The Australian Industry Energy Transitions Initiative is a platform for Australia’s emissions-intensive industry and related businesses to coordinate learning and action on net zero emissions supply chains.

This pioneering initiative convenes Australian industry and business leaders to collectively explore and address the challenges associated with decarbonisation.

This has supported Australian heavy industry to realise the opportunities of a decarbonised global economy by working collaboratively to develop pathways and actions towards achieving net zero emissions in critical supply chains by 2050.
The Australian Industry ETI has drawn together industry to develop pathways and actions towards achieving net zero emissions in critical supply chains by 2050.

The Industry ETI has brought together leading global and Australian experts on the energy transition as well as industry participants representing over 30% per of the ASX 100 market cap and 22% of Australia’s industrial emissions.

The initiative is convened by:

- Climateworks Centre
- CLIMATE KIC Australia

With research support from:

- CSIRO
- Energy Transitions Commission
- ARMi
- BloombergNEF

With funding from:

- Australian Government
- Australian Renewable Energy Agency (ARENA)

Industry & Business Participants:

- apa
- aurecon
- Australian Gas Infrastructure Group
- AustralianSuper
- BHP
- BP
- Bluescope
- cbus
- cefc
- Fortescue
- HSBC
- nab
- ORICA
- Rio Tinto
- Schneider Electric
- Wesfarmers Chemicals, Energy & Fertilisers
- Woodside Energy

Supported by:

- AI Group
- Australian Industry Energy Transitions Initiative
Industry comprises a significant proportion of Australia’s annual energy use and emissions

The industry sector accounts for 44 per cent of Australia’s total emissions, with the five supply chains in focus for the Australian Industry ETI contributing an estimated 25 per cent.

Industry’s share of Australia’s annual emissions (scope 1 and 2)

Annual domestic emissions (scope 1 and 2) from the Australian Industry ETI focus supply chains

Emissions based on 2020 levels.
Most Australian Industry ETI supply chains are heavily export-focused, feeding into global supply chains and making a significant contribution to the Australian economy.

Across all the Australian Industry ETI supply chains:

- ~A$236bn generated in exports
- 17.3% contributed of Australia’s GDP
- ~414,000 people employed

Iron ore: World’s largest producer of iron ore
Bauxite: World’s largest producer of bauxite
Lithium: World’s largest producer of lithium

The actions of other countries to avoid or abate emissions will influence the demand and costs of Australia’s commodities and resulting supply volumes. Provided decarbonisation occurs quickly and effectively, Australia’s natural assets in mineral resources, renewable energy capacity and strong industrial capabilities position Australia to make the most of the global net zero opportunity.
The work of the Australian Industry ETI

Phase 1 report
(and companion technical report)

June 2021
Concluded that existing and emerging solutions can address almost all emissions in Australian Industry supply chains.

Phase 2 report

June 2022
Identified 70 MtCO₂e, or 88% of abatement potential in the key industrial regions of Pilbara, Kwinana, Hunter, Illawarra and Gladstone, in our five supply chains of focus.

Phase 3 report
(and companion technical report)

Feb 2023
For the first time in Australia, outlines the pathways for heavy industry decarbonisation, identifying key challenges and enablers across five supply chains and the broader energy system.
The report draws on evidence-based and independent analysis, complemented by industry knowledge and experience.

Global technical experts informed assumptions and sense checked modelling results, which were then validated by Australian industry experience.

Strategy, investment and government affairs experts informed the actions needed to achieve the transition.

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Nov 2019, Apr 2020
Consultation workshops

Mar 2020
Inaugural steering group meeting

Oct 2020
Scenario development workshop

Jun 2021
Phase 1 report ‘Setting up industry for net zero’ published

Aug 2021
Research reference group - validating assumptions and principles

Mar 2022
Pathways reference group - exploring enablers and barriers

Jun 2022
Phase 2 report ‘Setting up industrial regions for net zero’ published

May–Dec 2022
Phase 3 report development

Sep 2022
Final steering group meeting

Feb 2023
Phase 3 report ‘Pathways to industrial decarbonisation’ publication
The Australian Industry ETI utilises the Aus-TIMES model to explore different emissions reduction scenarios.

The modelling for the ETI uses the AusTIMES model, an adaptation of the TIMES model, which is an energy system modelling framework used in over 20 countries and developed and maintained under the IEA Energy Technology Systems Analysis Project.

