



# National Supergrid

CONNECTING AUSTRALIANS  
TO A ZERO-EMISSIONS FUTURE

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JANUARY 2023

## Recognition of traditional custodians

We recognise that Aboriginal people's sovereignty over their land was never ceded and the impact of this ongoing dispossession continues to this day. Beyond Zero Emissions stands in solidarity with First Nations peoples in calling for the establishment of a First Nations Voice in the Constitution, as described in the Uluru Statement from the Heart. We further support calls for the establishment of a Makarrata Commission on agreement-making and truth-telling between Aboriginal and Torres Strait Islander peoples and governments.

Beyond Zero Emissions maintains an office on the traditional lands of the Wurundjeri-willam people of the Kulin Nation, and in Newcastle on the lands of the Awabakal, Worimi and Wonnarua peoples. We pay our respects to all First Nations Elders past, present and those emerging.



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Hub Australia  
L18/1 Nicholson Street  
East Melbourne Victoria 3001

Eighteen04  
TAFE Campus, B Block  
Level 1/91 Parry Street  
Newcastle West NSW 2302

ABN: 48 554 925 975

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This document is available for download from <http://www.bze.org.au>

Requests and inquiries should be directed to [info@bze.org.au](mailto:info@bze.org.au)

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*Full appendices, including methodology, modelling, assumptions and further references are available on request and are published online at [www.bze.org.au/research](http://www.bze.org.au/research)*

# Acknowledgements

## Project leadership

**Strategic Oversight:** Heidi Lee

**Lead Authors:** Dr Chun Hin Ng, Dr Jane Sewell, Rowan Moorey and Kelvin Wicks

**Policy Lead:** Beth Mitchell

**Volunteer Expert:** Richard Keech, Director, New Energy Thinking

**BZE Expert Advisor:** Michael Lord

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## Peer review

Stephanie Bashir, CEO, Nexa Advisory

Edward Hawkins, Senior Manager Climate and Energy, Engevity Advisory

Richard Keech, Director, New Energy Thinking

Alastair Leith, Director, Useful Design

Jenny Lewis, Senior Consultant, WSP

Michael Lord, BZE special advisor

Elijah Pack, Group Manager System Planning, AEMO

Alan Pears, Senior Industry Fellow, RMIT University

Alison Reeve, Climate Change and Energy Deputy Program Director, Grattan Institute

Daniel Sim, DM Planning & Investigations Manager, Ausgrid

Jesse Steinfeld, Future Grid Planning Manager, Transgrid

## Stakeholders consulted through research phase

Stephanie Bashir, CEO, Nexa Advisory

Gloria Chan, Executive Director, CEFC

Jonathon Dore, DSO Services Lead, Ausgrid

Andrew Dyer, Australia Energy Infrastructure Commissioner

Kate Healey, Policy Manager, RE-Alliance

Richard Keech, Director, New Energy Thinking

Alastair Leith, Director, Useful Design

Jenny Lewis, Senior Consultant, WSP

Oliver Nunn, Managing Director, Endgame Economics

Elijah Pack, Group Manager System Planning, AEMO

Lani Perlesz, Project Manager, ClimateWorks Center

Nina Polaschek, Manager, Industry, Manufacturing and Electrification, Energy,  
EPW QLD Government

Alison Reeve, Energy + Climate Fellow, Grattan Institute

Daniel Sim, DM Planning & Investigations Manager, Ausgrid

Stephen Tansing, Advanced Projects Engineer, Honeywell

# Executive Summary

**'National Supergrid' outlines a five-year grid investment program that will deliver sovereign energy, secure supply chains, good quality jobs and lowest-cost competitive energy to ensure a prosperous and zero-emissions Australia.**

There is tremendous demand for faster deployment of renewables, from businesses, industries, investors and communities as well as federal and state governments. Our current grid is the handbrake on delivery of new renewable energy. The federal government's Powering Australia plan sets the

## A nation-building opportunity

The National Supergrid we propose is an ambitious nation-building program that reflects Beyond Zero Emissions' own research and deep engagement with policy makers, industry partners and experts.

National Supergrid will set the context for private investment in renewable generation, energy storage and cleantech manufacturing so that Australia can capitalise on renewable energy opportunities, accelerate emission reductions and secure the industries that will deliver our zero-emission future.

Australia's abundant renewable resources mean we can export green energy and green products to the world, and fully and reliably meet our domestic energy needs. The transition to renewable energy is an opportunity for Australia to lay the foundations for a thriving society and prosperous economy.

Transforming the existing energy grid unlocks this opportunity. This means building capacity for smart grid management tools that connect rooftop solar, batteries and electric vehicles, building sufficient energy storage capacity to maintain consistent supply, ensuring stable grid parameters and expanding transmission to connect renewable energy zones and strengthen interconnectors.

right direction, but moves too slowly. A 'National Supergrid' is the grid we need to bring more renewables online, more quickly.

The rapid deployment of Australia's 'National Supergrid' is a critical nation-building initiative. Just as past government investment in rail, roads and ports opened up new economic opportunities for Australia, rapid deployment of new renewable energy will be the foundation of Australia's prosperity for generations to come.

The work must be done fast and at a scale that reflects the quantity of renewable generation required to power the new opportunities. The federal government has a key role to play in setting a clear, unifying vision and coordinating with all stakeholders to create a roadmap that delivers investment confidence, fosters collaboration and leverages synergies, all at an accelerated pace.

The current Rewiring the Nation funding commitment sets a baseline. Accelerating the investment timeframe and introducing further funding from programs such as the National Reconstruction Fund, will ensure grid transformation can happen at the necessary speed and scale.



# Five steps to build the National Supergrid foundations

- 1.** Invest a minimum of \$20 billion in grid infrastructure over the next five years to lay the foundations of a National Supergrid for strong economic growth. The five-year investment program is detailed in Table 1 (page 8).
- 2.** Prioritise grid upgrades that promote rapid decarbonisation in regional industrial ecosystems (Renewable Energy Industrial Precincts) in locations such as the Hunter and Gladstone to unlock private investment and drive growth of zero-emissions industry.
- 3.** Adopt a holistic approach to upgrade all grid assets including transmission, energy storage, distribution, and system security. The National Supergrid takes a holistic view of the grid, beyond 'poles and wires', to deliver reliable, robust and low-cost energy where and when it is needed.
- 4.** Embed social licence and community benefits as core principles. Success is contingent on the inclusion and empowerment of all impacted communities, including First Nations peoples, regional and remote communities.
- 5.** Accelerate the move towards 85% renewables by 2028 by harnessing the capabilities of the Supergrid, and target close to 100% by 2030. This will drive down emissions and shield businesses and households from volatile fossil fuel prices.

# Benefits for energy security, cost of living and economic growth

A National Supergrid delivers critical grid infrastructure and unlocks private investment into renewable generation, energy storage and new cleantech opportunities. Specific benefits include:

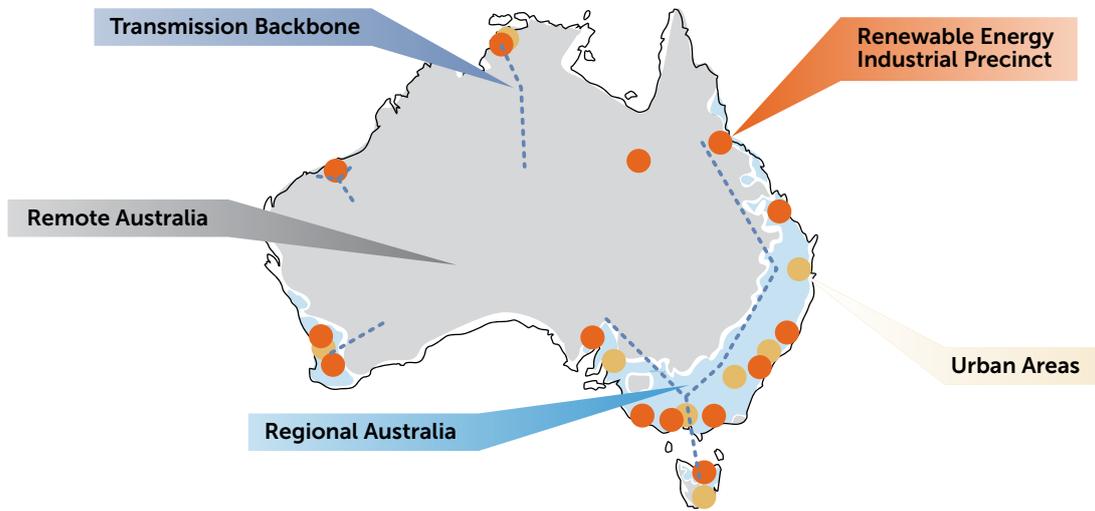
- **Increasing energy security by decoupling Australia's energy markets from international fossil fuel markets** which are geopolitically exposed and subject to ongoing price uncertainty and escalation. (For example, spikes of 200% in spot prices in the National Electricity Market (NEM) over 2022 as an outcome of the war in Ukraine).<sup>1,2</sup>
- **Easing cost of living pressures by enabling households to tap into modern, efficient, electric technologies** such as heat pumps, electric vehicles (EVs), batteries and rooftop solar. Our analysis shows that an average Australian household can save up to \$4,021 annually on energy bills by electrifying their homes and cars.
- **Creating sustainable economic growth and supply chain security through prioritising grid upgrades to industrial regions.** Low-cost, zero-emissions renewable energy will support existing industries to decarbonise and create new renewable industries (For example, in critical minerals, green steel/aluminium production and renewable hydrogen for domestic and export markets). This is critical as Australia's trading partners increasingly seek secure, zero-emissions supply chain partners. Beyond Zero Emissions' Export Powerhouse research (2021) showed that these markets could be worth \$333 billion by 2050, triple the value of our 2019 fossil fuel exports.<sup>3</sup>
- **Improving energy equity for rural, remote and First Nations communities** through investment in grid infrastructure and storage to reduce reliance on high-cost fuel. This improves energy access and sovereignty and unlocks additional revenue streams, economic growth and job opportunities.

## Best practices for a successful transition

Best practice principles for a successful deployment of a National Supergrid are:

- **Collaboration:** All stakeholders need to be engaged to collaborate openly and transparently. This is critical to ensure an efficient delivery, avoiding unnecessary competition or project duplication.
- **Social licence:** Early community engagement and the consideration of community benefits, work and training opportunities, biodiversity and equitable access to infrastructure are critical to gaining and maintaining social licence.
- **First Nations free, prior and informed consent and economic opportunity:** Partnerships formed under free, prior and informed consent with First Nations peoples are vital in ensuring that new economic opportunities are inclusive.
- **Workforce transition and diverse participation:** The National Supergrid is an opportunity to unlock a world-class grid infrastructure and renewables workforce with leading industry knowledge on how to deliver renewable infrastructure at scale and across diverse contexts.
- **Industrial capability in a zero-emissions economy:** The National Supergrid brings low-cost firm renewable energy to industry, ensuring Australian industries stay internationally competitive while driving demand and off-take for new industrial production capacity.
- **Investment in Australian innovation:** Many world-leading clean technologies are being developed by local innovators. Proactive support now will encourage local innovation and associated manufacturing to remain onshore.
- **Emission reductions aligned to an IPCC 1.5°C scenario:** The National Supergrid addresses emissions from the electricity sector, responsible for 36% of Australia's greenhouse gas emissions, and is a key enabler for decarbonisation in all other sectors.

# A National Supergrid serves households and industry across Australia



Transmission Backbone	Renewable Energy Industrial Precinct	Urban Areas	Regional Australia	Remote Australia
<p>Renewable generation</p>	<p>Renewable generation</p>	<p>Renewable generation</p>	<p>Renewable generation</p>	<p>Renewable generation</p>
<p><b>Supergrid</b></p> <p>Transmission \$8.7B</p> <p>System security \$1.7B</p> <p>Long duration energy storage \$3.6b</p> <p><b>Supergrid</b></p>	<p><b>Supergrid</b></p> <p>REIP Transmission \$2B</p> <p>Industry substation \$600m</p> <p>Pumped hydro foundations \$300m</p> <p><b>Supergrid</b></p>	<p><b>Supergrid</b></p> <p>DER management \$335m</p> <p>Neighbourhood distribution \$175m</p> <p>Community hubs Portion of \$500m</p> <p><b>Supergrid</b></p>	<p><b>Supergrid</b></p> <p>Regional distribution \$336m</p> <p>Energy storage innovation \$400m</p> <p>Community hubs Portion of \$500m</p> <p><b>Supergrid</b></p>	<p><b>Supergrid</b></p> <p>Stand-alone power system \$400m</p> <p>Remote transmission \$1 billion</p> <p><b>Supergrid</b></p>
<p>Emissions reduction</p> <p>Energy security</p> <p>Accelerated renewable uptake</p> <p>First Nations partnerships</p>	<p>Zero emissions industry</p> <p>Renewable exports</p> <p>First Nations partnerships</p> <p>Bill savings</p>	<p>Home solar / batteries</p> <p>Building / transport electrification</p> <p>First Nations partnerships</p> <p>Bill savings</p>	<p>Agrivoltaics</p> <p>Farm/community renewables</p> <p>First Nations partnerships</p> <p>Bill savings</p>	<p>Energy independence</p> <p>Efficient resource sharing</p> <p>First Nations partnerships</p> <p>Bill savings</p>

## An accelerated investment plan

Beyond Zero Emissions proposes a \$20 billion investment program **over the next five years** to build the National Supergrid foundations. The investment program breaks down as follows:

Table 1: Distribution of funding for grid infrastructure investment

Infrastructure	Funding*	Details
<b>Transmission</b> \$11.7 billion	\$8.7 billion	Support transmission projects identified in the AEMO 2022 ISP Hydrogen Superpower for delivery in the next 5 years to 2027/28.
	\$2 billion	Support transmission projects that enable the delivery of renewables to two industrial precincts for clean commodities and manufacturing.
	\$1 billion	Support transmission in the Pilbara (WA) to fast-track renewable energy sharing. Support the Electric Superhighway (NT) to deliver energy independence and opportunities to First Nations peoples.
<b>Storage</b> \$4.3 billion	\$3.6 billion	Support for 6 GW/50 GWh medium duration (8 hr) battery storage projects to unlock renewables and provide critical firming capacity.
	\$400 million	Support for local innovators to scale up next-gen energy storage technologies.
	\$300 million	Support the groundwork for pumped hydro assets, focusing on brownfield and off-river sites, as well as projects that support our industrial regions.
<b>Distribution</b> \$2.3 billion	\$335 million	Support collaborative establishment of a national distributed energy resources management system to optimise household solar, batteries and electric vehicles.
	\$175 million	Support distribution upgrades to enable electrification for communities.
	\$400 million	Support the rollout of stand-alone power systems and microgrids to remote and First Nations communities for improved energy independence.
	\$336 million	Support rural communities and farmers to decarbonise and connect mid-scale renewables (1-5 MW) to unlock new revenue streams.
	\$500 million	Support distribution upgrades to enable the electrification of community hubs, schools etc. to ease cost pressures and free up funding for service delivery.
	\$600 million	Support distribution upgrades to industrial clusters, helping them to electrify and adopt modern, renewable powered manufacturing processes.
<b>System Security</b> \$1.7 billion	\$1.5 billion	Support the delivery of critical assets such as synchronous condensers.
	\$200 million	Support the accelerated rollout of advanced grid forming inverters.

