Low Carbon Aotearoa

Energy Roadmap to 2030

The Aotearoa Circle

Mā te Kaitiakitanga ko te Tōnuitanga

Prosperity Through Guardianship

Letter from the co-chairs

When we started this journey ten months ago, our primary objective was to inform Government thinking on the upcoming national energy strategy. We quickly realised our 'why' was much bigger than this, and much closer to home. We were here for our future generations, to ensure a legacy that sees our whānau and mokopuna healthy, prosperous, and thriving.

Energy touches everything – done well, it supports our industries, allows us to travel freely, keeps us warm, and ensures we have food on the table. But done poorly, it can lead to inequitable outcomes, stifled economic growth, and environmental degradation – so it is critical we get it right as we transition our energy system to one that is fit for our low carbon future.

Climate change and achieving our emission reduction targets inevitably present challenges for an energy system currently supplied by 60% non-renewable sources, but they also present significant opportunities. Our goals for cleaner, more affordable, and secure energy are clear, but there are a variety of solutions, some existing and some not yet available, that will get us there. Aotearoa is already the envy of many with our highly renewable electricity system. This means our challenges are different from those elsewhere in the world, as we need to tackle emissions reductions in more challenging components of the energy system, while others are still wrestling with taking carbon out of electricity. We should seize this opportunity to be innovative and show leadership in the new technologies, systems, jobs, and industries that can and will emerge as we tackle these hard-to-abate sectors.

The question we asked our Leadership Group, and that we want Government, industry, and New Zealanders to consider is – when you step forward 10 years, what will have been the legacy of the energy transition, and what will Aotearoa be famous for as a result?

As an example, we can look to the Danish wind industry. In the 1970s, when around 90% of the country's energy needs were met by imported fuels, the Government identified the need to transition away from fossil fuels to become more energy independent. A combination of policies to support renewable energy innovation, research, development, and commercialisation saw Denmark emerge as the world's pioneer for wind energy. It remains a global centre for wind turbine manufacturing, with Danish company Vestas remaining the leading manufacturer worldwide.

We identified many such opportunities for Aotearoa. We are uniquely primed to stand up new bioenergy sectors, to green our gas system, and to demonstrate use cases for green hydrogen. As we tackle emission reduction in industrial and stationary heating, we can develop and export new expertise. We are uniquely positioned to lead the world in zero-emissions domestic aviation and ferries, and if successful, we can teach others how to do this. As we shift to using more electricity, and more variable renewable generation, demand-side management will play an increasingly key role. We need to ask whether the technologies, systems, and sharing economy involved with this shift are Aotearoa's chance to be trailblazers. A new national energy strategy can help unlock these and other opportunities from the transition.

Adopting He Ara Waiora as the Te Ao Māori framework in our roadmap development provided an important perspective from which to consider the transition and our future energy system. It has elevated our consciousness to acknowledge the environment as central to our existence – ko au te taiao, ko te taiao ko au – we are the environment and the environment is us. He Ara Waiora reminded us of what is important as we have prioritised our actions. This wellbeing framework, along with the wider body of mātauranga Māori held by our iwi and hapū provide Aotearoa with unique solutions and opportunities for innovation in our future energy system.

Finally, we acknowledge the inequity that Māori continue to endure after generations of disconnection from their land and natural resources, and the role energy developments have played in this. Partnership between Crown and Māori will be key to finding solutions that address energy poverty, enable innovation, and empower iwi investment in our future energy system.

This report is the outcome of ten months' worth of voluntary commitment and contribution from many individuals across Aotearoa. As a Leadership Group, we had many learnings to guide us, but we had even more through the support of our Technical Advisory Group and the many expert reviewers and specialists we engaged with. We sincerely thank all of you. The discussions we have had have been robust, challenging, and energising, and we look forward to continuing the journey to a low carbon energy system that enables us all to thrive.

BELLA TAKIARI-BRAME
Co-Chair

CHRIS JEWELL
Co-Chair

"Mahue iho he tapuwae, he ara hīkoinga haere ake"

"Leave behind only your footprints for others to follow (What we do today will influence tomorrow and beyond)"

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"On behalf of this and future generations, I urge you: Choose ambition. Choose solidarity. Choose to safeguard our future and save humanity"

Antonio Guterres, COP26

Our why: unlocking opportunities for Aotearoa as we tackle the climate crisis

The changes Aotearoa needs are not incremental. The ways of the past will not meet the needs of the future. Tackling the climate crisis is the defining challenge of our generation and is critical to save future generations. Urgent, coordinated action by Government, private sector, and citizens is needed at scale by 2030 to limit climate change to 1.5°C and deliver on our committed emission reduction targets. Our energy system contributes 44% of Aotearoa's total emissions, and nearly 90% of our carbon dioxide emissions.[1] We have the solutions to decarbonise our energy system, but it won't happen by accident – it will require national commitment and action that accounts for Aotearoa's unique energy system and challenges.

The transition to a low carbon energy system also presents a significant opportunity to create further wealth and wellbeing across Aotearoa's communities. This opportunity is threefold. Firstly, to use our highly renewable electricity system and significant renewable energy potential to decarbonise high energy consumption sectors. Secondly, to take the knowledge and skills we develop on our decarbonisation journey to the world. And finally, to attract industries to Aotearoa to take advantage of our low carbon energy system. This is a chance for Aotearoa to showcase its talent, ethos, and values to the world and create a way of living we can all be proud of.

The Aotearoa Circle has brought together many of the country's energy experts to create this roadmap. We have set a vision for our future energy system, assessed how the system is currently performing against our future state objectives, and adopted a framework to incorporate Māori principles and values into our decision making. This process has led to our recommendations. Some of our ideas are already underway, and we are simply lending support for their continuation. Others offer a logical next step, and others would require a deeper analytical assessment to identify those with the greatest impact. We hope that our collective experience can provide a useful input to the Government's thinking on emissions reduction and energy decarbonisation.

Achieving a low carbon, equitable, secure, and regenerative energy system will be a major challenge

Our target future state focuses on ensuring four objectives for our energy system are met: (1) to provide affordable energy for all whānau and businesses, (2) to be very low carbon in line with Aotearoa's emissions reductions targets, (3) to minimise impacts on and begin to regenerate local natural environments, and (4) to be reliable and secure. We know there are trade-offs between these objectives – for example, building new renewable energy infrastructure may impact local land and water resources, and relying more on intermittent renewable energy sources presents reliability challenges. These are important discussions we need to have.

We assessed our current energy system and we are not on track to achieve our emissions reduction targets across transport, industry and building sectors. Much more action is needed to achieve vast reductions in our energy emissions within this decade. We know that energy affordability is a problem for some. Too many whānau cannot afford to heat their homes. While our energy system has a track record of performing well, we know achieving reliability and security will become more challenging as we reduce our reliance on fossil fuels. We don't know enough to understand our energy system's overall impact on local natural environments. However, we do know that some energy schemes have caused long-term cultural and environmental harm. **Improving our knowledge about the overall impacts of our energy system on the natural environment and understanding what a regenerative energy system looks like** are key recommendations to ensure habitats and biodiversity are protected during the transition.

We also know that the establishment of many of the energy assets we rely on today have created long-term unresolved grievances for Māori, and we must not make this same mistake in the future. **We recommend the He Ara Waiora framework** is adopted to inform the Government's energy work going forward to ensure a te ao Māori point of view is incorporated.

Big shifts are needed in all our energy-using sectors

Transport accounts for nearly half of our energy emissions[2] but technology exists today to decarbonise much of our fleet. This means that transport needs to do the heavy lifting this decade, through a combination of adopting low-emissions technologies and a redesign of how people and freight move around. There are great examples of industry leadership on both fronts with electric ferries, hydrogen trucks, fleet electric vehicle uptake, and zero car parking policies. **We agree with the CCC that it is time to set a target date to end light vehicle ICE imports**. Encouraging behaviour change in transport requires bold decisions and leadership. **We recommend a significant increase in public transport funding** – and a brave idea is to make public transport free to support both transport decarbonisation and equity outcomes. In terms of freight, our heavy truck fleet contributes 27% of transport emissions, despite accounting for only 7% of travel.[3] Low-emissions heavy vehicle technologies are also available today and are becoming more viable in Aotearoa.[4] **We recommend targeted financial incentives for low-emissions heavy vehicle technologies, including a purchase discount scheme and road user charge exemptions.**

Industrial manufacturing and processing represent 20% of Aotearoa's energy emissions. Simply exporting the carbon problem offshore is not the answer and could raise global emissions. Decarbonising industrial process heating is an opportunity where Aotearoa can learn first and be a test bed for emerging decarbonisation solutions. Electrification, conversion to biofuels or green hydrogen are all options. **We recommend substantially increasing the Government Investment in Decarbonising Industry (GIDI) fund**, as well as simplifying the fund's terms to focus on cost-effective abatement potential. Moreover, our industries are laggards in investing in efficiency and our energy intensity per unit of GDP is 18% higher than the OECD average.[5] **We recommend increasing funding provided via EECA's Energy Transition Accelerator with a shift towards implementing practical initiatives to reduce business energy use.**

Aotearoa also has a poor record regarding the energy efficiency of our homes, which currently tend to be poor quality and hard to heat. Retrofitting existing homes and ensuring new builds are high quality can be one of the lowest cost, fastest, and most equitable way to reduce emissions. **We recommend increasing Warmer Kiwi Homes programme funding to $100m per year, targeting upgrading of 20,000 low-income homes per year to Healthy Homes Standards.**

Renewable energy supplies will underpin the transition to low carbon

New renewable electricity will play the most important role in decarbonising our energy system. Widescale electrification will require a significant increase in new renewable generation. All roadblocks to rapid roll out need to be addressed. **We think it will be essential to make enabling fast-paced and sustained build of new low carbon energy infrastructure a key success criterion for the new Resource Management system.** Incentivising co-location of activities within low emissions energy hubs may emerge as a useful tool and should be further considered. The first mover disadvantage, where the electricity grid requires investment for new renewable connection but no one party can fund it alone, represents an ongoing barrier to new renewable generation investment. **We recommend a full analysis of the regulatory, investment and other barriers that contribute to the current first mover disadvantage challenge so that the preferred solution can be identified and implemented.**

As we increase the renewable proportion of our energy system, we know reliability and security will become increasing issues. Solving the flexibility challenge and addressing dry year risk will be important and may require new technologies. It is becoming evident that conventional market approaches struggle to provide the necessary incentives for fast start and intermittency support capacity. **We have provided some options to fine tune electricity market settings to support flexibility and better manage intermittency.**

A visionary approach to other low carbon energy technologies could place Aotearoa as a global leader and attract international industries to take advantage of these technologies to produce low emissions products. Bioenergy remains a nascent industry in Aotearoa but provides a significant opportunity to green the existing natural gas stream and decarbonise hard to abate industries, as well as providing a secure domestic energy source. **We recommend developing a Bioenergy Action Plan**, developed with the bioenergy sector and users as part of the Government's Energy Strategy work, that sets out priorities for the bioeconomy and the regulatory settings that will enable supply to scale up in a regenerative way.

To achieve the energy supply system we are aiming for, our regulatory system needs to reward reductions in emissions, empower consumers, and put digitalised energy systems first. **We recommend amending energy sector regulations to clearly recognise and prioritise emissions and resilience benefits** to ensure regulation does not present a barrier to investments that contribute to our objectives. **We also recommend reinforcing the role of the Council of Energy Regulators** to ensure regulatory bodies are working together, and with the regulated industries, towards aligned goals.

The right settings need to be in place to enable an urgent and just transition

To transition at the scale and pace required, we need the right mix of market and non-market levers. The ETS is central to creating incentives to decarbonise. At the current price of over $70/t, many additional abatement opportunities are coming into play that were not viable a year ago. It remains important to create a stable carbon pricing regime providing long term investment certainty so businesses can confidently invest in decarbonisation. **We recommend ringfencing ETS revenues to fund the most critical elements of our energy system decarbonisation**, such as stationary heat and transport emissions. Market-led approaches like the ETS are good for scaling up technologies that are already commercially feasible but are unlikely to succeed at the scale and pace we need to support critical emerging technologies. This is why we have presented a suite of non-market measures throughout the roadmap to complement the market. Emerging energy technologies also require **significantly scaled up targeted investment in research, development, and diffusion.**

Our future energy system will require a whole new range of skillsets to be developed and fostered. A lack of skilled workers risks creating bottlenecks in the roll-out of new technologies. Global employment in the energy sector is predicted to nearly double by 2050.[6] Given the energy sector in Aotearoa is already facing skills shortages, the transition will come with an increasingly wide skills gap unless this is tackled head-on. **We recommend a deep assessment of the current energy sector talent base, the skills and workforce required for the future**, and **development of an energy system skills accord**, in partnership with the energy sector, the education sector, and iwi/Māori. People and communities that currently rely on emissions-intensive industries risk being left behind in the transition, so **planning and support for redeployment, upskilling, and career change will be critical for a just transition**.

We need a coordinated approach going forward

To achieve the vision we have set out, we need a plan. We recommend the Government commits to **preparation of a 30-year integrated energy strategy that includes a 10-year action plan**. This strategy should recognise the interconnected nature of the system and lay out a target sequence of where to apply our efforts first across transport, industry and electricity. The strategy should consider the opportunities for Aotearoa to be a world leader and include a deep assessment of how best to unlock these. We agree with the CCC that the focus should be less on 100% renewable electricity and instead on a **renewable energy target – of at least 50% by 2035**, if not more and sooner. The strategy needs to be **co-designed with iwi/Māori**, and we also recommend it is **developed in partnership with the energy sector**. Our roadmap is a good example of a coordinated cross-sector approach to strategic planning, and we don't want to lose this momentum.

The work on the energy strategy needs to be complemented and swiftly followed by action – and **everyone has a role to play**. There are simple changes individuals can make today to reduce their energy consumption, such as changing transport modes. Covid-19 has demonstrated that rapid societal behaviour change is possible with strong leadership and an agreed goal. Organisations need to help their customers change, business and community leaders need to influence change, and Government needs to bridge the gaps where the necessary changes are not happening.

