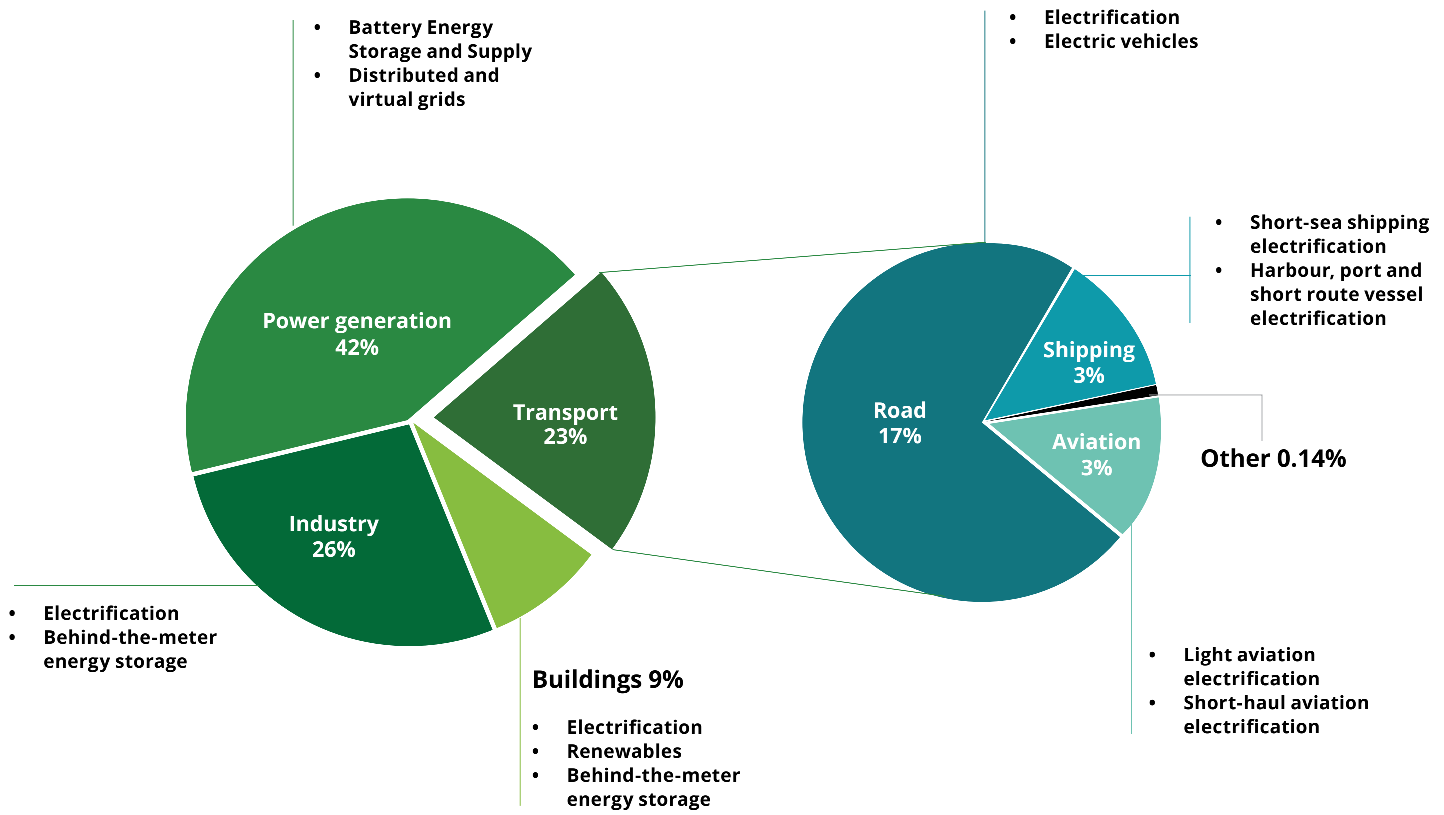
Batteries are essential for decarbonisation.

They are essential to decarbonising power systems, industry, and transport – three sectors crucial to achieving national emissions targets (see Figure 7).

However, to curb emissions growth, battery adoption needs to accelerate, from grid storage to electric vehicle (EV) adoption, and the supply of batteries must scale up rapidly.

Most Asia Pacific economies have emissions targets for power generation, but fewer have specific strategies for battery storage and transport.

Figure 7: Global CO_2 emissions from energy combustion addressable through battery technology



Source: Deloitte analysis based on Deloitte,[3] IEA[9] and Our World in Data[10]

Battery costs have dropped sharply, with average storage prices reaching US$100/kWh – a threshold often seen as critical for cost parity with internal combustion engine (ICE) vehicles[35].

This price drop boosts commercial viability for both EVs and grid storage. But cost alone won't deliver transformation.

The role of batteries in net-zero

The core role of batteries is to store electrical energy. Lithium-ion technology has made batteries integral to modern electronics and electric vehicles, and their application is growing and increasingly foundational to the energy transition. As new technologies and chemistries improve cost, and storage capacity, batteries are reshaping energy systems. These include alternative metal-ion batteries (like sodium-ion or zinc-ion), solid state batteries, and flow batteries.

Batteries can now stabilise grids, enable consistent supply from intermittent renewables like wind and solar, and bridge power outages. Large-scale Battery Energy Storage Systems (BESS) are becoming core infrastructure for decarbonised electricity grids, while Behind-the-Meter (BTM) solutions power homes, businesses, and industry.

In 2024, annual battery demand exceeded 1 terawatt-hour (TWh), and global manufacturing capacity surpassed 3 TWh, on track to triple by 2030[35]. As a result, the global market is forecast to grow from US$120 billion to US$330 - US$500 billion by 2030[36].

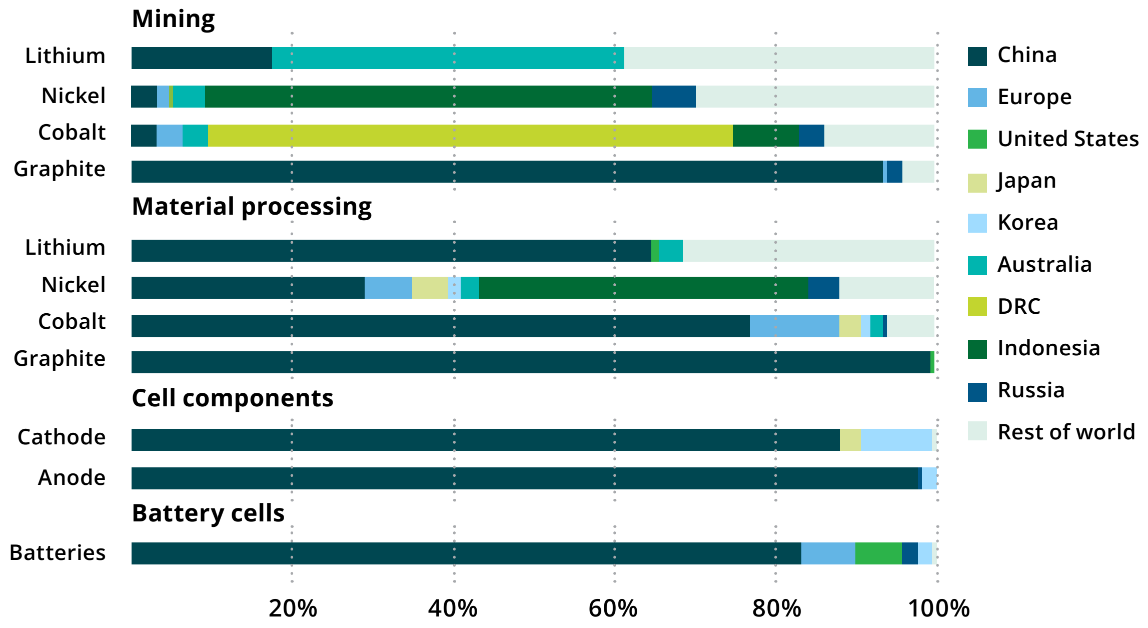
EVs are the primary driver of battery demand. Their share of new car sales is expected to jump from around 22% in 2024 to 40% by 2030[37]. While growth has fluctuated with the availability of subsidies, the sales trend continues upwards. Unlike many other clean energy technologies, EV conversion has been largely consumer-led. Asia Pacific's EV fleet could reach 671 million by 2050 under a net-zero scenario[38].