AusTIMES optimises the mix of technologies and fuel use to achieve minimum overall system cost, according to imposed conditions in each of our three core scenarios. The representation of sectors, technologies and commodities in the model is tailored specifically to Australia’s energy system.

The modelling includes the whole Australian economy, with a focus on industrial sectors, however other sectors also change in line with scenario narratives. The findings should not be considered projections, but indications of what could be required to meet the requirements of the scenarios.
Three core modelling scenarios were designed to compare key drivers of industrial decarbonisation

**Incremental scenario (>2°C):** A lack of domestic and industry action leads to slow decarbonisation throughout the economy that fails to keep emissions below a 2°C carbon budget.

**Industry-led scenario (2°C):** Leadership in existing heavy industry accelerates technology deployment and abatement, but significant extra investment is needed as action is not borne equally across the economy. Overall, emissions stay within a carbon budget to limit temperature rise to 2°C, despite an accelerated pathway for industry.

**Coordinated action scenario (1.5°C):** Action is driven across all sectors of the economy to reduce emissions aligned to a 1.5°C carbon budget. This scenario represents a significant stretch beyond current efforts across climate policy and low-emissions technology development and deployment.

* Including sensitivity studies to investigate impact of (a) new hydrogen and green iron export industries called ‘Coordinated action with exports’ and (b) impact of gas prices

Though emissions associated with Australian exports are not modelled in this study, demand has been aligned to scenarios such as BloombergNEF’s New Energy Outlook and the IEA’s ‘Net zero by 2050’ which show changes in production and export demand as key trading partners reduce their emissions consistent with a 1.5°C trajectory.
The Australian Industry ETI has identified a possible but challenging pathway to decarbonise heavy industry consistent with global efforts to limit warming to 1.5°C.

This transition would require a significant stretch in ambition and would only be achieved with strong, effective, coordinated action from government, industry, and finance. But if we succeed, it presents the opportunity to ensure Australia, its industries, its regions and communities are positioned to prosper in a decarbonising global economy.

This is a moment of opportunity to align and focus efforts to create a globally competitive, equitable, net zero emissions industrial economy in Australia.
With strong ambition, coordinated action and government support, industry emissions could be reduced by 92 per cent by 2050, based on 2020 levels.

Industry emissions could be reduced by 92 per cent in the ‘Coordinated action scenario’, decreasing from 221MtCO₂e/year in 2020 to 17MtCO₂e/year in 2050. This, with high quality and verifiable offsets for the remaining 8 per cent, would transition industry to net zero emissions. Significant reductions in emissions from electricity use can be achieved, facilitated by economy-wide action leading to greater grid decarbonisation compared to the ‘Incremental’ and ‘Industry-led’ scenarios. Increased electrification and fuel switching decrease emissions from the direct combustion of fossil fuels by 86 per cent; while switching to zero emissions feedstocks reduces non-energy emissions by 94 per cent by 2050. Emissions reductions of this magnitude would help keep Australia within its fair share of a 1.5°C compatible carbon budget.
The emissions reductions achieved in the ‘Coordinated action scenario’ would be enabled by significant investment, renewable energy and hydrogen deployment

- **A$625 billion**
  - for investment needed by 2050
  - including A$440 billion for energy system investment and A$190 billion for industry technology investment

- **2.2 million tonnes**
  - of hydrogen needed each year by 2050
  - in 2030, 53 per cent of hydrogen produced is blue. However, by 2050, green hydrogen makes up nearly 100 per cent of production

- **600TWh**
  - of electricity needed each year by 2050
  - requiring a 2-fold increase in Australia’s total current electricity generation and 260GW of renewable capacity
Renewable energy is a critical enabler of industrial decarbonisation and must be scaled up rapidly.

In the ‘Coordinated action scenario’, by 2050, 600TWh/yr of electricity could be needed, requiring a 2-fold increase in Australia’s total current electricity generation and 260GW of renewable capacity.