\*The proposed funding mechanisms are discussed in the report. Detailed modelling for the costings are provided in the appendix.

# The Vision

## National Supergrid: connecting Australians to a zero-emissions future

Australia's future prosperity depends on a robust, renewably powered electricity grid that reliably delivers low-cost, zero-emissions energy at scale, a 'National Supergrid'.

A National Supergrid allows Australia to fully harness our abundant renewable resources, create opportunities for industry including regional manufacturing, and shift to 100% renewable energy by 2030. A National Supergrid delivers a range of important benefits:

- **Strong energy security** by decoupling energy markets from volatile fossil fuels which are geopolitically exposed and subject to price uncertainty and escalation. In 2022, the war in Ukraine caused spot prices in the National Electricity Market (NEM) to spike by over 200%.<sup>4</sup> In the Australian Capital Territory where energy is sourced from 100% renewables, energy prices increased by 9%.<sup>5</sup>
- **Reduced cost of living** with resilient, renewable electricity coupled with modern energy-efficient electrical appliances, will generate substantial savings on household energy bills. Beyond Zero Emissions' analysis shows that an average

Australian household can save between \$2,811 and \$4,021 each year on their energy bills offering tangible household relief. A holistic consideration of the grid network including distribution will support households to electrify to reduce cost of living pressures.

- **Economic growth and supply chain security** to support the growth and competitiveness of low-cost, zero-emissions electricity delivered reliably and at scale is vital to existing and emerging industries. Prioritising grid infrastructure to key industrial regions will accelerate Australia's capability to deliver renewable commodities to global trading partners who seek sustainable, transparent and ethical supply chains. Beyond Zero Emissions' *Export Powerhouse* report identifies the potential for \$333 billion worth of renewable exports by 2050, three times the value of Australia's fossil fuel exports in 2019.<sup>6</sup>
- **Energy equity for rural, remote and First Nations communities** with investment in grid infrastructure to reduce reliance on high-cost fuels. This improves energy access and sovereignty and unlocks revenue streams, economic growth and job opportunities.

CSIRO data shows energy generation from firmed renewables will cost \$27/MWh less than coal.<sup>7</sup>

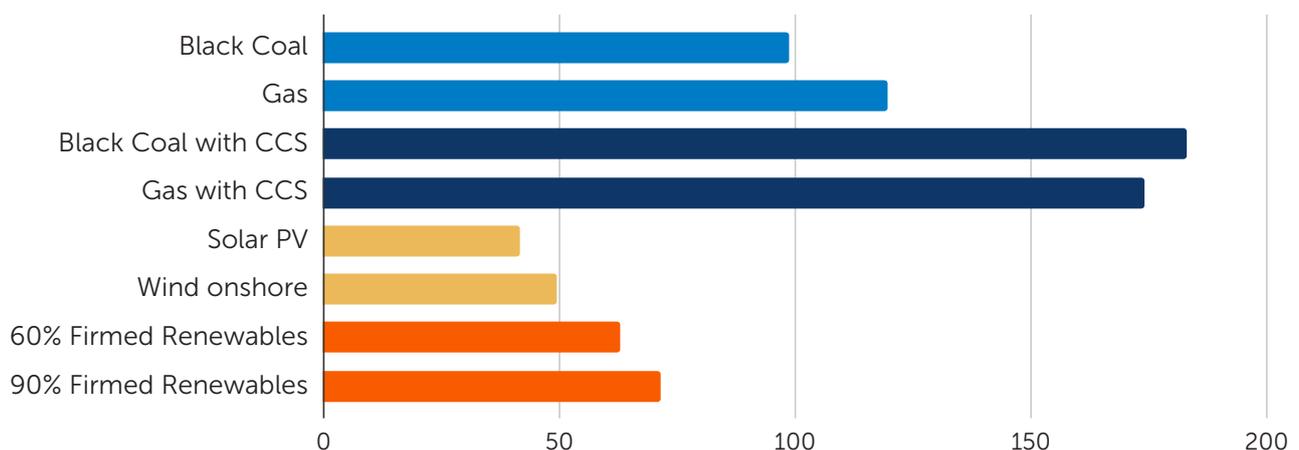


Figure 1: Average cost of generation from different technologies in 2030 in \$/MWh<sup>8</sup>

## **We must expedite investment in our electricity grid to facilitate the rapid deployment of renewables and deliver on our emission reduction targets.**

There is a tremendous amount of support and desire for more renewables, from businesses, industries, investors and communities as well as federal and state governments.<sup>9,10,11</sup> What is missing is the ambition for a rate of deployment that is in line with the need and opportunity at hand.

We are at the limit of what our existing grid infrastructure can support and there is a need for timely deployment of transmission to connect renewable energy zones (REZs).<sup>12, 13</sup> Investment in a National Supergrid can deliver the right infrastructure at the right time to free up grid congestion, fast-track connections and unlock a new wave of private investment into wind, solar and energy storage. Unlocking this investment has the additional benefit of helping to manage the accelerating retirement of existing coal power stations (Eraring, Bayswater, Loy Yang)<sup>14,15</sup> and provide additional firming renewable supply to act as a buffer against unexpected outages or closures.

Recent energy price spikes are an indication of things to come if we continue to rely on volatile and ageing fossil fuel generation, and fail to replace it with firming renewables and the grid infrastructure that supports them.<sup>16</sup> The Australian Energy Market Operator (AEMO) identifies a pressing and widespread need for grid investment to support our energy transition.<sup>17</sup>

**There is a key role for the federal government to play in coordinating with all stakeholders to articulate a roadmap that delivers investment confidence, fosters collaboration and leverages synergies at an accelerated pace.**

*“Australia is the best placed country in the world to be a renewable energy superpower, generating 395,000 jobs and \$89 billion in revenue by 2040. We can get there by unions, government, business, and climate organisations working together.”*

Michele O’Neil | ACTU President<sup>18</sup>

*“We need a transition that creates jobs, delivers affordable, reliable and secure energy and positions Australia for a decarbonised global economy.”*

Jennifer Westacott | Chief Executive of Business Council of Australia<sup>19</sup>

*“It should be a win-win. First Nations can assist in unlocking new energy investments and use clean energy to address any energy security issues, opening the door for greater economic advancement and ensuring a clean energy future for our people.”*

Chris Croker | Managing Director of Impact Investment Partners<sup>20</sup>

*“The next three years could set Australia up to achieve a new clean energy advantage and a thriving and clean economy. Working with the states and territories, industry and others, the Commonwealth can help prepare for faster, more coherent and successful transitions.”*

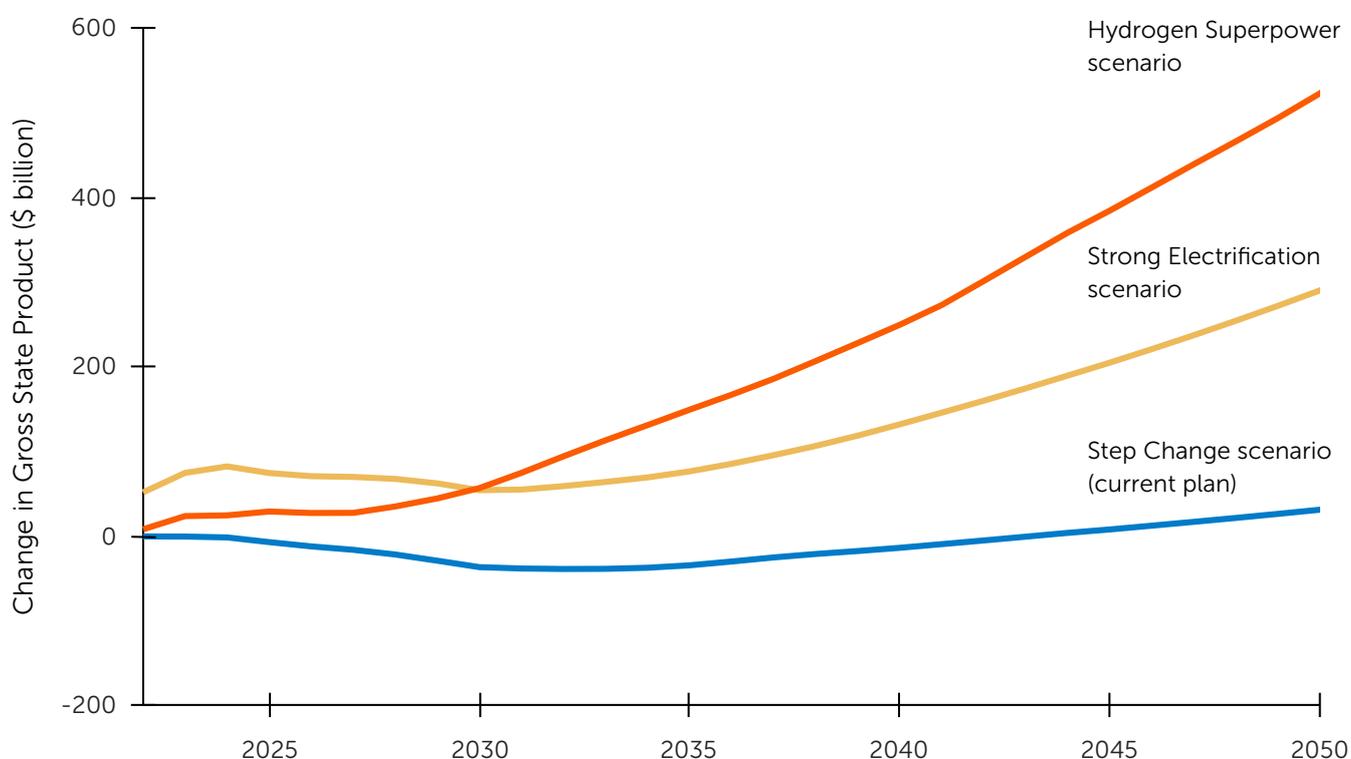
Innes Willox | CEO of Australian Industry Group<sup>21</sup>

## AEMO's scenario analysis

AEMO's 2022 Integrated System Plan (ISP) provides a backdrop, highlighting critical grid investments and offering three deployment scenarios.<sup>22</sup> Two scenarios of particular note are the Hydrogen Superpower (1.5°C aligned, hydrogen focus) and Strong Electrification Sensitivity (1.5°C aligned, electrification focus). The National Supergrid proposal aligns with this rapid rollout and adds a

holistic lens that fully captures Australia's renewable energy opportunity, setting the foundations to align with AEMO's more ambitious scenarios and achieve long-term economic benefits. Economic analysis of these scenarios shows how an ambitious deployment of grid infrastructure and renewables can lead to strong economic uplift (Figure 2).<sup>23</sup>

### Rapid investment and strong ambition drives economic outcomes (AEMO modelling)



**Figure 2: AEMO economic modelling of Gross State Product (GSP) of different 2022 ISP scenarios, represented as the change in GSP compared to business as usual (Steady State scenario). Hydrogen Superpower and Strong Electrification are closest in ambition to the proposed Supergrid. Step Change represents the scenario that is most in line with existing policy.**

Hydrogen Superpower and Strong Electrification depict a future where economic output in NEM states (measured as gross state product, GSP) is significantly greater than in the third scenario, Step Change. The Step Change scenario aligns most closely with the current government ambition of 82% renewables by 2030, notably this scenario does not deliver emission reductions in line with the IPCC's 1.5°C ambition.

Step Change is projected to have relatively minor additional benefits to GSP over business as usual, with slower decarbonisation and limited consideration given to the renewables required for new industries including renewable hydrogen and green commodities such as green steel. In contrast, the economic impact of the buildout associated with the Hydrogen Superpower scenario depicts an additional increase in GSP of over \$500 billion by 2050.

Strong, ambitious and early investment into our grid is critical to unlock these new industry opportunities and their economic benefits.

The declining cost of zero-emissions technologies coupled with global demand for renewable exports is creating market conditions most aligned with Hydrogen Superpower.<sup>24</sup> The conflict in Ukraine, which has driven rapid renewable uptake in Europe, and the passage of the US Inflation Reduction Act, which allocates \$USD369 billion towards clean energy, are recent examples of momentum behind

accelerated decarbonisation.<sup>25, 26</sup> As Australia's major trading partners accelerate climate action, we can expect announcements of increased ambition towards a zero-emission future.

Australia is uniquely placed to take a starring role in the zero-emissions future thanks to our wealth in critical minerals and our access to abundant renewable energy from wind and solar. Our ability to realise the opportunities depends on the speed we can deliver new renewable energy.

## Rewiring the Nation sets us on the right path

**The government's Rewiring the Nation initiative points us in the right direction but we need to move faster and do more.** Rapid, coordinated grid infrastructure upgrades are the necessary path to accelerate our emissions reduction and put us in line with the IPCC 1.5°C scenario.<sup>27</sup>

**With the support of the National Reconstruction Fund and other federal programs** we can lay the foundations for a decarbonised society earlier than the current 10-year horizon. To achieve this, Beyond Zero Emissions recommends the following five steps over the next five years:

- 1. Plan and allocate a \$20 billion grid infrastructure investment program** to lay the foundations of a National Supergrid to be deployed over the next five years for strong economic growth as outlined in the 'Building the Foundations' section.
- 2. Prioritise grid investment and a rollout of renewables that is appropriately scaled and designed to power zero-emission industries** in key regional industrial ecosystems such as the Hunter and Gladstone. AEMO's Step Change scenario can decarbonise Australia but it isn't scaled to deliver the renewables required to repower industry with renewable energy or to support emerging export industries such as renewable hydrogen. The National Supergrid is scaled to support these renewable industries.