Battery storage in electricity grids is also accelerating. Installed capacity across the globe rose from 1 GW in 2013 to 85 GW in 2023 – half of it added in the last year[39]. By 2040, Asia Pacific alone could host 2.2 TW of storage, over 60 times today's level – significantly increasing renewable potential[40].

Scaling battery supply requires a major investment boost. The IEA estimates battery-related investment was over US$150 billion in 2023. But this remains well short of the US$500 - US$800 billion needed by 2030 to meet transition targets[41].

China dominates the global battery value chain, from raw material inputs to chemical processing and manufacture, controlling 83% of current production and over 2 TWh capacity[42] (see Figure 8). Outside of China, manufacturing capacity is concentrated in the US, EU, Japan and South Korea – but more countries are seeking to build their own capacity, often in partnership with the leading global manufacturers.

Figure 8: Geographical distribution of the global battery supply chain



China dominates across the entire downstream battery supply chain

Note: DRC = Democratic Republic of the Congo. Graphite refining is only refining of natural graphite tospherical graphite. Mining and processing are based on production data. Cathode, anode and batteries are based on manufacturing capacity data.

Source: International Energy Agency (IEA)

Yet momentum is fragile. EV demand has proven volatile, battery prices have fallen faster than input costs, and profit margins – especially for small and mid-size firms – are under pressure. Project failures and delays in some markets have increased uncertainty.

However, economies with strategic public support continue to drive progress. Across Asia Pacific, India, Malaysia, Vietnam and Indonesia are all targeting growth in battery manufacturing.

Scaling up both production and adoption is the core challenge

To fully realise batteries' potential, policymakers must help scale up both production and adoption. Yet shifting EV demand, falling prices, tight margins, and uncertain trade conditions complicate investment and supply chain decisions. And in many countries, the regulatory, market, and grid infrastructure is not yet in place to support large-scale EV charging, grid storage or more distributed power-systems.

Governments face a strategic choice: build domestic capacity or rely on low-cost imports from a concentrated global market. And in many cases, they will need to do both. Across Asia Pacific, broader deployment of both demand-side incentives and supply-side strategies will be essential.

Key issues for policymakers

1) China – maintain market access

China's rise as a global leader in EVs and batteries has delivered low-cost clean energy technology at scale. But growing protectionism in its key export markets, through tariffs and industrial policy, now threatens the continued growth of its EV and battery industries, which has relied on high overseas margins to offset lower domestic prices.

To maintain market access, Chinese firms are expanding production overseas. Although current offshore battery capacity is modest (~30 GW) and concentrated in Europe, Japan, Thailand and Vietnam, it provides a foothold to bypass some trade barriers, build strategic partnerships and integrate into local EV ecosystems. Trade tensions may require a rethink of global footprints, but China's scale and technology remain strategic assets – and an opportunity to support the development of low-carbon industries across the region.

New regulatory challenges are also emerging. The EU's 2023 Battery Regulation imposes strict lifecycle requirements: including carbon footprint disclosures, content and performance standards, and end-of-life obligations. While China's domestic recycling system is mature, meeting EU standards demands greater transparency, data sharing and supply chain collaboration with new partners.

In the long run, these pressures will catalyse innovation. Chinese firms that adapt quickly have the potential to export circular economy solutions globally.

2) Diversify production capacity

More governments are recognising battery manufacturing as a strategic industry to support electrification, and new projects are launching across Asia Pacific. But with China's scale capacity depressing global prices, building local capacity remains challenging. Europe has seen major projects stall, while the US expanded rapidly (see box).

Approaches for regional battery independence in the US and EU

The US and EU have major policy efforts underway to develop domestic EV and battery industries, recognising their strategic value in the net-zero transition.

The US relied on significant financial incentives through the Inflation Reduction Act (IRA) that have now been curtailed, with over US$245 billion targeted at EV and battery development.

Key policies included tax credits for battery inputs and manufacturing investment grants across the battery value chain, and tax credits for battery storage projects. With the phase out of IRA incentives, it is unclear whether the pace of development will be sustained.

The EU's approach emphasises targets and regulatory mandates over direct subsidies. The EU Batteries Regulation sets targets for domestic production, EV adoption, recycling, and storage. Financial support is focused on improving access to private capital through innovation and transition funds, and tariffs have also been imposed on Chinese EVs and batteries to boost the competitiveness of European manufacturers.

Both the EU and the US are adding capacity – each account for about 150 GW or 6% of global production today. But while US projects were accelerating, Europe is experiencing setbacks – including NorthVolt's failure and delays across several major battery projects.

Japan and South Korea, with advanced battery manufacturing industries, are well-positioned to meet rising demand through overseas expansion. Across Southeast Asia and India, interest in domestic and export-oriented production is rising (see box).

However, success will depend on strategic partnerships, investment support and targeted industrial policy leveraging labour or material resources to compete globally.

Developing Indonesia's EV and battery industry

Indonesia is pursuing a nation-building clean energy industrial strategy. The starting point was a ban on raw mineral exports, particularly nickel, to drive domestic processing and attract foreign investment. Backed by strong resource reserves and an established auto manufacturing industry, the country aims to become Southeast Asia's leading EV and battery hub, targeting 140 GWh of battery production and 600,000 EVs by 2030[43].

Incentives, such as import duty waivers and lower sales taxes for locally produced EVs, have created a favourable investment environment. Major players have responded: China's Contemporary Amperex Technology Co., Limited (CATL) is developing a US$6 billion mining-to-battery project; LG Energy is leading a US$9 billion EV battery value chain project; and Hyundai, Toyota, and BYD are all building EV manufacturing capacity in Indonesia.

This strategy serves a dual-purpose: establishing a high-value industry and supporting Indonesia's broader goals to electrify power and transport systems.

3) Support EV adoption

EVs made up 22% of global passenger car sales in 2024, but most Asia Pacific markets still lag, except China, where EVs reached 48% of new sales[44]. With transport emissions rising and decarbonisation timelines tightening, policymakers must act to accelerate adoption. This is critical not only for emissions goals, but also to stimulate investment in battery manufacturing.

While high upfront costs have slowed EV adoption in many markets, affordability is improving. Battery prices, once 30-40% of an EV's cost, have fallen tenfold over the past decade. And with well-to-wheel efficiency three to four times higher for EVs over ICE vehicles, EVs offer immediate efficiency gains, with or without renewable generation.

Policy must now tackle adoption barriers.

Range anxiety, limited charging infrastructure and entrenched customer preferences remain obstacles. Incentives, such as tax rebates and purchase subsidies, have proven effective, including for market leaders like Norway and China. Infrastructure investments including public charging networks and battery swapping schemes, can also shift perceptions. Beijing provides a model for EV adoption as part of its wider air pollution policies (see box).

Governments also need to provide clear direction to industry. Fuel economy standards, ICE phase-out targets and public fleet procurement can all accelerate the shift.

Public sector EV procurement can increase visibility, build trust, and act as an early market anchor.

Clean air and EV adoption in Beijing

Beijing's air quality has improved significantly over the past two decades, driven by a comprehensive strategy targeting industrial emissions, construction, residential energy use and transport. EV adoption has been a central pillar of the city's transport reforms.

Since 2009, Beijing has led with electrification of public fleets, followed by incentives for private and public EV adoption. These have combined national and local purchase subsidies, tax exemptions, and preferential licencing, toll waivers and discounted parking. Policies have steadily expanded electrification of bus and taxi fleets and scale charging infrastructure.

EVs now account for around 50% of new vehicle sales in Beijing, compared to 37% nationally, and the city's EV stock is nearly double the national share[45]. Between 2013 and 2020, PM 2.5 air pollution concentrations fell by over 50%.

4) Integrate batteries into future grids

As battery storage becomes central to expanding renewable electricity generation, policymakers can accelerate regulatory and infrastructure reform. In competitive markets with clear price signals, battery storage can shift from being a grid-stability cost to a profit driver. But in regulated markets, weak price signals limit efficient investment in both battery storage and broader power sector upgrades.

It's not just about cost. Effective adoption requires modernised regulation: defining how markets work with increased storage, who pays for it, and integrating storage into grid planning and management. This also means preparing for emerging opportunities such as distributed grids and leveraging EVs in the overall power network.

Where policy and market conditions align, growth is surging. Texas added 4.4 GW of battery storage in 2024 – three times the 2023 total. Driven by abundant renewable energy and incentives, Texas is on track to lead the US in battery capacity[46].

Whether this momentum continues as federal support tapers remains uncertain.