<table>
<thead>
<tr>
<th>Electricity generation required in the Australian Industry ETI scenarios</th>
<th>Total renewable energy generation capacity needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>2030</td>
</tr>
<tr>
<td>LARGE-SCALE SOLAR PV</td>
<td>20GW</td>
</tr>
<tr>
<td>WIND</td>
<td>60GW</td>
</tr>
<tr>
<td>ROOFTOP SOLAR PV</td>
<td>45GW</td>
</tr>
<tr>
<td>HYDROPOWER (excludes pumped hydro)</td>
<td>10GW</td>
</tr>
</tbody>
</table>
Integrated hydrogen systems could play an important role in decarbonising industry and are key for new export-oriented industries.

Hydrogen production in the Australian Industry ETI scenarios and export sensitivity*

*note: scale of axes are different

In the ‘Coordinated action scenario’:

- Costs of green hydrogen decrease to become cost-competitive with grey and blue hydrogen by the mid-2030s
- By 2050, almost all hydrogen is produced via electrolysis
- Domestic demand for hydrogen could be as high as 2.2 million tonnes (268PJ) per year in 2050
- 24 million tonnes per year are produced in the ‘Coordinated action with exports’ sensitivity study in 2050, including an assumed 18 million tonnes for green hydrogen exports and 4 million tonnes for green iron exports.
The modelling results show a relatively strong preference for locating hydrogen production close to capital cities. This may reflect the importance of access to lower-cost, firmed renewable electricity through customer-owned storage, access to a skilled workforce, water and bulk material handling ports.

The high demand for hydrogen in the ‘Coordinated action with exports sensitivity’ shows that all locations for hydrogen production will need to keep pace with the scale of production. After capital cities, a preference for north Queensland, Tasmania, and Western Australia locations is seen.

The brown circles represent the amount of hydrogen production in each region. Hydrogen circles are placed outside the map for clarity, but refer to areas labelled.
Achieving the scale of decarbonisation needed requires strategically planned investment

From now until 2050, A$625 billion of strategically planned investment could be needed to decarbonise Australia’s industry and energy system in the ‘Coordinated action scenario’.

It is estimated that business as usual investment (‘Incremental scenario’) would cost A$400 billion during the same period.

This means an additional A$225 billion above business as usual could be needed to transition the energy system and invest in technologies to achieve net zero emissions by 2050.

*This chart shows the investment in each scenario. Energy system investments support all sectors of the economy, including industry. Costs should not be considered projections, as they reflect the least-cost pathway for each scenario. This chart does not include operating costs, including the price of fuel.
Action from government, industry and investors could support up to 1.3 million jobs between 2025 and 2050 in the ‘Coordinated action scenario’

INCLUDING:

64,000

annual construction jobs

- from 2025 to 2050 in the ‘Coordinated action scenario’
- Approximately double the number of jobs created in the ‘Incremental scenario’ (business as usual)

129,000

ongoing operations and maintenance jobs

- in the ‘Coordinated action scenario’
- 53,000 more than the ‘Incremental scenario’

Analysis undertaken by Accenture
Emissions reduction by supply chain

To achieve a 92 per cent reduction across all of industry in Australia, each of the supply chains analysed require significant investment, renewable energy capacity and hydrogen deployment. In the ‘Coordinated action scenario’, a total of A$129.1b of technology investment and expenditure could be needed across supply chains, with the largest investment required in LNG and aluminium. An additional 115 TWh/yr of renewable energy could be required across supply chains with the greatest demand coming from aluminium. Hydrogen plays a key role in decarbonising the iron & steel supply chain representing 480,000 t/yr of the total 723,000 t/yr required across supply chains by 2050.

- **Iron & steel**
  - By 2050:
    - Emissions Reduction: 99%
    - Technology Investment: A$19.5b
    - Renewable Electricity Required: 29TWh/yr
    - Hydrogen Required: 480,000 t/yr

- **Aluminium**
  - By 2050:
    - Emissions Reduction: 98%
    - Technology Investment: A$36.0b
    - Renewable Electricity Required: 44TWh/yr
    - Hydrogen Required: 12,000 t/yr

- **Other metals**
  - By 2050:
    - Emissions Reduction: 90%
    - Technology Investment: A$9.2b
    - Renewable Electricity Required: 26TWh/yr
    - Hydrogen Required: 26,000 t/yr

- **Chemicals**
  - By 2050:
    - Emissions Reduction: 96%
    - Technology Investment: A$28.3b*
    - Renewable Electricity Required: 10TWh/yr
    - Hydrogen Required: 205,000 t/yr