Government also has a critical leadership role to play in the actions they take. The Carbon Neutral Government Programme sets good intentions but should be stronger, incorporate local government, and leverage Government buying power to drive adoption of cleaner technology. We recommend **acceleration of the decarbonisation of Government fleets, potentially through a cross-agency procurement system** – if Government can show leadership in overcoming the barriers to fleet decarbonisation, this will make it easier for individuals and businesses to follow suit. A similar approach could be taken with a **Government PPA for 100% renewable electricity** – procurement is a key lever Government can pull to generate a shift in the market. Additionally, **committing to carbon neutral education facilities** presents an important way to show leadership to the next generation.

And finally, the private sector has a critical role to play. Businesses are already doing great things in terms of understanding their emissions, reducing energy use, implementing decarbonisation initiatives, and investing in renewable energy. This all needs to continue, at an increased scale and pace. We think there is an active role for the group of energy sector representatives that have contributed to this roadmap to play going forward. Our Leadership Group has committed to:

- Develop a compilation of energy industry practices, to be led by Ara Ake, including case studies of innovative and commercially viable solutions in Aotearoa to assist with decarbonisation of different parts of the energy sector
- Develop and collate TCFD scenarios for energy decarbonisation, to be led by The Aotearoa Circle, that can be shared and used as a resource for businesses in Aotearoa
- Make an active and sustained contribution to any Government-led initiative, alongside the education sector, to develop an energy system skills accord and training programme
- Support development of the Government's energy strategy through providing a forum for discussion, engagement, and testing of ideas to expedite this urgent work

The Leadership Group would like to thank all those who have contributed to this significant body of work. Your time commitment, attention to detail and passion for the opportunity that affords Aotearoa has been infectious.

"Ki te ora te taiao, e ora taku mokopuna"

"If the environment is well, so too will be my grandchild."

Our roadmap on a page

Vision

Our energy system accelerates the transition to a net-zero future that supports the wellbeing of current and future generations and enables Aotearoa to thrive.

Objectives

Objective 1

Our Whānau, businesses and communities have equitable access to affordable, low-emissions energy that enables them to thrive.

Objective 2

Our energy system transitions at the scale and pace required to help Aotearoa meet its 2050 net-zero emissions target and contribute to global efforts to limit warming to 1.5°C.

Objective 4

Our energy system is resilient, reliable, and secure.

Objective 3

Our energy sector takes responsibility for its environmental impact and supports a regenerative Aotearoa.

Themes

4 sector themes

1. Keeping whānau warm, dry, and healthy

2. Redesigning how people move around

3. Rethinking freight and aviation

4. Setting the low carbon trajectory for business and industry

4 system themes

5. Ensuring a coordinated transition

6. Enabling the new energy infrastructure we need

7. Achieving a diversified and reliable electricity system

8. Moving towards a regenerative energy system

Te Tiriti o Waitangi and He Ara Waiora underpins the transition and our future energy system

Our recommendations

		THEME	RECOMMENDATIONS	OBJECTIVES
Four sector themes	1	Keeping whānau warm, dry, and healthy	1.1 Reduce household energy costs by improving the energy efficiency and performance of homes 1.2 Implement targeted actions to address energy hardship	
	2	Redesigning how people move around	2.1 Reduce the need for private vehicle travel and incentivise shift to low-emissions public and active transport 2.2 Accelerate uptake of low-emissions alternatives for light vehicles	
	3	Rethinking freight and aviation	3.1 Accelerate uptake of clean, low-emissions transport fuels 3.2 Accelerate uptake of low-emissions alternatives for freight transport, including low-emissions fuels and mode shift 3.3 Take a proactive role in global initiatives to decarbonise the aviation and marine transport sectors	
	4	Setting the low carbon trajectory for business and industry	4.1 Transition industrial processes, heating, and cooling to low-emissions technologies 4.2 Improve the energy efficiency and performance of commercial and industrial buildings 4.3 Make our businesses more energy efficient	
Four system themes	5	Ensuring a coordinated transition	5.1 Clarify goals for the transition and Aotearoa's future energy system, along with the role of key technologies, through the Government's energy strategy 5.2 Put in place the right settings to move together towards the goals for Aotearoa's future energy system	
	6	Enabling the new energy infrastructure we need	6.1 Create an enabling regulatory environment that supports a rapid transition 6.2 Create a favourable environment for investment in renewable energy and energy efficiency projects	
	7	Achieving a diversified and reliable electricity system	7.1 Prioritise low carbon investments that improve system reliability and security 7.2 Scale up use of distributed energy resources (DER), community energy networks, and microgrids, while ensuring these support a more reliable system	
	8	Moving towards a regenerative energy system	8.1 Incorporate regenerative thinking into the energy system 8.2 Better understand and manage the impacts of our energy activities on air, land, water, and biodiversity	

Opportunities for partnering with Māori:

We have developed some early proposals to incorporate Māori knowledge and worldviews into the energy transition, that will need to be further developed with Māori as this conversation progresses.

1. Te Tiriti o Waitangi as the foundation

Reflecting the spirit and intent of Te Tiriti to enable genuine partnership between the Crown and Māori.

2. Mātauranga as the innovator

Enabling Māori knowledge to inform decision-making, to monitor progress, and to guide innovation.

3. Whānau and hapori (communities) as the drivers

Ensuring better outcomes for communities through prioritising local partnerships and iwi investment.

Low Carbon Aotearoa - An Energy roadmap to 2030

Our journey

This roadmap represents the outcome of almost a year's worth of voluntary commitment and contribution from many individuals across Aotearoa.

About The Aotearoa Circle

The Aotearoa Circle is a unique partnership of public and private sector leaders, unified and committed to the pursuit of sustainable prosperity in Aotearoa New Zealand and to reversing the decline of our natural resources. Collectively, this partnership has been formed to promote transformational change.

Leadership and contributors

The Aotearoa Circle has brought together a diverse Leadership Group (LG) representing the key areas of the energy trilemma (affordability and access, security of supply, and sustainability), and a Technical Advisory Group (TAG) who are providing key skills and expertise to deep dive into energy system issues, barriers, and opportunities. Both the LG and TAG include representatives from energy suppliers and distributors, consumers, Māori stakeholders, regulators, interest groups, and public sector agencies. The project has also benefitted from the work and contribution of the Secretariat and other contributors who provided specialist input and external review.

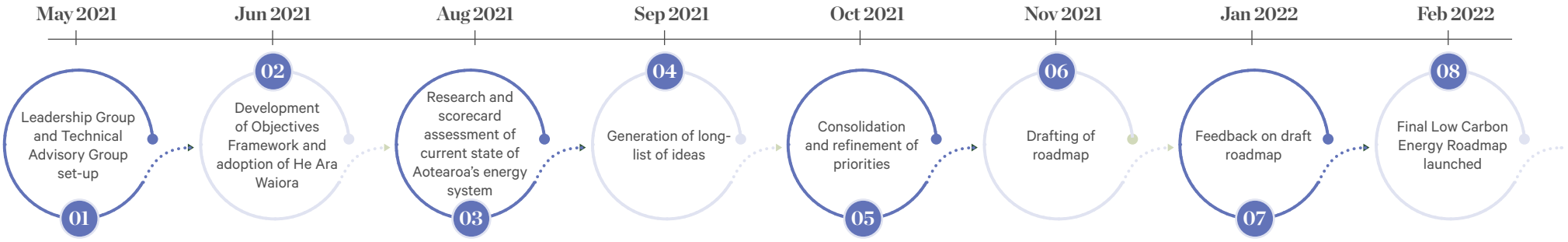
About the roadmap

The recommendations within this roadmap have been developed jointly by the members of the Leadership Group and Technical Advisory Group, together with the EY Secretariat, and are supported by international and domestic research.

The roadmap was developed in 10 months, relying on participants' volunteered time and expertise. Within these time constraints, the roadmap recommendations have not each been analysed in detail to determine, for example, cost-benefit ratios or abatement costs. We see this as being part of the Government's work in developing the new energy strategy. The roadmap does, however, represent a consensus view of the types of things a large group of stakeholders involved with the energy system see as important. We therefore believe this roadmap makes a significant contribution to surfacing the issues facing our energy system transformation and starting the cross-sector dialogue on how to move forward.

Aotearoa's energy system defined

Energy is essential to our society and supports all facets of our daily lives. Our report considers the entire energy system - that is, everything related to the production, conversion, delivery and use of energy in the forms of heat, fuels and electricity. This could be the power lines that deliver your electricity, the petrol that powers your car, or the coal used to heat an industrial plant. In understanding our energy system we also need to consider how other aspects of our society/infrastructure impact our energy use. This could include the way that we insulate our house, our access to public transport or expectations about how often we work from home.



An overview of our Low Carbon Energy Roadmap

The roadmap outlines a target future state for our energy system through the overarching vision, four objectives, and the 'ends' set out in He Ara Waiora.

A scorecard assessment against our objectives, a set of decision-making principles, and focus questions derived from He Ara Waiora helped us to prioritise the most important actions needed to reach our future state.

The roadmap presents our recommendations to shift to a low carbon energy system and enable Aotearoa to thrive, categorised within eight themes. This is complemented by three foundational opportunities to ensure a true partnership approach is used through the transition and that te ao Māori is embedded in the energy system.

Vision: Our energy system accelerates the transition to a net-zero future that supports the wellbeing of current and future generations and enables Aotearoa to thrive

Objective 1: Our Whānau, businesses and communities have equitable access to affordable, low-emissions energy that enables them to thrive

Objective 2: Our energy system transitions at the scale and pace required to help Aotearoa meet its 2050 net-zero emissions target and contribute to global efforts to limit warming to 1.5°C

Objective 4: Our energy system is resilient, reliable, and secure

Objective 3: Our energy sector takes responsibility for its environmental impacts and supports a regenerative Aotearoa

Scorecards: How are we currently performing against our objectives?

Principles

1	2	3	4	5
Systems thinking	A just transition	Informed and empowered consumers	Well-signalled change	Future-oriented and innovative

He Ara Waiora Focus Questions

1	2	3	4	5
Reflecting a holistic, intergenerational approach to wellbeing	Prioritising the health of our natural environment, recognising the interconnectedness with human wellbeing	Supporting individual and community wellbeing and aspirations	Supporting Māori roles and responsibilities as kaitiaki of the natural environment for future generations	Providing opportunities for iwi/Māori to partner realising the shared vision

Recommendation Themes

1	2	3	4	5	6	7	8
Keeping whānau warm, dry, and healthy	Redesigning how people move around	Rethinking freight and aviation	Setting the low carbon trajectory for business and industry	Ensuring a coordinated transition	Enabling the new energy infrastructure we need	Achieving a diversified and reliable electricity system	Moving towards a regenerative energy system

Opportunities for a Te ao Māori and Partnership Approach to the transition

1	2	3
Te Tiriti o Waitangi as the Foundation	Mātauranga as the Innovator	Whānau and Hapori as the Drivers

Scorecard - summary

Our scorecard process provided an indication of the areas that are performing poorly in relation to our desired future state. This enabled us to target our priority actions towards those areas needing more work. We used a 1-5 scale for the scorecards, with 1 meaning we are very far off track based on the difference between current and target future state and our current trajectory, and 5 meaning we are very well on track to meet or exceed our target future state. Where there is insufficient information available about the indicator, this was rated as 'Not available'.

More detailed scorecard results can be found in Appendix 1.

Objective 1:

Our Whānau, businesses and communities have equitable access to affordable, low-emissions energy that enables them to thrive.

How we are tracking: Energy costs currently comprise a significant portion of New Zealanders' household spending, and this is higher for Māori whānau and those in the lowest income quartile.[7] While the composition of our energy bills is expected to change, it is likely that without additional interventions that any energy cost rises will continue to be felt most strongly by those that can least easily afford to meet them. Energy hardship does not have an agreed definition in Aotearoa, but we know the percentage that cannot afford to heat their homes is too high. Moreover, energy affordability for businesses is not well reported on, beyond direct prices.

Energy Affordability for Households & Communities	2
Energy Affordability for Businesses	3
Energy Access	5

Objective 2:

Our energy system transitions at the scale and pace required to help Aotearoa meet its 2050 net-zero emissions target and contribute to global efforts to limit warming to 1.5°C

How we are tracking: Aotearoa's current trajectory is not on track to achieve this objective, as represented by He Pou a Rangi - the Climate Change Commission's (CCC's) Policy Reference Case Scenario.[8] We have chosen to benchmark our requirements for the future energy system against the CCC's ambitious Tailwinds Scenario where this is available, to indicate the significant scale of the change required. We are performing particularly poorly in our R&D spend[9] and we have a long way to go across the board to achieve our transport, industry and building emissions targets.

Transition to Renewables	2
Building Emissions	1
Transport Emissions	1
Industry Emissions	2

Objective 3:

Our energy sector takes responsibility for its environmental impacts and supports a regenerative Aotearoa

How we are tracking: The key finding of the scorecard for Objective 3 is the lack of tracking and reporting, at a national level, of the impacts of energy activities on the natural environment. Any data that does exist is typically held by industry and councils and not aggregated. Impacts are controlled by consents under the RMA, but they can still be locally significant. Better reporting is important to understand how we are performing. Air quality impacts of energy activities are well known and are a moderate problem for some regions.