Asia Pacific is also beginning to scale quickly. China leads globally, with 23 GW added in 2023 toward its 2025 40 GW target[47]. India aims to install 47 GW by 2032, supported by US$2.2 billion in Production-Linked Incentives (PLI) and its Viability Gap Funding Mechanism covering up to 40% of capital costs for new projects[48].

Australia's Capacity Investment Scheme (CIS) has launched tenders for 9 GW of storage capacity as part of its overall renewables plan. The CIS has provided support for 3.9 GW of battery storage[49]. A new AUD$2.3bn residential and small commercial battery subsidy complements the policy that has seen four million Australian households adopt solar PV. These moves align with Australia's National Battery Strategy which aims to add value to its mineral resources by supporting battery manufacturing in targeted segments – such as grid storage and heavy vehicles.

5) Increase recycling and circularity

Battery recycling is becoming essential as demand for battery mineral inputs rises. With recovery rates exceeding 90% for critical metals in a battery pack, recycling offers a lower-emissions alternative to raw material extraction. Yet recycling remains complex and costly. Currently 85% of global recycling capacity is in China, but the US and Europe are now advancing their capabilities[50].

To prepare, policymakers must set clear roadmaps – defining targets and expectations for industry. The EU's regulations, for greater producer responsibility and take-back obligations, are prompting greater coordination across the value chain.

Automotive and battery manufacturers, and increasingly miners and processing companies, are collaborating to close the loop. BHP is working with carmakers to reclaim key metals from spent batteries. Redwood Materials is building a US$3.5 billion plant in South Carolina with an array of automaker customers[51].

But to get started, policymakers need to motivate the industry to improve recycling collection rates and incentivise the development of the first facilities.

6) Support R&D for alternative chemistries

Battery price declines have been driven by falling raw material costs, economies of scale and advances in lower-cost technologies. Continued R&D is critical, not only to improve battery performance and energy density but also to reduce dependence on scare minerals through alternative chemistries, improved material efficiency and recycling. Emerging technologies reaching commercial viability include sodium-ion, solid-state and zinc-based chemistries.

As China leads both production and innovation, new technologies are key for other nations aiming to build competitive domestic industries. The EU is backing battery R&D through the Net-Zero Industry Act. India's Atmanirbhar Bharat[52] strategy combines 'Made In India' programme funding domestic innovation and funding[53].

Rather than competing solely on lowest-cost EV batteries, policymakers should identify technology niches and support their commercialisation. Australia, for example, has emerged as a leader in Vanadium Flow Batteries (VFBs), ideal for grid and off-grid storage due to long life, fast response and reliability. The Australia Renewable Energy Agency (ARENA) backed the country's first grid-scale VFB at Yadlamalka in South Australia, with AUD$5.7 million grant in 2020[54].

Meeting Asia Pacific's rising battery demand

Asia Pacific can accelerate EV adoption and battery storage deployment to deliver major emissions reductions while building a competitive regional industry. But to do so, countries must collaborate on investment, policy, and infrastructure.

Coordinate on recycling standards

Battery recycling is essential for resource security and sustainability. Global supply chains call for common standards for battery design and recycling approaches that can support efficient, regional circular value chains. Policymakers should align domestic strategies with global initiatives – such as the Global Battery Alliance.

Build regional hubs

Not every country can support a domestic battery industry given the scale required for commercial success. Instead, governments should identify strategic niches and forge long-term partnerships. With China, South Korea and Japan expanding their manufacturing footprint, and trade access becoming more uncertain, some Asia Pacific economies can position themselves as regional hubs.

EV adoption – learn from the best

Direct incentives, such as purchase subsidies and public procurement, and vehicle emissions standards have been shown to drive adoption. But indirect measures like charging infrastructure and congestion pricing also matter. Asia Pacific economies can accelerate progress by adapting proven policy methods to their local context – and aligning on roadmaps to make sure they are not left behind.

Breaking through adoption barriers

The economics of EVs and battery storage favours rapid adoption. But social and practical barriers remain – policymakers must address these while enabling investment to build momentum.

Weighing the cost of supporting EV uptake and battery production against broader public benefits – reduced congestion, cleaner air, and lower fossil fuel dependence – is essential. The core task is designing mechanisms to account for the costs and benefits of these shifts.

China's dominance in EVs and batteries offers affordable, advanced technology that can accelerate consumer adoption across the region. Yet it also raises strategic questions about how to grow domestic industries – and the jobs that come with them. For most countries, the key tension is managing open market access with local industrial development.

04 Industrial transformation

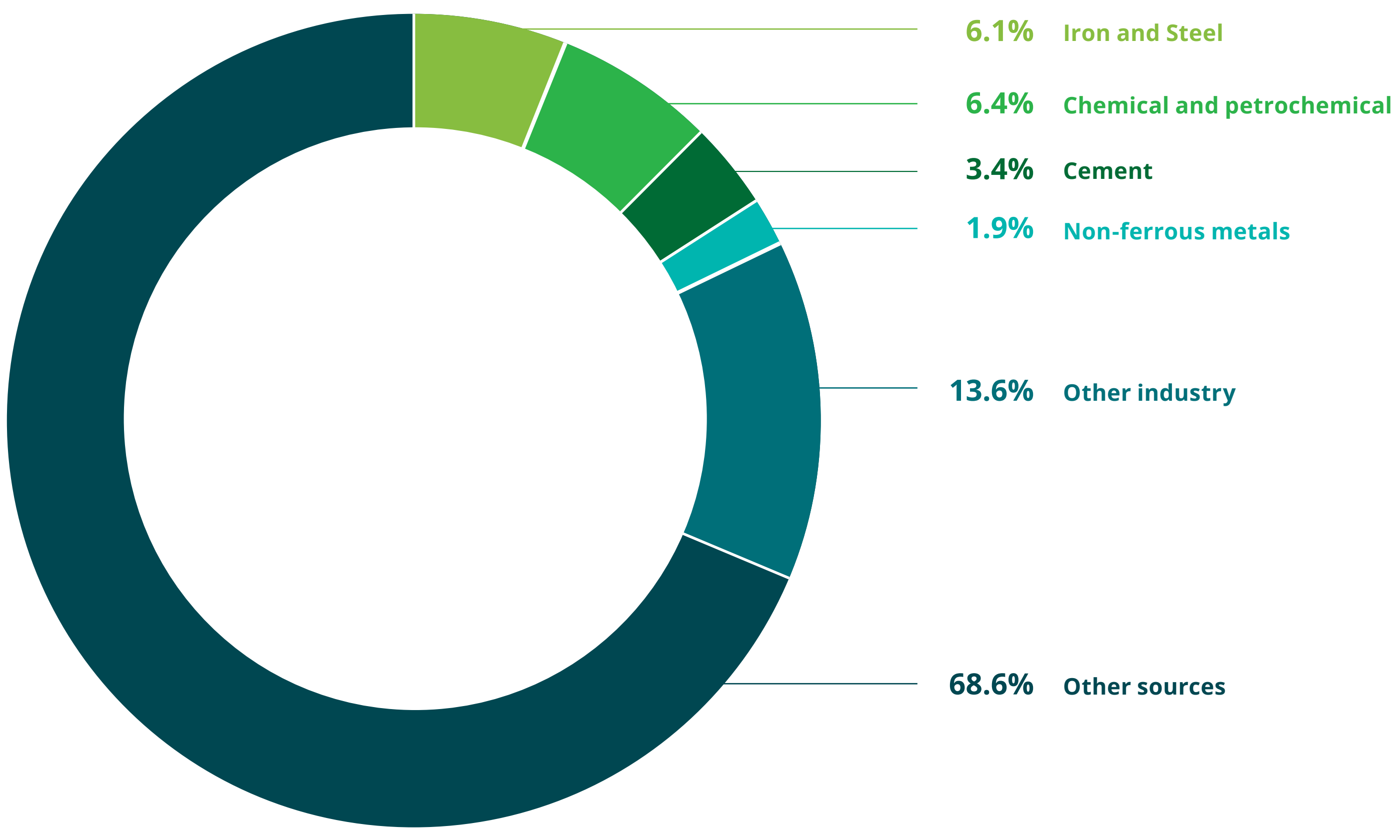
Asia Pacific dominates global industrial production and emissions

Industry accounts for a substantial share of global greenhouse gas emissions, making their decarbonisation essential for meeting net-zero targets

Industries like steel, cement, and aluminum are fundamental to modern economies and have limited substitutes, necessitating their decarbonisation rather than replacement. Asia Pacific dominates global industrial production – accounting for 74% of steel, 77% of cement, 65% of chemicals and 50% of fertiliser output[55].

