vector response

climate change commission draft advice 2021

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executive summary

Affordable electrification lies at the heart of Aotearoa's decarbonisation pathway.

To deliver affordable electrification, change is our only option. Vector does not believe we can continue to squeeze a new energy system, with different characteristics and new objectives, into our 1998 electricity market design with its "more with more" supply-side dominated lens. Vector believes that the Government's renewable generation and transport electrification ambitions call for more than just tinkering with existing market and regulatory structures founded on marginal economic efficiency as the key objective. This objective was designed for the initial market reforms of nearly a quarter-century ago. But to deliver for the future, a new phase, and certainly new ambitions for the electricity sector calls for regulatory and policy settings with a broader decarbonisation objective able to capture new value and deliver greater customer choice. If we do not take the opportunity to design, shape and regulate the sector differently, we doubt there will be an affordable path to decarbonisation through electrification. This sentiment is reinforced by our current engagement with overseas regulators looking to fundamentally recalibrate energy regulatory objectives to support decarbonisation.

Vector is a key enabler of Aotearoa New Zealand's decarbonisation goals, and we see that role rapidly accelerating.

Vector has led the way in investing and innovating in new customer choice and solutions to respond to the challenges arising from climate change, decarbonisation and new technologies. We do so through our Symphony strategy and by partnering with global leaders in a range of technologies. Vector's strategy supports decarbonisation by focussing on customers, balancing commercial outcomes and questioning whether the current energy system will be up to the challenge ahead.

To deliver decarbonisation, we need a bold and collective vision of a new energy future that ensures customer choice, affordability and reliability.

The potential of dynamic optimisation, through harnessing data and the aggregated flexibility of new customer demand-side assets, is just one example highlighting the need to move business incentives away from "more" to "better" at every stage of the electricity value chain. Aggregated flexibility, such as new customer demand-side assets being proven on Vector's Auckland network, offers immediate "avoided cost" efficiencies which in turn unlock new competitive pressure from demand to genuinely rival supply.

Such disruptive service offerings and "whole of system" cost reduction business models were not anticipated in the siloed market structures of the original Bradford energy reforms designed around a different objective. We instead need reforms that focus on customer outcomes, balanced with government and business needs, but with a modernised objective able to better serve the energy sector. This is particularly true as rapid advances in renewable energy, digital technology and electric transport look set to only accelerate as economies commit to investing trillions of dollars to solve decarbonisation objectives.

Aligned policies and forward-looking regulatory settings are urgently required.

Vector has long called for a Ministry for Energy and Decarbonisation as the necessary catalyst to align policies and forward-looking competitive and regulatory settings supportive of industry transformation. The siloed structures of today's regulatory frameworks relate to a different time and today deliver an electricity supply chain dominated by process regulation, fragmented regulatory bodies, a blind-belief in market theory and a dominant focus on remote supply. Change is needed within the sector, and across policy and regulation - to align policy and regulatory goals, effectively monitor progress and deliver regulatory accountability, and, to ensure strong coordination, particularly with transport given the importance of transport electrification.

A managed and agreed transition for gas is needed to avoid significant customer cost and disruption for 300,000 households and small businesses.

There is an urgent need to find a sensibly balanced gas transition compact that meets the objectives of Government (carbon and affordability objectives), customers (disruptive supply and cost of appliance replacement) and gas network infrastructure owners (financial return and economic maintenance). If a clear transition path cannot be agreed, there are likely to be significant customer cost implications as well as major disruptions for businesses and households. This is because gas networks will likely be forced to cease investment to maintain supply in large parts of the network - well before any targeted customer transition timeframes. This in turn is likely to invoke significant backlash from as many as 300,000 household and commercial gas customers across New Zealand.

The Commission's proposal to effectively curtail use of gas network infrastructure over time fundamentally breaks the regulatory compact and the basis on which infrastructure owners have historically, and in good faith, invested. A fundamental aspect of such a regulatory compact is that capital returns on such assets are matched to the 40-50 year lives of the assets. With the Commission's proposal now threatening to break the regulatory compact, Vector is calling for a new Gas Transition Contract to be agreed between gas infrastructure owners and the Government as a means to maintain investor and customer confidence in our transition and ensure customer choice, reduced economic impacts, and investor confidence are all maintained through the transition.

Finally, customers have significant investments in gas-based appliances that remain expensive to replace, but the cost implications of any gas transition extend to associated structural changes to commercial and residential property to accommodate changing technologies (estimated as between $2,000 and $5,000 per premise). Combined with risk of early transition from network termination (but ahead of customer appliance replacement) such costs can be expected to invoke additional customer backlash further underscoring the value in an agreed Gas Transition Contract.

Electrification of transport calls for bold policies.

Electrification of transport in New Zealand is so fundamental to our carbon reduction pathway that bold and aligned policy initiatives to support EVs and hybrids are called for. To ensure the infrastructure is ready and resilient for electrification, there must be a step-change in confidence that our policy and regulatory settings support network transformation, digitalisation for smart and connected EV charging, and appropriately fund the investment required.

Every lever needs to be considered to promote investment in renewable generation.

Further leveraging distributed renewable generation is an opportunity to unlock a wider investor base to meet the Commission's requirement for a rapid expansion of renewable generation. To support the country's renewable generation targets it will be important to unleash new investment by those with the capacity and capability to both deliver a diverse base of renewable generation but also to support disruptive business models able to meet changing customer behaviours and assets.

Vector's vision is to Create a New Energy Future.

Vector's optimism for the future lies with decarbonisation not only being a climate imperative, but also an opportunity to drive significant modernisation through digitalisation and, the use of data, unlocking greater optimisation and thereby delivering full system cost efficiency for the benefit of customers.

Key recommendations

1.1 Ensure that EV chargers are smart to minimise the impact to electricity network peaks and therefore cost to consumers

Smart EV charging must be enabled and integrated with the network to manage new demand for electricity. By algorithmically staggering the times that EV chargers draw power from the network, widespread smart EV charging will ensure that new demand from EVs can be managed on the network without unnecessary capital costs and reliability impacts. Initiatives to curb peaks in response to new demand, supported by integration with network infrastructure, is an opportunity to increase utilisation, reducing electricity costs to all customers. Specifically, we recommend levers to ensure:

· That the supply of EV chargers in New Zealand are smart and digitally enabled - including rapid amendments to regulatory settings and network connection standards to accommodate new or updated standards.