Whenua (Land and Soil)	not available
Koiora (Biodiversity)	not available
Wai (Water)	not available
Air Quality	3

Objective 4:

Our energy system is resilient, reliable and secure

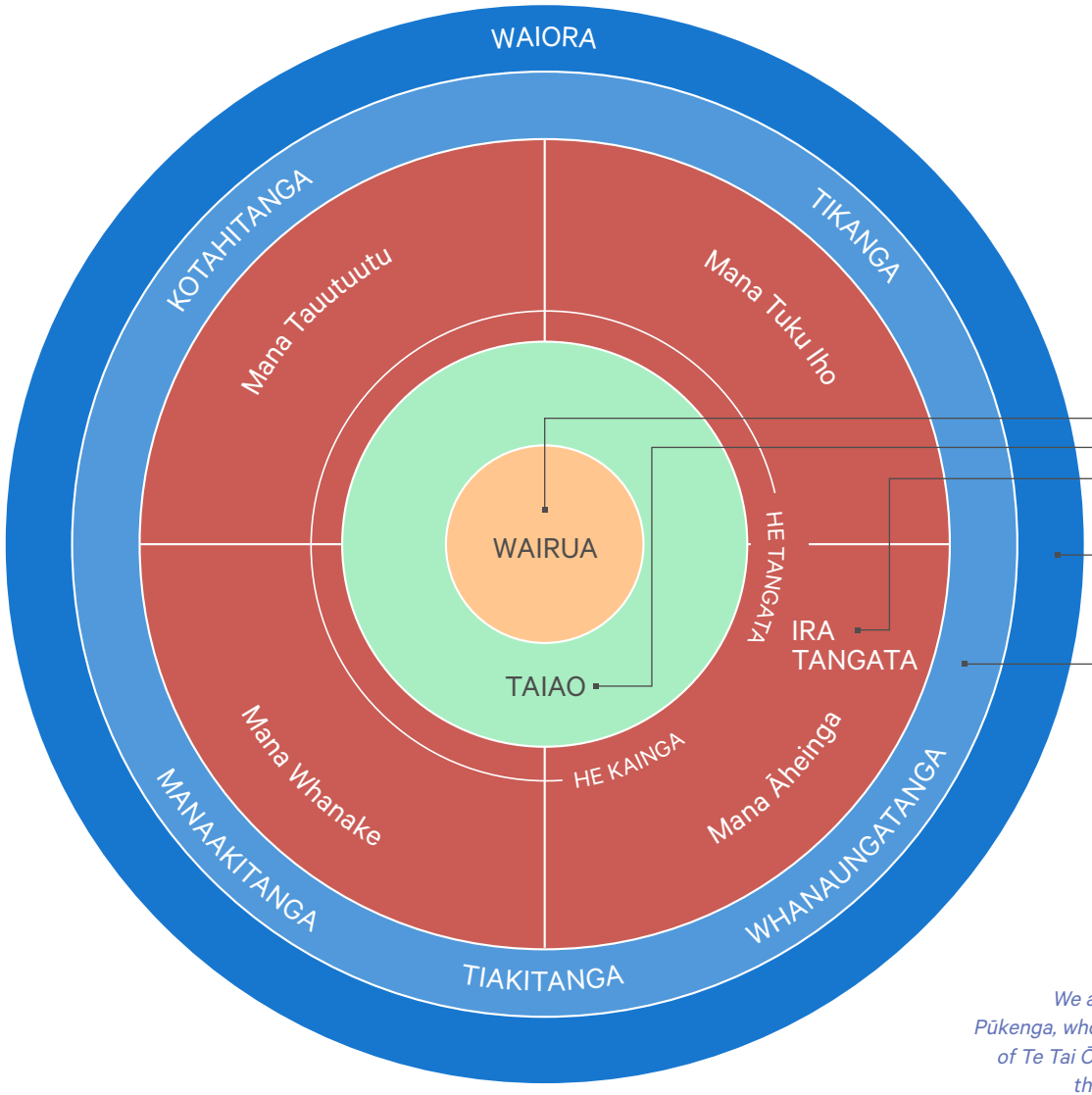
How we are tracking: The reliability and security of Aotearoa's energy system is not currently of significant concern. However, as we continue to decarbonise and increase reliance both on the electricity system and on variable renewable electricity generation, ensuring a reliable and secure supply may become more challenging. Energy storage and demand management will be increasingly important metrics to track and perform well in, to ensure continuous supplies from variable generation sources.

Resilience	4
Reliability	3
Security	2

He Ara Waiora

He Ara Waiora is a framework centred on a te ao Māori view of wellbeing. We have adopted He Ara Waiora, a framework used by both Te Tai Ōhanga – The Treasury and He Pou a Rangi - the Climate Change Commission to understand waiora, wellbeing. He Ara Waiora presents a holistic, intergenerational approach to wellbeing and poses a set of questions directly related to the key principles of tikanga, tiakitanga, kotahitanga, manaakitanga and whanaungatanga.

He Ara Waiora is a wellbeing framework founded on matauranga Māori (Māori knowledge). It reflects the intergenerational, holistic and interconnected nature of wellbeing from a te ao Māori perspective, to benefit all New Zealanders. The framework views wellbeing through a 'means' and 'ends' frame.



Wairua (spirit) is at the centre as the source of waiora (wellbeing)

Taiao (Environment) is paramount and a pre-determinant of human wellbeing

Ira tangata (human) reflects the relational human elements of wellbeing:

- Mana Tuku Iho – identity
- Mana Āheinga – aspiration and capability
- Mana Tautuutu – community belonging and cohesion
- Mana Whanake – prosperity

Waiora is experienced both individually and collectively.

These values underpin how the government should act responsibly through: Kotahitanga (alignment across government), Manaakitanga (ethic of care),Tikanga (right decision-making processes), Tiakitanga (guardianship) and Whanaungatanga (relatedness).

We acknowledge the expert Māori thought leaders, Ngā Pūkenga, who initially developed the framework and the support of Te Tai Ōhanga – The Treasury, who now act as kaitiaki over the framework, to apply He Ara Waiora to our project.

Our recommendations to achieve a low carbon energy system

Our recommendations

The following pages outline our recommendations to achieve the future state energy system set out in our objectives framework. These recommendations are informed by:

- Our scorecard results, which helped us to prioritise the areas that require the greatest changes to meet our objectives.
- Our principles, which helped us to address trade-offs and to avoid negative relationships between the different energy system outcomes.
- He Ara Waiora and our accompanying focus questions, which helped us to consider how the recommendations contribute holistically to wellbeing.
- An assessment for each proposed action of our confidence in the problem, the solution, and the urgency of action.

More detail on our principles and our He Ara Waiora focus questions can be found in Appendix 2.

The recommendations are structured within four sector themes and four system themes. The energy system is broad, and significant action is needed within all of these areas in order to achieve the future state we want.

Within the following pages, further detail is provided on each theme, including why change is needed, desired outcomes, and a description of the likely future state if action is not taken. Case studies provide examples of where the outcomes we are seeking through our recommendations are already being achieved, either in Aotearoa or overseas.

Each theme then includes recommendations separated into three categories:

1 | Do Now (ināia tonu nei):

These are the urgent priority – these are actions where there is consensus and confidence in both the problem being solved, the solution, and the urgency to begin taking action. These things should be initiated in the next 1-2 years.

2 | Plan (whakamahere):

These are actions where we need to step back and plan before acting. We may be uncertain on either the problem we are trying to solve or the best solution available. These actions are not as high priority as our 'Do now' actions, but there is still consensus that something needs to be done within the timeframe of the roadmap (to 2030) – and in some cases, planning needs to start quite urgently.

3 | Monitor (tirotiro):

The energy system is rapidly evolving – these are actions where we are not so confident in either the problem being solved and/or the solution. There is consensus that there is likely to be a problem, but more investigation is needed to confirm the exact nature of the problem and/or the best solution before acting on it.

We have also indicated a responsibility 'lead' for each recommendation. While many of these things are actions for the public sector to lead initially, significant commitment will be needed from the private sector and the public for these things to be successful. Overall change within each of these areas is a collective responsibility.

Theme 1

Keeping whānau warm, dry, and healthy

What:

Reduce household energy costs by improving the energy performance of homes

Implement targeted actions to address energy hardship

Why change is needed:

Our scorecard shows that energy costs comprise a significant portion of spending for all households in Aotearoa, but the system is performing particularly poorly for the between 6%[10] and 25%[11] of New Zealanders that cannot afford to heat their homes adequately.

Household energy spending is highly linked to the poor efficiency and performance of Aotearoa's homes, with many buildings poorly insulated, ventilated and heated.[12] Retrofitting existing homes, and ensuring new builds are high quality, will enable reduced energy use and therefore costs, as well as benefiting the health of those living in these homes.

Changes are underway through the Electricity Price Review, the energy efficiency work of MBIE and EECA, MBIE's Building for Climate Change programme, and MBIE's work on energy hardship – but more work is needed.

The transition to a low carbon energy system will require some energy costs to increase further (e.g. petrol and diesel). There are many low carbon opportunities that will also reduce energy costs – for example, operating an EV is expected to be cheaper than running an ICE vehicle[13], and distributed generation can offset electricity bills. However, we need to ensure all households have equal access to these opportunities.

Further commitment is needed to ensure those most disadvantaged in our communities aren't further burdened by the energy transition.

Desired outcomes:

- New and existing buildings are required to become more energy efficient, warmer, and drier
- New Zealanders are using efficient home appliances that use less energy and are cheaper to run
- Energy hardship in Aotearoa is well understood and quantified, and targeted support is provided to those in hardship (with those in hardship helping to design these support initiatives)
- The right pricing mechanisms are used to ensure equitable access to low-emissions, affordable energy

Ultimately, the desired outcome is zero energy hardship in Aotearoa, and all New Zealanders living in warm, dry, well-ventilated homes.

Counterfactual

As there is no focus on improving the quality and performance of homes, many New Zealanders will continue to live in low-quality, hard-to-heat homes. This will mean building-related energy emissions continue to be high and the health and wellbeing of the people living in those homes will continue to be adversely impacted. Many will continue to be forced to choose between turning their heaters on and other essential expenses, such as putting food on the table.

Case studies:

Nau Mai Rā – a Kaupapa Māori Electricity Retailer, Aotearoa

Founded on the principle of manaakitanga, the small team at Nau Mai Rā works directly with their customers in hardship to understand what support they need most, whether that be an assessment of the efficiency of their home or temporary or longer-term support to cover bills. They are exploring and implementing alternative billing models that enable targeted relief to be provided to those unable to afford their electricity bills.

EnergyMate, Aotearoa

A partnership between electricity retailers, lines companies, and community budgeting services, and run through the Electricity Retailers Association of New Zealand (ERANZ) the EnergyMate pilot provided free in-home energy coaching services for households at risk of energy hardship. The service focused on ensuring power plans and payment terms met the household's needs and recommendations to increase energy efficiency and reduce household energy use.

Theme 1 (continued)

Keeping whānau warm, dry, and healthy

What:	Do now (ināia tonu nei)	Responsibility Lead	Plan (whakamahere)	Monitor (tirotiro)
Reduce household energy costs by improving the energy performance of homes	1a: Set a timeframe for moving towards high Homestar ratings for new buildings 1b: Increase Warmer Kiwi Homes programme funding to $100m per year targeting upgrading of 20,000 low-income homes per year to Healthy Homes Standards 1c: Ban inefficient appliances (such as incandescent lightbulbs and unflued gas heaters) that have cost-effective alternatives 1d: Introduce mandatory disclosure requirements at point of sale on the energy performance of homes	MBIE EECA EECA, MBIE MBIE	1h: Go beyond the Healthy Homes Standards to put in place more ambitious targets for the energy efficiency of rental homes 1i: Implement lower cost bulk energy deals for social housing and/or Work and Income consumers, learning from trials already completed 1j: Amend the Winter Energy Payment to target only households in energy hardship – allowing a much smaller number of households to have a much more substantial support mechanism. Link to energy efficiency funding in action 2b.	1k: Monitor and regularly report on barriers to consumer data access and opportunities to improve consumer outcomes through data access 1l: Monitor the rural/urban divide through the energy transition to see if targeted actions are necessary to ensure low-emissions technologies remain affordable for rural communities 1m: Monitor and regularly report on the market changes generated by the Electricity Price Review and ensure these are providing better outcomes for consumers
Implement targeted actions to address energy hardship	1e: Finalise the definition for energy hardship in Aotearoa, ensuring those in hardship are involved in these conversations 1f: Start tracking and publishing the number of households captured under this energy hardship definition 1g: Work with existing community support networks, such as iwi/hapū, religious groups, migrant groups, or rural community hubs, to build out energy support programmes for households	MBIE MBIE MSD, Energy Sector, Community energy efficiency organisations(e.g. Community Energy Network, Eco Design Advisors)		

Theme 2

Redesigning how people move around

What:

Reduce the need for private vehicle travel and incentivise shift to low-emissions public and active transport

Accelerate uptake of low-emissions alternatives for light vehicles

Why change is needed:

Transport contributes around 44% of Aotearoa's energy sector emissions[2], so significant change is needed to achieve the net-zero carbon future we are aiming for. Road transport makes up 91% of transport emissions, and light passenger and commercial vehicles make up 73% of those road transport emissions[3] – so reducing emissions from light vehicles is a key challenge for Aotearoa.

Shifting to alternative transport modes and low-emission vehicles provides the opportunity to improve transport affordability – for example the cost of operating an EV is rapidly becoming lower than running an ICE vehicle[13]. However, we need to ensure the opportunities for greater energy affordability are available to all New Zealanders, particularly those with lower incomes who have the most to gain from reduced transport costs.

ICE vehicles also contribute to air pollution, particularly in Aotearoa's towns and cities, so cleaner alternatives can support improved environmental and associated health outcomes[14].

Desired outcomes:

- Urban development ensures that future residents will need to travel less and have easy access to public and active transport
- High quality and affordable public and active transport infrastructure and services make these modes of transport more attractive than driving in most cases
- EVs and other low-emissions vehicles make up a very large proportion of private, public transport, and fleet vehicles – around 95% by 2050 – this shift needs to link to a reinforced and smarter electricity system
- Increased uptake of low-emissions, clean transport fuels in light ICE vehicles (see actions in Theme 3)
- Lower-income and rural New Zealanders have equitable access to low-emissions vehicle options and supporting infrastructure

Counterfactual

Without targeted action to shift transport demand away from private vehicles, particularly those powered by fossil fuels, transport emissions will reduce, but not at the scale and pace required to meet our targets. People will continue to travel via private vehicle as the default, with those unable to afford the upfront cost of low-emissions alternatives unfairly disadvantaged as petrol and diesel prices rise.

Case studies:

BlueLA, USA

This partnership between the City of Los Angeles and car-sharing and EV charging infrastructure provider Blink Mobility, provides targeted electric car-sharing services to lower-income communities. Low-income members receive a 25% discount for the service.

Norway's 54% EV Share

Norway is well ahead of the rest of the world in terms of low-emissions vehicle uptake, with 54% of new vehicles sold in 2020 being electric. This has been achieved through a suite of tax benefits that lower both the upfront and ongoing costs of EVs compared to ICE vehicles, as well as significant public investment in extensive charging infrastructure.

Delivering decarbonisation through places

The UK's Decarbonising Transport – A Better, Greener Britain plan outlines a suite of actions to ensure towns and cities are designed to reduce the need for transport, especially by private vehicle. This includes embedding transport decarbonisation principles in spatial planning and local authority decision-making, and a commitment to deliver at least one zero-emission transport city.