- **LNG**
  - By 2050:
    - Emissions Reduction: 91%**
    - Technology Investment: A$39.6b
    - Renewable Electricity Required: 6TWh/yr

*including expenditure on hydrogen
**including a 36 per cent per cent reduction in LNG exports between 2020-30 and a 73 per cent reduction between 2020-2050

Emissions reductions are based on 2020 levels.
Focus on iron and steel

Technology deployment timeline for the decarbonisation of iron and steel in the ‘Coordinated action scenario’

By 2050:
- 99% reduction in emissions
- A$19.5 billion in technology investment
- 29TWh/yr of renewable electricity needed
- 480,000t/yr of hydrogen required

This chart shows the timeline of implementation that the model finds to be the least cost pathway, based on technology assumptions and other changes across the Australian economy.

By 2050:
- 99% reduction in emissions
- A$19.5 billion in technology investment
- 29TWh/yr of renewable electricity needed
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This chart shows the timeline of implementation that the model finds to be the least cost pathway, based on technology assumptions and other changes across the Australian economy.
Focus on iron and steel

Changes in fuel use for iron ore mining in the ‘Coordinated action scenario’

The ‘Coordinated action scenario’ shows that a shift to decarbonised iron ore mining and steelmaking will include switches in fuel types. By 2035, diesel use in iron ore mining is replaced by bioenergy (temporarily as a transition fuel), hydrogen (for fuel cell electric vehicles) and electricity (for electrification and battery electric vehicles). For steelmaking, the model finds an initial gas use increase, as gas DRI-Melter-BOF increases in the medium term. However, after 2040, the use of hydrogen quickly becomes significant, increasing from only 8 per cent of total energy use to 63 per cent in just ten years.
Focus on iron and steel

The ‘Coordinated action scenario’ shows that decarbonising the iron and steel supply chain in line with a 1.5°C carbon budget requires the development and deployment of low-emissions technologies alongside an unprecedented energy system transformation, presenting significant challenges and uncertainties. Further action is now urgently needed from industry, government, and investors.

Challenges for iron and steel decarbonisation in Australia:

<table>
<thead>
<tr>
<th>DEVELOPING EMERGING TECHNOLOGIES</th>
<th>DEPLOYING TECHNOLOGIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>and securing suitable ore types for future steelmaking</td>
<td>into existing plant and operations and building out steel recycling</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTEGRATING</th>
<th>ACHIEVING SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>renewable electricity and hydrogen capacity at scale</td>
<td>while remaining cost-competitive</td>
</tr>
</tbody>
</table>

Recommended actions to achieve the decarbonisation of iron and steel:

- Develop iron and steel supply chain roadmaps
- Develop a national strategy for the development of green iron export markets and future-proof iron ore production to enable green steel
- Set short, medium and long-term goals for the development of renewable energy at scale
- Set targets that drive the development of a large-scale, decarbonised hydrogen market
- Prioritise funding for pilots and demonstrations
- Investigate iron ore compatibility with green steelmaking technologies
- Develop firm commitments for offtake for green steel
- Certification for emissions standards for steel
- Develop a workforce plan for the transition
- Build a circular economy through steel recycling
Focus on aluminium

Technology deployment timeline for the decarbonisation of aluminium in the ‘Coordinated action scenario’

This chart shows the timeline of implementation that the model finds to be the least cost pathway, based on technology assumptions and other changes across the Australian economy.

By 2050:

- **98% reduction in emissions**
- **44TWh/yr of renewable electricity needed**
- **A$36 billion in technology investment**
- **12,000t/yr of hydrogen required**
Focus on aluminium

The ‘Coordinated action scenario’ shows that decarbonising the aluminium supply chain in line with a 1.5°C carbon budget requires the development and deployment of low-emissions technologies and will be reliant on achieving cost-competitive, reliable renewable electricity at scale. Urgent action should be taken to overcome these challenges to help create a prosperous, globally competitive, net zero aluminium supply chain in Australia.