· Alignment of these standards with building codes and wider regulations, and ongoing coordination between infrastructure providers and Local Government (including for the Commission's recommended charging infrastructure plan).

· The integration of smart chargers with digital platforms to enable optimisation across network infrastructure

· Greater network visibility of EV installations and access to smart metering data to support coordinated management and network planning .

1.2 Consider the impact on electricity peak demand from any proposed transition away from gas, and, the need for a managed transition if significant customer backlash is to be avoided

Analysis jointly commissioned by Vector has found that accounting for capital costs (currently excluded from the Commission's assessment of household costs from transitioning from the end use of gas) would cost customers between ~$2,000 - ~$5,000 – to accommodate the replacement of customer water heating and cooking, or, water heating, cooking and space heating, respectively. We recommend that the Commission:

· Reconsider their analysis around likely customer cost of the transition from gas proposed in their pathway, reflecting the true capital costs which would be required of customers as well as customer impacts from change in infrastructure investment – which could be avoided through a balanced transition compact. If we do not have a balanced transition for gas this will result in unnecessary increased costs to gas customers, higher costs to electricity customers, as well as compromise the investment that is needed for the Commission's own pathway – which includes a role for gas out to 2050.

· Account for the interplay between gas and electricity including the significant impact any gas transition will have on electricity networks and energy affordability.

· Consider timing, the optionality of green gases for gas users to transition to, and the significant downstream impacts and costs on customers and infrastructure providers.

· Support an important discussion between Government and infrastructure owners to agree a new Gas Transition Contract to avoid a likely scenario of significant customer backlash.

1.3 Re-engineer our system to drive new decentralised renewable generation – rather than our current bias towards remote generation

We recommend re-engineering our electricity market to drive greater uptake of distributed energy systems. Enabling and incentivising a wider range of generators (including distributed, standalone generators) and demand-side participation supports electricity affordability while also lifting community resilience as the economy electrifies. Localised energy systems increase resilience and avoid the cost of unnecessary transmission upgrades and losses from remote build generation. We recommend that:

· The Commission recognise the dominant focus historically applied to remote supply solutions and which has crowded out a balanced focus on the value of distributed generation and demand side participation that harnesses customer assets and actions.

• That the Commission enable active demand side participation in meeting the target to reach 60% renewable energy by 2035 – including both granular demand response, as well as storage solutions such as those being investigated by the NZ Battery Project to help overcome the dry year risk.

• Greater emphasis is placed on the investment in, and integration with, digital platforms for secure network management and coordination.

• The cap on electricity network company involvement with connected renewable generation be removed to increase the uptake and smart integration of distributed generation.

•That regulation be aligned with the uptake of community and customer owned distributed solar – including to support the pathway to allow multiple traders on a single ICP to better promote disruptive business models for customers such as peer-to-peer trading.

1.4 Rethink Regulation to ensure that it supports the future, not simply the objectives of the past

Current regulatory frameworks were designed for a different time in the evolution of the electricity sector. For the purposes of the original Bradford market reforms, key regulatory frameworks promoted refinements to our existing electricity market model (via the Electricity Authority) driven by the objective of increasing marginal efficiency and consumer welfare incrementally over time (via the Commerce Commission). Neither of these narrow objectives truly enable the rapid or transformational change and investment needed now , nor are they fit for the significant challenge of decarbonisation and the coordinated integration of customer assets. Therefore, we recommend:

• That the regulatory frameworks governing the Electricity Authority and Commerce Commission be reconsidered and redesigned in light of decarbonisation to ensure electricity regulation supports, rather than hinders, the delivery of decarbonisation.

• Shifting from a regulatory framework that responds to the risk of the Bradford era reforms – to one which puts customers and decarbonisation at the centre.

• That regulatory frameworks remove the shackles on those with capital and capability to deliver the bold change which is required of our electricity system.

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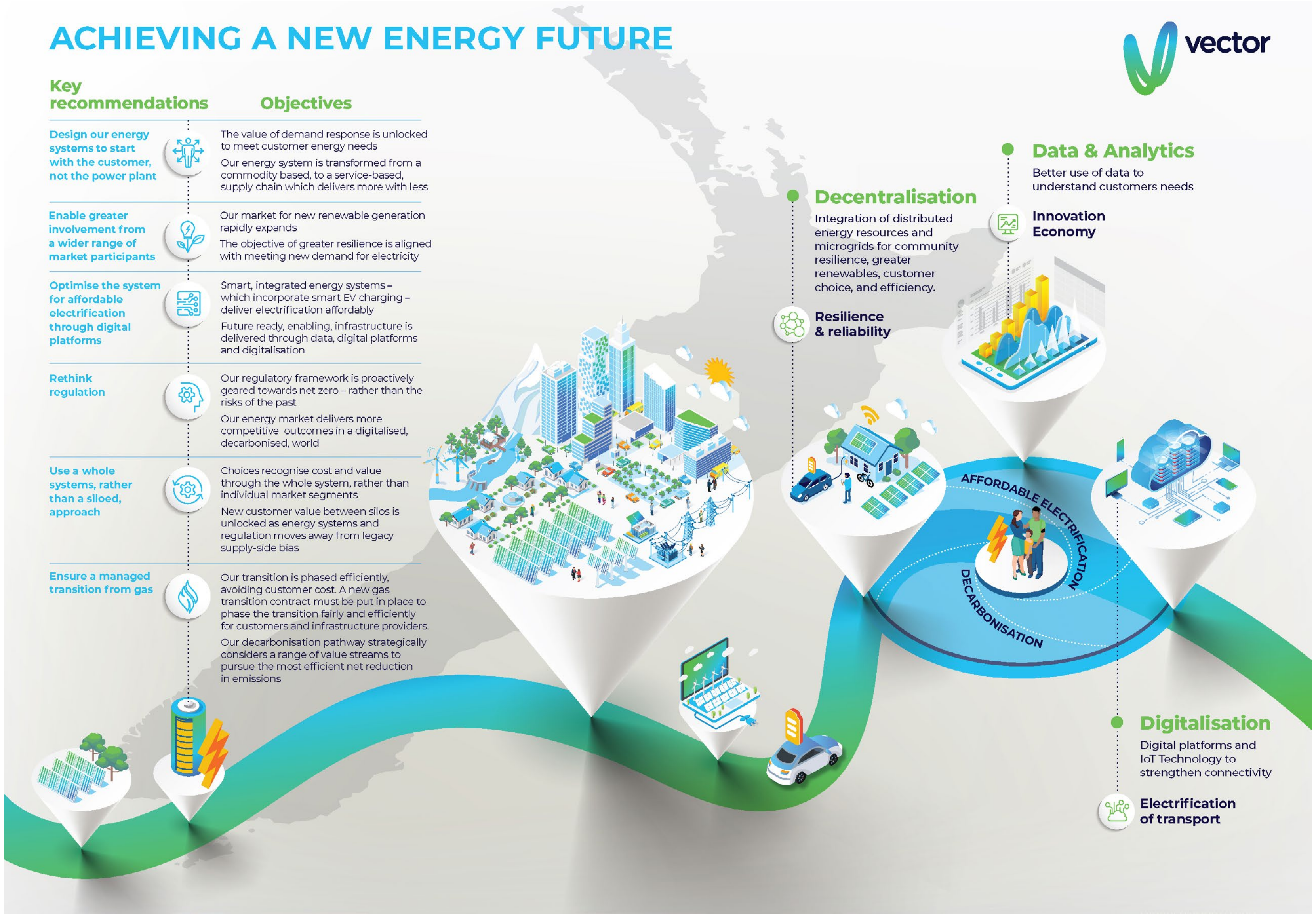