Theme 2 (continued)

Redesigning how people move around

What:	Do now (ināia tonu nei)	Responsibility Lead	Plan (whakamahere)	Monitor (tirotiro)
Reduce the need for private vehicle travel and incentivise shift to low-emissions public and active transport	2a: Accelerate implementation of the National Policy Statement on Urban Development to allow for increased urban density and reduce private vehicle use 2b: Require urban development and transport infrastructure decisions to be informed by emissions and air quality impact information on a nationally consistent basis 2c: Increase the proportion of local and central government transport funding designated for active transport and low-emissions public transport infrastructure and services	MHUD MfE, MoT, NZTA, Local Government MoT, NZTA, Local Government	2h: Roll out congestion pricing to support travel demand management, initially in Auckland, building on the work of The Congestion Question 2i: Undertake an assessment of the costs and benefits of providing free public transport	2j: Monitor rates of remote and flexible working following the Covid-19 pandemic and identify Government interventions that may encourage this to manage travel demand 2k: Monitor information and education provision about low-emissions vehicle technologies (e.g. via Right Car website, vehicle labelling) and identify whether this needs to be further expanded to encourage behaviour change 2l: Monitor public and private EV charging installations to ensure supporting transmission and distribution infrastructure is in place
Accelerate uptake of low-emissions alternatives for light vehicles	2d: Strengthen standards and incentives until low-emissions light vehicles are as financially attractive for consumers as ICE vehicles 2e: Set a time limit on light ICE vehicles entering, being manufactured or assembled in Aotearoa 2f: Scale up the Low Emission Transport Fund or provide another mechanism that is designated for: • EV leasing, purchasing and sharing schemes targeted at access for low-income and vulnerable groups or areas • EV charging infrastructure at marae, papakainga, and social housing • addressing EV charging infrastructure needs in rural areas • addressing just transition issues associated with phase out of ICEs (e.g. light utility vehicles) 2g: Accelerate the Carbon Neutral Government Programme's mandated transition of Government fleets to low-emissions vehicles, potentially through a cross-agency procurement system, considering alternatives to battery EVs where appropriate	MoT MoT EECA MfE		

Theme 3

Rethinking freight and aviation

What:

Accelerate uptake of clean, low-emissions transport fuels

Accelerate uptake of low-emissions alternatives for freight transport, including low-emissions fuels and mode shift

Take a proactive role in global initiatives to decarbonise the aviation and marine transport sectors

Why change is needed:

Road transport contributes 91% of Aotearoa's transport emission, and trucks contribute around 25% of this (with light vehicles responsible for the remaining)[3]. However, the heavy vehicle emissions proportion will grow as light vehicles decarbonise. The truck fleet is heavily reliant on diesel, with alternative solutions (including electricity, green hydrogen, and biofuels) still facing technical, commercial, and supply challenges.

Vehicle emissions also contribute to poor air quality – both heavy and light vehicles contribute, but diesel produces most of the pollutants of concern to human health (including nitrogen oxides and particulate matter)[14]. Adoption of alternative fuels will therefore support better air quality as well.

While the proportion of transport emissions contributed by the aviation and marine sectors is relatively small (at around 8% of total transport emissions)[3], these emissions are hard to abate – there is no current technology mix that can enable the aviation industry to fully decarbonise by 2050.

International commitments including the International Civil Aviation Organisation's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and the International Maritime Organisation's tightening emissions regulations will put increasing pressure on these industries to decarbonise, including emissions beyond the scope of the Paris Agreement.

Desired outcomes:

- Low-emissions, clean transport fuels are the norm
- A heavy road vehicle fleet that has significantly reduced its reliance on high-emissions fuel sources
- Air pollutants emitted from vehicles drop significantly, improving air quality in Aotearoa's communities
- An increased proportion of freight carried by rail and coastal shipping
- Low-emissions aviation technologies are integrated into the domestic fleet, and sustainable aviation fuels are being introduced to our international flights
- Low-emissions marine fuels are utilised for our shipping fleets

Counterfactual

Without any new interventions, heavy vehicle transport will become the main contributor to transport emissions as the light vehicle fleet electrifies[3]. While limited adoption of low-emissions alternatives may occur, the forecast increase in freight demand would counter these small emissions efficiency improvements. Heavy diesel vehicles will continue to contribute to GHG emissions and air pollution. Likewise, innovation in, and uptake of, low-emissions aviation and marine transport may occur, but far too slowly to support our vision and objectives.

Case studies:

UK's Jet Zero Council

The Jet Zero Council is a partnership between the aviation industry and Government with the aim of delivering zero-emissions transatlantic flights. The focus is on developing and industrialising zero emissions aviation technologies, establishing UK production facilities for sustainable aviation fuels, and developing a coordinated policy and regulatory framework to achieve net-zero aviation.

Hiringa Refuelling New Zealand

This project, led by Hiringa Energy, with funding support from the Covid Response and Recovery Fund (CRRF), is deploying green hydrogen production and refuelling stations at key freight and logistics locations. This is intended to demonstrate the commercial viability and models for zero emissions road freight and lower the barrier for trialling hydrogen-based new technologies – TR Group, also supported by the CRRF and EECA, is importing 20 hydrogen fuel cell trucks to lease to customers in 2022. The trucks will utilise Hiringa's refuelling network.

Theme 3 (continued)

Rethinking freight and aviation

What:	Do now (ināia tonu nei)	Responsibility Lead	Plan (whakamahere)	Monitor (tirotiro)
Accelerate uptake of clean, low-emissions transport fuels	3a: Implement the Sustainable Biofuels Mandate to require lower-emissions transport fuels , including a focus on local production and an ambitious timeframe for adoption of sustainable domestic and international aviation and shipping fuels	MBIE	3j: Introduce targeted financial incentives for the R&D and deployment of low-emissions fuel options, including aviation and marine fuels 3k: Further develop the MOT's freight decarbonisation work to develop incentives to prioritise rail and coastal shipping over road transport	N/A
	3b: Update Aotearoa's fuel specifications to include low-emissions transport fuels	MBIE		
	3c: Mandate fuel providers to develop and publish transition plans	MfE		
	3d: Amend aviation fuel regulations to phase out leaded aviation fuels	MBIE		
	3e: Set best in class vehicle emissions standards that keep pace with ICE efficiency improvements for both carbon and air quality	MoT		
Accelerate uptake of low-emissions alternatives for freight transport, including low-emissions fuels and mode shift	3f: Introduce targeted financial incentives, potentially through the EECA Low Emission Transport Fund, for all low-emissions heavy vehicle technologies, including a purchase discount scheme and road user charge exemption	EECA, MoT		
	3g: Increase the proportion of the Low Emission Transport Fund Public Charging Infrastructure funding that is designated for chargers on state highways and other key freight routes and expand the fund's terms to include alternative refuelling infrastructure	EECA, MoT		
Take a proactive role in global initiatives to decarbonise the aviation and marine transport sectors	3h: Establish a public-private advisory body to accelerate aviation decarbonisation through sustainable aviation fuels and zero emissions aircraft, tasked with implementing technical, commercial, infrastructure and regulatory requirements to enable uptake	Aviation Sector, MoT, CAA		
	3i: Approve amendment of the Marine Protection Rules to implement MARPOL Annex VI and reduce air pollution from ships, and provide funding to support marine fuels innovation in partnership with the seafood and shipping sectors	MoT, Maritime NZ		

Theme 4

Setting the low carbon trajectory for business and industry

What:

Transition industrial processes, heating, and cooling to low-emissions technologies

Improve the energy efficiency and performance of commercial and industrial buildings

Make our businesses more energy efficient

Why change is needed:

Manufacturing industries contribute around 20% of our energy sector emissions[2]. Stationary heat specifically makes up around one-third of Aotearoa's overall energy use and 27% of our energy-related emissions, with natural gas and coal being the dominant fuel sources[15]. Industrial processes and stationary heating are also often hard to decarbonise. This means that without targeted action, these emissions are not projected to reduce at nearly the scale and pace needed to meet our emission reduction targets.

Aotearoa's energy intensity is high[5], but this doesn't need to mean we are emissions-intense in global terms. Reductions in industrial emissions need to be managed carefully to ensure energy-intense industries don't move offshore and we can still produce the goods we need and which support our thriving economy.

Businesses, including industrial, commercial and agricultural, face significant investments to reduce their energy use. Commercial and industrial buildings aren't required to be energy efficient. Many businesses are likely using more energy than they need to, and therefore spending more than they need to.

Desired outcomes:

- A clearly signalled and coordinated approach to reducing industrial process and stationary heat emissions, utilising policy settings that complement the ETS and market settings
- Hard-to-abate and EITE sectors receive targeted support to reduce emissions
- Energy-intense industries, powered by low-emissions energy, are a significant part of Aotearoa's future economy
- Businesses understand their energy use and take opportunities to reduce their consumption
- The energy efficiency and performance of commercial and industrial buildings is tracked and well understood across public and private sectors, which supports investment in efficiency improvements

Counterfactual

Industrial processes continue to be largely powered by fossil fuels. Uncoordinated industrial decarbonisation action and increasing carbon prices push some emissions intense trade exposed (EITE) industries offshore, so that we are importing higher-emissions products than could be produced using Aotearoa's low-emissions energy system. Commercial and industrial buildings remain inefficient, and businesses continue to both use and pay for more energy than they need.

Case studies:

Zero Carbon Humber, UK

The UK's Industrial Strategy sets out Grand Challenges for the future of industry, one of which is establishing zero-carbon industrial clusters. Humber is the most carbon-intensive industrial cluster in the UK, and 20% of the region's economic value comes from energy-intensive industries. Zero Carbon Humber is a partnership between industries, the energy sector, and academia who have set out a plan to achieve a zero-carbon industrial cluster by 2040, supported by both public and private sector funding.

Australia's Commercial Building Disclosure Programme

This programme requires sellers and lessors of commercial office spaces over 1,000m^2 to provide energy efficiency information to prospective buyers and tenants. This is part of a package of initiatives to tackle the energy emissions from commercial buildings, which are responsible for 25% of electricity use and 10% of carbon emissions in Australia.

Theme 4 (continued)

Setting the low carbon trajectory for business and industry

What:	Do now (ināia tonu nei)	Responsibility Lead	Plan (whakamahere)	Monitor (tirotiro)
Transition industrial processes, heating, and cooling to low-emissions technologies	4a: Develop a stationary heat action plan, with input from industry, ensuring this is linked with the Government's national energy strategy 4b: Substantially increase the Government Investment in Decarbonising Industry (GIDI) funding 4c: Introduce a ban on new coal-fired boilers for low/medium temperature heating requirements, and a timeline for the phase-out of fossil fuel used in all boilers 4d: Mandate emissions-intensive industries to develop and publish transition plans	MBIE EECA MBIE MfE	4h: Allocate National Science Challenge or other MBIE science funding to research and innovation on emissions reduction in hard to abate sectors 4i: Designate low-emissions industrial hubs and provide favourable conditions (such as via consenting, rate relief or grant programme terms) for industrial businesses to locate within these hubs 4j: Commit to energy neutral education facilities through the Carbon Neutral Government Programme	4k: Monitor emissions impact of diesel for back-up power systems, and if necessary, implement mechanisms to phase these out 4l: Monitor emerging low-emissions industries and how these can be attracted to Aotearoa 4m: Monitor progress in decarbonising publicly owned stationary heat systems, and accelerate decarbonisation if not on track to meet targets 4n: Monitor installation of scrubbing technologies, and investigate implementation of a target to accelerate installations to improve air quality
Improve the energy efficiency and performance of commercial and industrial buildings	4e: Set a timeframe for mandating participation in NABERS (or an alternative energy performance labelling programme) for all large public and private industrial and commercial buildings 4f: Set a timeframe for mandating a high Greenstar rating for new public and private industrial and commercial buildings	MBIE MBIE		
Make our businesses more energy efficient	4g: Increase funding provided via EECA's Energy Transition Accelerator, and shift this towards implementing practical initiatives to reduce business energy use	EECA		

Theme 5

Ensuring a coordinated transition

What:

Clarify goals for the transition and Aotearoa's future energy system, along with the role of key technologies, through the Government's new national energy strategy

Put in place the right settings to move together towards the goals for Aotearoa's future energy system

Why change is needed:

Aotearoa is currently lacking clear goals and priorities for the energy transition and for our future energy system. There is no clear agreement about national energy infrastructure needs and how to coordinate investment to ensure these needs are met – which means they probably won't be. The role of certain technologies in the transition and in the future energy system, most notably gas and bioenergy, is not clear, which creates investment uncertainty, and may mean we do not achieve the full benefit of these energy sources.

A national energy strategy will clarify these goals, particularly if it is developed in partnership with Māori, has bipartisan support, and has input from across the energy system.

Some parts of our energy system are not setting us up for future success – for example, shortages in labour and the right skills will significantly limit our ability to tackle our energy challenges. This requires education of the next generation and redeployment of our existing skilled energy workforce.

We also can't achieve our target future state with the technologies we have today. Investment in R&D, as well as deployment, is needed to help important new technologies advance from the lab to the market.

Desired outcomes:

- A new national energy strategy, developed with Māori, that clearly sets out:
  - A long-term horizon of national energy infrastructure needs and priority investments
  - Milestones on the pathway to a renewable energy target
  - The role of key energy technologies (including gas, bioenergy, green hydrogen, carbon capture, wind and offshore energy) in our transition and future energy system
- Representation of iwi/Māori in energy sector coordination and governance, and in the sector itself
- An education system that provides emerging specialist and transferrable energy skills
- An adaptable energy workforce that is able to adopt and deploy new technologies
- Smart energy supply chains that support local jobs and economies
- A substantial increase in energy R&D spending which stimulates innovation and solutions to emerging challenges

Counterfactual:

Uncertainty about priorities hinders investment in the developments necessary to transition to a low carbon energy system. Different energy system players work at cross-purposes, which limits the overall value generated. Lack of coordination creates increased costs through potentially inefficient allocation of capital, and investment in enabling infrastructure does not keep pace with the deployment and scaling up of new technologies. Lack of skills development and lack of investment in R&D limits deployment of emerging technologies needed in the future. Displaced workers are left behind in the transition rather than having their skills harnessed by redeployment. The future energy system continues to not work for Māori, who do not benefit as much as they could from emerging energy technologies.