- 3. Embrace a holistic consideration of critical grid assets to maximise renewable generation and efficiency of the National Supergrid.** This includes transmission, energy storage and system security. Importantly, this also includes consideration of distribution network upgrades to enable cost of living benefits and improved energy independence for rural, remote and First Nations communities.
- 4. Adopt social licence and community benefits as core principles.** A successful rollout of the National Supergrid is contingent on the inclusion and empowerment of all communities, including those of regional, rural and First Nations peoples.
- 5. Leverage the National Supergrid infrastructure for a faster transition to renewable energy.** Current planning for a Step Change scenario leaves Australia reliant on fossil fuels for close to half of electricity generation (over 40%) until 2028. This is too long. The National Supergrid aims to move our grid towards 85% renewables in the next five years and close to 100% renewables by 2030.

A National Supergrid delivers the grid infrastructure that will allow us to maximise our abundant renewable energy opportunities, accelerate emission reductions and secure a prosperous renewable future shared by all. This will place Australia as a global front-runner for new markets and grow our reputation as a leader in decarbonisation.

A National Supergrid will deliver 50 GW more renewable capacity over five years than the current plan (AEMO's Step Change scenario)

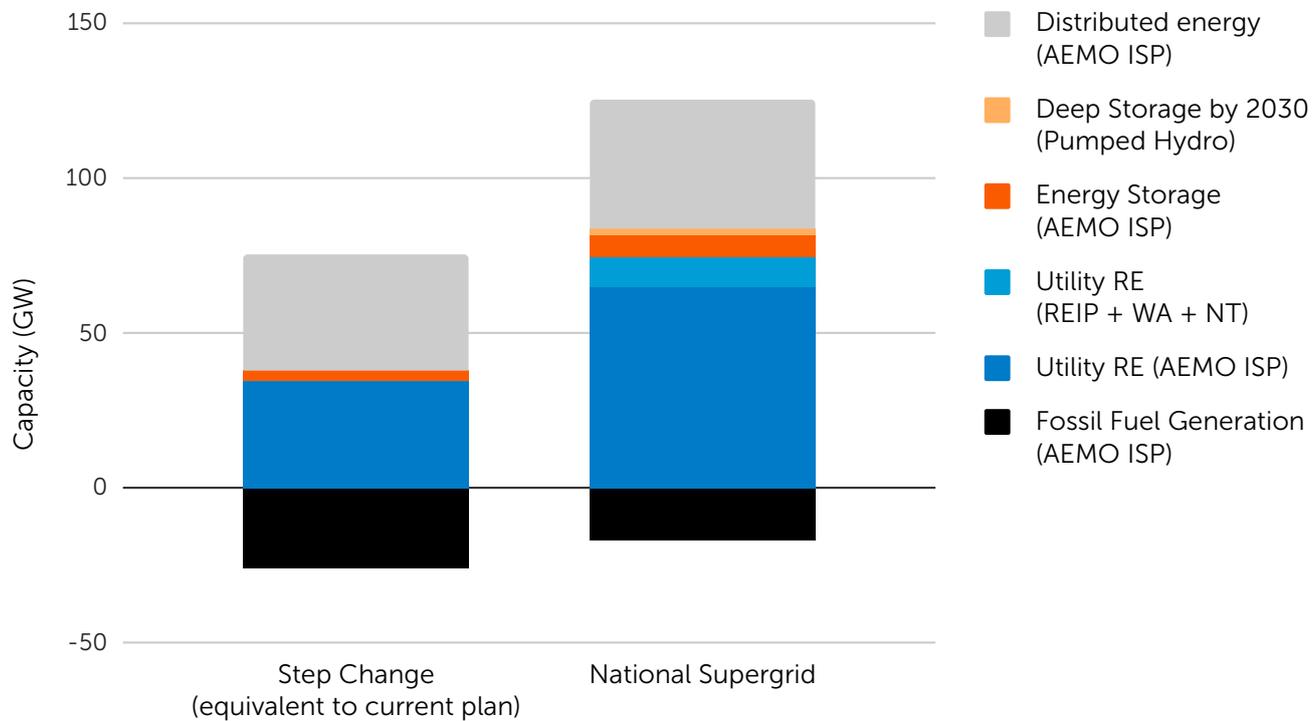


Figure 3: Comparison of GW capacity in the next five years (to 2027/28) of the current Step Change trajectory to the National Supergrid proposed from Beyond Zero Emissions.

# Building the foundations

## The Supergrid in the next five years

The existing energy grid is under pressure. Performance is challenged by congestion and connection delays and by overall underinvestment in infrastructure. Accelerated coal closures and global events, notably the impact of the war in Ukraine and its implication for gas supplies from

Russia, are creating disruption and uncertainty around supply. To limit Australia's exposure, we need a rapid deployment of renewable energy supported by robust, future-oriented grid infrastructure.

### A National Supergrid serves households and industry across Australia

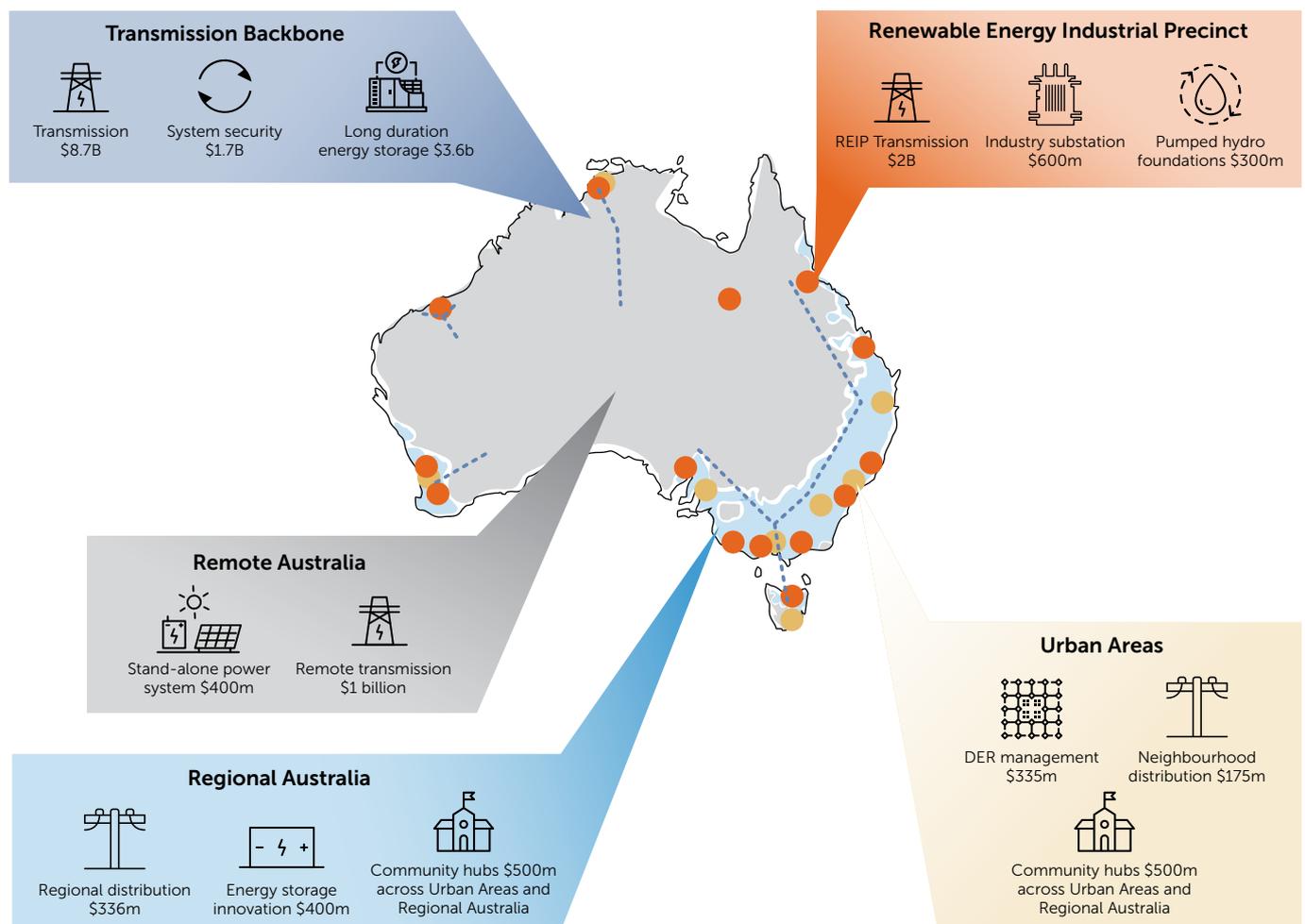
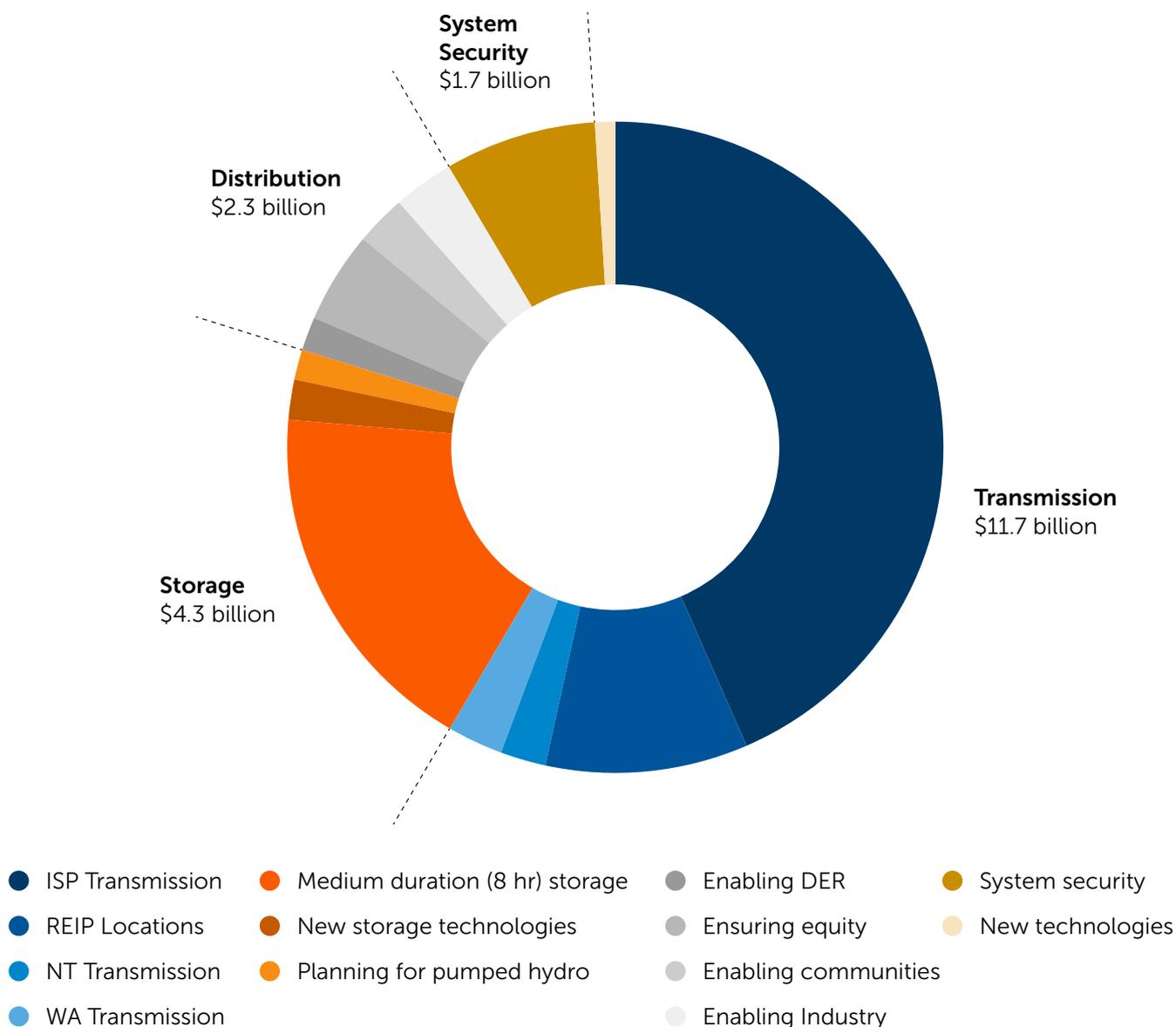


Figure 4: A National Supergrid services households and industry across Australia

**Government intervention is needed to bring certainty** to the timely delivery of critical grid infrastructure. An intense five-year grid infrastructure structure buildout, coordinated at a national level, is an effective way to relieve these market uncertainties and unlock a wave of new private investment in renewable generation and grid firming.

The detailed allocation of Beyond Zero Emissions' recommended \$20 billion grid infrastructure investment program to build the National Supergrid foundations over the next five years is outlined in Figure 5. This National Supergrid funding draws from the existing Rewiring the Nation, National Reconstruction Fund and other Powering Australia programs.

**Recommended funding allocations over five years to build National Supergrid foundations**



**Figure 5: Funding to deliver foundations of a National Supergrid distributed across four key areas: transmission, storage, distribution and system security**

# Transmission

## \$11.7 billion in government equity funding for nationally significant transmission projects

We propose \$11.7 billion is allocated to nationally significant transmission projects over the next five years in the form of equity. Government equity funding increases delivery certainty and allows for optimum conditions, including best-practice social licence, community engagement, First Nations inclusion and biodiversity protection.