Challenges for aluminium decarbonisation in Australia:

- Develop aluminium supply chain roadmaps for heavy industry
- Set a series of short, medium, and long term goals to develop renewable energy at scale
- Develop storage solutions to deliver low-cost firmed renewable electricity
- Set targets that drive the development of a large-scale, decarbonised hydrogen market
- Establish partnerships for development of net zero haulage between OEMs and miners
- Promote research and development of emerging technologies for process heat abatement and inert anodes
- Develop early supply, demand and enabling infrastructure to scale net zero solutions in the aluminium supply chain
- Energy markets should prioritise enabling demand management
- Build the circular economy through aluminium recycling in Australia

Recommended actions to achieve the decarbonisation of aluminium

- Develop aluminium supply chain roadmaps for heavy industry
- Set a series of short, medium, and long term goals to develop renewable energy at scale
- Develop storage solutions to deliver low-cost firmed renewable electricity
- Set targets that drive the development of a large-scale, decarbonised hydrogen market
- Establish partnerships for development of net zero haulage between OEMs and miners
- Promote research and development of emerging technologies for process heat abatement and inert anodes
- Develop early supply, demand and enabling infrastructure to scale net zero solutions in the aluminium supply chain
- Energy markets should prioritise enabling demand management
- Build the circular economy through aluminium recycling in Australia
Focus on other metals

Technology deployment timeline for the decarbonisation of other metals (copper, nickel, zinc and lithium) in the ‘Coordinated action scenario’

This chart shows the timeline of implementation that the model finds to be the least cost pathway, based on technology assumptions and other changes across the Australian economy.

By 2050:

- 90% reduction in emissions
- A$9.2 billion in technology investment
- 26TWh/yr of renewable electricity needed
- 26,000t/yr of hydrogen required

The shaded area shows emissions over time.
Focus on other metals

The 'Coordinated action scenario' shows that decarbonising the other metals supply chain in line with a 1.5°C carbon budget requires Australia to address significant challenges and uncertainties. Meeting growing demand with sustainable production will require further development of green mining technology; additionally, renewable energy and hydrogen infrastructure will need to be effectively integrated with new and existing mines.

Challenges for other metals decarbonisation in Australia:

- Developing emerging green mining technologies
- Deploying technologies and transitioning existing plant and operations
- Integrating renewable electricity and hydrogen at scale
- Meeting growing demand with sustainable production and building a circular economy of other metals

Recommended actions to achieve the decarbonisation of other metals:

- Develop other metals supply chain roadmaps
- New mines should be designed for net zero production
- Develop a workforce plan for the transition
- Support the development of remote renewable energy systems and hydrogen for off-grid mining
- Research, development and commercialisation support for flexible renewable energy infrastructure
- Support for partnerships to produce value-added products from mineral carbonation
- Establish partnerships for development of net zero haulage between OEMs and miners
- Development of an Emissions Reductions Fund methodology for mineral carbonation
- Support for the build-out of low-emissions haulage infrastructure in remote operations
- Build the circular economy through other metals recycling in Australia
Focus on chemicals

Technology deployment timeline for the decarbonisation of chemicals in the ‘Coordinated action scenario’

By 2050:

- 96% reduction in emissions
- A$28.3 billion in technology investment and hydrogen expenditure
- 10TWh/yr of renewable electricity needed
- 205,000t/yr of hydrogen required

This chart shows the timeline of implementation that the model finds to be the least cost pathway, based on technology assumptions and other changes across the Australian economy.
Focus on chemicals

The ‘Coordinated action scenario’ shows that decarbonising the chemicals supply chain in line with a 1.5°C carbon budget requires rapid technology deployment and supportive market, regulatory and policy environments. Strong, effective and coordinated action is needed from industry, government and investors and will be critical to achieving the emissions reductions needed to stay within a 1.5°C carbon budget.

### Challenges for chemicals decarbonisation in Australia:

- **Developing emerging technologies** and preparing for large-scale production of green products
- **Deploying technologies** early to boost clean feedstock and pursue quick wins
- **Integrating** renewable electricity at scale
- **Meeting growing demand** to take advantage of new opportunities

### Recommended actions to achieve the decarbonisation of chemicals:

- Develop chemicals supply chain roadmaps
- Develop a national strategy for the development of new export markets for green hydrogen and green ammonia
- Develop a workforce plan for the transition
- Set targets for deployment of renewable energy
- Set targets that drive the development of a diverse portfolio of hydrogen production
- Prioritise funding and support for pilots and demonstrations
- Develop partnerships with mining companies for low-emissions commercial explosives and precision blasting
- Develop early supply, demand and enabling infrastructure to scale net zero solutions
- Develop a series of net zero industrial precincts or hydrogen hubs