Globally, industrial end-use emissions make up about 31% of total emissions, with iron and steel, chemicals and petrochemicals, and cement make the largest industry emissions (see Figure 9). The figure is higher in Asia Pacific with the UNEP estimating around 40% of the region's total end-use emissions[56].

Figure 9: GHG emissions, by industry (%)



Source: Deloitte analysis based on Climate Watch, World Resources Institute Data (2021)

Most national strategies prioritise power sector decarbonisation. But as 2035 targets approach, industrial emissions need to be on the agenda. Many industrial operations rely on burning fuels for heat and emissions-intensive methods like blast furnaces. The challenge is these industries are high-emitting, hard to abate and expensive to change.

Industrial decarbonisation is complex. Two-thirds of industrial emissions come from process heat, three-quarters of which require temperatures above 400°F/752°F with few low-carbon alternatives. Many processes, such as those in cement and fertiliser production, are inherently carbon-intensive[57].

Unlike decarbonising the power sector, where renewables are outcompeting fossil fuels on cost, industrial decarbonisation remains commercially challenging. Key low-carbon industrial technologies are early-stage, and alternatives are energy-intensive. Retrofitting, replacing, or retiring emissions-heavy assets add further cost and complexity.

The job for policymakers is to help make the necessary transformation more affordable by providing strategic direction and investment to encourage innovation and market growth. Investment and incentives are needed through the supply chain to drive the transition, addressing price gaps and boosting customer demand.

Achieving deep emissions cuts requires concerted action

Global demand for industrial goods continues to increase. Achieving deep emissions cuts requires action across five fronts:

Boost material and process efficiency

Improve industrial operations, product design and end-use efficiency. For example, the Global Cement and Concrete Association targets 22% emissions reductions via smarter construction[58].

Electrify with renewable energy

Powering industry with renewable electricity is critical – especially for industrial process and low temperature heat. High-temperature processes, such as steel, glass and cement making, have few viable alternatives to combustion and will likely require future fuels.

Develop alternative processes

Emissions intensive industrial processes need new feedstocks and chemistries. Innovations like direct reduction of iron with hydrogen, or green ammonia fertiliser are emerging. For cement, where ~88% of emissions come from clinker production, alternatives remain limited[59].

Capture residual emissions

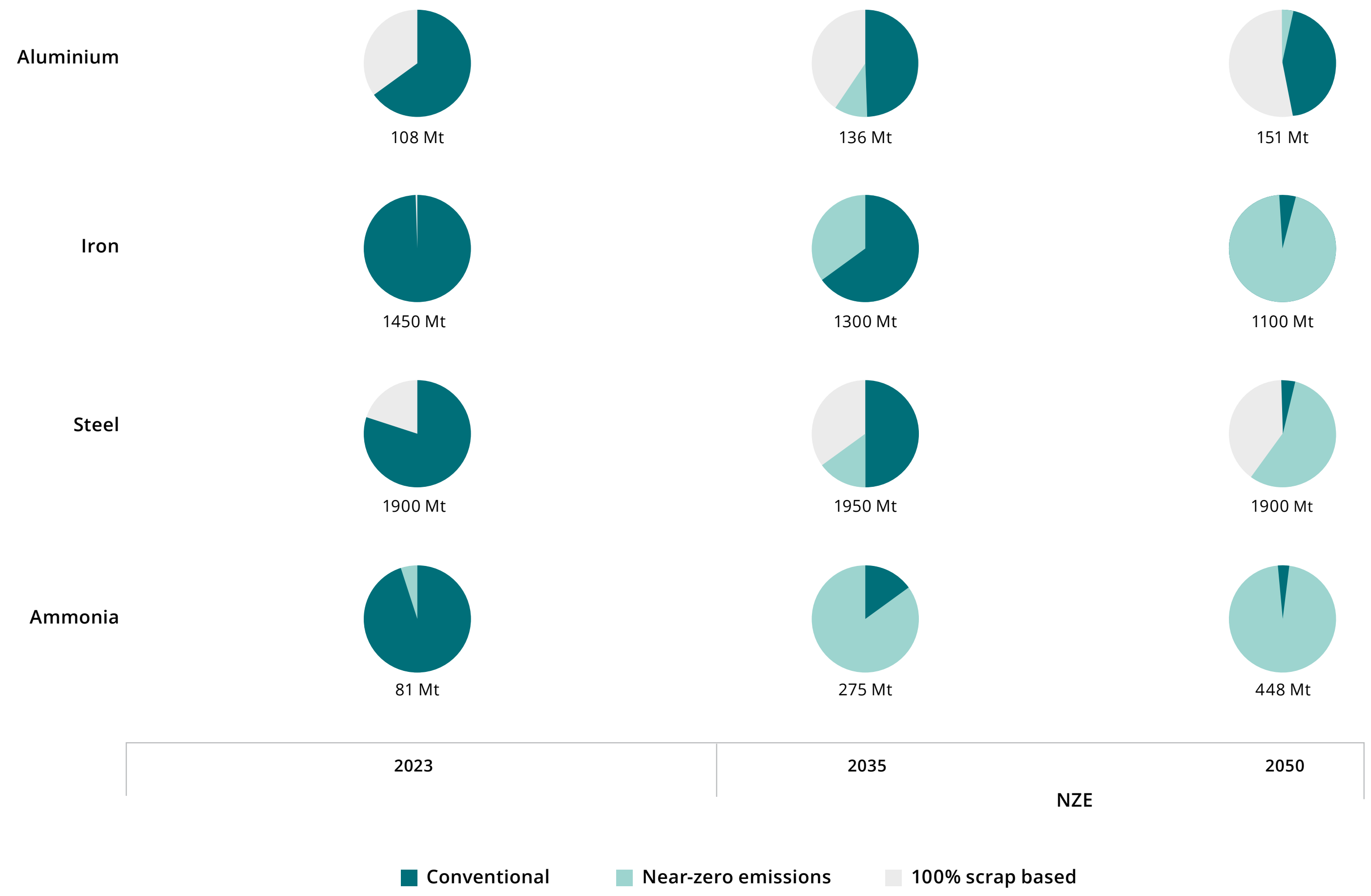
Full decarbonisation of production processes won't be possible for all sectors. Carbon Capture, Utilisation and Storage (CCUS) will be necessary – along with emerging negative emissions technologies – that can turn carbon emissions from a liability into a resource.

Offset where needed

Given slow transformation timelines, offsets will play a role in meeting near-term targets – particularly through funding reductions elsewhere or boosting natural capital.

Today, near-zero carbon industrial production is virtually non-existent for heavy industries. Most green steel, cement and chemical plants remain at pilot or demonstration stage (see Figure 10). Rapid scale-up is essential.

Figure 10: Global materials production with near-zero emissions and conventional technologies



Notes: NZE = Net Zero Emissions by 2050 Scenario. The figures for ammonia exclude the portion destined for urea production with fossil CO_2 as a feedstock. The figures for alumina include only metallurgical alumina. Values for iron and steel are rounded to the nearest 50 Mt.

Source: Deloitte analysis adapted from International Energy Agency (IEA)

Globally, decarbonising heavy industry could require US$54 billion annually in additional capex to 2050 – plus US$140 billion per year for the supporting infrastructure, including renewables, future fuels, and carbon capture[60]. With Asia Pacific accounting for most of global industry, much of this capital needs to be mobilised in

Decarbonising industry is an immense challenge

Low-carbon industrial technologies are early stage and alternatives are costly. Few buyers are paying low-emission premiums at scale, and while initiatives like the First Movers Coalition (a global coalition of companies leveraging their purchasing power to decarbonise heavy-emitting sectors) show intent, actual investment and support for innovation lags far behind the need.

Governments must step in to bridge the gap. Policy support and funding are critical, but difficult. Targets must drive change without undermining competitiveness or burdening consumers. Incentives must be large enough to address price differences – but how to pay for them remains unresolved.

Delay carries risk too – early movers are shaping markets and slow-movers risk being stranded. The growing interest in applying carbon taxes on imports, such as in the EU, is a clear indicator that emissions intensity will be priced into market access.

This challenge holds opportunity. Much of the cost gap stems from fossil fuel subsidies and unpriced externalities. In addition to progressively eliminating these subsidies, carbon pricing will be critical in driving industrial decarbonisation. Where it has been deployed, it has driven fuel-switching choices. We must redevelop the industrial economy to decouple growth and emissions while unlocking growth and jobs.