Our analysis assumes that the federal government pursues a significant level of equity in identified transmission projects to accelerate the approval of projects and bring forward benefits within the next five years. Potential alternatives include a shared equity arrangement with state governments, transmission networks and private investors, with loans as potential alternatives. The recently announced joint 20% equity of Marinus Link with the Victorian, Tasmanian and federal governments along with loan funding from CEFC is an example of how this can work in practice.<sup>28</sup>

**Government equity for transmission projects will delay network cost pass throughs until after benefits from renewables are delivered.** Once sufficient renewables have come online to drive down wholesale costs, the government can sell the assets to the relevant transmission body (who should jointly design and operate the asset) and recoup the funds invested. This ensures public support for renewables by making sure the benefits outweigh the cost. A recent survey from KPMG of senior representatives across the energy sector highlights strong support for an equity funding model.<sup>29</sup>

This significant government intervention is recommended in the short-term. Consumer trust is at an all-time low and analysis from NEXA Advisory reveals the potential for further electricity price increases due to delays in transmission deployment.<sup>30, 31</sup> There is an urgent need for certainty around transmission in order to bring online low-cost generation from renewables.

Table 2: A selection of federal programs that can support Supergrid transmission investment and benefits

Program	Applicability
Rewiring the Nation	Directly supports transmission upgrades
Northern Australia Infrastructure Fund	Can support transmission upgrades
Powering the Regions Fund	Can support transmission for REIP and industry opportunities
National Reconstruction Fund	Supports the build out of capabilities required to deliver transmission like green steel/aluminium (Priority areas: Renewables and low emission technologies, Value-add in resource)
New Energy Apprenticeships	Supports the build out of the workforce needed
First Nations Clean Energy Strategy	To help guide transmission developments

## Transmission projects

### Box 1: AEMO ISP

Seven projects are scheduled for delivery in the next five years, worth a total of \$8.7 billion (see Table 3) from the AEMO 2022 ISP's Hydrogen Superpower scenario. This timing delivers four out of the five critical actionable projects identified in the AEMO 2022 ISP, including the recently announced allocation to Marinus Link.<sup>32</sup> This timing keeps the window open for the delivery of the VNI West KerangLink in 2028/29. Given the rapid deployment of renewables (two years to construct a 1 GW wind farm project)<sup>33</sup> equity from earlier projects like Humelink can be recovered in time to free up the \$750 million allocated to KerangLink.<sup>34</sup>

We note that the AEMO ISP projects in Table 3 align with the Hydrogen Superpower scenario but, given the recent transmission and policy

announcements from state and federal governments, the transmission projects and their timings proposed in Table 3 may be accelerated. The inclusion of transmission to offshore wind projects is another key consideration and is a promising development opportunity that is not currently allocated in Table 3. It is important that a national lens be maintained through the federal government, allocating resources and delivering projects that bring about the most efficient transition pathway for our grid. Coordination with states, bipartisanship and long-term thinking are vital.



**Table 3: The transmission projects identified for fast-tracking to build the National Supergrid foundations in the next five years. The timings for the AEMO 2022 ISP are taken from the Hydrogen Superpower scenario, see appendix for more details.**

Transmission Project	Source	Additional capacity (MW)	Cost (\$m)	Deployment timeline
Darling Downs REZ Expansion	AEMO 2022 ISP	800	43	2025-2026
South East South Australia REZ expansion (Stage 1)	AEMO 2022 ISP	600	57	2025-2026
Facilitating power to Central Queensland (Stage 1)	AEMO 2022 ISP	400	137	2026-2027
Humelink	AEMO 2022 ISP	2,200	3,315	2026-2027
New England REZ Transmission Link	AEMO 2022 ISP	3,070	1,905	2027-2028
Sydney Ring	AEMO 2022 ISP	5,000	880	2027-2028
Marinus Link (Cable 1)	AEMO 2022 ISP	750	2,380	2027-2028
Hunter Renewable Energy Industrial Precinct (REIP)	BZE Proposal	1,500	1,000	2026-2027
Gladstone REIP	BZE Proposal	1,500	1,000	2026-2027
Connecting the Pilbara (WA)	BZE Proposal	1,500	550	2027-2028
Electric Superhighway (NT)	Original Power	200	450	2027-2028
<b>Total</b>		<b>20,520</b>	<b>11,717</b>	

## Box 2: Renewable Energy Industrial Precincts (REIPs)

Our analysis of two REIP locations, the Hunter and Gladstone, shows there is a need for 3 GW of renewable generation in each location to decarbonise their aluminium smelters.<sup>35,36</sup> This can reduce close to 14 million tonnes of CO<sub>2</sub> or 2.8% of Australia's annual emissions. We propose \$1 billion in transmission upgrades in each location to deliver 3 GW of renewables over the next five years to support the decarbonisation of the aluminium smelters and build the infrastructure foundations of REIPs in these key industrial regions.

These investments target the *minimum* grid upgrades required to facilitate the decarbonisation of existing anchor tenants, in this case the aluminium smelters. As additional renewable hydrogen projects and industry decarbonisation targets firm up, governments should proactively coordinate additional transmission to deliver the needed renewables and provide a secure investment environment. This co-investment between industry, grid infrastructure owners and government are at the core of a REIP.



## Box 3: Western Australia and Northern Territory

The National Supergrid funding encompasses key WA and NT projects, including Original Power's proposed Electric Superhighway in the NT.<sup>37,38</sup> This transmission link connects Darwin-Katherine to Alice Springs and provides new renewable opportunities to First Nations communities and businesses with flow through benefits to mining, agriculture and service sectors. We recommend \$450 million to support this critical transmission infrastructure. This investment supports the NT government's Electricity System Plans and helps realise the "Sunshine for Sale" scenario to in turn support the NT's ambition for a \$40 billion economy by 2030.<sup>39,40</sup>

In WA, federal funding can be used to support transmission works identified in the Whole of System Plan to deliver an accelerated uptake of renewables required to offset the retirement of coal plants by 2030.<sup>41</sup> Importantly, there is an opportunity for federal funding to deploy transmission in the Pilbara to enable grid

optimisation and partnerships between Horizon Power, Alinta Energy, the various mining giants and local developers such as Pilbara Solar. Federal support can help accelerate work by the Independent System Operator to bring all parties to the table in a way that is independent and inclusive.<sup>42</sup> In addition, there is a need to coordinate across the renewables roll out to decarbonise mining, one of the key recommendations for the Pilbara region from the Australian Industry Energy Transitions Initiative report.<sup>43</sup> We recommend \$550 million for transmission works in the Pilbara to bring an additional capacity of 1.5 GW of renewable energy on line.



# Storage

## \$4.3 billion to deliver firmed energy, prioritising regional manufacturing growth

Energy storage is vital to supporting scaled renewable energy generation and the National Supergrid. While lithium-ion batteries are a popular form of storage, firming of the grid can come from a wide range of technologies that include pumped hydro, thermal energy storage, compressed air energy storage, redox flow cells as well as hydrogen (see [Box 4](#)). Modelling from AEMO shows that a 1.5°C aligned National Supergrid will require an additional 13 GW and 67 GWh of new storage assets (not including Snowy Hydro) in the next 5 years. This includes the urgent need for 6 GW and 50 GWh of medium storage (4-12 hr duration) by 2027/28 and is the focus of the National Supergrid report.

In the near term, this can be delivered by (8 hr) lithium-ion batteries which are rapid to deploy. However, other long duration energy storage technologies such as those from MGA Thermal and Raygen can be part of the solutions package (see [Box 4](#)). While lithium-ion batteries (8 hr) and next generation storage technologies are rapidly moving down the cost-curve, government support will be needed in the next few crucial years to fast-track delivery of grid scale projects. **By deploying medium duration energy storage technologies, we reduce our dependence on expensive gas fired firming, bringing immediate electricity cost relief.** A number of current programs support storage deployment, and these programs can provide the funding support required to deliver firmed energy to key REIP locations and secure manufacturing growth in these regions (Table 4).

Table 4: A selection of federal programs that can support National Supergrid energy storage investment and benefits

Program	Applicability
Rewiring the Nation	Intended to unlock storage capacity
Accelerating Firming and Storage Capacity	Directly supports large-scale battery projects
Powering the Regions Fund	Can support storage for REIP and industry opportunities
National Reconstruction Fund	Supports the build out of capabilities required to deliver energy storage such as lithium mining/processing and local manufacture of energy storage technologies (Priority areas: Renewables and low emission technologies, Value-add in resource)
National Battery Strategy	Supports the development of an Australian battery industry

## Medium duration storage

**We recommend \$3.6 billion in government underwriting (20%) of the capital cost** to support delivery of battery storage projects. AEMO identified the need for 6 GW/50 GWh of medium duration storage will cost approximately \$18 billion. This is based on CSIRO's Gencost report with the assumption that most of this capacity will be delivered through (8 hr) battery technologies.<sup>44</sup> Collaboration with energy storage targets and state based initiatives such as Victoria's \$157 million towards storage<sup>45</sup> will help leverage additional private investment to secure project delivery.

## New storage technologies

**We recommend that \$400 million be allocated in the form of grants to fast-track the scale up and deployment of new storage solutions**, particularly those developed from Australian research and innovation. Based on past projects, \$400 million in government grants (supporting 32% of total project cost) could support the equivalent of 360 MW/2900 MWh (8 hr) of storage (see appendix). Next generation energy storage technologies need to be supported to scale up local manufacturing capabilities and are vital to ensuring the success of our homegrown clean technologies.

### Box 4: Home-grown, long-duration energy storage

**MGA Thermal:** A recently invented type of thermal storage material with a high energy density and long lifetime that is ideal for bulk energy storage at utility scale.

**LAVO:** Hybrid lithium-ion/hydrogen technology and low pressure metal hydride hydrogen storage solution, allowing energy to be stored over time and dispatched for use when needed.

**Raygen:** Low cost, high efficiency solar-plus-storage system provides renewable electricity on demand at utility scale. Water-based storage allows energy to be stored for hours or days.

**Redflow:** Redflow's zinc bromine flow battery is a non-lithium-based energy storage alternative that offers commercial and utility scale battery solutions.

**Gelion:** Revolutionary zinc-bromide battery technology that is affordable, scalable, and safe to reliably store and dispatch renewable energy when and where it is needed.

**Graphite Energy:** commercial scale thermal energy storage that is graphite based and suitable for process heat applications.



## Planning for pumped hydro

**We propose \$300 million as government grants to pumped hydro projects** to support the feasibility and design process of these deep storage projects. AEMO's modelling shows a dramatic increase in the need for deep storage (12hr+) by 2030 and the timely delivery of these assets is critical. This \$300 million will fast-track pumped hydro projects around the country with priority to be given to brownfield sites (i.e. old mine pits), closed off-river systems to minimise environmental impacts, and

projects that support vital industrial regions (REIPs). There are significant opportunities for partnership with states such as Queensland and NSW which have announced ambitious pumped hydro plans supported by \$274 million and \$97.5 million in funding respectively.<sup>46,47</sup> This funding can also help deliver grid infrastructure and other renewable components, such as solar farms, needed to lock in private investment.<sup>48,49</sup>

# Distribution

## \$2.3 billion in distribution will support distributed energy generation, enable industry and promote energy equity

Distribution networks are vital to delivering electrification benefits to consumers, including enabling them to play a more significant role in supporting the grid through Distributed Energy Resources (DER) such as rooftop solar. Distribution also enables the decarbonisation of our transport sector with upgrades needed to support the growing home and public EV charging network. \$2.3 billion in government support is proposed across four key areas: Enabling DER,

Ensuring Equity, Supporting Communities and Enabling Industries. **Importantly, until the regulatory framework around distribution network spending is updated, the proposed \$2.3 billion of federal funding for distribution upgrades will be consumer and community driven. Distributed Network Service Providers must not be granted waivers under the ring-fencing rules to allow them to access this money directly.**

Table 5: A selection of federal programs that can support National Supergrid distribution

Program	Applicability
Rewiring the Nation	Can support broader grid infrastructure
Community Batteries for Household Solar	Unlocks community scale DER benefits
Solar Banks	Partners with distribution upgrades to deliver DER benefits to households who cannot access solar
Energy Efficiency Grants	Combines with distribution to enable energy efficient appliances/ technologies and deliver energy savings
First Nations Community Microgrids Program	Supports First Nations distribution/microgrid upgrades
Driving the Nation Fund	Partners with distribution upgrades to integrate EVs

### Enabling DER

**We propose \$335 million in co-funding to enable the coordinated use of DER** such as household solar, batteries and EVs in virtual power plants (VPP). This will help to optimise Australia's energy grid, reducing peak loads and efficiently integrating renewable generation and storage from households.<sup>50</sup> Projects such as Project EDGE in Victoria and Project Symphony in WA have made progress in this area but are network and location specific.<sup>51,52</sup> A collaborative national DER program that builds on these pilot projects can coordinate benefits and maximise investment productivity.

Importantly this investment has the potential to alleviate load pressures and can help in avoiding or deferring expensive network upgrades.

*“DER integration is complex, with many stakeholders. It cannot be the responsibility of any one organisation.”*

Engineers Australia | Integrating DER in the electricity grid<sup>53</sup>

To deliver this, our analysis reveals an approximate spending requirement of \$1.1 billion to upgrade network systems, smart metering and development for which we recommend the federal government provides \$335 million or 30% in grant funding (see appendix). This federal funding will play a critical role in ensuring a national DER management system is developed and delivered at speed in partnership with service providers, retailers, consumer groups and grid regulators/operators. An open and transparent system that is integrated across all networks enables better optimisation and, more importantly, helps provide confidence to consumers to allow participation and orchestration of their solar/battery/EV assets.

Partnering with state based programs, such as the South Australian Home Battery Scheme subsidy, Tasmania's Energy Saver Loan Scheme and ACT Sustainable Household Scheme, can increase the scale and distribution of these programs and their cost of living benefits.<sup>54, 55, 56</sup> Additionally, the engagement of public facilities such as schools, community housing and health clinics in VPP programs can deliver a reduction in ongoing operational costs and has the potential to free up public funding for service delivery.

## Ensuring Equity

**We allocate \$911 million in federal grant funding to ensure a fair allocation of distribution upgrades to low-income, disadvantaged and regional communities.** This is key to ensuring that cost of living benefits from the National Supergrid flow through to all Australians. We recommend delivery through grant funding, ideally covering 100% of the cost to maximise the cost of living benefits of these upgrades. A public grant submission process will ensure that the upgrades are delivered directly to communities.