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**Developing emerging technologies and preparing for large-scale production of green products**

**Deploying technologies** early to boost clean feedstock and pursue quick wins

**Integrating** renewable electricity at scale

**Meeting growing demand** to take advantage of new opportunities
Focus on LNG

Technology deployment timeline for the decarbonisation of LNG in the ‘Coordinated action scenario’

By 2050:
- 91% reduction in emissions including LNG production decrease
- A$40 billion in technology investment
- 6TWh/yr of renewable electricity needed

This chart shows the timeline of implementation that the model finds to be the least cost pathway, based on technology assumptions and other changes across the Australian economy.
Focus on LNG

The ‘Coordinated action scenario’ shows that a transition in line with 1.5°C is challenging for Australia. The Australian Industry ETI modelling assumes that LNG production will decrease with a global push for decarbonisation, but also shows that strong, effective and coordinated action is needed from industry, government and investors to achieve a pathway in which Australian emissions from LNG production decrease substantially.

Challenges for LNG decarbonisation in Australia:

- Developing emerging technologies with demonstration and planning
- Deploying mature technologies and achieving decarbonisation quick wins
- Integrating renewable energy at scale
- Achieving scale despite global demand changes

Recommended actions to achieve the decarbonisation of LNG:

- Develop LNG supply chain roadmaps
- Develop a roadmap for future energy supply in a decarbonising global economy
- Develop a workforce plan for the transition
- Set targets for deployment of renewable energy for LNG production
- Ensure that public funding for development and demonstration activities catalyses greater industry investment
- Improve the business case for the reduction of emissions intensity at brownfield sites
- Prioritise practices and upgrades to capture fugitives and improve efficiency
- Implement practices to reduce flaring while upholding high safety standards
- Regional roadmaps to develop electricity and CCS infrastructure
- Create roadmaps and partnerships to provide the energy needed for liquefaction
Together, the Australian Industry ETI has identified five objectives to enable heavy industry to transition to net zero emissions consistent with global efforts to limit warming to 1.5°C:

1. **Accelerate development and demonstration** of the emerging technologies needed for Australia to be a net zero emissions superpower.
2. **Drive deployment of low carbon solutions across the economy**, reduce barriers and support investment towards the transition to compete in a decarbonising global economy.
3. **Develop integrated regions, supply chains and energy network solutions**.

TRANSITION TO THE LARGE-SCALE, COST-COMPETITIVE, RENEWABLE ENERGY SYSTEM OF THE FUTURE

SET A STRONG, CLEAR, ENDURING FRAMEWORK WITH A NET ZERO GOAL TO ALIGN INDUSTRY, FINANCE AND GOVERNMENT EFFORTS ON THE TRANSITION OF AUSTRALIA’S INDUSTRY
The transitions required for Australia and its industry sector to remain globally competitive are complex by nature, requiring significant action across technology and infrastructure, finance and investment, policy and regulations, and partnerships and collaboration. To ensure these efforts align, the transition will need goal-oriented frameworks across government, industry, investors and other supporting actors that are strong, clear, and enduring, with further opportunities to align action to help limit global warming to 1.5°C.

All Australian states and territories, as well as the federal government now have net zero emissions targets. The next decade should be used to scale the infrastructure needed to meet long-term objectives, develop technologies needed for the transitions as well as to deploy mature technologies, as waiting until this gap has closed before beginning to implement decarbonisation solutions will prevent Australia from meeting net zero ambitions and lock industry out of lucrative global markets.

Immediate action by the government can help to ensure financing is aligned and proactive in addressing these gaps in development, deployment, scale and integration. Coordinating policy and programs across state, territory and federal governments with the aim of strategically targeting barriers and driving investment will help enable an effective pathway towards net zero goals.

**OBJECTIVE**

Set a **strong, clear, long-term framework with a net zero emissions goal** to align industry, finance and government efforts on the transition of Australia’s industry
### OBJECTIVE

Set a **strong, clear, long-term framework with a net zero emissions goal** to align industry, finance and government efforts on the transition of Australia’s industry.