Key issues for policymakers

1) Set clear industry policy goals

Policy uncertainty is a risk for early movers. Governments need to establish long-term targets and collaborate with industry on transition plans. Roadmaps must align across sectors, underlying power and fuel infrastructure, and along supply chains. And critically, industrial companies and investors need clarity on carbon pricing, incentives, and funding mechanisms to support long-life assets.

Industrial policy is re-emerging as a driver of economic growth. The EU Green Deal and similar initiatives signal a new wave of public investment targeting industrial decarbonisation.

2) Manage industrial electricity demand

Electrification is the first step in decarbonising industry – but it relies on access to clean power. In Asia Pacific, electricity demand is rising rapidly, forecast to grow 5.2% annually to 2027 and potentially triple or more by 2050[61].

While renewables are growing fast, fossil fuel generation is also increasing to meet both demand and energy security needs.

The growth of energy-intensive industries – alongside surging demand from AI and data centres (435 TWh by 2030, or 2.6 times 2023 levels[62]) – makes coordinated planning critical.

Industrial companies need policymakers to align industrial and power generation strategies to ensure access to renewable electricity. This includes co-locating industry alongside new supply, mandating renewable purchasing (as Germany does for new data centres), and prioritising direct use of renewable electricity over less efficient sources – such as converting clean electrons to clean molecules for industrial combustion whilst also undertaking long term planning to enable future fuel production.

As energy and emissions costs increasingly shape industrial competitiveness, access to low-cost renewables will become a key competitive advantage. Some economies, like Australia, aim to leverage this by building value-added exports powered by renewable electricity (see box).

Australian green steel and iron exports

Australia dominates global iron and metallurgical coal exports, supplying 40-70% of key inputs to its major Asian trading partners. It is now charting a new course to move up the value chain by leveraging its renewable energy resources to produce low-emissions iron and steel.

Australia aims to become a major exporter of hot briquetted iron (HBI), offering its trading partners a lower emission and lower cost alternative to domestic production. Replacing 10% of Asia's steelmaking with Australian green HBI could cut 268 Mt CO_2 annually from the region's emissions[63].

Trade agreements that align economic growth, investment and emissions reduction are central to this strategy. In July, the Australian Prime Minister led a mining delegation to Shanghai to position Australian green iron as strategic input to decarbonisation of China's steel industry. Achieving a high-level agreement between China and Australia shows the growing role of bilateral value chain collaboration to accelerate net-zero progress across the region.

Government support includes investment in hydrogen and renewables infrastructure. Australia is also pushing for regional carbon pricing and harmonised green steel standards – recognising that without policy intervention, commercial viability may not arrive before the 2040s[64].

Several projects are underway, with more in the pipeline:

- Green Steel of Western Australia is building an AUD$2.5 billion direct-reduced iron (DRI) facility that will initially be powered by natural gas with plans to transition to hydrogen.
- Fortescue Future Industries is developing an AUD$50 million hydrogen DRI trial plant using clean hydrogen, powered by its own renewable generation, to produce near-zero emissions HBI[65].
- Liberty's Whyalla steelworks received AUD$2.4 billion federal and state package to support the transformation of the plant. The project aims to produce iron and steel for domestic and export markets powered by local renewable energy and clean hydrogen[66].

3) Accelerate transition technologies

Many industrial decarbonisation technologies are at pilot, demonstration, or first-commercialisation stages. Few are ready for full-scale deployment, and there are few standard industry solutions to the major decarbonisation challenges. As a result, many companies are focused on incremental efficiencies, still trialling technology or building pilot plants.

Even promising technologies face hurdles. In steel making, hydrogen-based direct-reduced iron (DRI) offers huge promise but depends on uncertain hydrogen supply. In cement, clinker alternatives exist, but supply chains are sub-scale and regulatory approvals for construction are still being developed.

Recycling technology is also important – from established use of recycled steel and aluminium, to emerging areas in plastics and concrete – but getting the right policies to improve collection rates, or create end-use markets is key. Policymakers can play a role in setting direction for the full product lifecycle – from increasing recycled and waste inputs as industrial feedstock, to product design, material use and repairability.

Companies need support to invest in first-of-a-kind retrofits or facilities, particularly as early-stage projects carry the most technical risk. Venture-funding and support for demonstration plants and pilots can be the necessary bridge from the lab to production.

Cooperating on industry decarbonisation – Japan's Joint Crediting Mechanism

Access to decarbonisation technology remains a barrier for many emerging economies. Japan's Joint Crediting Mechanism (JCM) addresses this by linking export credits and project support for Japanese clean energy technologies with low-carbon development in partner countries.

Japan has established 23 bilateral agreements, including with Indonesia, Vietnam, and the Philippines, and is supporting over 240 projects. The JCM blends foreign aid with market-based mechanisms, enabling Japan to count emissions reductions towards its own targets.

The JCM offers a model for technology transfer and accelerating industrial decarbonisation in emerging markets – and scaling advanced clean technology industries at home.

4) Create markets for low-emissions industry

New industrial products require markets. Clear definitions of low-carbon products like green steel or low-carbon cement are essential for procurement, trade and performance standards. Regulations need to be adapted from production-stage to end-use product and construction standards. Emissions transparency is becoming critical for supply chain reporting and carbon pricing.

Without addressing the externalities of fossil-fuels and levelling the economics of low-emissions industry, other policy measures will be less efficient. The EU's Carbon Border Adjustment Mechanism (CBAM) is incentivising decarbonisation of Asia Pacific industries by requiring the pricing of carbon in their value chains. By 2040 it could raise US$80 billion annually by taxing imports based on carbon-intensity[67].

5) Build demand for low-emissions industry

Corporate climate pledges are growing, but without clear price and demand signals, investment will lag. Low-emissions industrial products face higher costs, and willingness to play a premium remains limited. Policymakers must close the cost gap and stimulate demand, especially for early-stage projects.

Governments can lead with procurement. Programs like Australia's Sustainable Procurement Policy and China's Green Building Materials initiative set clear market signals. Product mandates and low-carbon content quotas – already common for fuels and recycled materials – can also drive demand, provided they align with realistic supply and manage end-user costs. For instance, a 25% premium on green steel is estimated to add just 1% to vehicle prices[68].

Managing price differences is critical. Production and purchase incentives, like India's Production Linked Incentives and long-term offtake agreements help producers secure demand and pricing stability that can unlock investment.

6) Manage industrial asset lifecycles

Industrial facilities are long-lived which complicates decarbonisation investment decisions. Many high-emission assets will remain economically viable for a long time, and retrofitting is costly. Policymakers must evaluate how to incentivise retrofits, mitigate ongoing emissions, or accelerate retirement – while preserving jobs and economic activity.

Building capacity also carries risks. With zero-carbon solutions still emerging, new projects often rely on interim technologies. In steelmaking, oxygen and blast furnaces still outpace investment in electric arc furnaces or direct reduced iron – locking in emissions for decades[69].

In response, governments are increasingly turning to industrial policy and public capital to accelerate towards low-carbon industry (see box).

Accelerating the green steel transition

Europe's ageing steel infrastructure – averaging over 40 years old – needs urgent modernisation to remain competitive and meet emissions targets. The EU is mobilising support through the Innovation Fund (covering up to 60% of project costs) and the Important Projects of Common European Interest (IPCEI), which backs hydrogen and green steel infrastructure. The European Commission has also approved €9 billion in state and for low- and zero-emission steel projects. Market demand is strong with 54 of the 59 green steel offtake commitments globally being inked in the EU[70].

Several flagship projects have been funded that will test both the technology and policy frameworks for scaling green steel across Europe:

- HYBRIT (Sweden): following its successful pilot, HYBRIT is developing a demonstration plant to produce 1.2 Mt of hydrogen-based, zero-emissions steel per annum[71].
- Stegra (Sweden): A €6.5 billion project integrating clean hydrogen, iron and steel is aiming for 5 Mt of green steel per annum by 2030[72].
- tkH2Steel (Germany): A €3 billion green steel plant aims to produce 2.5 Mt of steel and save 3.4 Mt of CO_2 annually – but faces uncertainty over whether it can obtain the required supply of hydrogen[73].

7) Mitigate residual emissions

Even with deep decarbonisation, heavy industry, particularly cement and concrete, face unavoidable residual emissions. CCUS is essential to address this gap, but current deployment is limited with just 50Mt CO_2 captured annually across 45 global facilities[74]. To reach net-zero targets, CCUS must scale rapidly, and industry will need to lead much of that acceleration.