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introduction

Vector commends the Commission's draft advice on the need to transform our energy systems.

It is clear that Vector and other energy companies must play a decisive role in enabling New Zealand's emissions reduction pathway. As a majority customer owned business, Vector is focused on doing so while also unlocking major co-benefits for energy consumers. However current regulatory settings – designed around an out-dated model of a linear and siloed electricity sector – will prevent us from realising that full potential, ultimately putting New Zealand's transition to zero emissions at risk.

In this submission Vector asks the Commission to build on its draft advice to include recommendations to remove barriers holding us back and to empower us to unlock the required energy transformation.

Our message is that to deliver on the Commission's pathway we need to rethink our energy system. An energy system with the consumer (rather than the centralised powerplant) at the centre will unlock benefits of decarbonisation, affordability, customer choice, and resilience.

The Commission's pathway requires	which Vector can enable through	but we face some barriers.
The strategic expansion of the electricity system for the affordable electrification of energy use.	Investment in future ready infrastructure, including: • Dynamic optimisation of networks • Using data, digitalisation and decentralisation to significantly improve efficiency • Enabling coordinated smart charging of EVs.	Regulation of networks is backward facing, promoting incremental benefit to ensure a minimum standard is delivered. It does not promote the type of forward investment and fundamental transformation required. The sector is siloed, hindering the full potential of data and digitalisation required to realise dynamic optimisation.
Rapid expansion of renewable generation	• Driving the uptake of solar as a source of new renewable generation and competition in the market. • Direct network investment in renewable generation and micro-grids • Powersmart solar projects – including for large commercial customers.	Our current, centralised system, locks standalone generators out of the market. EDBs are prevented from investing significantly in renewable generation. Aspects of our regulatory and market framework add undue complexity and undermine the value proposition for customer-generators.
Distributed generation and demand response to unlock new value and help to reduce the amount of fossil-fuelled generation required	The provision of a range of multi-site storage/battery solutions – including distributed solutions Solar and distributed generation can offset demand for hydro generation, keeping reservoirs full for peaks, and can directly reduce emissions used for gas peaking during summer months Leveraging demand response to flatten demand peaks can help us to strategically overcome the dry year risk	The current centralised mindset focuses only on the supply side, at the expense of demand side solutions and levers. This risks locking in unnecessary costs for future generations. There is a need to re-engineer our energy system to start with demand, rather than centralised supply in our transition to greater renewable energy.
Our future electricity systems are resilient in the context of new risks	Investment in cyber security, decentralised network solutions – including micro-grids and V2H, as well as future ready networks to deliver continued security of supply in a changing environment	Regulation and the resulting allowable revenue for EDBs does not support the level or type of investment which is required today to deliver for the future.

future energy systems need to be designed for – and start with – the customer

customers are the drivers of our emissions reduction pathway – as well as our new energy future

We support the Climate Change Commission's (the Commission's) focus on reducing emissions from the end use of energy – such as transport, industrial processes and buildings – and the relevance of customer behaviour and impact in reducing emissions. Just as our successful response to climate change relies on changes to consumer behaviour, underpinned by the right enablers, the transformation of our energy systems to a low emissions future also needs to start with the customer and be supported by enabling platforms.

We agree that innovations that enable consumers to participate in the market will help reduce the amount of fossil-fuelled generation. Starting with the consumer in transforming our energy system can deliver other profound benefits to the affordability, resilience, choice, and efficiency in electricity market. These benefits will also promote the confidence that is necessary for consumers to invest and convert to electrification.

3.1 We support the Commission's principle to leverage co-benefits – we see this as being aligned with the'decarbonisation dividend'

We support the Commission's principle to 'leverage co-benefits' – or benefits which go beyond reducing emissions that can be gained through our pathway. We see this as being strongly aligned with the notion of a 'decarbonisation dividend' – captured in the recent report ReCosting Energy. Led by the UK Think Tank, Challenging Ideas, this latest report has been developed in partnership with global cross-industry project team – including Vector, Centrica, Elexon, the UK Electricity System Operator, and Imperial College of London's Grantham Institute for Climate Change – and proposes a shift in the way we assign value through our energy system by unlocking value between the silos and enabling participation of a wider range of actors. The notion of a decarbonisation dividend holds that decarbonisation is not just a cost that customers have to bear – but rather, by transforming our supply chain to start with the customer rather than the powerplant, our transformation should add additional value to their lives. Focusing on co-benefits, or the 'decarbonisation dividend' is about shifting the mindset, analytical frameworks and the view of the key risks and objectives that sit at the heart of our energy market governance. As highlighted by previous reports led by Challenging Ideas, ReDesigning Regulation, the 'trilemma' has been at the centre of wider energy policy thinking for ten years and positions energy market decision making as a balancing act between security, decarbonisation and affordability. In doing so:

"the trilemma has created the impression that there are trade-offs, and that these are competing problems, rather than complementary ambitions'.