In addition, while the distribution upgrades are critical to enabling these benefits, delivery requires coordination with programs such as Solar Victoria's Solar for Community Housing, NSW's Solar for Low Income Households, the federal Community Batteries and Solar Banks as well as innovative financing solutions like Brighte.<sup>57, 58, 59</sup> Close coordination with federal and state schemes, retailers, network providers and community groups will be required to ensure that benefits are maximised. Key opportunities to ensure equity through distribution upgrades include:

- **Fast-tracked distribution upgrades** to regions and neighbourhoods of low-income, social housing and rural communities. These should be delivered in parallel with programs for energy efficiency, electrification, PV and EV uptake. This program would provide upgrades to substations, feeders, transformers, switchboards and other augmentations to enable electrification and uptake of solar and batteries on a neighbourhood or town scale. This program can work in tandem with Community Batteries for Household Solar and Solar Banks.
- **Stand-alone power systems and microgrids** for remote communities, including those of First Nations and edge-of-grid communities. Projects like Borroloola's Ngardara solar microgrid project, Marlinja Community solar project and NT Solar Energy Transformation Program demonstrate the immense benefits that these renewable systems can bring in terms of cost, reliability and energy independence.<sup>60,61,62</sup>

*“Solar power offers the chance for our people to live and work on country, create good jobs for our young people and help our communities better prepare for climate change impacts.”*

Gadrian Hoosan | Garrwa custodian and Coordinator for Ngardara Project

Stand-alone power systems also bring significant benefits to networks with the potential to save \$700 million from reduced maintenance costs.<sup>63,64</sup> This program builds on the First Nations Community Microgrids, growing the ambition to benefit more First Nations communities while expanding it to include other remote and edge of grid communities.

- **Connecting mid-scale renewables (1-5 MW)** to enable new opportunities in renewables for landowners and First Nations peoples. Federal funding for distribution can support the ability of First Nations peoples, farmers and other land holders to connect medium scale

(1-5 MW) renewable projects to the grid for additional revenue streams, the deployment of agrivoltaics to generate electricity and increase yields, and decarbonise regional agricultural processing facilities and transport. By opening up opportunities for stakeholders to tap into and benefit from grid infrastructure in their area, we can build social licence from local communities around grid upgrades and renewable build outs.<sup>65</sup>

- **Edge-of-grid upgrades** to provide simple line and transformer upgrades to support the electrification and decarbonisation of edge-of-grid properties and communities who would benefit from remaining on the grid. These include farmers and First Nations communities who may want to export renewables back into the grid or may have requirements beyond what is available from stand-alone power systems.

Table 6 outlines the recommended distribution of investment across each of these areas, with additional information in the appendix.

**Table 6: Allocation of the distribution funding for ensuring equity**

Upgrade type	Cost per unit	Number of units	Cost (\$ million)
Fast-tracked distribution upgrades	\$5,000,000	35	\$175 million
Stand-alone Power Systems and microgrids	\$200,000	2000	\$400 million
Connecting mid-scale renewables	\$1,000,000	300	\$300 million
Edge of grid upgrades	\$60,000	600	\$36 million
<b>Total</b>			<b>\$911 million</b>

## Supporting Communities

**We propose \$500 million in grants for distribution upgrades to community hubs in regional and urban centres** to enable the electrification and/or the increase of EV charger rollout. These include places such as schools, community centres, local shopping strips, and public/community car parks and spaces. These community hubs, typically located in our suburbs, will benefit greatly from

electrification but they are also large enough energy users that they may require new distribution upgrades. This is beyond the budget constraints of many publicly funded bodies.

Federal government grants to help fund these distribution upgrades will support electrification efforts, accelerating savings that flow back to

communities and public services through reduced running costs. The placement of EV chargers in high traffic community locations and local destinations may also encourage the charging of EVs during the daytime peak of solar generation, reducing grid network pressures while encouraging EV uptake.

Our analysis estimates an average of \$500,000 per upgrade and includes works such as integrated substation and switchboard upgrades. With a \$500 million fund, this is the equivalent of upgrading 1000-2000 community hubs/schools depending on the grant model. We propose that these grants be open for public submission and assessed based on social benefit criteria.

## Enabling industry

High gas prices are creating significant stress for Australia's manufacturers and we need to fast-track industrial electrification and the transition to renewables to maintain their competitiveness. As traditional gas-fired boilers are replaced with high efficiency heat pumps and electrical heating, industries will require support to bring on the necessary grid connections, be they substation upgrades, additional line capacity or switchboard upgrades including those required to meet current compliance codes. Likewise, new industries such as battery and electrolyser manufacturing and critical minerals processing will also require significant additional distribution capacity. This funding will ensure that existing and new manufacturers will have the enabling infrastructure ready to support their decarbonisation plans beyond transmission.

### **We propose \$600 million in grants to support the necessary distribution upgrades to industries**

located within renewable energy ecosystems including Renewable Energy Zones, Clean Manufacturing Precincts and larger Renewable Energy Industrial Precincts. The geographical/energy ecosystem focus of this grant program aims to incentivise efficient upgrades by prioritising industry collaborations and encouraging clusters of manufacturers within the same distribution network/industry park to partner up and share costs as they shift towards renewables.

This helps facilitate efficient upgrade pathways for distribution networks as well as address current regulations that punish first movers (who are currently required to meet the entire cost for upgrades triggered by the electrification of their operations). It helps drive local industry collaborations to:

- coordinate on upgrades in bulk to save on costs, rather than each installing their own isolated needs
- encourage synergies around demand-side participation by offsetting peak energy use from each other to reduce the overall cost of upgrades required
- share their own DER to optimise energy use
- coordinate on energy efficiency upgrades to deliver best bang for buck, supported by programs such as Energy Efficiency Grants for Small and Medium Businesses.

Based on capital costs from similar scaled distribution upgrades, such as the installation of a new substation, we estimate an average cost of \$24 million per industrial cluster. If we assume a 50% co-contribution from the federal government and private industry this investment can facilitate the upgrade of around 50 industrial clusters around Australia, and enable both electrification and the establishment of new renewable industries. The grants should permit multiple industry collaborators to coordinate their efforts in a broader REIP location. The grant funding should give priority to upgrades that will enable the electrification of whole industry parks, clusters and ecosystems.

### **Other funding opportunities:**

National Reconstruction Fund, Community Batteries, Solar Banks, National EV Charging Network and Australian Renewable Energy Agency.

# System security

## \$1.7 billion in government co-funding over five years to ensure system security and stability as the penetration of renewable energy grows

System security must be proactively managed to ensure correct system parameters are maintained as the penetration of renewables increases. The National Supergrid is modelled to have 85% renewables generation by 2027/28. According to AEMO modelling, this is equivalent to a required system strength spending of \$3 billion in order to maintain smooth grid operations.<sup>66</sup> **We propose \$1.5 billion in government co-funding (50%) over the next five years to ensure the timely delivery of assets** such as synchronous condensers which are proven to save costs in addition to facilitating increased renewable penetration.<sup>67,68</sup>

**We propose a further \$200 million in grants to support the uptake of new system security technologies** such as grid-forming inverters. A recent AEMO whitepaper highlights the opportunity to attach these advanced inverters to battery systems, replicating many of the system security capabilities of traditional fossil fuel generators and enabling the efficient integration of renewables.<sup>69</sup> These are critical future grid technologies and investment now can demonstrate their capabilities, support their uptake and drive economies of scale. There is potential for these technologies to be funded through ARENA to demonstrate applications and return on investment to improve private sector uptake.

Table 7: A selection of federal programs that can support National Supergrid distribution investment and benefits

Program	Applicability
Rewiring the Nation	Can support broader grid infrastructure to unlock renewables
Clean Energy Finance Corporation	Direct funding to support grid balancing technologies
ARENA	Direct funding to support system security and reliability



# Supporting a prosperous, equitable Australia

## Energy security: Renewable energy delivers energy independence

The Russia/Ukraine conflict and its impacts on global energy markets highlight the risk of a fossil fuel dependent economy. Market projections for coal, gas and oil all point to a prolonged tightening global market with elevated prices and high volatility.<sup>70, 71</sup> Any energy system that relies on fossil fuels is exposed, with electricity, gas and petrol all experiencing dramatic price increases compared to the same time last year ([Figure 6](#)). Households and businesses were impacted by all three. Rising energy bills are causing many to cut back on expenses, and energy affordability is a concern for 88% of Australians.<sup>72, 73</sup> Gas-dependent industries are particularly exposed, with many experiencing gas price increases of over 400%.<sup>74, 75</sup>

Firmed renewables provide energy security and independence. Our renewable resources of sun and wind are sovereign and the technology exists to generate abundant low-cost zero-emissions energy. Supported by strategically planned transmission, distribution and storage assets Australia can transition to a fully renewable grid.

The benefits are clear from a comparison of the NEM spot price (68% fossil fuels) and the Australian Capital Territory (ACT, 100% renewable) in 2022 and 2021. [Figure 6](#) shows how Australian-generated renewable electricity can shield users from global price shocks.<sup>76, 77</sup>

*“The best way the Australian energy sector can relieve these price spikes for the longer term is to break the dependency between commodity prices and electricity prices. And that is, of course, moving to renewable generation where the fuel is our sun, wind and water.”*

Daniel Westerman | CEO of AEMO<sup>78</sup>

ACT electricity prices were largely protected against the volatile international fossil fuel energy market in 2021-2022

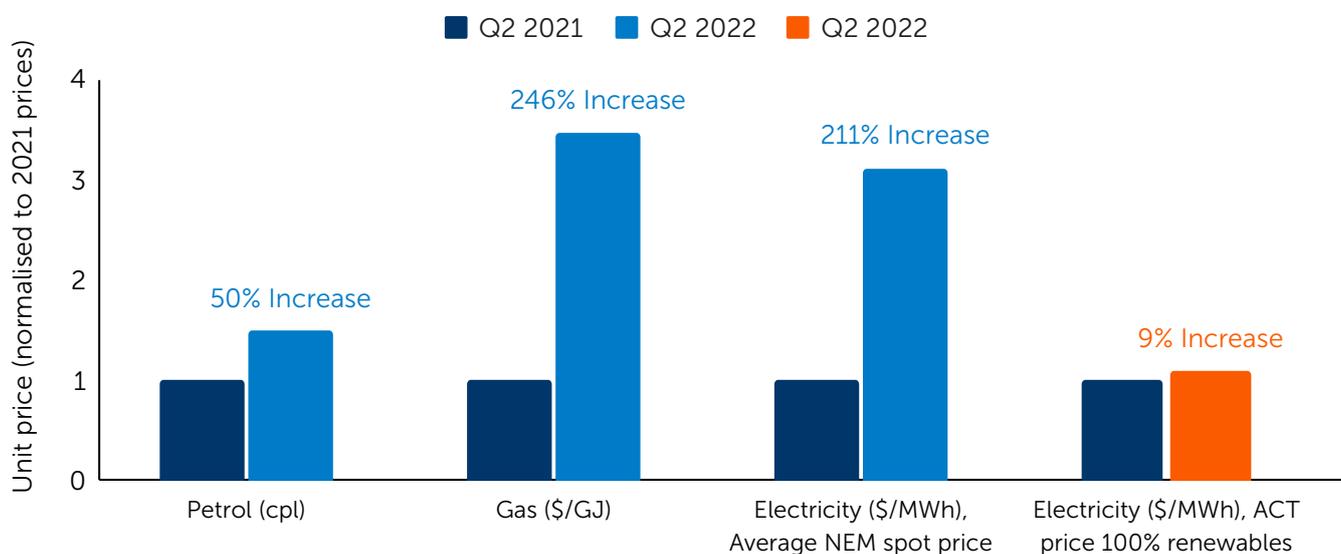


Figure 6: Impacts of a tightening and volatile international fossil fuel energy market on domestic energy prices. All fossil fuel-based systems experienced significant price increases.<sup>79, 80, 81</sup> ACT running on renewables was protected (orange). To allow for accurate price comparison, petrol prices included for Q2 2022 do not take halving of the fuel excise into account.

## Ease cost of living: Households that electrify will save money

All-electric homes are cheaper to run. The significant cost of living reductions are tangible in household budgets and this can build public support for grid investment. Including distribution upgrades in the transition plan and funding allocations is crucial to ensure that all Australians benefit from access to reliable, low-cost renewables to power their all-electric homes.

Going all-electric with efficient, modern electric technologies allows Australians to insulate against gas and petrol bill shocks.<sup>82, 83</sup> Technologies and appliances such as heat pumps and electric vehicles can be more than five times more efficient than fossil fuel equivalents, and are available on the

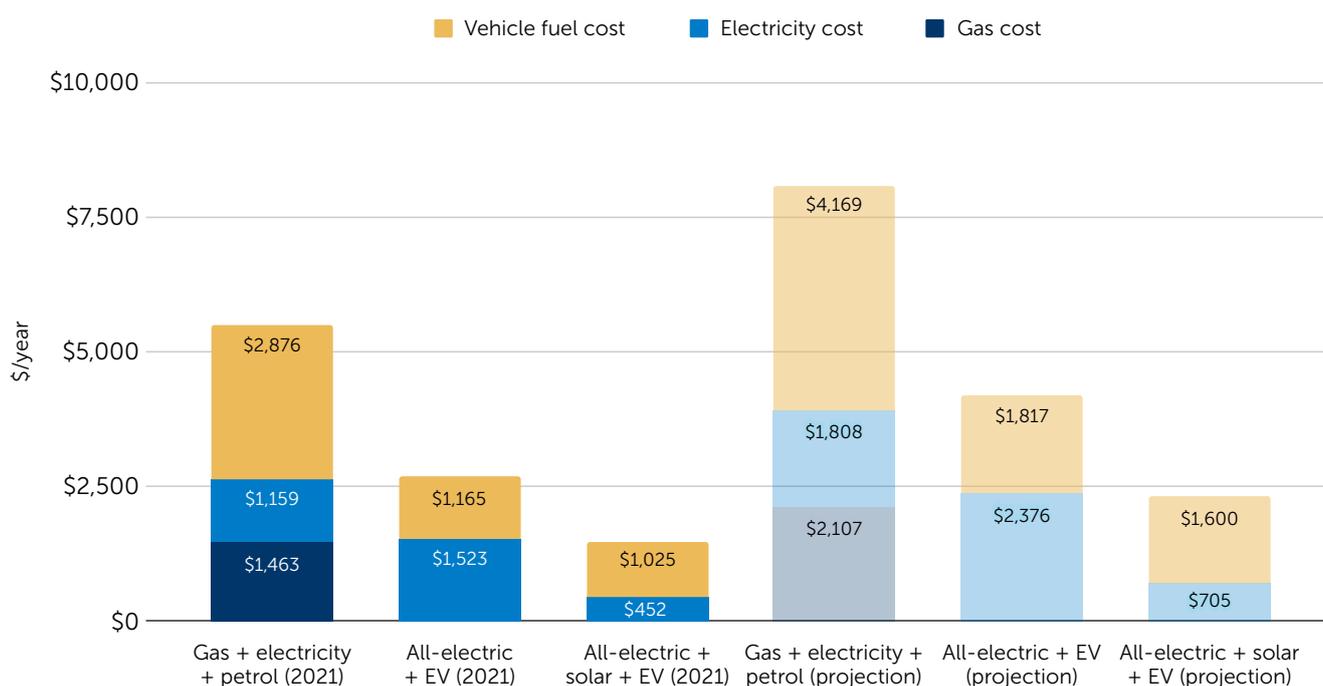
market now.<sup>84, 85, 86</sup> These technologies deliver a range of co-benefits, such as quieter, healthier and safer homes and streets.<sup>87, 88, 89</sup>

**BZE modelling shows that electrifying households reduces the cost of living for households.** Based on 2021 prices, an average household on gas with a petrol car could save on average \$4,021 by switching to an all-electric home with solar and EVs (Figure 7). Even without solar, the annual savings for an all-electric household is \$2,811 per year, and this excludes additional benefits that can be achieved through insulation and other energy efficiency upgrades.

