THE FUTURE IS ELECTRIC
A Decarbonisation Roadmap for New Zealand’s Electricity Sector
Key findings

The electricity sector can enable rapid decarbonisation of the energy system

The 2020s will be a critical decade for the electricity sector and New Zealand’s transition to net zero carbon. With decisive early action supported by the right policy, regulatory, and market settings, the electricity system can:

- By 2030, transition to 98% renewables and kick start electrification, reducing New Zealand’s emissions by 8.7 Mt CO₂-e per year
- By 2050, enable rapid electrification of transport and heating, reducing New Zealand’s emissions by 22.2 Mt CO₂-e per year

This roadmap leads to faster and greater emissions reduction contributions from the electricity sector than previously outlined by the Climate Change Commission. If it is adopted, it would signal the sector’s dedication to the rapid and deep decarbonisation of New Zealand’s energy system.

These exciting outcomes are within reach for New Zealand – but only if action is taken at pace.

This will require unprecedented levels of investment but will lead to flat household electricity bills and declining household energy bills

The transition that enables deep, rapid decarbonisation at the lowest cost relies on a rapid build out of renewable generation and sees peaks and dry years supported by batteries, demand response, some renewable overbuild and a small amount of fossil fuelled generation (2% of total generation) in 2030. It will require an investment of $42 billion in the 2020s, including increases in spend across generation, transmission and distribution.

Modelling identifies that this investment can be supported with slight increases in electricity unit prices. However, continued energy efficiency improvements will mean that household electricity bills (excluding EVs) will remain flat. The transition will ultimately lead to lower average household energy bills of ~10% in 2030 and ~45% in 2050 as electrification of transport delivers significant fuel savings for consumers.

To deliver this future the electricity system will undergo a rapid transformation, starting in the 2020s

In the 2020s, the electricity system will transition from one that consists of primarily baseload, mid-merit, and flexible resources to one that comprises mostly intermittent and flexible resources.

As more intermittent generation enters the electricity system and 95%+ renewables is achieved this decade, the value of slow-start fossil fuel thermal power plants for meeting peak demand will decline significantly. There will be an increasing need for faster, more responsive flexible supply-side and demand-side resources. Some renewable overbuild, industrial demand response and modest levels of gas generation will also be needed to meet dry years in 2030.

Delivering this will require a much smarter, more flexible electricity system that saves $10 billion in net present value terms by 2050.

From 2030, the transition will likely become easier as the cost of technologies like lithium-ion batteries, long-duration storage, zero-emissions generation, and smart system enablers like automation decline in the 2020s. Electricity networks, particularly distribution networks, will also benefit from this increased system flexibility, allowing them to better manage complex, multi-directional power flows that will emerge on their networks.

Aotearoa New Zealand has a world leading electricity sector, but slow reform will significantly jeopardise this position. Timely, meaningful reforms could lead to a system close to 100% renewables by 2030 that delivers energy at a more affordable price than today.

This report outlines what the electricity sector needs to do to deliver this transition, and the required policy, regulatory, and market settings required to drive this change.
4 key electricity system challenges

New Zealand’s energy system is one of the best in the world. It is ranked 9th in the world and 1st in Asia for its combined equity, security, and sustainability. New Zealand’s high share of renewable electricity (82%) is a major contributor to this performance, enabling New Zealand to affordably generate a low level of emissions and be resilient to global energy shocks through increased energy independence.

However, today only 28% of New Zealand’s total energy consumption, including across transport and heat, is from renewable sources. Electrification offers the potential to decarbonise the broader energy sector, while improving equity, through lower household energy bills, and security, through increased energy independence.

But to maintain and improve energy equity, security, and sustainability, 4 key electricity system challenges need to be met:

- **Renewable generation**: Develop new renewable generation at a sufficient pace.
- **Dry years**: Ensure sufficient flexible generation and demand energy for dry years.
- **Peak demand**: Ensure sufficient flexible generation and demand capacity to meet increasing peak demand.
- **Networks**: Develop sufficient distribution and transmission infrastructure (including smart virtual infrastructure) to enable new electrification, generation, flexible capacity, and flexible energy.

A whole of system approach to addressing these challenge areas will enable the best transition for the sector as there are many solutions that can concurrently meet more than one of these system challenges. For example, demand-side flexibility like electric vehicle demand shifting can assist with meeting peak energy demand and peak demand on networks at the same time.