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By framing our energy transition as an 'inherently zero-sum game' this approach puts a ceiling on the ambition of what our energy systems can deliver for customers, and on the transformation that is required to create a decarbonised, customer centric energy system.

"By replacing the problems with ambition, the issues around security of supply, decarbonisation and affordability can be dealt with by adopting a forward-moving and dynamic approach". – ReShaping Regulation, Challenging Ideas, 2017

The Commission's advice considers potential co-benefits in terms of health, environment and 'broader wellbeing'. There is an opportunity and a need to further leverage co-benefits of customer affordability, customer choice, and resilience.

We recommend that the Commission broaden its understanding of 'co-benefits' to capture a wider scope of benefits across the supply chain, and that it be deepened to capture the benefits that can be delivered by customer centric energy services through the supply chain. As is discussed further in Chapter "Dynamic Optimisation for Affordable Electrification" in section "Unlock the value between silos", the value of new energy technologies and assets through the whole system is demonstrated by

Vector/EECA V2H trial

The value of distributed solutions for increasing customer resilience is Vector's Vehicle to home (V2H) trial. This enables customers in Piha, a community which is at the edge of our electric network, to power their homes in an outage utilizing the remaining EV battery capacity.

the Whole Energy-System Cost metric (WESC). As an alternative to the levelized cost of energy (LCOE), the WESC reflects the net cost or value of energy assets on a dollar per MWh basis – accounting for whole system benefits such as displaced generation, system balancing impact, and distribution network impact. This illustrative analysis has has found that despite their capital cost, a residential smart EV charger for instance, actually adds new value to the system of ~$174 NZD per MWh.

Vector's View:

Truly unlocking these benefits requires us to transform the way that we consider our energy systems – to start with the customer, rather than centralised supply. This is an exciting 'tipping point' for electricity where the old-fashioned market design is being truly challenged by a new market designed from the bottom up and facilitated by the digital revolution.

3.2 Digitalisation is a key enabler of affordable energy

Ensuring that distributed systems deliver the most value for all users of our electricity system requires their integration and management through the right digital platforms – like Vector's Distributed Energy Resource Management System (DERMs). The importance of smart network management of new distributed assets is discussed further under the chapter "Dynamic optimisation for affordable electrification", and the potential to unlock new value in meeting future demand from distributed generation is discussed further under the chapter "Levers to expand the market for new renewable generation and broaden competitive pressure." As is mentioned further, digital solutions like DERMs can act as a platform enabling the integration of new technologies, as well as the emergence of new competitive markets and products. This is about enabling the creation of new markets – which are not constrained by the currently flawed market structure.

Leveraging these platforms to support the delivery of optimal customer services, drives our transition from a commodity based to a service-based energy system. We support the Climate Change Commission's recognition of the value of platforms and business models for affordable electrification, and we support the Commission's Necessary Action 16 – Support Behaviour Change, and recommend that enabling data and digitalisation of energy usage should be a recommendation under this 'Necessary Action'.

This transition is a shift which is occurring across industries and our economy, in response to climate change and the need to gain value in a way that is more sustainable than just generating, distributing, and consuming more.

As a key enabler of this transformation, our energy systems are not immune to this imperative to change. Our energy supply chains need to move away from a central planning mindset, to the enablement of distributed, customer driven, systems. This requires us to manage new complexity driven by the integration of more distributed assets and bi-directional flows of power – rather than the perpetuation of a centralised, linear supply chain.

Doing more from less – from consumption to optimisation

"To deliver Net Zero requires a philosophical change in how we look at the energy system from a consumption model to an optimisation model, driving value rather than commodity, fully utilising capital rather than wasting it and most importantly recognising, rewarding and incentivising consumer and demand side optimisation. With the potential of millions of assets, generation, storing, hedging we need to unlock the value and potential of a much wider group of players – a consumption model will stand in its way." –

ReCosting Energy, 2021

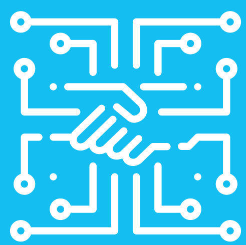
This transition is a shift which is occurring across industries and our economy, in response to climate change and the need to gain value in a way that is more sustainable than just generating, distributing, and consuming more.

As a key enabler of this transformation, our energy systems are not exempt from this imperative to change. Our energy supply chains need to move away from a central planning supply-side dominated mindset, to the enablement of distributed, customer driven, systems. This requires us to manage new complexity driven by the integration of more distributed assets and bi-directional flows of power – rather than the perpetuation of a centralised, linear supply chain. As is discussed further in Chapter "Dynamic optimisation for affordable electrification" Vector has led the way in this strategic direction through our Symphony Strategy – which seeks to deliver future ready energy systems that enable decarbonisation and respond to customer needs, by leveraging a range of solutions and value streams to ultimately deliver more with less. However, we continue to experience regulatory decision making which impedes, rather than supports, this approach. Just as the Commission's pathway reflects the investments that need to be made today to deliver for the future, energy solution providers need to incorporate the right solutions now to enable our transition and avoid cost in the future.

Digital inclusion

Covid-19 has accelerated digitalisation. Whilst this is an opportunity for decarbonisation this is also a challenge to ensure that the benefits are distributed equally. By avoiding cost at a system level, digitally enabled optimisation gains benefits for all energy consumers – not just those who have invested in smart distributed assets – like solar PV and battery systems.

We support the Commission's recommended Equitable Transitions Strategy, however we recommend that the timeline for this should be brought forward to avoid locking in impacts to low income households through decisions that are made before the end of 2023. As well as avoiding cost through smart infrastructure design (including the smart management of new demand from EVs) digital inclusion, should be a key objective of this strategy.



3.3 Data is a key enabler of customer and utility solutions – including new flexibility services and demand response markets

Data can drive efficient, customer centric energy services, which enable affordable electrification. For example, ensuring that network planning and investment is built on data driven analytics rather than traditional top-down planning can ensure that infrastructure is built to enable customer choice and to meet customer needs. Other disrupted industries have put customer needs and preferences at the heart of their design – the same needs to be true for our entire energy value chain in order to achieve the pathway proposed by the Commission.

Providing customers with near real-time feedback can also trigger important behavioural change. In winter 2019, our peak-time rebate trail, in partnership with Mercury, demonstrated customers' willingness to reduce the load during peak hours upon notification 24 hours prior. The programme was targeted specifically to only reward those who could contribute on a specific day and did not penalise those who had higher loads than usual. We observed that reduction potential is quite similar to a direct control solution like hot water load control. Smart meter data will be essential to monitor the response over a prolonged period to understand if response fatigue will set in.