Case studies:

Council of Financial Regulators (CoFR), Aotearoa

The CoFR has set five priorities for the sector, one of which is climate risks. The CoFR is focused on increasing coordination and building capacity and knowledge across the regulatory agencies, recognising their role in supporting the sector to prepare for climate change.

Australia's Bioenergy Roadmap

The Australian Renewable Energy Agency has developed a roadmap to identify bioenergy's role in Australia's future energy mix and to enhance growth of the sector. It outlines actions to enhance markets for priority uses and to develop the resources and supporting industry.

The UK's Energy & Utilities Skills Partnership

This partnership of utility businesses is working together with Government and regulators to identify the skills and workforce renewal to support the future industry. They are working on a Skills Strategy, Skills Accord, and platform to attract talent to the sector.

Theme 5 (continued)

Ensuring a coordinated transition

What:	Do now (ināia tonu nei)	Responsibility Lead	Plan (whakamahere)	Monitor (tirotiro)
Clarify goals for the transition and Aotearoa's future energy system, along with the role of key technologies, through the Government's new national energy strategy	5a: Make good on the CCC's recommendation to develop the national energy strategy in partnership with iwi/Māori	MBIE	5j: Amend the role of the Council of Energy Regulators, to play a facilitation and coordination function through the energy transition	5k: Monitor the price of carbon in the ETS and adjust ETS settings to ensure the price continues to drive decarbonisation action
	5b: Include within the Government's new national energy strategy, with input from the energy sector: • an Integrated System Plan – a 30-year horizon of national energy infrastructure needs • a review of the 100% renewable electricity target • a renewable energy target – 50% by 2035 – and a pathway, milestones, and investment priorities to reach that target	MBIE		
	5c: Develop a Gas Transition Plan, working with the gas sector, that sets out: • the role of gas in the transition and our future energy system (acknowledging the role it can play in supporting decarbonisation, affordability and security) • the role of existing infrastructure for low carbon gas (i.e. biogas and green hydrogen) • the timing of the transition from fossil gas to low carbon gases	MBIE		
	5d: Develop a Bioenergy Action Plan, working with the bioenergy sector, that identifies: • priorities for the bioeconomy • the regulatory and market settings that will enable supply to scale up in a regenerative way • what's needed to maximise the value of bioenergy for our energy system and Aotearoa's economy.	MBIE		
	5e: Develop an Energy Sector Adaptation Plan that: • collates data on the climate change risks facing energy assets, including information collected through the Climate Change Risk Assessment process • identifies data gaps to drive research priorities • identifies priority actions to mitigate and prepare for the climate change risks facing energy assets	MBIE, MfE		
Put in place the right settings to move together towards the goals for Aotearoa's future energy system	5f: Use ETS revenues to fund the most critical elements of our energy system decarbonisation, such as stationary heat and transport emissions	MfE, MBIE, EECA		
	5g: Develop an energy system skills accord, as a partnership between Government, tertiary and research institutions, and the energy sector, that identifies: • key skills required for the future energy workforce (including consideration of Matauranga Māori and tikanga) • how these will be developed through the education and training system	Te Pūkenga, Tertiary and Research Institutions, Energy Sector		
	5h: Develop detailed transition plans for workers in emissions-intensive sectors, working with impacted communities that bring together: • options to optimise use of transferrable skills • options for redeployment and upskilling • practical support options for workers to make choices that transition their careers	Te Pūkenga, MSD, MBIE, Energy Sector, Unions		
	5i: Through the National Science Challenge (and other science funding) increase investment in energy research, development and diffusion, initially targeted at: • mātauranga Māori • opportunities for iwi/Māori entities (e.g. cleaner geothermal) • solutions to dry-year risk	MBIE, Tertiary and Research Institutions		

Theme 6

Enabling the new energy infrastructure we need

What:

Create an enabling regulatory environment that supports a rapid transition

Create a favourable environment for investment in renewable energy and energy efficiency projects

Why change is needed:

A significant build-out in renewable energy infrastructure is required to support Aotearoa's decarbonisation targets[8, 13, 16].

Renewable energy projects in Aotearoa are becoming more attractive investments. However, the very long timeframes and high costs associated with consenting projects hinder the build-out needed[17]. Similarly, economic regulation can create barriers to investment in the infrastructure we need.

The ETS is championed as the primary driver of increased renewable energy utilisation. However, further support may be needed as overall, not enough renewable energy opportunities have been identified, let alone committed to, to provide for the range of forecast demand.

Existing electricity generation and commitments are also dominated by a few key large players and a few key technologies. Achieving our objectives will require new, smaller players to enter the market. A more diverse range of generation is also needed, in order to ensure our system is reliable, some of which will require support to relieve barriers to entry.

Desired outcomes:

- A regulatory environment that enables renewable energy infrastructure developments, while ensuring local natural environments are adequately protected
- An investment environment that provides certainty and rewards investment in renewable energy and energy efficiency developments
- Targeted support mechanisms in place to encourage growth in diverse forms of generation
- A renewable energy sector that includes more players, including those that currently face barriers to entry
- Growth in renewable energy capacity at the pace required to meet our targets

Case studies:

Australia's Electricity Network Opportunity Map

This publicly available map highlights areas in the electricity grid where the future demand for power is expected to outstrip supply, with this intended to show the most valuable opportunities to invest in renewable generation, battery storage, and demand management.

NSW Renewable Gas Certification Pilot, Australia

A partnership between NSW Government and industry has developed the certification pilot to support consumer certainty in their ability to purchase verified and accredited zero emission gas. This is intended to boost industry investment in renewable gases such as biomethane and green hydrogen.

Counterfactual

Renewable energy projects will continue to be pursued even without targeted initiatives, as solar, wind, and geothermal have more commercially attractive generation options than building new coal- or gas-fired plants. However, uncertainty in the regulatory and investment environment, and the time and cost of consenting, discourages some developments, does not reduce prices sufficiently to incentivise further electrification and developments outside the electricity sector are limited. The GHG emissions from the energy sector reduce, but not nearly enough to reach our net-zero targets.

Theme 6 (continued)

Enabling the new energy infrastructure we need

What:	Do now (ināia tonu nei)	Responsibility Lead	Plan (whakamahere)	Monitor (tirotiro)
Create an enabling regulatory environment that supports a rapid transition	6a: Make enabling fast-paced and sustained build of new low carbon energy infrastructure a key success criterion for the new Resource Management system 6b: Update EA, GIC, and ComCom regulations, such as the ComCom pricing principles, to clearly recognise and prioritise emissions and resilience benefits and long-term issues of national interest, so that these regulations do not present a barrier to energy infrastructure investment	MfE EA, GIC, ComCom, MBIE	6g: Develop a standardised integrated resource management consenting tool, that can be tailored to local situations, to provide more consistent assessment of energy infrastructure consents 6h: Develop a renewable generation investment service to attract new capital to our markets and connect potential users with suppliers - for example by running offshore wind energy permit rounds 6i: Establish a PPA platform for renewables offtake, including information provision, optional standardised contracts, hedging support, and mechanisms for pooling for smaller players 6j: Commit to procure 100% renewable electricity from new generation sources for the Government's own consumption 6k: Create incentives for the uptake of onsite renewable energy - especially where this could enhance iwi/Māori participation in energy assets 6l: Create ways for smaller players, especially iwi/Māori, to participate in the wholesale electricity market (e.g. through digital platforms) to reduce their costs 6m: Create a regulatory regime for the development of offshore wind assets, addressing any barriers in existing legislation applying to developments in the territorial sea and exclusive economic zone 6n: Create a regulatory regime for carbon capture and storage, addressing barriers relating to the RMA Crown Minerals Act, and EEZ Act, as well as barriers to credit access within the ETS 6o: Develop economic, safety, certification, and consumer regulations and standards for green hydrogen	6p: Monitor development in emerging energy technologies that support the goals of the national energy strategy, and identify where financial support (e.g. via tax incentives) may be required to relieve barriers to entry in these markets 6q: Monitor the renewable electricity certificate market, and if needed, revise standards and governance to better incentivise expansion of renewable electricity generation
Create a favourable environment for investment in renewable energy and energy effciency projects	6c: Utilise and grow existing green financing mechanisms, such as the NZ GIF, sustainability linked loans and green bonds, to reward investments in renewable energy and decarbonisation, particularly in hard-to-abate sectors - and ensure these enable smaller-scale investments 6d: Expand the renewable energy certificate market and certification standards to include renewable gas and biofuels markets 6e: Introduce a formal cost-sharing mechanism for multi-party grid connection contracts to reduce upfront barriers for conversion to electricity 6f: Undertake a full analysis of the factors contributing to the first mover disadvantage and implement the preferred solution	Finance Sector, NZ GIF, MBIE, EECA Certified Energy MBIE, ComCom, EA EA, Electricity Sector		

Theme 7

Achieving a diversified and reliable electricity system

What:

Prioritise low carbon investments that improve system reliability and security

Scale up use of distributed energy resources (DER), community energy networks, and microgrids, while ensuring these support a more reliable system

Why change is needed:

Our current electricity system relies on flexible thermal fuel to manage variability in renewable generation, including the following challenges:

- Daily demand variability that doesn't match supply
- Year-to-year variability of hydro generation

Phasing out of these thermal supplies will either require significant over-building of renewable generation to meet times of peak supply – which would come at a high cost – or alternative reliability solutions.

Within the current market, the value of flexible solutions is not necessarily recognised. Markets and/or commercial structures are needed that support a high degree of flexible supplies.

Poorly managed demand also contributes to 'peakier' loads that are harder to supply securely. As more DER comes online, these need to be well-managed and digitally connected to ensure they do not become a reliability problem, instead of a solution.

Various work programmes are underway to address these electricity market challenges - such as the Market Development Advisory Group and their work on the wholesale market under 100% renewable electricity supply, and the Electricity Authority's work on hedge market development, real time pricing, updating regulatory settings for distribution networks, and future security and resilience. This work needs to be progressed and accelerated to ensure our electricity markets enable the future electricity system we need.

Desired outcomes:

- A dynamic, flexible electricity system that can respond to the variability in both renewable generation and electricity demand
- A digitally connected electricity system, including generation, storage, and DER
- Increased adoption of smaller-scale community electricity networks / microgrids where these suit community needs
- Electricity consumers know how to, and do, manage their flexible loads to match times of higher supply, supported by digital integration, playing their role in achieving reliable and secure supply

Counterfactual

Without investment in solutions to the reliability risks of a highly renewable electricity grid, we may see increasing incidences of power outages when supply doesn't match demand – our system fails to 'keep the lights on'. Without DER being carefully managed, these technologies could exacerbate the 'supply versus demand' issue – for example, EV charging profiles that further contribute to peak loads – rather than reaching their potential of improving reliability. Moreover, consumers won't be able to fully participate in the electricity systems which will diminish incentives for residential solar, EVs and batteries.

Case studies:

Europe's DSO-TSO Roadmap

Europe's Clean Energy Package set a goal for redesigned electricity markets adapted to greater flexibility and guaranteeing equal participation for all service providers, including active customers. Europe's DSO, TSO, and energy company industry bodies together developed a roadmap towards achieving the right market settings for a more flexible grid. Recommendations in the roadmap include data requirements, technology standards, and principles for service providers to adhere to.

PowerMatching City, The Netherlands

Run by a consortium of energy industry players and academia, this is a 'living lab' testing a smart microgrid within several Dutch communities of around 25-40 households. The microgrid integrated high use of distributed solar generation, heat pumps, smart appliances, electric vehicles, and community-scale wind and gas. As well as technical feasibility, the trial has also been used to consider business models that support highly renewable microgrids, such as demand response pricing mechanisms.

Theme 7 (continued)

Achieving a diversified and reliable electricity system

What:	Do now (ināia tonu nei)	Responsibility Lead	Plan (whakamahere)	Monitor (tirotiro)
Prioritise low carbon investments that improve system reliability and security	7a: Establish electricity market settings, products, and regulations that manage increased intermittency of renewables and better provide for DER, recognising the whole system value of flexible assets, which may include: • support for increased investment in resource adequacy (including grid connected batteries) • flexibility markets for demand side participation • peak hedging / sleeving PPAs • consumer rights to export and rules on data exchange	EA	7h: Establish a fund to support feasibility studies looking at microgrid solutions for off-grid and fringe-of-grid communities	7i: Monitor electricity system interactions as new generation comes online and establish mechanisms to optimise coordination 7j: Monitor advances internationally in low-cost ways to reduce peak energy demand and adopt approaches that may be suitable in Aotearoa 7k: Monitor implementation of technology and communication standards for incoming DER and identify whether further mechanisms are needed, such as registration, incentives, or mandates for smart technologies
	7b: Accelerate work by the EA and ENA to develop a DSO-TSO Roadmap that outlines an agreed approach to distributed flexibility and milestones for implementation	EA, ENA		
	7c: Address barriers in electricity sector economic regulations that currently prevent sufficient investment in digital technologies that enhance integration and associated cybersecurity needs	EA		
Scale up use of distributed energy resources (DER), community energy networks, and microgrids, while ensuring these support a more reliable system	7d: Address regulatory barriers to microgrid solutions (e.g. in the Electricity Act and the EA Code)	MBIE, EA		
	7e: Increase funding allocated to the Māori and Public Housing Renewable Energy Fund and expand this to include funding for marae and charitable community centres to implement distributed generation and storage solutions	MBIE		
	7f: Introduce technology and communication standards and an integrated digital platform for DER technologies	EA, EECA, Energy Sector		
	7g: Establish pricing safeguards to ensure low-income households are not adversely impacted by increased penetration of DER	MBIE, MSD		

Theme 8

Moving towards a regenerative energy system

What:

Incorporate regenerative thinking into the energy system

Better understand and manage the impacts of our energy activities on air, land, water, and biodiversity

Why change is needed:

There currently isn't a very good understanding of the overall impacts of our energy system on the natural environment, particularly on our whenua (land), wai (waterways), and koiora (biodiversity). Without an understanding of these impacts, we cannot start to address them.