Recent analysis supports these findings. The Victorian Gas Substitution Roadmap found all-electric homes with solar could save more than \$2,000 annually, while the Climate Council found that households could save up to \$1,900 a year

from electrification.<sup>90, 91</sup> In addition, analysis from the Queensland Government shows how switching to an EV can save \$1,200 a year in fuel costs, and is supported by data from the EV Council highlighting a \$1,000-\$1,500 savings in annual running cost.<sup>92, 93</sup>

### Modelled household energy cost savings as households electrify their energy use



**Figure 7: Modelled household energy cost savings comparing an average dwelling<sup>94</sup> and vehicle ownership<sup>95</sup> per dwelling with ducted gas heating, gas hot water and gas cooking to all-electric, EVs and rooftop solar. Prices on the left reflect historical 2021 prices while prices on the right (greyed out) reflect the impacts to the same bills using the 44% increase in gas and 56% increase in electricity projections from the recent federal Budget. For simplicity, we have averaged the savings across Australia but the benefits of moving away from gas towards efficient electrical appliances are consistent across all locations, regardless of climate. Additional details can be found in the appendix.**

*“Australian households are trapped in a vicious cycle of escalating gas bills, which are fuelling a cost-of-living crisis...It would be cheaper for households in all Australian capital cities analysed to be fully electric.”*

Climate Council of Australia | Switch and Save<sup>96</sup>

Further analysis based on energy price increases forecast in the October 2022 Budget (44% for gas and 56% for electricity)<sup>97</sup> reveals savings potential between \$3,891 and \$5,779 per year. This reflects the scale of efficiency benefits from electrification with technologies such as heat pumps and EVs paired with rooftop solar. As gas and oil markets continue to tighten, the argument to switch to all-electric households as rapidly as possible is compelling. A National Supergrid will be vital.

**Upgrading and modernising distribution networks can enable household electrification.** Electricity networks in many parts of Australia are insufficient to meet the increases in electricity demand from households' move to electric appliances and transport. Modernising distribution networks as households adopt household solar, batteries, and other distributed energy resources such as smart meters, can enable network service operators to manage energy in the grid more efficiently and maintain reliability of energy supply.<sup>98</sup> This helps minimise, offset or defer costly grid upgrades and the associated pass through costs to consumers.<sup>99</sup> For example coordination of DER through aggregated systems such as virtual power plants and vehicle-to-grid (V2G) integrations can create capacity within a distribution network by storing and dispatching energy when and where it is needed in any given day. These efficiencies can defer or eliminate the need for high-cost upgrades in some distribution networks and enable funding to be directed to areas where distribution network upgrades can not be addressed through efficiencies.

**Support for low-income, disadvantaged communities and renters to electrify is necessary to ensure an equitable transition.** It will be critical to coordinate distribution upgrades with initiatives to support low-income households to electrify so that cost of living benefits flow to those most in need. Carefully managing network cost pass throughs will also be important as grid projects are rolled out. Excellent models of this in practice are emerging in some jurisdictions. In the ACT, for example, households can access zero interest loans to enjoy the benefits of electrification without the high upfront cost.<sup>100</sup>

Coordinated planning and partnerships between state governments, distribution networks, retailers and consumer groups will be needed. The prize is a chance to revolutionise our household energy, making it smarter, cleaner, more secure and affordable.

# Industry and exports: Zero-emissions industrial ecosystems in the regions

The energy transition is a once-in-a-generation opportunity for a renewable industrial revolution, securing jobs for this generation and the next.

**Global decarbonisation is driving a rapid shift away from fossil fuel dependent industries and fossil fuel exports.**<sup>101, 102</sup> Our unique mix of abundant renewable resources and strong energy and minerals export history are a strong platform from which to drive economic growth at home and decarbonisation around the world. Beyond Zero Emissions' *Export Powerhouse (2021)* report

shows that we can generate \$333 billion in revenue by 2050, by exporting renewables-powered commodities such as green steel/aluminium, renewable hydrogen and sustainably mined and processed critical minerals. This is supported by independent findings, summarised in Table 8.

Australia has the opportunity to firmly embed itself within the supply chain of a zero-emissions economy, supplying critical materials, energy and green commodities to our trading partners.

**Table 8: Renewable exports and local manufacturing opportunities identified for Australia**

Publication, Organisation	Export Opportunity
<b>Export Powerhouse,</b> Beyond Zero Emissions	Australia has the potential to grow a new green export mix worth \$333 billion per annum by 2050, almost triple the value of fossil fuel exports in 2019.
<b>Sunshot,</b> Australian Conservation Foundation, WWF-Australia, Business Council of Australia, Australian Council of Trade Unions	Australia's clean export opportunities are enormous. By conservative estimates, they have the potential to generate an additional \$89 billion of gross value (\$148 billion in revenue) and 395,000 jobs for Australia in 2040. This is larger than our fossil fuel industry today and with many more jobs. <sup>176</sup>
<b>Australian and Global Hydrogen Demand Growth Scenario Analysis,</b> Deloitte	The hydrogen sector could produce an increase to Australian Gross Domestic Product (GDP) of up to \$26 billion on a Net Present Value (NPV) basis and 16,900 jobs by 2050. <sup>177</sup>
<b>Start with Steel,</b> Grattan Institute	Australia has a historic opportunity to create a multi-billion-dollar, export-focused manufacturing sector. This includes \$65 billion in annual export revenue and 25,000 manufacturing jobs from green steel. <sup>178</sup>
<b>Future Charge,</b> Accenture	Diversified battery industries could contribute \$7.4 billion annually to Australia's economy in 2030 and 34,700 jobs. <sup>179</sup>

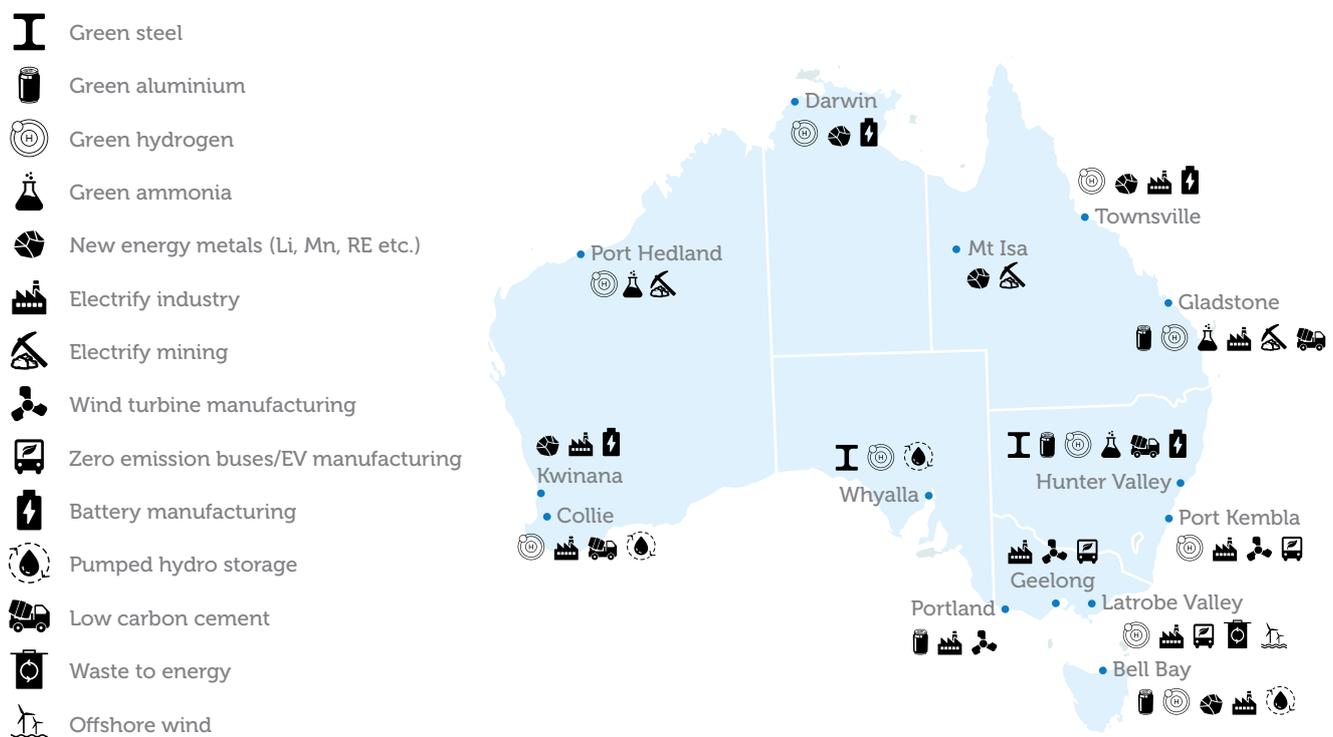
To realise these local manufacturing and export opportunities requires a model that efficiently coordinates the transition to industrial decarbonisation. Beyond Zero Emissions' work in partnership with WWF-Australia demonstrates the value of a Renewable Energy Industrial Precincts (REIPs) model, where regional industrial ecosystems are powered by 100% renewables.<sup>103, 104, 105</sup> Figure 8 highlights ideal REIP locations for a National REIP program targeting industrial decarbonisation.

**REIPs provide a unified and coordinated vision, eliminating the 'chicken and egg' problem** by coordinating infrastructure, energy and skills required to transform our existing manufacturing heartlands into thriving zero-emission industrial powerhouses.<sup>106, 107</sup> Government support for key planning and infrastructure works, such as land use mapping, infrastructure needs and grid upgrades, builds confidence for private investment.

At an investor roundtable co-hosted by Beyond Zero Emissions and Climateworks Centre to discuss the potential in REIPs, prominent business leaders representing Australia's largest fund managers, banks and institutional investors agreed that investment certainty was the key to unlocking private investment. Participants noted that common user infrastructure including transmission incentivised private investment by reducing the risk, for example mitigating the risk that large scale renewable projects would see energy production curtailed.<sup>108</sup>

**Australia's industrial communities know change is coming** and local industrial players are championing the charge towards repowering with renewable energy. Many elements are coming into place but federal support in the coordination and planning is needed.<sup>109</sup> REIPs provide the structure and support, ensuring a vision of continued leadership of these communities in Australia's energy and manufacturing future.

**Figure 8: Renewable Energy Industrial Precinct locations around Australia and their potential industry opportunities.**



Our work in the Hunter and Gladstone regions has revealed a strong industry desire for a well planned transition while maintaining economic prosperity.<sup>110</sup> Economic analysis of REIPs in these regions shows that it is possible to do both, creating over 45,000 new jobs and delivering an increase in annual revenue of \$13 billion by 2032.<sup>111, 112</sup> Recent analysis from the Australian Industry Energy Transitions Initiative (ETI) highlights similar opportunities in five key industrial locations around Australia. Applying a REIP-aligned approach, ETI's analysis demonstrates the potential to create between 212,000-461,000 jobs and secure up to \$100 billion in investment while reducing CO2 emissions by over 90 million tonnes (88%).<sup>113</sup>

Each REIP will be shaped by its existing industry and workforce as well as local resources and community desires. For example:

- **Gladstone:** Gladstone is a hub for renewable hydrogen projects, backed by high quality renewables combined with a deep water port and an experienced gas export workforce. Existing major local industries for alumina and aluminium have committed to net zero targets and are actively collaborating on how to meet their transmission, storage and renewable energy requirements.
- **The Hunter:** The mining equipment, technology and services (METS) sector is already working towards zero-emissions solutions. Aluminium and chemical manufacturing businesses are planning for decarbonisation, while legacy industries such as steelmaking and research make the Hunter ideal for green steel manufacturing. Newcastle's port facilities provides ready-made export capabilities.
- **Port Hedland:** Decarbonisation of iron ore mining and critical minerals operations, alongside large-scale renewable project proposals, presents an opportunity for a REIP or REIP-like collaboration to accelerate project development. Port Hedland is also a prime location to showcase First Nations partnerships and the value of their engagement and participation in renewable industries.

**REIPs are a compelling and logical solution for rapid industrial decarbonisation** while delivering economic opportunities that honour the industrial heritage, values and aspirations of the local community. A critical part of the REIP program will be community consultation and planning for workforce transition, to maintain social licence by giving local communities a stake in the transition and engaging them in the process. In Gladstone, ongoing work from The Next Economy provides a model for successful engagement of communities and local government in the development of an energy transition pathway.<sup>114</sup>

*"We need to get to net zero as quickly as we can for climate reasons, but we need to make sure we do it in a way that no-one gets left behind."*

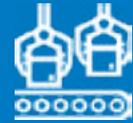
Dr Amanda Cahill | CEO The Next Economy<sup>115</sup>

**Regardless of the local specifics of a REIP, the critical role of grid infrastructure is consistent to all locations.** Beyond Zero Emissions' recent analysis of existing industries and projects announced in Gladstone reveals a need for over 34 GW of renewable generation and deployment of grid transmission and storage infrastructure at an investment calculated to be \$28 billion. At this scale, investment by the state or public/private partnerships will play a key role in delivering strategic projects that can build investor confidence and lay the foundation for large-scale private sector investment in renewables.