As seen in many other industries, data unlocks significant value through transformation. Data can drive efficient, customer centric energy services, which enable affordable electrification. For example, network planning and investment that is driven by data analytics rather than traditional top-down, aggregate level, planning can ensure that infrastructure is built to enable customer choice and to meet customer needs. Other disrupted industries have put customer needs and preferences at the heart of their design – the same needs to be true for our entire energy value chain in order to achieve the pathway proposed by the Commission.

There is an opportunity to unlock further customer value by improving the flow of data through our energy system. For example, it has taken several years of negotiation for networks to gain access to consumption data from incumbent gentailers refusing to make this available – despite the benefits that this data can add to network planning and operations – including outage detection and safety improvements. This has almost been resolved by way of the latest default distributor agreement (DDA) facilitated by the Electricity Authority (EA). However, we consider this process and the time that it has taken for networks to access this data to be an example of coordination failure.

As New Zealand transitions to a low emissions economy, the need for near real-time and more granular data delivered by smart meters is becoming more apparent offering potential benefits which extend through our energy supply chain – delivering new value to customers. Smart meter services can enable granular demand response programmes, remote connections and disconnections, and near real-time data for network performance monitoring.

In conjunction with digital platform like Vector's DERMs, smart meter data can enable the efficient integration of distributed energy resources (DER) into low-voltage networks without compromising system security and reliability, as well as dynamic load control. The need for network coordination for the efficient integration of DER is discussed further in the Chapter "Dynamic optimisation for Affordable Electrification", section 3.5 – "Unlock the value between silos". Unlocking the value of data through our energy system, in conjunction with digital platforms, is key to delivering integrated energy systems which meet customers' needs and deliver greater system efficiency – effectively incorporating digitally enabled demand-response solutions such as smart EV chargers.

Vector is currently undertaking a trial of 200 smart EV chargers in Auckland, using the trial to understand customer charging behaviour and its impact on electricity demand peaks. This trial, which is discussed further in Chapter "Dynamic optimisation for affordable electrification", will help to inform smart network management and the design of energy systems which meet customer needs and preferences, efficiently. For example, interim findings have found that pricing incentives have limited impact in changing the time of charging, and that algorithmic charging – which staggers charging – has a key role to play in flattening demand peaks (as opposed to scheduled charging, for instance). These insights highlight the value of digitally enabled, data driven energy systems.

There is an opportunity to unlock greater efficiencies and innovation through data generated by smart meters. Metering service providers such as Vector Metering are well placed to deliver data services, ensuring the realisation of significant network and customer benefits and avoiding the unnecessary cost of duplicating information systems. The New Energy Platform (NEP) developed by Vector and Amazon Web Services (AWS) will enable energy companies to leverage further value from data through enhanced analytics capability, delivering smarter energy services.

The New Energy Platform (NEP is a data analytics and IoT solution set to be developed and co-funded by Vector and Amazon Web Services (AWS) through the strategic alliance

As part of the multi-year strategic alliance between Vector and AWS, the New Energy Platform (NEP) is an Internet of Things (IoT) and analytics solution for the energy industry and will be introduced first in Australia and New Zealand. Drawing on cloud, IoT, and data analytics technology, this platform will enable greater energy data processing, and smart, efficient energy services. The insights collected by the NEP will support the development of tailored product and pricing solutions for customers based on their energy consumption habits. In the future, insights from the NEP will enable energy companies to develop innovative solutions and new market models that accelerate the uptake of renewables, electric vehicles, and digital applications. The NEP can displace legacy systems creating a step change in processing power, flexibility.

Driving smart, customer centric future energy systems which can deliver decarbonisation requires the right capability

As highlighted by the Climate Change Commission, ensuring the right level of capability needs to be underpinned by investment in the right skills development - and our digital economy:

"the education and science and innovation systems in Aotearoa are critical for ensuring low emissions economic growth...Aotearoa is known as a country of innovators and problem solvers. Being an early mover in researching new technologies and adopting existing technologies will benefit not just the climate, but the economy and wellbeing of New Zealanders". – the Climate Change Commission

Investing in smart, energy efficient buildings (both new and retrofitted) and digitally enabled energy systems is also an opportunity to align our Covid-19 economic recovery with our emissions reduction pathway. Energy efficiency is job-intensive. For example, the American Council for Energy Efficiency Economy (ACEEE) has found that a $1 million investment in a building efficiency improvement will initially support approximately 20 jobs throughout the economy". As highlighted by the ACEEE *"An energy efficiency investment creates more jobs than an equivalent investment in either the economy on average or in the utility sector and fossil-fuels. Most energy efficiency jobs are also local because they often consist of installation or maintenance of equipment locally".*

International partnerships can also strengthen New Zealand's data analytics capability, digital economy for future high value job creation, as well as an efficient, digitalised energy transition. The strategic alliance described above, through which Vector and AWS are co-funding the development of the New Energy Platform to take to global markets, is set to create at least 30 new, highly skilled, roles in Auckland.

3.4 Energy efficiency measures and distributed generation have a key role to play to support affordability and decarbonisation

There is an opportunity to go further in driving these future outcomes by targeting passive housing standards and enabling smart home technology in our future housing stock

Energy efficiency can prevent wasted emissions, support healthier, warmer homes, and deliver greater affordability. We agree with the Commission's comments that:

"household electricity bills will depend on electricity prices, as well as demand. Households that are able to make energy efficiency improvements may be able to reduce demand or improve the level of comfort in their homes. Households should be able to reduce their household electricity bills by, for example, switching to heat pumps, or installing insulation or LED lightbulbs".
– the Climate Change Commission

We support any intervention to support equitable investment in energy efficiency. Our data has found that higher income households have benefitted from energy efficiency at a rate which is four times faster than low income households. In Auckland access to energy efficiency is not a level playing field. Access to finance and home-ownership remains a key determinant of the rate of change. Over the last decade, we have seen owner-occupied homes decrease energy use at a faster pace than tenanted homes, which adds to the burden of increasing Auckland house prices for those not on the property ladder. On behalf of its customer owners, Vector's majority shareholder Entrust, continues to prioritise investment in solutions which deliver new value to customers.