We do know that some energy activities, including renewables that will play a key role in decarbonising the system, have adverse impacts on local natural environments – such as solid waste generated by batteries, land use impacts of utility-scale solar and bioenergy production, or freshwater impacts of hydro generation and green hydrogen production. The priority to date has been on minimising impacts, or offsetting them elsewhere, and the Resource Management and consenting system has gone some way to creating positive environmental outcomes. However, the cumulative impact on te taiao is not well understood and has, in some local cases, been negative.

A shift in approach to environmental impacts is expected through the Resource Management Reform. Emerging global targets and standards under the UN Biodiversity Conference (COP 15) and the Taskforce on Nature-Related Financial Disclosure, along with the development of Te Mana o te Taiao, Aoteroa's Biodiversity Strategy, represent important shifts towards caring for and protecting natural environments. This theme looks to apply regenerative thinking specifically to the energy system.

Desired outcomes:

- A clear and agreed definition and examples of what a regenerative approach looks like for the energy system
- Guidance and frameworks to enable decisions and investments that support a regenerative energy system

Counterfactual

If we don't explicitly seek to understand, mitigate, and reverse the impacts of our current and future energy activities on te taiao, the energy system will continue to contribute to degradation of natural environments. Trade-offs between achieving our other energy system objectives and sustaining the wellbeing of te taiao will not be understood, so environmental wellbeing will continue to be deprioritised.

Case studies:

Battery Industry Group Product Stewardship Scheme, Aotearoa

Aotearoa's Battery Industry Group (BIG), with over 170 members, focuses on collaboration, innovation, circular solutions, and responsible management of large batteries (including those from EVs and stationary energy storage). The BIG have developed a potential product stewardship scheme for large batteries. This scheme would encourage waste to be designed out, battery products and materials to be kept in use, and the regeneration of natural systems. The scheme sets out clear governance structures, targets, responsibilities, and data/reporting requirements.

Aotearoa Primary Sector Council's Agriculture, Food and Fibre Sector Vision and Strategic Direction towards 2030

Aotearoa's agricultural sector is beginning to embrace a regenerative approach. The Primary Sector Council, a group of agribusiness leaders, developed this strategy document, which puts the health of te taiao and the relationship of the sector with nature firmly at the heart of the vision for the future of the sector.

Theme 8 (continued)

Moving towards a regenerative energy system

What:	Do now (ināia tonu nei)	Responsibility Lead	Plan (whakamahere)	Monitor (tirotiro)
Incorporate regenerative thinking into the energy system	8a: Introduce a 'Stewardship Code' for the energy sector, outlining accountability for positive environmental and social outcomes	MfE, Energy Sector	8g: Undertake a natural capital review of the energy system to understand key environmental risks and regenerative opportunities and link with energy system operators to action opportunities	8k: Monitor the environmental impacts of increasing Aotearoa's supply of biofuels and consider introducing guidance that prioritises regenerative supply practices
	8b: Define what regenerative means in the context of Aotearoa's energy system, including a mātauranga Māori lens	MfE	8h: Allocate National Science Challenge or other MBIE science funding to research likely impacts of new energy technologies on local environments (e.g. ocean energy on tidal habitats, offshore wind on marine habitats, and hydrogen production on water resources)	8l: Monitor advances internationally in regenerative opportunities associated with new energy technologies (e.g. uses for the oxygen by-product from hydrogen production) and adopt these where relevant to Aotearoa's circumstances
Better understand and manage the impacts of our energy activities on air, land, water, and biodiversity	8c: Mandate regular reporting on the environmental impacts of energy activities, including on whenua/land and soil, wai/water, koiora/biodiversity and air	MfE	8i: Develop clear nationally consistent land use decision-making guidance that avoids location of new energy activities on land of high biodiversity value, but promotes co-existence of complementary land uses (e.g. primary production) with energy assets	
	8d: Collate data on the environmental impacts of energy activities into a central, accessible database	MfE, Local Government, Energy Sector	8j: Establish a timeframe to reach zero tolerance for toxic material release from energy infrastructure and activities, supported by clear risk-based management guidance in the interim	
	8e: As part of Resource Management reforms require transparent and holistic assessments of the impacts of new energy infrastructure developments on whenua/land and soil, wai/water, koiora/biodiversity, and air, alongside climate impacts/benefits	MfE		
	8f: Develop guidance for appropriate rehabilitation, repair and disposal practices for energy activities, including product stewardship schemes where relevant - starting with solar PVs and EV batteries	MfE, Energy Sector groups (e.g. Battery Industry Group)		

Opportunities for improving our energy system in partnership with Māori

An inclusive low emissions future for Aotearoa is one that holds partnership with Māori at its core in order to ensure equitable and transformative outcomes for all New Zealanders. Leveraging mātauranga Māori alongside science and other forms of knowledges provides Aotearoa with a unique point of difference to innovate solutions. Prioritising whānau, community and environmental wellbeing is paramount to the future vision of a system that supports intergenerational wellbeing, regenerative energy approaches and realises economic potential.

There are many areas of opportunity to embed te ao Māori in the energy system moving forward, including ensuring:

- Partnership as the foundation - reflecting the spirit and intent of Te Tiriti to enable genuine partnership between the Crown and Māori.
- Mātauranga Māori guides innovation - enabling Māori knowledge to inform decision-making, to monitor progress, and to guide innovation.
- Whānau and hapori (communities) as the drivers of change - ensuring better outcomes for communities through prioritising local partnerships and iwi investment.

We understand the importance of engaging with Māori to plan for and determine the right way forward, therefore this report does not intend to define these priority actions for Māori in the energy system. Instead, we outline some next steps that will unlock key actions moving forward and highlight some potential flow-on actions that we have identified based on existing activity and examples.

There are universal actions that can be drawn across all three opportunity areas:

- Early engagement with whānau, hapū, iwi and experts to understand shared priorities and opportunities for partnership and the inclusion of mātauranga Māori
- Understand key blockers and opportunities for partnership and iwi investment

Each of these will be discussed on the following pages.

Opportunity 1

Partnership as the foundation

There is an opportunity to embody the spirit and intent of Te Tiriti o Waitangi by working in genuine partnership with Māori to drive the evolution of Aotearoa's energy system and to enable a just and coordinated transition. A partnership approach will enable Māori to input directly into system design to achieve equitable and beneficial outcomes for all.

Fundamental next steps

- Crown engage with whānau, hapū and iwi to identify a collective shared vision and priorities for the evolving energy system
- Crown and Māori to plan the strategy development process up front to enable Māori and communities to drive and influence this journey
- Map out the sector to identify barriers and key opportunities are for partnership

Potential flow-on actions

- Co-design the national strategy with key experts and by engaging with whānau, hapū and iwi
- Encourage and provide cultural capability (including an understanding of Te Tiriti o Waitangi) training for all people working on the evolving system design
- Crown to identify and provide resourcing to Māori and communities to enable participation in the process of developing a national strategy
- Do work to understand existing partnership models and opportunities for innovation within the different intersections of the energy system

Some Government agencies are reflecting Te Tiriti o Waitangi in their organisational DNA. **Te Pūkenga's** governing legislation[18] requires it's governance, management and operations to give effect to Te Tiriti o Waitangi. The **health system reforms** and **WAI 2575**[19] outline that Māori must be co-designers, with the Crown, of the primary health system for Māori. This reflects the importance of committing to a genuine partnership approach to achieve better outcomes.

When **Te Arawhiti** was being established the Minister in charge undertook extensive engagement across Aotearoa (with 30 hui and 1600 attendees) to understand what the key blockers, challenges and opportunities were for the Crown-Māori relationship in order to inform the purpose and function of the new agency. This ensured that local perspectives informed the creation of the governments approach.

Opportunity 2

Mātauranga as the innovator

Mātauranga Māori reflects Māori ways of knowing and understanding the world and includes the values, beliefs and experiences that underpin it. Aotearoa is in a unique position to leverage diverse systems of knowledge to inform the energy system to unlock innovation potential. Working in partnership with Māori to ensure authentic and appropriate use of Mātauranga Māori will enable it to inform decision-making, monitoring, and also to guide innovation of new technologies and solutions. Mātauranga enables us to draw from the richness of the past to inform our future.

Fundamental next steps

- As part of an initial engagement process, the Crown and Māori detemine the role of mātauranga in national and local decision-making
- Research where mātauranga Māori based innovation is happening
- Provide funding for mātauranga Māori based renewable energy research and development

Potential flow-on actions

- Develop a complementary mātauranga Māori framework to guide decision-making and monitoring related to the energy system
- Crown to provide funding to support mātauranga Māori based innovation, research and technology development

The **Environmental Protection Agency** developed a mātauranga Māori framework to help inform decision-making and provide decision-makers with an understanding of how mātauranga Māori should be used appropriately in their processes. They use the waka hourua (double hulled canoe) to represent mātauranga and science moving forwards together.

The **Bay of Plenty Regional Council** developed the framework He Korowai Mātauranga to support the inclusion of mātauranga Māori in BOPRC processes. It was informed by mātauranga Māori practitioners and aims to foster meaningful relationships, establish common goals, values and outcomes, recognise and respect the value of mātauranga Māori, to ensure mātauranga Māori is managed in a way that reflects its intention.

Vision Mātauranga is a policy framework run out of MBIE with the purpose to unlock the innovation potential of Māori knowledge, resources and people to assist New Zealanders to create a better future. This provides strategic direction within the science and innovation system.

Opportunity 3

Whānau and hapori (communities) as the drivers of change

Achieving better outcomes and improved wellbeing for whānau and local communities are a core focus of local partnership initiatives and iwi investments. There is an opportunity to ensure that benefits are distributed evenly to communities who are adjacent to energy schemes and who have relationships with taonga that support energy generation. Community involvement in the energy system at the local level will contribute towards addressing energy hardship and keeping whānau warm, dry and healthy.

Fundamental next steps

- Map the energy ecosystem to understand local and regional energy activity to pinpoint what is happening and who needs to be involved in local partnership initiatives
- Co-ordinate and connect iwi investors to renewable energy development opportunities
- Provide hapū, iwi and communities with resourcing and capabiltiy uplift to access low carbon technologies

Potential flow-on actions

- Understand the partnership opportunities between the private sector and mana whenua
- Incentivise local Māori partnerships for renewable energy projects
- Investigate economic mechanisms for Māori participation in renewable energy

Mercury has partnered with iwi through several joint ventures with Māori land trusts for geothermal operations and developments. They have also partnered on several enviromental improvement initiatives, including working with Te Arawa River Iwi Trust and Waikato River Authority to trial water quality monitoring.

Halcyon power is a joint venture between Tūaropaki Trust and Japan's Obayashi Corp to supports a green hydrogen production facility at the Mokai geothermal power plant. This is an example of indigenous leadership and a global investment opportunity to develop green hydrogen in alignment with Tūaropaki's values.

As part of the Feed-in Tariff Programme, Ontario introduced the **'Aboriginal Price Adder'** – which is an increased contract price for projects having a minimum percentage of aboriginal ownership. The Aboriginal Price Adder encourages aboriginal partnership with Aboriginal communities and for aboriginal communities and prospective partners to maximise Aboriginal participation in the investment.

Appendices

Appendix 1:

Scorecards - How are we performing against our objectives?

These scorecards present an indication of how Aotearoa's current energy system is performing against the objectives we have set for it. We have used readily available information to obtain a general picture of how the system is performing currently and what future trends look like. The purpose is to inform where we focus our actions in the roadmap to help us get on the right track to achieve our objectives. We also frequently found that there are information gaps that we'll need to fill in order to know whether we are meeting some objectives

Topics & Indicators	Each objective has been split into several topics, within which indicators have been selected with the objective of providing a complete picture of performance against the topic. In some cases, there is very little data available about a topic. Where this is the case, we have suggested indicators that may be useful to measure in the future.
Current State	Where available, the current state of indicator performance is recorded.
Target Future State	Where modelling has been done and/or targets have been set in an agreed strategic document, these targets have been noted. We have not set any new targets. Where targets are not available, this has been noted as 'to be determined' or TBD - these are indicators it could be useful for the Government's Energy Strategy to set targets for.
Commentary	This provides any qualitative information available about current and target future states, as well as information about indicator trends and trajectories to support the assessment.
Indicator & Topic Score	The current state, the difference between current and target future state, and information about the indicator trend/ trajectory have been used to assess the indicators. Indicator assessments have been aggregated to provide an overall topic score. The scoring is as follows: **1** We are very far off track to meet the objective – there is a significant difference between current and target future state, and our current trajectory does not put us on the right path **2** We are far off track to meet the objective. **3** We are moderately on track to meet the objective – significant work is needed, but we are on the right course. **4** We are well on track to meet the objective. **5** We are very well on track to meet or exceed the objective – our target future state is not far from our current state and/or our trajectory means the target future state will not be hard to achieve. **n/a** Not available - there this is limited information available about this indicator at this time

Case studies

For some topics, a better understanding of performance can be gained through case studies, rather than numeric indicators. We have included case studies that demonstrate not only:

- What we are aiming for; but also
- What we want to avoid.

These have been considered in the topic assessment scoring and can be taken into account in developing actions.

Objective 1: Our Whānau, businesses and communities have equitable access to affordable, low-emissions energy that enables them to thrive.

Energy costs currently comprise a significant portion of New Zealander's household spending, and this is slightly higher for Māori whānau and those in the lowest income quartile. While the composition of our energy bills is expected to change, it is likely that without additional interventions that any energy cost rises will continue to be felt most strongly by those that can least easily afford to meet them. Energy hardship does not have an agreed definition in Aoetearoa, but we know the percentage that cannot afford to heat their homes is too high. Energy affordability for businesses is not well reported on, beyond direct prices, so this may be a gap to fill.