### RECOMMENDED ACTIONS

<table>
<thead>
<tr>
<th>ENABLER TYPE</th>
<th>RECOMMENDED ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology and Infrastructure</td>
<td>Ensure federal, state and territory policy and programs are complementary, and designed to transition Australia’s industry and broader economy to net zero emissions.</td>
</tr>
<tr>
<td>Partnerships and collaboration</td>
<td>Develop a national strategy to become a leading supplier in new export markets such as green ammonia and green iron in the decarbonising global economy. Green hydrogen production for export could be in the order of 18Mt per year by 2050, and around 60Mt of green iron.</td>
</tr>
<tr>
<td>Finance and Investment</td>
<td>Develop a workforce plan to invest in and develop the skills needed for the transition, at the scale required, within key regions</td>
</tr>
<tr>
<td>Policy and Regulation</td>
<td>Further financial sector commitment and action to net zero in line with a 1.5°C transition</td>
</tr>
<tr>
<td>Policy and Regulation</td>
<td>Support the development and adoption of an Australian investment taxonomy to provide transparent and credible definitions of what constitutes sustainable investment.</td>
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</tbody>
</table>
Investment in the transition to net zero in heavy industry, at the scale identified in this pathway, will only be possible if there is confidence that a large-scale, reliable, low-cost energy system is available to power the needs of industry in the future and drive comparative advantages in low-cost sustainable production.

Ensuring access to cost-competitive, reliable, low-emissions electricity will be a critical driver of decarbonisation. The key to affordable electricity is minimising renewable integration costs including storage, transmission and system security. Transmission investment is difficult to avoid, with co-locating renewable energy generation with end-users as the main opportunity to lower the investment needed. Long and short-duration storage is required to ensure a reliable supply of renewable energy.

Customer-owned storage (home batteries and vehicle-to-grid), large-scale batteries, pumped hydro and hydrogen are key storage resources.

Competitiveness in a decarbonised global economy will be driven by access to low-cost, reliable renewable energy.

Renewable energy development will require access to land where high-quality renewable energy is located as well as investment in shared infrastructure to deliver energy as either electricity or hydrogen to areas of high industrial concentration. Capital investment and labour costs in Australia may be higher than its competitors, so an energy cost advantage over international benchmarks is required by many industries to maintain an international competitive advantage.
## OBJECTIVE

Transition to the large-scale, cost-competitive renewable energy system of the future

<table>
<thead>
<tr>
<th>RECOMMENDED ACTIONS</th>
<th>ENABLER TYPE</th>
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<tbody>
<tr>
<td>Ensure energy planning includes deployment of renewable energy and energy management to unlock investment at the scale required for heavy industry decarbonisation and new export industry development.</td>
<td>Technology and Infrastructure, Partnerships and collaboration, Finance and Investment, Policy and Regulation</td>
</tr>
<tr>
<td>Set targets that drive the development of a large-scale, decarbonised hydrogen market and coordinate updated regulation for rapid and safe development of hydrogen production, transport and storage.</td>
<td>Technology and Infrastructure, Partnerships and collaboration, Finance and Investment, Policy and Regulation</td>
</tr>
<tr>
<td>Strengthen energy market system planning to anticipate decarbonisation of heavy industry in line with 1.5°C warming scenarios with energy and green metals export scenarios as the central case.</td>
<td>Technology and Infrastructure, Partnerships and collaboration, Finance and Investment, Policy and Regulation</td>
</tr>
<tr>
<td>Undertake coordinated, detailed energy system and infrastructure planning studies that consider the regional context of industrial decarbonisation.</td>
<td>Technology and Infrastructure, Partnerships and collaboration, Finance and Investment, Policy and Regulation</td>
</tr>
<tr>
<td>Drive international energy competitiveness by benchmarking energy development at globally competitive costs of generation by making the most of Australia’s vast renewable resources at scale.</td>
<td>Technology and Infrastructure, Partnerships and collaboration, Finance and Investment, Policy and Regulation</td>
</tr>
</tbody>
</table>
The pathway set out by the Australian Industry ETI for a 1.5°C scenario uses a range of emerging technologies that require further development and demonstration before commercial scale deployment.