The Commission has also noted that improvements in energy efficiency may not always translate into lower demand, as many customers may choose to heat their homes more as a result of savings made.

"Because homes in Aotearoa are typically underheated in winter, households may choose to heat their home more after improving energy efficiency, rather than reducing their energy use or emissions. We assume that existing homes' energy intensity improves by 6% by 2035. We assume newly built homes are 35% more energy efficient compared to today's performance".
– the Climate Change Commission

We note that passive housing – houses which require much less heating – would reduce the impact of energy efficiency savings being offset by more heating (known as the "rebound effect"), strengthening the connection between efficiency and reduced demand. Passive buildings 'turn off the tap' when it comes to wasted energy and wasted emissions.

We agree with the assumptions related to the future energy intensity of homes mentioned above. Whilst there are a number of uncertain variables which would impact this, this is broadly consistent with our own current energy efficiency modelling for Auckland. As always there is an opportunity to change our projection of the future based on the investments that we make today – this is what underpins the Climate Change Commission's emissions reduction pathway. The Commission is proposing our future be more than the sum of today's inputs and actions multiplied by years. We agree and hold that there is an opportunity to turn the dial further on energy efficiency gains by making the right investments today. We recommend that the Commission push further in its view of what is possible by way of a smart, digitalised energy future which is built around customer needs – including to recognise the potential of IoT enabled smart home technology and passive housing –to strengthen energy efficiency.

Examples of international policies to drive more efficient housing include:

- In Germany, passive builds that meet a set efficiency level qualify for significantly reduced interest rates for the life of the loan that can transfer between owners (available for the first mortgage only).
- The case of the EU, which doesn't allow incandescent lightbulbs, has shown that the additional up-front cost of efficient lightbulbs tends to reduce over time, as demand and the market expands. An advantage of being a 'fast follower' of this policy is that the market for LED lightbulbs already exists at scale globally.
- The benefits of increasing the thermal capacity of buildings is also being investigated in Switzerland. This approach focuses not just on insulation efficiency but leverages the larger thermal capacitance of heavier buildings to enable them to retain warmth, allowing slow, constant heating – as opposed to having peaks when people come home. The desired net effect is that less heating is required, particularly during spring and autumn, as the heat from the day lasts through the night.

Transforming operational efficiency

We note the Commission and the Ministry of Business Innovation and Employment (MBIE) are focused in the same direction when it comes to the Commission's recommendations to strengthen efficiency measures and the operational performance of buildings, and MBIE's Transforming operational efficiency framework consulted on last year. However, we also note the timeframes proposed by MBIE do not match the timelines set out by the Commission. MBIE has proposed the creation of an Operational Emissions Cap and Water Use Cap for new buildings that will tighten in a series of steps, reaching a final cap by 2035. Energy efficiency measures related to existing buildings are however outside the scope of the programme. Given existing buildings are expected to make up approximately 65% of New Zealand's building stock in 2050, as well as a similar percentage of building-related emissions, this represents a missed opportunity to achieve emissions reductions in the building management sector.

We support a faster progression of work to transform operational efficiency of new and existing buildings, including with the recommendations below, in line with the timelines proposed under the Commission's emissions budgets. As noted by MBIE:

"The most significant operational carbon emissions are the indirect carbon emissions from the use of electricity and water when we live and work in buildings...approximately 20% of all energy in NZ is consumed in the operation of buildings. Currently many buildings are cold, damp and poorly ventilated which impacts on occupant health and wellbeing. The indoor environmental quality (IEQ) of buildings is primarily related to how much energy is required to maintain suitable indoor conditions throughout the year i.e., the operational efficiency." - MBIE

There is a further opportunity to offset this demand and reduce emissions from buildings' electricity consumption through the integration of distributed solar and battery solutions. We note that onsite renewable generation and storage is not covered by MBIE's building for climate change programme. This represents a missed opportunity. We recommend that the Commission further recognise the potential of distributed generation, and recommend further steps to drive the efficient uptake of distributed energy systems. Further details on these recommendations are in Chapter "Levers to expand the market for new renewable generation and broaden competitive pressure" and "Dynamic Optimisation for affordable electrification", section "Let's learn from others regarding the need for smart integration of new distributed generation".

case study

Kupe Street – Ngāti Whātua Orakei housing development and site of Kainga Tuatahi project, Vector, launched 2016

The Kainga Tuatahi project, in partnership between Vector and Ngāti Whātua, supported by Entrust, provides behind the meter solar and battery systems for each of the 30 houses at Kupe street – a residential development for iwi first home-owners delivered by Ngāti Whātua Ōrākei. This project was designed to align with the objectives of Ngāti Whātua – to develop Waro Kore Papakāinga – a carbon zero community – with affordable and healthy housing. This includes bringing together innovative energy systems, waste systems, healthy waterways, kai sovereignty, and ecological enhancement.

The project enables customers to generate and store power for their own consumption and to export any surplus to the grid for a credit. In the year ending 2020, the solar battery systems provided on average, 36 percent of customers' total consumption. Overall, Kupe street households used 20% less grid sourced kWh pa on average than the control group. In the first four months, this resulted in savings of around 12.55 tonnes of carbon dioxide equivalent (CO2e). The systems have reduced some home-owners' electricity bills – for power from the centralised grid – to as little as $13 per month.

In addition to delivering these customer benefits, the trial, which is still ongoing, seeks to assess the performance of tesla powerwall batteries in maximising solar consumption, increasing resilience (by providing back up electricity for customers in the case of an outage), and reducing peaks. Analysis has so far shown that residential batteries can contribute to a 30% peak reduction in conjunction with solar.

We strongly support the Commission's recommendation to enable more independent generation and distributed generation. There are further opportunities to encourage distributed energy systems on the network through market and regulatory change – which could play a role in changing our market structure

As highlighted by ReCosting Energy, transforming our system to start with the customer and to unlock the 'decarbonisation dividend' requires us to 'reward customers' actions and assets'.

There are a number of aspects of our current regulatory framework which inhibit the customer value proposition of investing in these assets. For example, under our current regulatory framework there can only be one retailer per ICP preventing customers from sourcing some generation from the grid and other generation from community or Peer-to-Peer traded with other consumers, for example. Further market and regulatory barriers to the integration of new renewable generation is included in the next Chapter "Levers to expand the market for new renewable generation and broaden competitive pressure."