### Benefits of whole-of-sector approach

<table>
<thead>
<tr>
<th>Challenge Area</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Renewable Generation</td>
<td>Renewable Power Plants</td>
</tr>
<tr>
<td>2. Dry years</td>
<td>Flexible Resources (Flexible Generation and Flexible Demand)</td>
</tr>
<tr>
<td>3. Peak demand</td>
<td>Flexible Virtual Network (e.g. Smart EV Chargers, Ripple Control, Batteries)</td>
</tr>
<tr>
<td>4. Networks (Physical and virtual capacity)</td>
<td>Physical Network (Towers, Poles, Wires, Substations)</td>
</tr>
</tbody>
</table>

---

The preferred pathway to address these challenges

To identify how to best address these challenge areas, 5 possible pathways were constructed:

**Pathway 1: Business-as-usual**
Business-as-usual activity and investment achieves 98% renewables by 2030 with a high uptake of electrification, however this pathway doesn’t strongly harness smart technologies (e.g., batteries and distributed energy resources) and relies on peaking thermal and lower levels of demand response

**Pathway 2: Smart system evolution (preferred pathway)**
Broad alignment and a whole-of-system view (including consumers) encourages a smart transition, including use of batteries, distributed energy, and demand response, to deliver 98% renewables by 2030, with a high degree of electrification

**Pathway 3: Renewable energy pioneer**
A mandated target leads to 100% renewable electricity by 2030, aided by a high uptake of smart technologies (e.g., batteries and demand response), an uptick in the amount of intermittent generation capacity built, and biofuel peakers

**Pathway 4: Mega infrastructure build**
Government supports achievement of 100% renewables by 2030, with pumped hydro Lake Onslow playing an important role, particularly in dry years

**Pathway 5: Green export powerhouse**
Up to double New Zealand’s electricity needs are generated by renewables, with excess electricity used to generate hydrogen for export or green products (i.e., green aluminium). New Zealand’s renewable electricity generation serves as a source of competitive advantage and prosperity for the country

The preferred pathway, Smart System Evolution, performed the best when balancing considerations across energy equity, security and sustainability. This pathway saves $10 billion in total system costs on an NPV basis to 2050. However to achieve 98%+ renewable electricity from 2030 and to enable rapid electrification, a significant increase in generation and capacity is required.

---

**Generation and capacity need to increase significantly over next 3 decades**

![Graph showing annual generation and capacity](image-url)

1. Other includes gas co-generation, biofuel co-generation, and diesel
Source: Concept modelling, BCG analysis
Whole of sector view

To assess if activity underway from the sector is sufficient to meet the preferred pathway, stated intentions of the market was assessed.

Renewable generation: There is more than enough renewable energy generation in the project pipeline to achieve the roadmap’s aim of 98% renewable generation by 2030. $10.2 billion of investment will be required in the 2020s.

Peak demand (supply-side): More flexible, supply-side resources may need to be added to the pipeline as a lot of projects are early stage, and this is likely to occur as storage costs improve. Flexible resources will cost $1.9 billion in the 2020s.

Peak demand (demand-side): The development of flexible, demand-side resources for meetings peak energy and network needs is occurring at a sufficient pace to meet demand. However, the pace of change required to enable a smart system is likely to accelerate over the 8 years and the sector will need to increase efforts by 2030.

Dry years: There is sufficient flexible capacity and generation in the pipeline to meet dry year demand by 2030. Dry years can be met by renewable overbuild, large-scale demand response and gas (or in the future, biodiesel or biomethane). There are also investigations into several other potential projects (e.g., Lake Onslow, Southern Green Hydrogen, biomass at Huntly) which could provide dry year support. This investment is covered by the $10.2 billion in renewable generation and $1.9 billion in flexible resources.

Networks (transmission): There is sufficient transmission planned to enable increased renewable generation and electrification under Transpower’s Net Zero Grid Pathways program, however timely delivery of this will be critical to enabling the transition. $8.2 billion investment will be required in the 2020s.