Emerging technologies in the Australian Industry ETI supply chains include:

**Iron & Steel**
- DRI-EAF
- DRI-Melter-BOF
- Electrolytic steelmaking

**Aluminium**
- Electric and hydrogen calcination
- Inert anodes
- Mechanical vapour recompression

**Other Metals**
- Battery electric vehicles for haulage
- Hydrogen fuel cell electric vehicles for heavy haulage

**Chemicals**
- Electrification of Haber-Bosch process
- Fuel switching to green hydrogen for feedstock

**LNG**
- Carbon capture, utilisation and storage for emissions produced during gas processing

**OBJECTIVE**

Accelerate development and demonstration of the emerging technologies needed for Australia to be a net zero emissions superpower.
## OBJECTIVE

Accelerate development and demonstration of the emerging technologies needed for Australia to be a net zero emissions superpower

### RECOMMENDED ACTIONS

<table>
<thead>
<tr>
<th>ENABLER TYPE</th>
<th>Priority Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology and Infrastructure</strong></td>
<td>Prioritise funding and support for pilots and demonstrations to enable Australia to maintain and grow market share in existing industries and expand into new industries where Australia has natural advantage.</td>
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<tr>
<td><strong>Partnerships and collaboration</strong></td>
<td>Address common strategic risks and enable cost sharing through supply chain partnerships and multi-stakeholder collaborations.</td>
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<tr>
<td><strong>Finance and Investment</strong></td>
<td>Direct public funding towards development and demonstration activities, develop mechanisms to catalyse greater industry investment and better enable private finance and investment in early stage technologies.</td>
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<tr>
<td><strong>Policy and Regulation</strong></td>
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OBJECTIVE

Drive deployment of low-carbon solutions, reduce barriers and support investment towards the transition to compete in a decarbonising global economy.
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<th>RECOMMENDED ACTIONS</th>
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<td>Drive deployment of low-carbon solutions, reduce barriers and support investment towards the transition to compete in a decarbonising global economy</td>
<td>Ensure industry and climate policies enable efficient emissions reductions across the economy through mechanisms such as the Safeguard Mechanism while also committing to targeted measures to reduce barriers and support investment towards the transition.</td>
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<td></td>
<td>Develop early supply, demand and enabling infrastructure to scale net zero solutions through levers such as offtake commitments, government procurement contracts, aggregation of industry demand, feed-in tariffs, voluntary pledges, mandates and certification schemes for green products.</td>
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<td></td>
<td>Financial institutions should continue to focus their stewardship and engagement with industrial companies to align lending and investment to net zero emissions by leveraging credible pathways and benchmarks for industrial transition and reflecting lower risk of transition for aligned companies in lending and investment criteria.</td>
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</table>
The scale and complexity of the challenges and opportunities of decarbonisation can no longer be addressed by single organisations acting alone.

Development of clustered industrial precincts that leverage multi-user infrastructure and build a skilled workforce present an opportunity for more efficient investment in low-emissions industrial production.

A range of efforts at a precinct level, such as:

- demand-side response
- sector coupling and
- integrated hydrogen systems to balance energy loads from renewables

These could allow for more effective use of transmission, distribution and storage infrastructure as part of decarbonisation transformation.

OBJECTIVE

Develop integrated regions, supply chains and energy network solutions
## Objective

Develop integrated regions, supply chains and energy network solutions

## Recommended Actions

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<td>Commitment from government to develop a number of coordinated net zero industrial precincts, designed to leverage shared infrastructure and draw in large scale renewable energy from renewable energy zones or equivalent.</td>
<td>Technology and Infrastructure</td>
</tr>
<tr>
<td>Energy market reforms should give equal weight to energy efficiency, demand management, hydrogen production as a load balancing mechanism and customer owned storage to facilitate lower cost with special focus on firming for industrial processes.</td>
<td>Partnerships and collaboration</td>
</tr>
<tr>
<td>Build supply chain roadmaps for heavy industry to align suppliers, finance, consumers and decision-makers on the vision and milestones for the development of infrastructure, energy systems and technology solutions.</td>
<td>Finance and Investment</td>
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<tr>
<td>Build the circular economy and update business models to include data-driven, ‘product-as-a-service’ models.</td>
<td>Policy and Regulation</td>
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</table>
This is a moment of opportunity to align and focus efforts to create a globally competitive, equitable, net zero emissions industrial economy in Australia
Thank you

The Australian Industry Energy Transitions Initiative has been co-convened by Climateworks Centre, based at Monash University, and Climate-KIC, with delivery and research support from CSIRO, RMI, the Energy Transitions Commission, and BloombergNEF.