We support:

- "Necessary Action 9: increase energy efficiency in buildings" including the recommendation to introduce mandatory measures to improve the operational energy performance of commercial and public buildings, as well as to continue improving energy efficient standards for all new buildings, new and continuing stock, through measures like improving insulation requirements. We recommend that these measures incorporate the impact of onsite generation. We recommend that these measures incorporate consideration for onsite generation.
- We support the Commission's recommendation to expand assistance which targets low-income households.
- We support the recommendation "Assess the Government's current standards and funding programmes for insulation and efficient heating to determine whether they are delivering at an appropriate pace and scale, and how they could impact housing and energy affordability. The Government should give particular consideration to potential flow through costs to tenants, and to government-owned housing stock." Included under Necessary Action 1: An equitable, inclusive and well-planned climate transition.

Recommendations

- We recommend that Leveraging and enabling digitalisation be added as a principle underpinning the Commission's advice. This will ensure that the Commission's analysis and recommendations will support smart energy systems. This should include consideration for how investment choices being made today support digital inclusion – ensuring that all customers benefit from the value of digitalisation.
- We recommend that we start from the customer, rather than the power plant, in how we consider our energy system and make investments for the future. This requires a re-engineering of our system to start with demand, not supply.
- We recommend that the Commission include enabling digitalisation of energy usage and data to drive energy decisions as a recommendation under the Commission's Necessary Action 16: Support Behaviour Change.
- We recommend that the Commission's recommended Equitable Transitions Strategy, include digital inclusion as a key objective.

- We recommend the implementation of open standards for future smart home technology and products – this can avoid the risk of tech lock in and support the longevity of investment choices made by customers. We see an opportunity for this to be incorporated into MBIE's Building for Climate Change workstream.
- We recommend that public housing procurement decisions align with passive, smart, future housing stock including efficient joinery for new builds. Having enough of the right components ready for affordable, future-ready homes is critical. The greatest gains for future energy efficiency can be made at the point of construction.
- In addition to targeting energy efficiency we consider incentives for smart and passive home solutions.

Levers to expand the market for new renewable generation and broaden competitive pressure

4.1 There is an opportunity to meet growing electricity demand through levelling the playing field for independent, distributed generation and greater EDB participation in solar and micro-grids, and through a review of current market dominance and behaviour

The impact of Tiwai for both New Zealand's domestic pathway and global emissions – including imported emissions

The Commission has found that we need to increase annual electricity generation by 20% by 2035 to meet future energy demand. This is including the assumption that Tiwai exits fully by 2026.

As noted by the Commission, industry needs certainty to make the investment in generation to meet future demand. The continued uncertainty around the exit of Tiwai – which the business has continually used as part of a political negotiation strategy – has deferred this necessary investment. We agree with the Commission that:

"electricity generation companies may not commit to this expansion in capacity while there is uncertainty around the future of the New Zealand Aluminium Smelter at Tiwai Point". – the Climate Change Commission

With Tiwai currently consuming around 13 percent of New Zealand's total electricity, the timing of this exit will be material. As well as making New Zealand's renewable electricity generation available for wider New Zealand, supporting affordable electrification and our pathway to net zero, this exit would ensure that infrastructure which has been funded significantly by tax-payers, delivers value to them – rather than an overseas owned aluminium smelter.

As has been recognised by the Commission in its draft advice, and in particular in the commentary around the Nationally Determined Contributions (NDCs) it is key that New Zealand makes a fair contribution to emissions reductions globally. Part of this is approach is considering emissions which are produced through global supply chains, and the impact that our decisions would have on these emissions.

Whilst Tiwai does not disclose its emissions from shipping currently, importing primary materials to produce aluminium in New Zealand and exporting the product to global markets, would produce significant emissions. Taking a wider view of global emissions and scope two and three emissions, if Tiwai were located in a different economy which was closer to markets and primary materials, these emissions would be largely avoided. Just as New Zealand ought not to export emissions, we also should not import them – particularly when we are spending tax-payer and/or electricity consumer funded subsidies to do so (as has been the case with Tiwai's continued subsidisation).

As has been highlighted recently by Climate Change Minister, James Shaw, New Zealand needs to consider measures to police carbon in imports, and, whether such measures are to be included in a review of free allocations ('industrial allocations') under the Emissions Trading Scheme (ETS). The European Parliament has recently supported a proposal to tax imports from countries with lower carbon costs than in the EU – applying to imports of energy and energy intensive products including steel. We support the Commission's recommendation for a 'first principles' review of the free allocation of emission credits to energy intensive businesses in New Zealand – and hold that future decisions around Tiwai need to consider the impact of the business on New Zealand's imported emissions.

Leverage new, distributed generation to meet future demand

Meeting the future demand included in the Commission's pathway will require us to bring a range of new sources of generation to market – including distributed generation. The value of distributed solutions to increase renewables is demonstrated by the 'renewables revolution' experienced by the UK – whereby in 2019 over 14% of UK renewable generation was from small scale generation systems – across over one million different systems.

Both new solar and wind generation will have a key role to play to meet future electricity demand, achieving the Commission's recommended target to increase our reliance on renewable energy. However, within the Commission's more ambitious "Further Behaviour" scenario, solar is only set to provide 3% of our total primary energy supply by 2050. Even in the most ambitious scenario – tailwinds – which combines assumptions of further behaviour and further technology, solar only makes up 5% of total primary energy supply (with 89% of total primary energy supply being renewable). In its assumptions on the uptake of rooftop solar within the ENZ model the Commission has assumed that 10% of households will have 3.5kW solar panels by 2040. This is half the penetration Australia had experienced in 2018. We question the assumptions sitting under these projections. In particular, we consider the capital costs for utility solar included in the Commission's technical assumptions for the ENZ model to be too high for most installations (the Commission has currently set this at $1,800 a kW). Solar projects on suitable sites could be delivered with less capital cost than this assumption – with greater capital cost reduction per kW occurring for larger scale projects due to greater efficiencies of scale. The assumed fixed operations and maintenance costs assumed per kW per year also appear too high for large scale solar based on international pricing.