CCUS is viable today through geological storage, but remains costly, energy intensive and requires proximity to suitable geology. Infrastructure, including pipelines and improved capture technologies are urgently needed. New negative emissions options such as direct air capture (DAC), enhanced rock weathering and mineralisation must also advance.

Faced with high costs and energy demands, adoption of carbon capture risks stalling without robust price or investment support. The EU is backing infrastructure and industry investment, the US has offered tax credits, but in Asia Pacific, most support remains at the research and pilot stage[75].

Nature-based solutions also have an immediate role to play. Afforestation, wetland and mangrove protection and land-use management all offer ready and viable carbon mitigation with broader environmental and biodiversity benefits. While costs are lower than most CCUS options, policymakers need to ensure that nature-based solutions are valued, additional, robust and credible – with support for standards, measurement, certification.

Coordinating industrial transformation across Asia Pacific

Industrial policy risks being pursued for national interest alone. The scale of the challenge demands regional coordination through integrated supply chains and on policy, standards, and investment.

Rethink value chains

Asia Pacific governments should work towards common frameworks for certifying low-carbon products, measuring emissions, and pricing carbon. Harmonisation can lower market and technical risks, support cross-border trade and investment, and enable more efficient industrial development.

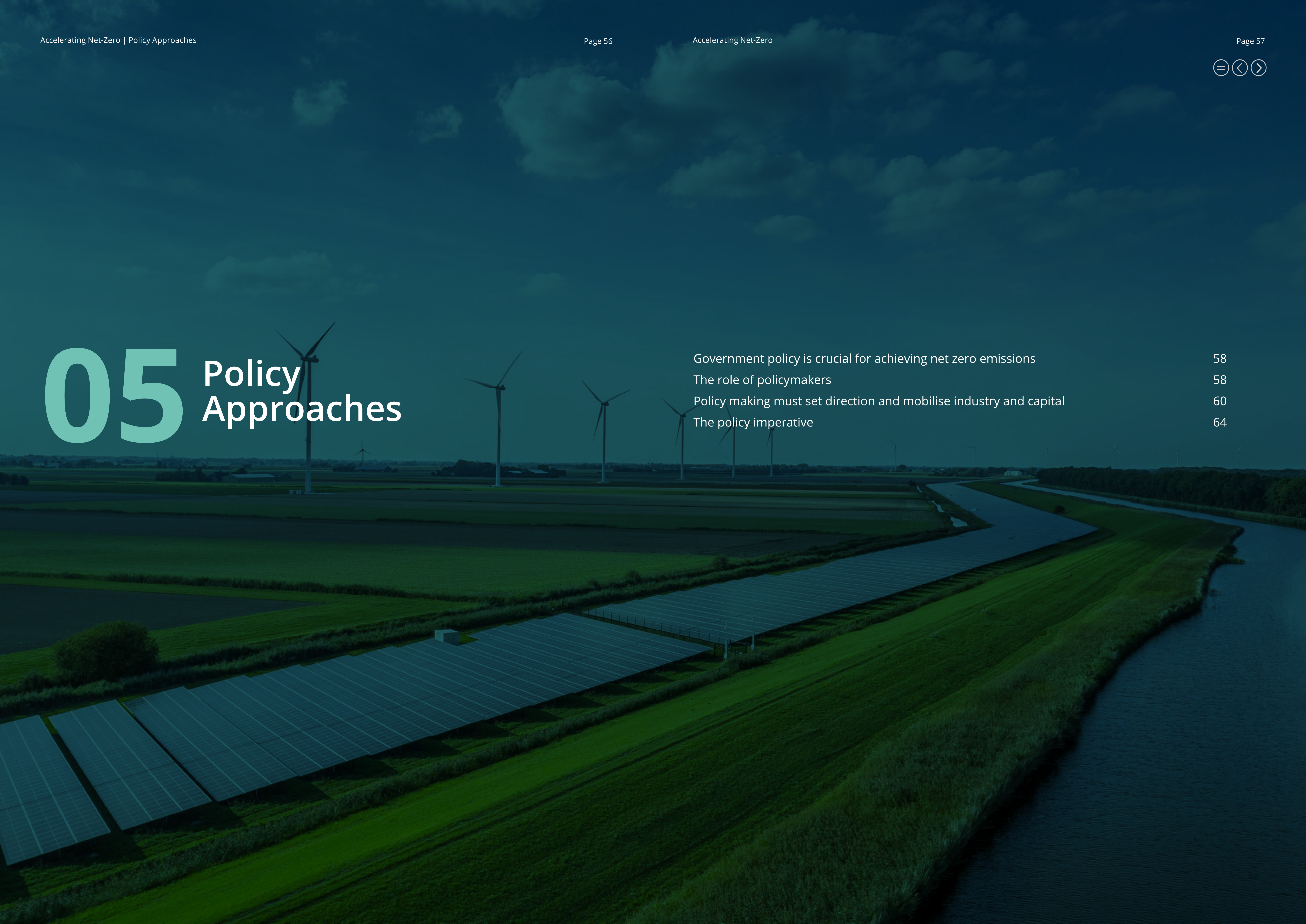
Build regional hubs

As carbon intensity shapes industrial inputs and outputs, governments and industry can focus on sourcing the most efficient clean electrons and molecules. This opens the door to more integrated, cross-border industrial supply chains – and raises a strategic question: is it time for a pan-Asia Pacific industrial strategy?

Industrial strategy for the net-zero economy

Industrial decarbonisation is costly and complex – but delaying action risks leaving economies and net-zero targets behind. For most governments, considerations of economic growth, security and prosperity are paramount. Policymakers must design credible transition roadmaps that align climate goals with economic strategy. This means mobilising capital, setting clear market incentives, supporting rapid innovation and, critically, pricing carbon.

As the EU races to build future-fit industrial capacity, Asia Pacific governments must act decisively to avoid falling behind. Done right, net-zero industrial transformation won't just meet climate targets – it can preserve existing jobs and help create up to 180 million new jobs across the region[76].



05 Policy Approaches

Government policy is crucial for achieving net-zero emissions

Without government intervention, the transition will stall

Accelerating the next wave of net-zero transition in Asia Pacific requires around $2.3 trillion in annual investment by 2030 – more than triple today's US$840 billion.

Governments cannot close this gap alone. They must act as catalysts, creating the conditions to crowd in industry participation and private capital.

The role of policymakers

Meeting emerging 2035 NDC targets requires deep and systemic transitions. Growth in renewable energy has shown what's possible when technology cost curves and the right policy mix align. That success must now be replicated across harder-to-abate sectors.

To scale the next wave of net-zero transition, policymakers must focus on four priorities:

1. **Targets:** Set clear and credible targets backed by robust policy frameworks, industry roadmaps and the incentives needed to achieve them.
2. **Innovation:** Fund R&D and early-stage innovation to de-risk emerging technologies.
3. **Investment:** Provide upfront investment support and targeted policy for high-cost projects.
4. **Carbon pricing:** Phase out fossil fuels subsidies and implement carbon pricing.

Policy is the critical accelerator. But strategies must reflect local context.

Access to renewable energy, mineral resources, the industrial base, and capital vary widely across Asia Pacific. So too does institutional capacity to design and orchestrate change. Developing economies in the region will require support from developed partners to close investment gaps, build capacity, and drive economic growth. (see box).

Catalysing investment into developing economies

Emerging and developing economies require 70-75% of global decarbonisation investment[77]. Yet weaker financial markets and higher country risk make capital scarcer and more expensive. It is in the global interest to support these transitions. While development finance plays an important role, real progress depends on partnerships that de-risk private investment.

Just Energy Transition Partnerships (JETP) offer a model for aligning transition plans, public funding and private investment. Both Indonesia and Vietnam launched JETP agreements in 2022 – Indonesia securing US$20 billion and Vietnam US$15 billion in pledges to decarbonise power systems and accelerate the shift from coal[78].

These plans combine ambitious targets, regulatory reform, long-term infrastructure roadmaps. Progress, however, has been mixed. The US withdrawal of funding created gaps, but other partners have moved to fill them. As of May 2025, US$1.1 billion has been committed to projects in Indonesia and US$700 million in Vietnam, spanning renewables and electrification[79]. While investment has been slower than expected, momentum is building as the project pipelines mature.

The next stages of transition will be expensive and politically challenging. Decarbonising fuels, transport, and industry risk rising prices, economic and social disruption – all of which can threaten public support. The most economically efficient way to decarbonise our economies at least cost is generally accepted to be carbon pricing (see box).