This approach can be replicated all around the country, from aluminium smelters in the Hunter<sup>116</sup> and Portland,<sup>117</sup> to steelworks in Whyalla<sup>118</sup> and Port Kembla<sup>119</sup> and the mining and processing industrial centres in Kwinana, Port Hedland, Mt Isa and Townsville. Businesses are announcing their intentions to decarbonise as they seek to harness Australia's natural renewable advantages.<sup>120</sup> There is an immense opportunity and need to leverage this interest to create benefits for the local communities and the broader economy.

How investment in the National Supergrid is scheduled and prioritised will play a critical role for its success. Through partnerships with industry, local communities, grid bodies and state governments, a National Supergrid that accelerates grid infrastructure to industrial regions can establish the foundation for strong regional and national economies based on zero-emissions industries.

## Box 5: The unique case for Western Australia and Northern Territory



A full incorporation of Western Australia and Northern Territory within Rewiring the Nation is critical. Reports published by Beyond Zero Emissions, including the *10 Gigawatt Vision* (NT) and *Collie at the Crossroads* (WA) showcase some of the potential opportunities.<sup>121, 122</sup> Both WA and NT play important roles in Australia's future as a renewable energy superpower, as regions of high renewable abundance and as the location of key critical minerals and ores for global supply chains.<sup>123, 124</sup>

### Opportunities in decentralisation

The decentralised grid clusters of WA and NT present unique opportunities for the Supergrid to deliver ready-made solutions such as stand-alone power systems and microgrids. These save network maintenance costs and importantly, provide vital energy sovereignty to First Nations and remote communities, freeing them from expensive diesel and providing low cost and reliable renewable energy. Learnings from these programs can be taken to deliver energy sovereignty and independence to remote communities all over the world.

### Industry coordination

Mining giants in the Pilbara as well as critical minerals processing in Kwinana and the NT have released ambitious plans to decarbonise, some by as early as 2030.<sup>125</sup> These companies are significant drivers of the Australian economy and have recognised the need to decarbonise in order to retain competitiveness in the global market.<sup>126</sup> To decarbonise, these high energy users will require substantial renewable generation supported by robust grid infrastructure.<sup>127</sup>

Government coordination and support through the National Supergrid can maximise the efficiency and access equity of these grid upgrades. This is important to minimise replicated infrastructure given the shortages in labour and materials. Similarly, government support presents the opportunity to provide up-skilling and training programs to grow a local renewables workforce. It is also an opportunity to build the foundations of a thriving First Nations renewable industry workforce. There is an immense opportunity for First Nations technicians, engineers, entrepreneurs and innovators to lead world-class renewable projects.

### Global scale renewable energy export opportunities

The importance of the role of WA and NT in our renewable exports is evidenced by large scale renewable export projects such as Sun Cable's Australia-Asia PowerLink and the Asian Renewable Energy Hub as well as the recent analysis from Net Zero Australia.<sup>128</sup> A strong government framework for these types of developments can ensure that delivery is aligned with best practices around environmental management and social licence, particularly relating to First Nations engagement and partnerships.

# The opportunity is now

National Supergrid is a nation-building project. This ambitious national grid upgrade program is Australia’s opportunity to pursue and enable the transformation of our economy towards a renewable powerhouse.

Critical components of the Supergrid are beginning to evolve. September 2022 saw a number of significant announcements: Queensland Energy and Jobs Plan, driving \$62 billion towards clean energy; AGL’s accelerated closure of Loy Yang A coal powered generator coupled with \$20 billion investment in renewable energy and storage; and, Fortescue’s \$9.7 billion commitment to zero emissions by 2030.

There is clear support from state governments (Table 9). This offers a solid base for the coordination of resources needed to fast-track private investment.

**To capture this once-in-a-generation opportunity to transform our energy grid requires a unifying vision from the federal government that is appropriately scaled to coordinate these ambitions.**

**Table 9: A selection of existing policies and works that highlight the early foundations of an Australian National Supergrid.**

State/Territory	Aligned policies, projects and works
ACT Government	Already has 100% RE.
NSW Government	Investing \$1.2 billion to fast-track the development of the state’s renewable energy zones, a Net Zero Plan is expected to attract more than \$37 billion in private sector investment.
NT Government	Invest \$30 million to fund electricity infrastructure projects and \$60 million over 6 years to underground Darwin’s power network, 50% renewable energy electricity by 2030.
QLD Government	Queensland Energy and Jobs Plan to invest \$62 billion in renewables, including \$365 million for Central Qld Grid Reinforcement.
SA Government	South Australia has a target of 100% renewable electricity by 2030. SA has several key projects including Demand Management Trials, interconnector between SA and NSW and SA VPP.
TAS Government	Tasmania has a world leading legislated target to reach 150 per cent renewable electricity generation by 2030 and 200 per cent by 2040.
VIC Government	Victoria has a target of at least 2.6 GW of energy storage capacity by 2030, \$540 million to establish six REZs, \$1.6 billion to create renewable energy hubs across the state.
WA Government	Invest \$3.8 billion in new projects before the end of the decade to help meet its 70% renewable target.



# Best Practice Principles: The heart of this proposal

## Holistic consideration of the grid

Today, transmission is one of the most significant bottlenecks to rapid renewables uptake, however it is not just transmission that needs investment.

- **Transmission is the highway on which our electricity is delivered.** We require new transmission lines to connect to areas with high quality renewable resources, and we need strong interstate connectors to efficiently distribute these renewables. The recent announcements of funding for VNI and Marinus Link projects are a strong start but there remains an urgent need for government funding to lock in additional transmission projects such as Humelink to enable low-cost renewables for consumers.<sup>129</sup>

*“The reality is that inaction in transmission is going to send overall energy prices soaring.”*

Energy Market Senior Executive | KPMG<sup>130</sup>

- **Firming and storage smooths and balances intermittent renewables.** Firming through energy storage is critical for a well-functioning renewables grid. AEMO has identified an urgent need for longer duration (4-12 hour) storage in the years to 2030. Current projects are typically in the 1-2 hour mark. Proactive government support is needed to ensure long duration storage projects are brought online in time.

*“Firmed. This is the technology that unlocks renewables. It stores the excess energy and fills in the troughs when it’s dark and still.”*

Daniel Westerman | CEO of AEMO<sup>131</sup>

- **Distribution is how we deliver renewable energy to and from homes, businesses and industry.** Distribution unlocks cost-of-living benefits, EV uptake and industry competitiveness. Distribution upgrades also unlock smart grid capabilities, delivering efficiencies that will drive down costs for consumers. In regional and rural communities, investment in distribution unlocks opportunities to increase energy independence, reducing reliance on diesel and easing cost of living pressures associated with high cost energy. There is a role for the government to support targeted distribution upgrades.

*“The scale of the transformation is illustrated by...the possibility that up to 45% of Australia’s electricity supply could be provided by millions of distributed, privately owned generators.”*

Electricity Network Transformation Roadmap | Energy Networks Australia<sup>132</sup>

- **System Security keeps our grid operating within the right parameters.** We need to make sure we have the assets to maintain the grid within safe and reliable operating parameters. As renewable penetration increases, so too does the need for system security services. Government support will ensure these systems are delivered.<sup>133</sup>

*“Identified shortfalls in system strength and inertia are set to be larger and occur sooner.”*

2021 System Security Reports | AEMO

## Collaboration

**The scale of the renewables build out and the speed at which it needs to deploy is unprecedented. Demands on the workforce, materials, budgets and grid systems mean collaboration between federal and state governments, industries, communities and investors will be critical.**

A collaborative national framework that targets long-term benefits can accelerate the grid and renewables rollout, ensuring each grid infrastructure project gets timely and equitable access to resources and avoiding an arms race for materials and skilled workers.

The AEMO 2022 ISP's Hydrogen Superpower scenario offers a starting proposed timeframe for the NEM. Note that it does not take into account the needs of WA and NT, heavy industry or exporters.

Beyond Zero Emissions' work on Renewable Energy Industrial Precincts presents a model that encourages regional collaboration, creating a sense of community and driving momentum. Developments in NSW around clean manufacturing precincts, the state's Net Zero Industry and Innovation program and the announcement of \$305 million to decarbonise heavy emitting industries reflect this.<sup>134</sup> There are similar plans in Central Queensland, driven by the Statement of Cooperation between public and private stakeholders such as Rio Tinto, Orica, Alpha HPA and the Queensland Government.<sup>135</sup> A National Supergrid sets the stage for coordination at a national level.



**Figure 9: Energy Renaissance team bringing storage innovations to the Hunter Innovation Festival, October 2022**

## Social licence and economic participation

### Local communities

A National Supergrid requires thousands of kilometres of transmission infrastructure and large scale renewables. Delivering these projects at speed and scale will require social licence from local communities. We can learn important lessons from projects such as the Western Victoria Transmission Network Project where loss of social licence has caused substantial delays.<sup>136</sup>

### Landholders as partners

Acknowledging regional communities, First Nations peoples and farmers as partners rather than barriers can remove a key risk to a successful renewables rollout and unlock opportunities for participation and empowerment of local communities. Governments can play a central role in creating guidelines and ensuring support for early and genuine community engagement backed by equitable benefit sharing schemes. This may be through remunerations and/or equity arrangements with landholders and neighbours for hosting transmission infrastructure, community ownership, and should ensure equitable access to infrastructure as well as best-practice mitigation of environmental

impacts.<sup>137,138,139</sup> The Strategic Benefit Payments Scheme in NSW, which pays landowners \$200,000 per kilometre of transmission hosted, offers an example.<sup>140</sup>

*“The roll out of renewable energy across Australia can be a massive positive for farming and regional communities...We need a plan to make sure farmers and farming communities can benefit.”*

Dr Fiona Davis | CEO, Farmers for Climate Action<sup>141</sup>

### Broadscale

All electricity customers will be affected by the National Supergrid and renewable rollout. To sustain the broad social licence and political will for these upgrades, people need to experience the benefits. This can be achieved through electrification of household energy consumption, which will realise tangible cost-of-living benefits. The federal government can deliver this by supporting targeted distribution upgrades and partnering with state and federal programs to offer all-electric upgrades to as many Australians as possible, starting with those most in need.

## First Nations free, prior and informed consent and economic opportunity

*“If done well, clean energy will provide a big boost to our communities. We have an opportunity to do development right this time, protecting country and sacred sites while delivering reliable power, jobs and economic opportunity for our communities.”*

Karrina Nolan | Executive Director of Original Power<sup>142</sup>

Some of the most resource and renewable rich areas lie in lands under Native Title. This is particularly true in, though not exclusive to, Western Australia and the Northern Territory, and is evidenced by existing mining operations as well as some of the world’s largest renewable export projects such as Sun Cable’s Australia-Asia PowerLink and Asian Renewable Energy Hub. Working in partnership with First Nations peoples includes taking into consideration environmental

and cultural heritage protections, project equity or benefit sharing, community benefit and work opportunities. Genuine partnerships can build the long-term relationships required for project success and a framework of trust for future collaborations.<sup>143</sup>

The National Supergrid is an opportunity for the government to support a new wave of First Nations led renewables projects, providing energy independence as well as economic opportunities. Government can ensure that all grid infrastructure development projects funded through the Supergrid fund engage First Nations peoples through implementation of the First Nation Clean Energy Network Best Practice Guidelines: Clean Energy Agreement Making on First Nations Land.<sup>144</sup>

This is particularly important for international developers who may not fully understand the importance of early and genuine engagement with First Nations peoples to success. The recently

announced federal government First Nations Clean Energy Strategy, combined with the Guidelines, can play a vital role in delivering benefits to First Nations peoples both now and into the future.

## Box 6: Organisations leading the way on First Nations inclusion

**First Nations Clean Energy Network:** A network of First Nations peoples working to ensure that First Nations communities share in the benefits of the clean energy boom.

**Original Power:** Original Power is a community-focused Aboriginal organisation that builds collective power to genuinely achieve self-determination in First Nations communities.

**Impact Investment Partners:** An organisation that finds opportunities to bring together investors and Aboriginal and Torres Strait Islanders, creating stronger, sustainable futures.

**Alinga Energy Consulting:** Independent consultant providing renewable energy and microgrid consulting services with a focus on remote and off-grid applications.

**Indigenous Energy Australia:** an Aboriginal organisation committed to combating climate change and improving the livelihoods of remote, regional, vulnerable and Indigenous Australians.

**Pilbara Solar:** A renewable energy development company that seeks to create opportunities for involvement and equity ownership by Aboriginal people.

**Beon Energy Solutions:** Actively engages First Nations communities in training, employment and procurement programs on the build out of large-scale solar farms.



## Workforce transition and diverse participation

Building the skills and workforce capacity to deliver the National Supergrid is a further consideration. Assessments by Infrastructure Australia and Transgrid indicate that over 130,000 jobs over the next five years are needed to deliver the grid infrastructure and renewables across the NEM.<sup>145, 146</sup>

Demand for the relevant skills will grow as Australia transitions to predominantly electric energy systems and Australia builds world-leading expertise on how to deliver renewable infrastructure at scale. Government support can fast-track skills acquisition and build collaborations with unions, industries and the education sector to train electricians, engineers, line workers etc. There are opportunities for technicians, graduates, apprentices and for fossil fuel workers looking to reskill.<sup>147</sup>

The demand for skilled workers is also an opportunity to drive workforce diversity. A national training and reskilling program, such as that from New Energy Apprenticeships that encourages

diverse participation including women, First Nations and culturally diverse communities will support the success of the National Supergrid build out and provides long term, well-paid employment.<sup>148</sup>

The Centre for Policy Development's analysis highlights how, with proactive planning and training, "decarbonisation and the energy transition presents enormous opportunities for regional Australia."<sup>149</sup>

*"The journey to net zero emissions can be one that creates good, well-paid, secure jobs, ensuring workers and communities undergoing transition are supported, and producing clean energy that is cheap and reliable, giving our economy a tremendous boost."*

ACTU | Secure Jobs for a Safer Climate<sup>150</sup>

## Industrial capability in a zero-emission economy

At the core of the National Supergrid is the consideration of how it can unlock sector coupling opportunities, leveraging partnerships between grid supply and industry demand to drive multiple economic opportunities and achieve efficiencies in infrastructure deployment.