Topics	Indicator	Current state	Target future state	Commentary	Indicator Score	Topic Score
Topic 1: Energy affordability - households and communities	Average household expenditure on energy as portion of total (all households)	5% (household) 11% (transport)[7]	TBD	Despite electricity prices in Aotearoa being 11th lowest of 32 OECD countries and below the OECD average[20], energy affordability is an issue for Aotearoa's households. Spend on household energy is higher for Māori whānau and those in the lowest income quartile – this may be linked to poor housing quality, which is tracked in Objective 2. Both household and transport energy costs as a portion of expenditure have been trending down since 2014[7]. This indicator is intended to capture energy in all forms – we expect the prices of some things to go up (e.g. petrol, diesel, gas) to support the energy transition, but it is hoped reductions in other prices (e.g. electricity) will counteract this.	3	2
	Average household expenditure on energy as portion of total (Māori households)	6% (household) 11% (transport)[7]	TBD		3	
	Average household expenditure on energy as portion of total (income quintile 1)	8% (household) 9% (transport)[7]	TBD		2	
	Percentage of households in energy hardship	Around 6%[10] – 25%[11]	0%	MBIE is progressing a definition for energy hardship, which is critical for tracking this metric. Past studies vary in their findings due to differing definitions, but energy hardship has been reported at between 6%[10] and 25%[11] nationwide.	1	
Topic 2: Energy affordability - businesses	Energy cost per unit for commercial businesses (c/kWh)	17.33 c/kWh (electricity) 5.52 c/kWh (natural gas)[21]	TBD	Aotearoa's industrial electricity prices are in the lower half of IEA countries[22]. There is currently little reporting on energy costs as a portion of business spend, revenue or value add, which could each be useful metrics to track energy affordability for businesses. The composition of energy costs for businesses is likely to change in the future as our energy mix changes.	3	3
	Energy cost per unit for industrial businesses (c/kWh)	15.30 c/kWh (electricity) 2.57 c/kWh (natural gas)[21]	TBD		3	
	Fuel oil cost per unit (c/l)	53.09 c/l[21]	TBD			
Topic 3: Energy access	Percentage of population with access to electricity	100%[23]	100%	World Bank data shows 100% of Aotearoa 's population have access to electricity[23]. As we transition away from fossil fuels, this may affect remote community access to small scale generation from diesel or other fossil fuels.	5	5

Case study: What we are aiming for

Nā tō rourou, nā taku rourou ka ora ai te iwi – With your food basket and my food basket, the people will thrive

Nau Mai Rā is Aotearoa's first kaupapa Māori electricity retail company, with an aim to end power poverty in Aotearoa in the spirit of manaakitanga. Nau Mai Rā's billing model puts some profits towards energy hardship causes – for example, the Whānau Fund was established in March 2020, during Aotearoa's first Covid-19 lockdown to assist whānau unable to afford electricity payments. Other causes include powering marae and kura kaupapa (schools) and other iwi and hapu driven energy initiatives.

Objective 2 [Part 1]: Our energy system transitions at the scale and pace required to help Aotearoa meet its 2050 net-zero emissions target and contribute to global efforts to limit warming to 1.5°C.

Our current trajectory is not on track to achieve this objective, as represented by the CCC's Policy Reference Case Scenario. We have chosen the CCC's ambitious Tailwinds Scenario where this is available, to indicate the significant scale of the change required to achieve the objective we have set.
On this page, we are performing particularly poorly in our R&D spend and we have a long way to go across the board to achieve our transport emissions targets.

Topics	Indicator	Current state	Target future state	Commentary	Indicator Score	Topic Score
Topic 1: Transition to renewables	Absolute GHG emissions from the energy system (tCO_2-e)	34 $MtCO_2$-e[8]	4 $MtCO_2$-e (2050)[8]	For comparison, the CCC's Policy Reference Case indicates we will be emitting 20.6 $MtCO_2$-e from energy by 2050.[8]	2	2
	Renewables as a percentage of total primary energy supply (TPES)	40%[2]	60% (2035)[8]	This is a 2035 target recommended by the CCC[8].	3	
	Renewables as a percentage of total final energy consumption (TFEC)	30%[8]	50% (2035)[8]	This is a 2035 target recommended by the CCC[8].	3	
	Energy emissions intensity (tCO_2-e/PJ)	38 $ktCO_2$-e/PJ[8]	4 $ktCO_2$-e/PJ (2050)[8]	For comparison, the CCC's Policy Reference Case indicates this will be 20 $ktCO_2$-e/PJ by 2050[8].	2	
	Energy R&D budget (per 1000 units of GDP)	$0.11[9]	TBD (higher than now)	Aotearoa ranks 23rd of 30 IEA member countries, with this being less than 10% that of the highest ranking IEA country.[9]	1	
Topic 2: Transport	Absolute GHG emissions from transport (tCO2-e)	16.6 $MtCO_2$-e[8]	0.3 $MtCO_2$-e (2050)[8]	The CCC's Policy Reference Case indicates 5.7 MtCO2-e from transport by 2050[8].	1	1
	Mode share of distance travelled by low-emissions options (%)	6%[8]	22% (2050)[8]	The CCC's Policy Reference Case assumes about 8% mode share by 2050.[8] This includes walking, cycing and public transport.	1	
	Road transport emissions intensity (tCO2-e/vkt)	302 tCO_2-e/vkt[8]	34 tCO_2-e/vkt (2050)[8]	The CCC's Policy Reference Case indicates 67 tCO_2-e/vkt by 2050.[8] It would be useful to record this metric for non-road transport as well (e.g. aviation, shipping).	1	
	Fleet share of low-emissions light vehicles (%)	1%[24]	95% (2050)[8]	The CCC's Policy Reference Case assumes an EV fleet share of 70% by 2050.[8] The recent Clean Car Discount indicates an intent to start supporting this transition. The CCC modeling includes only EVs, but it is recommended this indicator include alternative low-emissions vehicles.	2	
	Biofuel portion of liquid fuel (%)	0%[8]	43% (2050)[8]	The CCC's Policy Reference Case indicates we continue to be on track for 0% biofuel portion by 2050.[8]	1	

Case study: What we are aiming for

Māori innovation and ownership in low carbon energy

For many Māori in the central North Island, the ancestor Ngātoroirangi is credited as having brought geothermal energy to Aotearoa[25]. Māori Land Trusts and Incorporations have and continue to be at the forefront of geothermal energy production, and many undeveloped geothermal assets in Aotearoa are on Māori land. The Trusts and Incorporations involved in geothermal production are implementing innovative business models, processes, and technologies to accelerate the transition to renewable energy in a way that benefits local communities and the environment over the long term, in line with Māori principles.

Objective 2 [Part 2]: Our energy system transitions at the scale and pace required to help Aotearoa meet its 2050 net-zero emissions target and contribute to global efforts to limit warming to 1.5°C.

Emissions associated with buildings and industry are also not on track for the reductions required to meet this objective – for example absolute emissions from buildings are expected to increase slightly under the Current Policy Reference Case, when we need to achieve at least a ten-fold decrease[17]. Likewise, significant reductions are needed in industrial emissions – without forcing energy-intense industries offshore if the outcome is importing higher-emissions products from overseas.

Topics	Indicator	Current state	Target future state	Commentary	Indicator Score	Topic Score
Topic 3: Buildings	Absolute GHG emissions from buildings (tCO_2-e)	1.4 $MtCO_2$-e[8]	0.1 $MtCO_2$-e (2050)[8]	The CCC's Policy Reference Case indicates 1.5 MtCO2-e from energy by 2050.[8]	1	1
	Energy intensity per floor area of residential space heating (GJ/m^2)	0.08 GJ/m^2 [26]	TBD	Aotearoa's energy intensity per floor area of residential space heating is second lowest among 23 IEA countries reported, and this is reducing.[26] However, it is not clear if this is due to efficient use of energy, or people living in inadequately heated homes.	2	
	Percentage of houses with a roof cavity with roof insulation (120mm+)	45%[12]	100% (where feasible)	This is used as a proxy for compliance with the Healthy Homes Standards, and therefore housing quality, but it is suggested compliance across insulation, ventilation and heating requirements is reported on and tracked to provide a better picture of Aotearoa's housing quality.	2	
Topic 4: Industry	Absolute GHG emissions from industry (tCO_2-e)	17.4 $MtCO_2$-e[8]	3.5 $MtCO_2$-e (2050)[8]	The CCC's Policy Reference Case indicates 13.4 MtCO2-e from industry by 2050.[8]	2	2
	National average energy intensity (index, 1990=100)	63[5]	TBD	Energy intensity, expressed as an index of energy use compared to GDP, has been falling since 1990. Aotearoa's energy intensity is the second highest in the OECD and 18% higher than the OECD average.[5] Energy intensity targets need to ensure potential emissions leakage is avoided (see case study). Energy intensity may even grow as our renewable energy system attracts industry, but this can be decoupled from emissions intensity increase.	2	
	Portion of process heat demand supplied by fossil fuels (%)	56%[15]	TBD	Natural gas and coal are important fuels for process heat. Reducing industrial heat emissions is challenging due to cost and commercial feasibility for some applications.[15]	2	

Case study: What we want to avoid

Emissions leakage of energy intense industries

Many of Aotearoa's energy- and emissions-intense industries, such as manufacture of iron, steel, methanol and cement products, develop goods that will continue to be in demand - including to support the energy transition. For example, EVs, solar panels and wind turbines use methanol in their production. Producing these goods domestically is typically a lower-emissions option than overseas production (often within a higher-emissions energy system) and import of the same product. Industrial emissions and intensity targets therefore need to take the risk of emissions leakage into account.

Objective 3 [Part 1]: Our energy sector takes responsibility for its environmental impact and supports a regenerative Aotearoa.

The key finding of the scorecard for objective 3 is the lack of tracking and reporting, at a national level, of the impacts of energy activities on whenua (land and soil), wai (water) and koiora (living communities/ biodiversity). Any data that does exist is typically held by industry and councils and not aggregated up to a national level. Impacts are controlled by consents under the Resource Management Act, but they can be locally significant. Given these factors, the extent of the issue nationally is relatively poorly understood, and better reporting is important to understand how we are performing.

Topics	Indicator	Current state	Target future state	Commentary	Indicator Score	Topic Score	Case study: What we want to avoid
Topic 1: Whenua (land and soil)	Land used for energy production (area)	Not available	TBD	There is currently no national tracking or reporting of land used for energy activities. As the land required for some activities (e.g. solar, biofuels) increases, this may become important to track.	n/a	n/a	*Prioritising economic wellbeing above social, cultural and environmental* The waterways utilised in the Tongariro Power Scheme (TPS) are taonga to ngā iwi o te kāhui maunga, who regard this natural resource as part of their identity, mana and a source of wellbeing. The Waitangi Tribunal found in 2013 that the Crown, in developing the TPS, inadequately consulted iwi, whose responsibility as kaitiaki to protect, nurture and uphold the mauri of the waterways were inhibited. Detrimental impacts on Lake Rotaira included loss of water quality, habitat, and food and fish resources. The process was found to have breached multiple Treaty obligations, and the outcomes highlight our energy system's historic prioritisation of economic wellbeing over other aspects of wellbeing – particularly cultural and environmental[28].
	Percentage of energy activities that co-exist with other land uses	Not available	TBD		n/a		
	Area of contaminated land caused by energy activities	Not available	TBD	There is currently no national reporting on contamination from energy activities, so it is not clear what the scale of this issue is.	n/a		
	Volume of non-recyclable solid waste generated by energy activities	Not available	TBD	There is currently no national tracking or reporting of this, though industry players may hold this data individually.	n/a		
Topic 2: Wai (water bodies)	Consumptive freshwater and geothermal fluid use for energy activities	Not available	TBD	Most energy uses are non-consumptive, so they are not reported in national water use metrics. Consumptive hydropower can significantly deplete or alter some rivers (e.g. Southland Waiau, Whanganui, Waikato).[27] Hydrogen and pumped hydro are emerging water-using energy activities.	3	n/a	
	Percentage of energy activities compliant with national freshwater standards	Not available	TBD	This is not currently reported on at a national level. Tracking compliance could provide information about water quality and quantity impacts of energy activities.	n/a		

Objective 3 [Part 2]: Our energy sector takes responsibility for its environmental impact and supports a regenerative Aotearoa.

Burning fossil fuels for energy activities, including for transport, industry and home heating, has various impacts on local air quality – energy activities contribute between 55% and 95% of the air pollutants monitored in Aotearoa[14]. Generally air pollutants are declining, but exceedances of the National Environmental Standards for Air Quality continue to be recorded. These air pollutants can have significant impacts on human health – for example, PM10 exposure was attributed to 27 premature deaths per 100,000 people in Aotearoa in 2016[29].

Topics	Indicator	Current state	Target future state	Commentary	Indicator Score	Topic Score	Case study: What we are aiming for
Topic 3: Koiora (living communities/ biodiversity)	Habitat clearance for energy activities (area)	Not available	TBD	This is not currently reported on at a national level. It will become important as energy activities require greater land (e.g. solar, biofuels) and/or as ocean-based energy becomes more common (e.g. offshore wind).	n/a	n/a	*Energy sector partnerships for environmental regeneration* The Waiau Fisheries and Wildlife Habitat Enhancement Trust (Waiau Trust) manages restoration of the ecological health of the Waiau River, upon which Meridian's Manapōuri Hydro Station is located. The Trust is supported by Meridian. The Whio Forever Recovery Programme, a partnership between the Department of Conservation and Genesis, undertakes recovery efforts to secure viable populations of the at-risk duck species. Vector's Urban Forest programme promises to plant two native trees for every tree that is removed for Vector's distribution works and maintenance.
	Energy activities that incorporate regenerative contributions and/ or biodiversity improvements	Not available	TBD	This is not tracked or reported on, but there are case studies of this occurring (see box). A better understanding of how often this occurs could be useful. Suitable reporting frameworks may emerge through initiatives such as the Taskforce on Nature-Related Financial Disclosures.	n/a		
Topic 4: Air	NOx emissions (NES-AQ exceedances for one-hour average NOx concentrations)	5 of 13 airsheds[14]	0 exceedances	Energy activities contribute 95% of Aotearoa's NOx emissions, with vehicles the main contributor. Monthly average NOx concentrations are decreasing at all sites[14].	3	3	
	SO2 emissions – NES-AQ exceedances for one-hour average SO2 concentrations	4 of 16 industrial airsheds[14]	0 exceedances	Energy activities contribute 70% of Aotearoa's SO2 emissions - industry is a major contributor. All six industrial sites exceed the WHO guideline for 24-hour SO2 concentrations. Trends are mixed[14].	2		
	PM10 emissions – NES-AQ exceedances for 24-hour average PM10 concentrations	30 of 51 airsheds[14]	0 exceedances	Energy activities contribute 55% of Aotearoa's PM10 emissions. Exceedances are largely due to residential heating. PM10 is showing declining trends[14].	2		
	CO emissions – NES-AQ exceedances for 8-hour average CO concentrations	0 exceedances[14]	0 exceedances	Energy activities contribute 80% of Aotearoa's CO emissions. No exceedances have been recorded since 2006[14].	5		

Objective 4 [Part 1]: Our energy system is resilient, reliable and secure.