Getting it right is a major opportunity. Asia Pacific's net-zero transition could add US$47 trillion to the region's economy by 2070[80]. Effective policy can increase the pace of change – and reduce the cost. Deloitte estimates that policy interventions can de-risk the low-carbon finance premium and reduce global investment costs by US$2 trillion annually – saving US$50 trillion by 2050[81].

Carbon Pricing

At the heart of the economic challenge of net-zero transitions is the absence of meaningful carbon pricing. Without it, governments must pick winners and subsidise low-carbon technologies – an approach that is expensive and unsustainable. Carbon pricing can correct market distortions, enabling more efficient solutions to emerge and improve the effectiveness of other policy actions whilst reducing risks to taxpayers.

Fossil fuels currently benefit from US$7 trillion annually in implicit and explicit subsidies – around 7% of global GDP[82]. These include climate and health externalities, tax breaks, and direct subsidies.

Yet as of 2024, only seven Asia Pacific countries have carbon taxes or emissions trading schemes in place. And carbon prices remain well below the IPCC's recommended US$170 - US$290 per ton CO_2 by 2030 to meet the 1.5oC pathway[83]. Coverage is limited, with trading schemes excluding key sectors and only 24% of global emissions priced[84].

Under Article 6 of the Paris Agreement, international carbon markets are beginning to take shape – but progress is slow. In the meantime, Asia Pacific economies must expand carbon pricing to accelerate transitions. Concerns over carbon pricing persist, driven by fears of rising costs, industry impacts and public perception. Yet emissions intensity is becoming an important measure of competitiveness – one best tackled through international cooperation.

Carbon pricing can level the playing field for clean energy technologies – it can also generate up to US$4 trillion in public revenues to reinvest in transition[85].

Policy making must set direction and mobilise industry and capital

Policy making must set direction and mobilise industry and capital. Delivering system-wide change in energy and industry requires a coordinated policy mix and effective execution.

This means strengthening government capacity to design, implement, and iterate policy. And there is no one-size-fits-all solution. While each pillar of the transition faces specific challenges, policymakers must also tailor interventions to their context– using the right levers at the right time.

A lifecycle approach – targeted by sector and maturity – can create policy certainty and drive faster, more effective transition outcomes (see Figure 11).

Figure 11: Transition lifecycle policy approach

Policy Framework	Sector Strategy	Sector Development	Market Scaling
• NDC and Climate targets • Climate transition legislation • Energy policy and regulation • Carbon pricing and trading • Transition funding and appropriation • Industry and sector policy • Trade policy	• Sector institutions • Industry and infrastructure roadmaps • Network planning • Market architecture • Industry policy and regulation • Streamlined permitting	• R&D support • Venture funding • Concessional loans / grants • Demand and supply incentives • Risk sharing and guarentees	• Demand mechanism / mandates • Transition support (retrofit / decommissioning) • Trade agreements • Foreign investment / JVs

Source: Deloitte

1) Establish vision, targets, and policy framework

To drive least cost decarbonisation, governments must set clear, long-term targets – anchoring NDC commitments in legislation and backing them with credible roadmaps and transparent reporting. Industry and investors need confidence in stable policy settings to commit to large-scale, long horizon investments.

A credible framework includes enabling policies: sector strategies, funding mechanisms, carbon pricing, international cooperation, and investment in infrastructure and skills. Where possible, this should be underpinned by cross-party political support to build lasting confidence and reduce sovereign risk.

2) Empower independent agencies to set sector strategies and infrastructure plans

Delivering system-level transitions requires sector-specific policy, regulation, and infrastructure planning. Governments should empower independent institutions to lead this work in close collaboration with industry.

These institutions can develop regulation, set industry standards and coordinate infrastructure planning. As system operators, they can manage critical market mechanisms, such as procurement auctions, planning consents and funding disbursement (see box on the next page: Accelerating progress through focused agencies).

Accelerating progress through focused agencies

Accelerating progress through focused agencies

Net-zero transitions are cross-cutting, requiring coordinated execution beyond traditional policymaking. Independent agencies with technical expertise can accelerate policy execution, operate outside the sphere of political influence and build industry confidence.

The Australian Renewable Energy Agency (ARENA) drives technology deployment across solar, hydrogen, battery storage, transport, and low-emissions metals. It supports research, innovation and project commercialisation through grants, co-funding, and knowledge sharing. ARENA has backed 735 projects with AUD$2.6 billion, leveraging AUD$12.6 billion in total investment. Flagship initiatives include large-scale solar and battery projects, and the Murchison Green Hydrogen project[86].

The UK's National Energy System Operator (NESO), launched in 2024, oversees both systems operations and long-term planning for a net-zero grid. As a central authority, it can adapt rules quickly and manage key mechanisms like the Capacity Market and renewable energy procurement auctions - facilitating investment in 39 GW of generation projects[87]. NESO has already delivered reforms to clear grid-connection backlogs, published the future network plan and delivered the UK's first zero-coal winter.

3) Support research and innovation

Accelerating transitions requires innovation to scale - strong R&D and commercialisation capability is essential.

Governments can support early-stage R&D, sponsor innovation hubs, and build foundational research capability. Beyond grants and tax incentives, policy can drive innovation by convening partnerships, setting challenges, and creating the enabling environment.

Early-stage commercialisation often faces funding gaps. With a higher risk appetite, governments can act as venture partners – catalysing private investment through co-funding, offtake agreements, production incentives, and regulatory sandboxes. This can de-risk innovation and accelerate market formation where private capital is hesitant.

Given the high risk inherent with early-stage innovation and commercialisation, and the urgency of the net-zero transition, innovation support is not optional – it is essential.

4) Unlock investment to scale up net-zero solutions

The underlying need across the net-zero transition pillars in this paper is unlocking investment. Policy uncertainty, technology risk, and challenging economics continue to drive up the risk premium for low-emissions finance.

While there are many financial risks and financing mechanisms to consider, (see figure 12) policymakers should focus on five broad considerations:

Direct investment support

Use public finance tools (e.g. equity, concessional debt, risk-sharing) to lower capital costs and attract investors.

Establish and structure markets

Set standards and certification that create transparency and support trade. Sponsor markets through competitive tenders or auctions for low-emissions commodities to catalyse demand and price discovery.

Stimulate demand

Drive early adoption through mandates, incentives, and infrastructure investment to overcome price, technical and behavioural barriers.

Bridge the price gap

Where low-emissions options are more expensive, targeted production or tax incentives can buy time for cost curves to fall. Incentives alone are unlikely to resolve residual cost differences without addressing fossil fuel subsidies

Motivate industry

Support industry-led initiatives and embed climate disclosures, to increase transparency, focus and accelerate private sector action.

The policy imperative

The right policy mix depends on a clear view of national starting points and transition goals. At the core is a singular challenge: rapidly scaling finance for system-wide energy and technology shifts. Governments must act as catalysts – mobilising capital, reducing risk, and enabling market formation.