### National Supergrid and industry synergies through Renewable Energy Industrial Precincts (REIPs)

National Supergrid infrastructure that supports a REIP program can pair renewable energy supply and demand to unlock private industry investment and drive home a first mover advantage.

Initially, grid infrastructure to industrial precincts should focus on delivering renewable energy to locations where the existing demand exceeds the available supply (for example where there are sizeable commitments to and progress towards decarbonisation) and where the primary constraint is transmission. Fast tracking transmission projects to these locations removes the key barrier to decarbonisation of resident industries and provides an attractive climate to accelerate private investment in renewable energy and energy storage technologies.

The synergies between the grid and industries within a REIP are strengthened by demand-side participation. Hydrogen projects offer a clear example: electrolyzers can ramp up in periods of excess renewable generation and ramp down during periods of low generation. Transgrid's Energy Vision report shows how this synergy enables their ambitious clean energy superpower scenario to have the lowest cost electricity at \$10/MWh cheaper than current trends.<sup>151</sup> This type of demand-side participation must be planned now before export contracts are locked in.

***"Precinct-scale responses present opportunities to leverage multi-user infrastructure and existing workforce skills, and more effective use of transmission, distribution and storage infrastructure."***

Chris Lee | CEO of Climate-KIC<sup>152</sup>

### National Supergrid driving local procurement and industrial supply chains

The National Supergrid and renewables buildout requires substantial quantities of materials. Infrastructure Australia estimates that four million m<sup>3</sup> of concrete and 1.3 million tonnes of steel are needed annually for the rollout of a renewable grid.<sup>153</sup> This represents massive market potential for locally produced green materials. Government support for the infrastructure buildout can be conditional on the use of local content with ambition for content to be low-to-zero emissions. In some cases regulatory changes will be necessary to allow uptake and scaling of local innovation, for example in the case of concrete where cement substitution is constrained under current regulation. Regulations that act as a barrier to the use of low emissions innovations that are accepted in other developed countries may need to be reviewed. Updated procurement standards will help Australian manufacturers invest with confidence and expand their Australia production capabilities.<sup>154</sup> In this way, the National Supergrid rollout can underpin the rapid growth of locally produced green steel/aluminium and low/zero-carbon concrete, establishing the capacity that can be upscaled for future export capability.

***"There is a clear role that governments at all levels can play to create critical demand for low- and zero-carbon construction materials."***

WWF-Australia | The Time Is Now: Tackling Embodied Carbon...<sup>155</sup>

With the right support, existing Australian industry and Australian innovations can deliver many of these green materials and supply chains today. For example, renewable power purchase agreements can transform many existing steel electric arc furnaces and aluminium smelters into green equivalents, while regulatory changes can support Australian suppliers such as Boral and innovators such as Wagner's who have low/zero-carbon building material products that are tested and ready for broadscale deployment.<sup>156, 157, 158, 159</sup> The offtake needed for green steel to build out transmission and wind turbine towers can also unlock new green steel plants. Companies such as Nextracker are investing in local capabilities across their global operations, bringing back steel manufacturing in

Pittsburg.<sup>160</sup> Australia can replicate this approach in areas with a strong steel industry presence, such as in the Hunter.

This is an opportunity to build world-leading green steel facilities, powered by low-cost renewables and tailored to the production of renewable assets. This critical capability is in high demand here and internationally and represents a tremendous opportunity for Australia.<sup>161, 162, 163</sup>

## National Supergrid repowers local manufacturing

In addition to materials required for construction, a National Supergrid drives industry demand in adjacent sectors including solar PV, wind turbine (onshore and offshore), battery and electrolyser manufacturing, as well as upstream mining and minerals processing. These are all energy intensive activities that can deliver low-to-zero-emission goods once they have access to low-cost renewable energy. By repowering manufacturing with renewable energy the National Supergrid can accelerate the growth and diversity of the technologies manufactured in Australia to electrify our homes, businesses and transport. Clean manufacturing capability can present Australia with opportunities to partner with national and international companies looking to expand production capabilities and secure sustainable supply chains. This will spur a growth in the manufacture of heat pumps for domestic and industrial purposes, EV chargers, zero-emission buses, trucks and EVs.

*“Policy cleverly targeting gaps in national and international supply chains could support expansion of renewable energy technology manufacturing.”*

Jesse Adams Stein | Senior Lecturer, University of Technology Sydney<sup>164</sup>

## National Supergrid underpins renewable exports

The National Supergrid is the nation-building infrastructure needed to realise Australia's renewable export potential. With 90% of the global economy committed to net zero by mid-century,<sup>165</sup> exports need to be zero-carbon to be competitive.

The National Supergrid has a dual role: enabling clean exports through efficient access to renewable energy for manufacturing, and creating capability in the delivery of clean commodities such as green aluminium and steel. This locks in local manufacturing capabilities and has the immediate effect of securing early offtake of renewable energy, thereby de-risking and potentially accelerating private investment.

*“Governments will have a significant role to play in achieving this, with supportive policy, programs and support for regional leadership efforts, especially in infrastructure.”*

Anna Skarbek | CEO of Climateworks Centre<sup>166</sup>

## Box 7: Australia as a Cleantech Hub: Investment in innovation



A lens for the future is critical. Given the speed of change, the National Supergrid needs to invest in recent innovations and emerging technologies. This includes grid management technologies such as VPP, V2G and other DER management solutions, such as those from SwitchDin, eleXsys and Powerledger, will have significant benefits for grid operations.<sup>167, 168, 169</sup> Beyond this, technologies such as advanced manufacturing, grid-forming inverters, offshore wind and new solar technologies, such as Printed Solar from Kardinia Energy, should be the focus of targeted investment support to enable grid integration.<sup>170, 171</sup>

Locally developed, long duration energy storage technologies are another critical grid and manufacturing opportunity for Australia. We are a leader in next generation energy storage technologies with many homegrown innovators such as MGA Thermal, Raygen and

Redflow making global waves (see [Box 4](#), above). Governments should support their scale-up and integration into the National Supergrid. This is particularly prescient given the tightening supply chains for lithium-ion technology. By proactively investing in homegrown technologies that are decoupled from lithium supply chains, Australia can take the lead in storage technology and unlock local clean technology manufacturing.

Beyond Zero Emissions is developing a cleantech investment hub to highlight these innovators and technologies. There is a tremendous opportunity to identify and commercialise our world-class research and to deliver global decarbonisation solutions.

## Emission reductions aligned to an IPCC 1.5°C scenario

Emissions reduction is a driver for the National Supergrid. A National Supergrid can move towards achieving 100% renewables by 2030 in line with an IPCC 1.5°C scenario. National Supergrid infrastructure also enables decarbonisation across all other sectors.

The technologies needed to decarbonise the whole economy already exist (e.g. solar, wind, batteries, EVs and heat pumps). Beyond Zero Emissions' *Deploy* (2022) report shows how Australia can cut emissions up to 81% by 2030 by rolling out readily available technologies supported by National Supergrid infrastructure.<sup>172</sup>

A National Supergrid also creates the context in which Australian manufacturers can compete in the global green supply chain where demand is growing for low and zero-carbon goods and energy. Our renewable exports can drive decarbonisation across the world, cutting global emissions by 8%, equivalent to decarbonising the whole of Europe.<sup>173</sup>

*"Australia moving from an extreme laggard to the leading group amongst the developed democracies would significantly strengthen the global effort... We can make an even larger contribution to the global effort by using our comparative advantage in zero emissions production."*

Ross Garnaut | Jobs and Skills Summit Speech<sup>174</sup>

# Conclusion

The National Supergrid is a nation-building enabler for Australia to become a renewable energy powerhouse.

Our recommendations to build the foundations of the National Supergrid ensure that the benefits and social licence of a strong renewable-based economy will be embraced by businesses and communities nationally within a five year horizon. This can only be achieved through strong government support and adherence to leading practice.

Beyond the next five years, government planning, coordination and support will still be crucial but with the right foundations, direct government intervention can reduce barriers. Markets and the private sector can play a more balanced role, particularly around infrastructure, supported by appropriate regulatory frameworks to maintain equity, social licence and environmental best practice. This will be the growth phase of the National Supergrid and will build on the foundations set in the first five years to consolidate nation-building projects such as:

- **A mass electrification program of homes, businesses, transport and industry to deliver lower bills and improved competitiveness for all.** Beyond Zero Emissions' recent *Deploy (2022)* report shows that an ambitious national rollout of these key technologies can reduce emissions by as much as 81% by 2030 compared to 2005.<sup>175</sup>
- **A national Renewable Energy Industrial Precincts program.** As renewable exports grow in demand, we can decarbonise regional industrial ecosystems across Australia while driving local manufacturing and export opportunities.
- **Clean commodity export industries backed by a clean commodity export target** that drives both national ambition and global decarbonisation.

It's time for a bold and ambitious plan to deliver this next chapter of prosperity. Just as past government investment in rail, roads and ports opened up new economic opportunities for Australia, the rapid deployment of an Australian National Supergrid is a critical nation-building project. Careful coordination and a vision toward the future will deliver sovereign energy, secure supply chains, jobs and lowest-cost competitive energy to ensure a prosperous Australia for generations to come.

# Glossary

Term	Definition
<b>AEMO</b>	Australian Energy Market Operator
<b>AGL</b>	Australian Gas Limited
<b>ARENA</b>	Australian Renewable Energy Agency
<b>AREH</b>	Asian Renewable Energy Hub
<b>CEFC</b>	Clean Energy Finance Corporation
<b>Critical minerals</b>	Critical minerals such as copper, lithium, nickel, cobalt and rare earth elements are essential components in many of today's rapidly growing clean energy technologies
<b>CSIRO</b>	Commonwealth Scientific and Industrial Research Organisation is an Australian Government agency responsible for scientific research
<b>DER</b>	Distributed energy resources. Distribution level resources which produce electricity or actively manage consumer demand (examples include solar rooftop PV systems and batteries, and demand response via hot water systems, pool pumps, smart appliances and air conditioning control <sup>180</sup> )
<b>ETI</b>	Australian Industry Energy Transitions Initiative
<b>(B)EV</b>	A battery electric vehicle (BEV), pure electric vehicle, only-electric vehicle, fully electric vehicle or all-electric vehicle is a type of electric vehicle (EV) that exclusively uses chemical energy stored in rechargeable battery packs, with no secondary source of propulsion
<b>Firmed renewables</b>	Maintained output from a variable, renewable power source, widely used to keep the grid stable in the face of potential wind, solar, and hydro intermittency
<b>First Nations</b>	"Australian First Nations" are peoples with familial heritage from, and membership in, the ethnic groups that lived in Australia before British colonisation.
<b>GDP</b>	Australian Gross Domestic Product
<b>GSP</b>	Gross State Product
<b>Heat pumps</b>	A heat pump is a device that can heat a building (or part of a building) by transferring thermal energy from the outside using the refrigeration cycle.
<b>Hydrogen Superpower - Scenario</b>	AEMO's Hydrogen Superpower scenario is highly ambitious. It is the only scenario consistent with limiting global warming to 1.5°C while also largely replacing natural gas with hydrogen for domestic use and building a hydrogen export industry
<b>IPCC</b>	The Intergovernmental Panel on Climate Change is an intergovernmental body of the United Nations responsible for advancing knowledge on human-induced climate change
<b>METS</b>	Mining equipment, technology and services
<b>NEM</b>	National Electricity Market

Term	Definition
NPV	Net Present Value
REIP	Renewable Energy Industrial Precinct
Renewable hydrogen	Renewable hydrogen is renewable energy - solar and wind, tidal and wave energy - stored safely in the form of hydrogen gas, made from water.
Social licence	The acceptance granted to a company or organisation by the community to undertake an action, task or development.
Step Change - scenario	AEMO's Step Change scenario moves much faster initially to fulfilling Australia's net zero policy commitments that would further help to limit global temperature rise to below 2°C compared to pre-industrial levels. Step Change sees a consistently fast-paced transition from fossil fuel to renewable energy in the NEM.
Strong Electrification - scenario	Representing a high emissions-reduction future, aligned with the decarbonisation objectives of AEMO's Hydrogen Superpower scenario, only in this future, hydrogen uptake is limited and energy efficiency is also more muted. This leaves the majority of the emissions reductions to be achieved through electrification, testing the outer bounds of the existing system. No export hydrogen or associated green steel manufacturing facilities are therefore included in this sensitivity.
Suncable	Australian company Sun Cable wants to develop the world's biggest green-energy export project by building a giant 20-gigawatt solar farm in the Northern Territory before sending the power to Singapore via a 4,200-kilometre-long subsea cable.
Supergrid	A super grid or Supergrid is a wide-area transmission network, generally trans-continental or multinational, that is intended to make possible the trade of high volumes of electricity across great distances.
Synchronous condensers	Its purpose is not to convert electric power to mechanical power or vice versa, but to adjust conditions on the electric power transmission grid.
V2G	<i>Vehicle-to-grid</i> . Enables bi-directional or two way charging between an electric vehicle and a home or the grid. That is, an electric vehicle can be used to power homes and the grid using the EV's battery <sup>181</sup>
VPP	<i>Virtual Power Plant</i> . An aggregation of resources, coordinated using software and communications technology to deliver services that have traditionally been performed by a conventional power plant. In Australia, grid-connected VPPs are focused on coordinating rooftop photovoltaic (PV) systems and battery storage.

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For more information about moving to a zero-emissions economy, please contact:

**Heidi Lee,**  
**Chief Executive Officer**  
**Beyond Zero Emissions**

+61 418 258 081  
heidi.lee@bze.org.au

**Sanaya Khisty,**  
**Chief Strategy Officer**  
**Beyond Zero Emissions**

+61 423 769 230  
sanaya.khistry@bze.org.au

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