The resilience and reliability and security of our energy system is not currently of significant concern. However, as we continue to decarbonise and increase reliance both on the electricity system and on variable renewable electricity generation, ensuring a reliable and secure supply may become more challenging. Energy storage and demand management will be increasingly important metrics to track and perform well in, to ensure continuous supplies from variable generation sources.

Topics	Indicator	Current state	Target future state	Commentary	Indicator Score	Topic Score	Case study: What we want to avoid
Topic 1: Resilience	Energy infrastructure resilience against physical impacts of climate change	'Moderate'[30]	TBD	According to the National Climate Change Risk Assessment, climate change risks to electricity infrastructure continue to be of 'moderate' consequence in 2050[30]. Renewable generation, including hydro, may be impacted by climate change impacts on weather patterns.	4	4	*The impacts of climate change on our generation resources* Some of our largest hydro dams, including the Waitaki, Clutha and Waiau receive up to 50% of their summer flows (~20% of their annual flows) from snow melt. Snowpack in these catchments is expected to be at least 20% smaller in 2050 than today under a middle of the road emissions scenario.[34] In winter, this is counteracted by increasing rainfall within these catchments, but spring and summer flows at these dams are expected to decrease. We need to keep in mind that the energy generation we enjoy now may be different in the future under a changed climate, and continue to understand these changes.
Topic 2: Reliability	Energy storage (TBD, e.g. total storage capacity in MWh)	Not available	TBD	There is currently no metric to track the different forms of storage in Aotearoa. As we transition away from fossil fuels, energy storage becomes increasingly important to cope with variations in renewable generation – so will be increasingly important to track.	n/a	3	
	Normalised System Average Interruption Duration Index (SAIDI)	209 minutes per year[31]	TBD	The 5-year trend for SAIDI is downwards, while for SAIFI is relatively consistent.[31] As Aotearoa becomes more electrified, maintaining few and short interruptions will become more challenging.	3		
	Normalised System Average Interruption Frequency Index (SAIFI)	2.13 interruptions per year[31]	TBD		3		
	Energy use data availability	Not available	TBD	This isn't something that is currently tracked, but as demand management becomes a more important factor in reliability, this could be a useful metric to understand.	n/a		
	North Island Winter Capacity Margin (NI WCM)	1223 MW[32]	630-780+ MW[33]	The NI WCM is currently well above the security of supply standards (630-780 MW)[33]. Transpower analysis indicates additional generation won't be needed to achieve this until at least 2026[32].	3		

Objective 4 [Part 2]: Our energy system is reliable, resilient and secure.

Our current energy system has moderate diversity of energy sources, but diversity may reduce as we reduce our use of fossil fuels. On the other hand, much of the fossil fuel we use is currently imported, which is a security risk that will reduce as we move away from using oil. Emerging technologies provide important opportunities to increase use of resources produced domestically to improve our energy security.

Topics	Indicator	Current state	Target future state	Commentary	Indicator Score	Topic Score	Case study: What we want to avoid
Topic 3: Security	Diversity of primary energy supply	HHI Index: 2,167	TBD	Herfindahl-Hirschman Index (HHI) based on the proportion of TPES provided by different sources[35]. This falls within the 1,500-2,500 range representing moderate diversity[36]. As we reduce fossil fuel use, this number may become higher (less diverse).	3	2	*Significant energy supply incidents* **1998 Auckland CBD power failure:** a series of faults in Auckland's transmission lines left the CBD without power for five weeks. The Inquiry was critical of risk and asset management and contingency planning[37]. **2017 Auckland Fuel Supply Interruption:** the pipeline bringing diesel, petrol and jet fuel from Marsden Point Oil Refinery into Auckland ruptured due to an earlier pipeline strike. Airlines had to limit their use of jet fuel to 30% of their usual usage, causing significant disruptions to flights to and from Auckland. The supply interruption lasted 10 days and highlighted the vulnerability of Aotearoa's fuel infrastructure.
	Diversity of electricity generation	HHI Index: 3,740	TBD	HHI based on the proportion of electricity generated from different sources[35]. This is above 2,500 so represents a concentrated (not diverse) market[36]. Diversity may further reduce as we further decarbonise electricity.	2		
	Import dependence	28.9%[35]	TBD	This is the energy import proportion of TPES[35]. As fossil fuel use is reduced, import dependence may naturally fall.	3		
	Winter Energy Margin (WEM)	21.1%[32]	21.1%+[33]	Aotearoa's WEM is currently above security of supply standards (14-16%)[33], but Transpower analysis indicates without additional generation, we will fall below the standard by 2024-2026, depending on demand[32].	2		

Appendix 2

How we got to our recommendations list

Through our idea generation phase, we identified more than 300 possible actions that could be included in our roadmap.

We progressively narrowed this longlist down, using a combination of:

1. The scorecard results
2. Our principles
3. He Ara Waiora and accompanying focus questions
4. An assessment for each proposed action of our confidence in the problem, the solution, and the urgency of action

The recommendations list is not supported by full detailed analysis - for example, of costs, benefits, abatement potential and/or trade-offs. It is intended to provide a starting point, and a useful input generated by energy sector stakeholders, but more analysis is recommended to support implementation.

We are also aware that some of these recommendations are already underway. We have included these in the roadmap where the target outcome has not yet been achieved to ensure that the urgency around these actions is not lost. In some cases, we have also suggested where these actions should be scaled up or refined to create more impact.

Principles:

Our set of principles helped to address trade-offs and to avoid negative relationships between the different energy system outcomes.

1. **Systems thinking:** Decisions made about our energy system take a holistic, whole-of-system approach, seeking points of greatest leverage to support wellbeing of people and the environment across generations.
2. **A just transition:** Whānau, businesses and communities impacted by changes to our energy system are well supported.
3. **Informed and empowered consumers:** People have the knowledge and options to make the behavioural and lifestyle changes that are necessary to achieve society's long-term interests.
4. **Well-signalled change:** Policy and regulatory changes impacting our energy system are clearly signalled to enable informed decisions.
5. **Future-oriented & innovative:** Conventional solutions alone will not achieve the pace and scale of change needed – innovative solutions, including those drawn from mātauranga Māori, are supported.

He Ara Waiora:

The following focus questions were developed to help the team to consider how the actions contribute to the holistic vision of wellbeing articulated by He Ara Waiora.

1. Overall, do these actions reflect a holistic, intergenerational approach to wellbeing?
2. Do these actions prioritise the health of our natural environment and recognise the interconnectedness between human and environmental wellbeing?
3. Do these actions support individual and community aspirations and promote the capability necessary to achieve these aspirations?
4. Do these actions support Māori roles and responsibilities as kaitiaki of the natural environment for future generations and responsibilities of individuals and communities to sustain the environment?
5. Do these actions provide opportunities for Māori and iwi organisations to partner with Government, industry, communities and others in realising that shared vision?

Acknowledgements

This roadmap has been created through the voluntary efforts of contributors to the Low Carbon Aotearoa - An Energy Roadmap to 2030 initiative. Each member of the Leadership Group and Technical Advisory Group has invested many hours of their time. We were also supported by many others in developing this roadmap. To all those involved – thank-you.

We would like to formally acknowledge the following individuals who contributed to this work:

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- Andy Knight - Gas Industry Company
- Cristiano Marantes - Ara Ake
- Izzy Fenwick - The Aotearoa Circle, DNA
- Jane Taylor - The Aotearoa Circle, Silver Fern Farms, XRB, Orion
- Jason McDonald - Orion, Top Energy, Connetics, Mevo, Helios Energy
- Linda Mulvihill - Fonterra
- Shane Gowan - Beca
- Susan Paterson - Lodestone Energy, Reserve Bank of New Zealand, Arvida Group Ltd., Steel & Tube Holdings Ltd., ERoad, Theta Systems Ltd.
- Dr. Will Edwards - Tui Ora, Ageing Well NSC, Parininihi ki Waitotara
- MBIE (represented by Chris Bunny, Andrew Hume, Justine Cannon and Sharon Corbett)
- MfE (represented by Belinda van Eyndhoven)
- MoT (represented by Ewan Delaney and Mieke Welvaert)

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- Jenny Sullivan – Air New Zealand
- John Carnegie – Energy Resources Aotearoa
- Lucie Drummond – Mercury
- Luke Blincoe – Electric Kiwi
- Mana Newton – Tauhara North No.2 Trust
- Mark Toner – Vector
- Nicolas Vessiot – Transpower
- Ray Hall – Ngā Tāngata Tiaki
- Richard Hobbs – Transpower
- Robyn Holdaway – Vector
- Rowan Hooper – Todd Corporation
- Sheena Thomas – Z Energy
- Simon Millar – Pure Advantage
- Stuart Dickson – PowerCo
- Steve Murray – Tuaropaki Trust
- Tina Frew – Meridian Energy
- Tina Schirr – Business NZ Energy Council
- Tony Vranjes – Firstgas Group
- Victoria Daniell – Air New Zealand
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- Bioenergy Association
- Building Research Association of New Zealand (BRANZ)
- Community Energy Network
- Electricity Authority
- Electricity Networks Association
- Generation Zero
- MfE
- MoT
- MBIE
- National Energy Research Institute
- NZ Green Building Council
- NZ Hydrogen Council
- NZ Wind Energy Association
- Sir Jonathon Porritt
- Te Tai Ōhanga – The Treasury
- Vehicle Importers Association

Glossary

BIG: Battery Industry Group

BRANZ: Building Research Association of New Zealand

CCC: He Pou a Rangi - the Climate Change Commission

CRRF: COVID-19 Response and Recovery Fund

CoFR: Council of Financial Regulators

ComCom: Commerce Commission

DER: Distributed Energy Resources

EA: Electricity Authority

EEZ Act: Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012

EITE: Emission-Intensive and Trade-Exposed

ENA: Electricity Networks Association

EECA: Energy Efficiency & Conservation Authority

ERANZ: Electricity Retailers Association

EV: Electric Vehicle

ETS: Emissions Trading Scheme

GW: Gigawatts

GWh: Gigawatt-hour

GIDI: Government Investment in Decarbonising Industry

GHG: Greenhouse Gas

IEA: International Energy Agency

ICE: Institution of Civil Engineers

Ināia tonu nei: Do now

Koiora: biodiversity

KW: Kilowatt

KWh: Kilowatt-hour

MARPOL: The International Convention for the Prevention of Pollution from Ships

MW: Megawatts

MWh: Megawatt-hour

MBIE: Ministry of Business Innovation and Employment

MoT: Ministry of Transport

MfE: Ministry for the Environment

MSD: Ministry of Social Development

NZTA: New Zealand Transport Agency

NSW: New South Wales

NABERS: National Australian Built Environment Rating System

NCCRA: National Climate Change Risk Assessment

OECD: Organisation for Economic Co-operation and Development

PPA: Power Purchase Agreement

R&D: Research and Development

RMA: Resource Management Act

SOE: State-Owned Enterprise

Tirotiro: Monitor

Whenua: land

Wai: waterways

Whakamahere: Plan

References

1. MfE. New Zealand's Greenhouse Gas Inventory. 2019.
2. MBIE. Energy Statistics and Modelling. 2020.
3. MoT. Green Freight – Strategic Working Paper. 2020.
4. Ara Ake. Long Distance Heavy Freight Total Cost of Ownership (LDHF TCO) comparison tool. 2021.
5. MBIE. Energy in Aotearoa 2020. 2020.
6. International Renewable Energy Agency. Global Energy Transformation – A Roadmap to 2050. 2018.
7. Stats NZ. Household living costs price indexes. 2020.
8. CCC.Ināia tonu nei – A low emissions future for Aotearoa. 2021.
9. IEA. Energy Technology R&D Budget Database. 2021.
10. EPR Panel – delivered to MBIE. Electricity Price Review. 2019.
11. Concept Consulting – prepared for the Electricity Networks Association. Options for assisting customers in energy hardship. 2017.
12. BRANZ. Assessing the condition of NZ housing – Survey methods and findings. 2020.
13. Transpower. Whakamana i te Mauri Hiko. 2020.
14. MfE. Our Air 2018 Report. 2018.
15. MBIE. Process Heat in New Zealand – Opportunities and barriers to lowering emissions – Technical Paper. 2019.
16. Business NZ Energy Council. New Zealand Energy Scenarios. 2019.
17. Te Waihanga – NZ Infrastructure Commission. Rautaki Hanganga o Aotearoa – Draft New Zealand Infrastructure Strategy. 2021.
18. New Zealand Legislation. Education and Training Act 2020 – Schedule 13. 2020.
19. Waitangi Tribunal. Hauora – Report on Stage One of the Health Services and Outcomes Kaupapa Inquiry (WAI 2575). 2019.
20. MBIE. Tables of OECD Data. 2016.
21. MBIE. Energy Prices Statistics. 2020.
22. IEA. Distribution of residential and industrial electricity prices. 2019.
23. World Bank. Sustainable Energy for All Programme Database. 2021.
24. MoT. Fleet Statistics. 2021.
25. Waitangi Tribunal. He Maunga Rongo: Central North Island Claims, Vol. 1. 2008.
26. IEA. Energy Efficiency Indicators. 2018.
27. NIWA. New Zealand Water Accounts Update 2020. 2021.
28. Waitangi Tribunal. Te Kāhui Maunga – The National Park District Inquiry Report. 2013.
29. Stats NZ. Health Impacts of PM10 Data. 2018.
30. MfE. National Climate Change Risk Assessment. 2020.
31. Commerce Commission. Performance summaries for electricity distributors – Year to 31 March 2020. 2020.
32. Transpower. Security of Supply Annual Assessment. 2020.
33. Electricity Authority. Security Standards. 2012.
34. Meridian. Climate change impacts on NZ renewable electricity generation to 2050. 2019.
35. MBIE. Energy Balance Tables. 2020.
36. Electricity Authority. Electricity Market Information Website Glossary. 2021.
37. Ministerial Inquiry into Aspects of the Auckland Power Supply Failure. Inquiry into the Auckland Power Supply Failure Report. 1998.