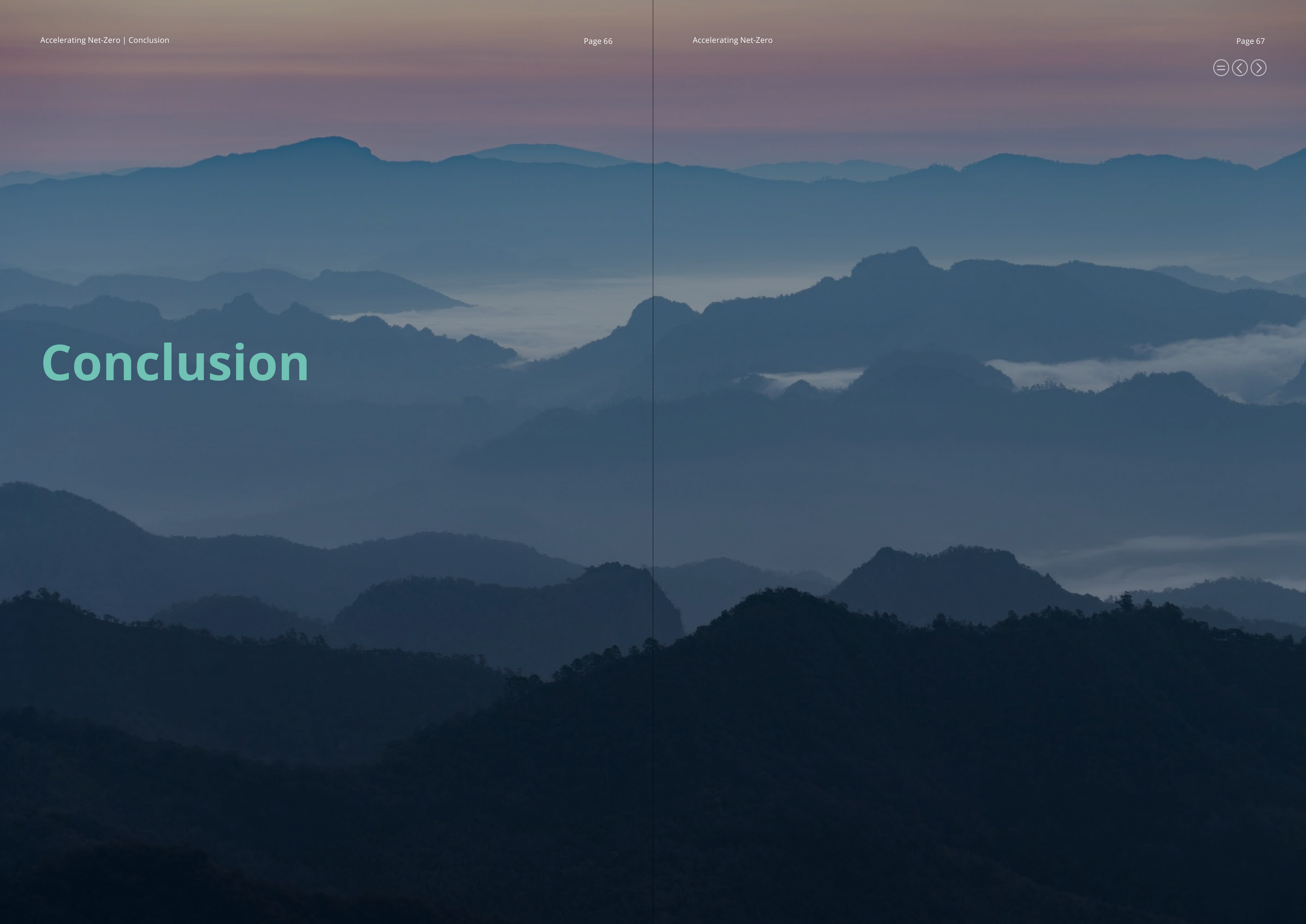
The next wave of technologies will not scale without support. This demands bold policy – accepting high costs, complexity, and political risk. Without it net-zero targets will remain out of reach.

For Asia Pacific, regional cooperation is growing in importance. Governments must align supply chains, market standards, capital flows and infrastructure. Strategic partnerships are needed to balance economic efficiency with national security and development goals. These are hard choices, but the scale of opportunity and the cost of inaction, demand decisive leadership.

Figure 12: Policy levers

	Policy Tools	How does it work?	Impacts
Policy frameworks	Climate and energy strategy	Provides market transparency and regulatory clarity	Sets clear direction, reduces political risk
	Carbon pricing	Put a price on carbon emissions	Reduce price gap between green / fossil fuel alternatives Raise revenue
	Remove fossil fuel subsidies	Stop implicit/explicit support for fossil fuels	Make fossil alternatives more expensive by internalising costs
	Infrastructure planning (grid, industry, CCUS)	Provide market clarity and timelines	Reduces policy and technical risk, accelerates project readiness
	Streamline planning	Accelerate project timelines	Reduces cost and technical risk, accelerates project readiness
	Trade policy / Investment policy	Improve access to overseas markets	Access additional demand, access additional sources of capital
Market architecture	Market creation (e.g. auctions, domestic financial market)	Facilitate access to tradeable markets	Reduces revenue risk, sets pricing signals
	Industry standards (definitions, product and end-use)	Set common industry and product standards	Reduces technical risk
	Climate and sustainability reporting	Increases industry transparency	Reduces financing costs and enables more efficient and aligned capital allocation
Technology and infrastructure	R&D support (e.g. funding, innovation hubs)	Accelerates technology learning	Reduces investment and financing costs
	Venture funding	Accelerates technology commercialization	Reduces investment and financing costs
	Infrastructure investment (e.g. grid, distribution and trade, CCUS)	Provides market clarity, accelerates access to required infrastructure	Reduces technical risk, stimulates demand, reduces investment and financing costs
Market incentives	Offtake contracts (PPA, CfD, FIT etc.)	Guarantee demand / price for producers	Reduces revenue risk, sets pricing signals
	Production incentives (tax-incentives, production incentive, green premium)	Increase revenue for producers	Reduce price gap between green / fossil fuel alternatives
	Demand incentives (rebates, mandates, procurement)	Stimulates demand and reduces purchasing barriers	Reduces revenue risk, increases demand
Finance support	Risk sharing and guarantees	Protect investors against losses	Reduce risk of default and cost of capital
	Public private partnerships	Mobile private capital for public infrastructure	Shares risk and cost of investment
	Green bonds	Targeted end-use bonds	Increased transparency, lower borrowing costs
	Concessional finance / grants	Co-finance in transition projects	Reduce investment and financing costs
	Equity and debt structures	Co-invest in transition projects with greater risk exposure	Reduce investment and financing costs
Implementation support	Industrial strategy	Develop industry ecosystem and skills	Reduces implementation barriers and technical risk
	Support training / job transition	Develop human capital for green transition	Reduce economic impact on society, reduces implementation barriers and technical risk
	Transition support	Fund retrofitting/ decommissioning and compensation for stranded assets	Reduce economic impact on industry

Source: Deloitte



Conclusion

The next wave of transition

Time is fast running out to reduce dangerous climate change by decarbonising our economies. The scale of change is unprecedented and demands bold leadership, rapid transformation, and system-wide shifts in energy, industry, infrastructure, and investment.

Policymakers face tough trade-offs. They cannot do everything at once and must instead focus on the most critical enablers – those that unlock private investment, accelerate innovation, and create viable new markets. Success will position Asia Pacific economies to not only meet their own climate targets, but to lead in low-emissions industries and export decarbonisation globally.

Governments cannot deliver net-zero transition alone – nor can industry. Progress hinges on credible transition roadmaps that reflect each country's strengths and context, yet some imperatives are common across Asia Pacific:

Policy clarity matters

Investors and industry need stable policy and regulation that cuts through complexity – and the political cycle.

Technology must scale fast

Accelerate R&D, support commercialisation, and de-risk early-stage development.

Stronger demand signals are needed

Incentives for early adopters and targeted market creation will send a stronger economic signal than plans and targets.

Price gaps must be managed

Prohibitive costs in low-emissions industries are not just the product of early-stage technology, they reflect fossil fuel subsidies. While incentives matter, addressing economy-wide carbon pricing is foundational.

Competition and collaboration need to be balanced

With growing trade uncertainty and a push to deglobalisation there is increased focus on domestic supply and energy security. Asia Pacific's opportunity lies in collaboration, not competition. We must link energy systems, technology access and capital to drive regional prosperity.

Expect disruption

The net-zero transition is high risk – and it needs to be fast. It raises socio-economic concerns, is dependent on immature technologies and is vulnerable to supply shocks. There will be failures. Energy volatility and workforce dislocation are very real challenges.

Policymakers should expect disruption. Supply constraints and price volatility are inevitable. The renewable energy transition has shown how rapid change can occur when economics and policy align. But it also exposed vulnerabilities, from Spain's recent grid failure to the price shocks after the end of cheap Russian gas. The next wave – future fuels, heavy industry, transport, and materials – will be harder, but essential.

We are not moving from a stable energy and economic system to a new one. The current energy system is already unstable and unsustainable. The transition is a necessary shift away from a model that is already disrupted by the accelerating impacts of climate change.

Countries cannot miss their targets. The climate risks are too great, as is the risk of being left behind in the emerging net-zero economy.

Governments need to address the hard choices they face with pragmatic and impactful policy choices. Their role is to pull the future forward – creating the conditions for investment, innovation, and industry transformation.

Politically, the next wave of transition will be more challenging. There will be winners and losers regardless of what governments choose to do. Public support may falter as the costs of transition become visible. Governments must act to support those affected rather than react to the costs of unplanned, unmanaged disruption.

Across Asia Pacific, a new kind of leadership is required. Durable, bipartisan consensus is needed to embed transition goals into long-term economic strategy. Regionally, it means shared goals, frameworks and markets, and cooperation across borders on energy, capital, and innovation.

The transition is underway. Creating a prosperous future for Asia Pacific requires pragmatic and bold policy leadership.

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