Networks (distribution): There are plans to collectively invest $22.0 billion in the 2020s in distribution infrastructure to support electrification and distributed energy resources. This would represent a ~30% increase in spend in 2026-30 relative to 2021-25. This is sufficient for increased electrification provided regulatory allowances can support this.
In order to achieve net zero by 2050 we need to hit these targets:

### Summary

- Rapidly build renewable generation to reach 98% renewable electricity; phase out coal
- Ramp up electrification supported by targeted thermal gen., demand flexibility and storage

### Electrification enablers

- Rapidly electrify light vehicle fleet
- 1 million EVs by 2030
- Commence large-scale transition of low/med temp. heat to electrification and biomass

<table>
<thead>
<tr>
<th>2020s</th>
<th>2030s</th>
<th>2040s</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Rapidly electrify light vehicle fleet</td>
<td>• Phase out ICE vehicles; transition heavy vehicles to electric/hydrogen</td>
<td>• Electrify almost all land transport</td>
</tr>
<tr>
<td>• Commence large-scale transition of low/med temp. heat to electrification and biomass</td>
<td>• Transition low and medium temp. processes</td>
<td>• 4.3 million EVs by 2050</td>
</tr>
<tr>
<td>• Significantly scale up batteries and further embrace new smart demand technologies</td>
<td>• Scale up elec./hydrogen for high temp. processes; phase out fossil fuels in buildings</td>
<td></td>
</tr>
</tbody>
</table>
Recommendations

**Support accelerated renewables development**
- Ensure consenting frameworks enable rapid renewable deployment via RMA reform
- Continue to improve consenting frameworks to enable rapid renewable deployment

**Encourage the right energy and capacity mix**
- Progress work to deepen contract markets
- Progress investigations into mechanisms to extend reserves
- Implement an emergency reserve scheme
- Inflation index scarcity pricing and Customer Compensation Scheme
- Implement deepened contract markets
- Implement mechanisms to extend reserves
- Review efficacy of emergency reserve scheme
- Review price signals to assess sufficiency

**Scale up transmission and distribution network investment**
- Accelerate approvals and consenting for key enabling transmission projects
- Ensure distribution funding for 2026-30 is sufficient to enable electrification
- Deliver key enabling transmission projects
- Implement efficient distribution funding flexibility mechanisms to enable investment where unforeseen needs arise

**Enable a smart electricity system**
- Improve distribution peak pricing signals and smart managed tariffs
- Establish roadmap for formation of competitive flexibility markets
- Update regulatory frameworks to support virtual network investment
- Mandate default off peak electric vehicle charging
- Continue to improve distribution peak pricing signals and smart managed tariffs
- Implement roadmap for formation of competitive flexibility markets
- Implement TOTEX funding framework and new innovation mechanisms
- Increase network investment in orchestration, including visibility and operation

**Drive decarbonisation through electrification**
- Further strengthen ETS and policies to support transport and heat decarbonisation
- Establish ban on ICE vehicles from 2032-2035
- Extend and expand GIDI funding if required

**Enable the implementation of this roadmap**
- Develop joint industry statement of intent and action plan
- Implement roadmap and incorporate into National Energy Strategy
- Continue roadmap implementation and monitor progress
- Evolve and update roadmap as context evolves
With bold and urgent action the electricity sector can support the rapid decarbonisation of the New Zealand economy while improving the equity and security of the energy system for consumers.


Boston Consulting Group (BCG) was commissioned to write this independent report on behalf of several participants across the electricity sector, comprising generators, distributors, and retailers.1 Concept Consulting conducted the quantitative modelling of pathways used in this report. BCG has drawn on this modelling, together with other data sources, to produce the resulting insights, conclusions, and recommendations.

RSM has provided probity assistance to ensure that the report is held to the highest standard of independence and integrity. This includes attending meetings between BCG and sector participants and confirming that changes made to the draft report are based on facts and not subjective interpretation. Russell McVeagh has provided compliance assistance to ensure appropriate information barriers and confidentiality requirements have been observed between sector participants in the provision of information to BCG.

1. Sector participants that commissioned this independent report include Contact Energy, Genesis Energy, Mercury, Meridian Energy, Vector, Unison Networks, Powerco, Wellington Electricity, and Orion. Manawa Energy, Lodestone Energy, Eastland, Nova Energy, Transpower, and Copenhagen Infrastructure Partners provided data but otherwise were not involved in the commissioning of this report.