Vector's View:

Taken overall, we do not consider the Commission's modelling to be reflective of the pace of falling solar costs. As reported by the McKinsey Global Institute, the price of solar PV cell per watt has declined by 85 percent since 2000. As we note further under section "Unlocking the value of distributed generation can add a new competitive pressure to the supply chain" our view is that the future wholesale energy prices projected by the Commission overall fail to reflect the potential of distributed solar generation to add a new competitive pressure to the market, and observed falling cost curves.

We note that in the New Zealand context, solar has less consenting barriers as compared with other renewable generation projects, in particular wind projects – which can take 6-12 months to consent. The RMA reform may exacerbate these barriers to wind generation. This is due to anticipated conflicts between biophysical limits, environmental outcomes and landscape effects. Our pathway for the future will of course be shaped by interventions that we make today, , and we recommend that the RMA reforms make it easier to advance all renewable energy projects – including wind projects, as a contributor to our future renewable energy. New Zealand is one of few developed jurisdictions without subsidies for solar, and there is an opportunity to gain value for our energy systems through larger scale commercial and industrial solar. This is also an opportunity to help electrify large industrial users. For example, the 1MW floating solar array delivered by Vector Powersmart for Watercare will offset about 25% of the water treatment plant's electricity use, generating enough power for about 200 average households for a year and reduce carbon emissions by 145 tonnes each year.

Vector PowerSmart 1 MW Solar Array - delivered for WaterCare at Rosedale treatment plant, 2020

The potential value of solar for New Zealand is real, now

We also note a view that many New Zealand roofs do not face the right way for effective rooftop solar generation. We disagree and find the statement bewildering. Most roofs are facing in a direction that would allow them to capture the sun, and you can tilt the mounts of solar panels to improve this. Research published by the University of Auckland has demonstrated the widespread potential of residential solar PV across Auckland. This work integrated LiDAR data on Auckland rooftops to develop a digital surface model of the city, including topography, buildings and trees to reflect the potential of solar driven by physical characteristics of customer's houses. Within this model, a solar radiation tool has been used to calculate the annual solar radiation on each square meter of roof area. The results show that if half of all residential rooftops installed a 3kW solar PV panel they could supply 1000GWh to the local Auckland community per annum (total annual consumption for the Auckland region is about 8000 GWh). We are working with the University of Auckland to develop this research further.

This value proposition is even stronger for larger scale projects – like commercial or industrial projects – where there is less duplication of infrastructure and greater economies of scale. Vector is undertaking work to further assess the value of commercial and industrial solar projects.

As has been shown by the floating solar array delivered for Watercare by Powersmart, solar projects also do not always need available roofspace, nor land.

Vector's View:

The Commission has recognised the value that customer and community generators can add in increasing our supply of low emissions generation – there is an opportunity to leverage EDBs as community-owned entities to both drive the uptake of solar and to optimise the network.

Research undertaken by Dr Richard Meade into the potential role of customer-owned network businesses to facilitate and accelerate the uptake of distributed renewable resources (DER) including the uptake of solar PV and the uptake of EVs has found that community owned networks, being driven by motivations wider than profit maximisation, may have a role to play both accelerating the uptake of distributed renewable generation and ensuring that it delivers the most value to communities through its integration.

"Because of their focus being broader than that of other types of firms, this means they often can justify providing services earlier, at higher quality, or at all, when profit-focused providers find it unprofitable to do so... These considerations point to customer-owned EDBs having a key role to play in accelerating the uptake of distributed renewables and other DERs. They also point to customer-owned EDBs having a role to play in accelerating the uptake of Community renewables schemes – as a means of ensuring the benefits of DERs are enjoyed by all customers, not just those able to afford them, while also minimising adverse DER impacts."
– Dr Richard Meade

This report – the "Role of Customer-Owned EDBs in Accelerating Distributed Renewables Uptake – Implications for Policy and Regulation" (Annex 2) builds on previous work undertaken by Dr Meade to understand the impact of customer ownership models on utilities' performance, comparing the quality and efficiency of electricity services delivered by both customer owned and investor owned utilities. This earlier work:

* Explored the implications of different ownership models of regulated monopolies for optimal price-quality regulation, finding that customer owned monopolies have different motivations to investor owned monopolies – valuing both the consumer surplus as well as profits – and that this should be taken into account for monopoly regulation; and

* Applied these findings to the electricity distribution businesses (EDBs) in New Zealand, finding that customer ownership of monopolies is associated with lower prices and costs, as well as greater quality (these findings reflect those of similar research undertaken in the US) than investor or government ownership.

Customer and/or community owned entities have increasingly begun to lead the ownership and operation of renewable energy systems through local community and customer cooperative solar projects globally. Such entities, having interests in local energy systems which go beyond the financial profits which they can generate – such as local community resilience, energy efficiency and low emissions energy – may be driven to invest in renewable energy systems before a purely profit motivated entity in the market would do so. By aligning this wider range of incentives, community-led distributed generation could have an important role to play in accelerating greater investment in renewables. Similarly, the interests of network businesses – particularly those which are majority owned by local communities – go

beyond a financial profit or the sale of electricity as a commodity. Rather these interests include local resilience, (both a reduction in outage frequency and duration, and a reduction in the number of customers impacted by outages); energy efficiency and system optimisation and the reliable and efficient access to energy for remote communities. By taking account of these wider benefits that distributed renewable generation can add, this makes local networks well placed to accelerate the uptake of distributed renewable generation by investing directly in these solutions. Enabling networks to include such solutions in their regulated asset bases – including smart EV charging and LED lightbulbs – is an opportunity to leverage

these incentives to deliver for customers and to optimise the network, and to support the uptake of these enabling technologies.

Gaining the most value from solar battery systems requires their smart integration with the network, the right capability, and connections with local communities

In order to get the most value from distributed solar – including system stability, distribution deferral, and maximising the use of low emissions energy sources – you need more than just a solar installation. You need visibility and coordination of the system that they are being integrated into; an understanding of network requirements and network management capability; and, connections with the local community – to align customer needs with their wider infrastructure system. Local networks have the characteristics to meet these requirements.

case study

Vector Powersmart Solution –
Laminex NZ Factory, Hamilton

Vector Powersmart, Laminex NZ Factory

In 2020 Vector Powersmart completed the 2,700 square meter solar panel system for the Laminex New Zealand Factory in partnership with the factory's landlord, Udy Investments.

The solar system has reduced Co2 emissions by 35 tonnes between November 2020 and late February this year and is set to generate enough power for 90 average homes per year. In December and January last year the solar panels exported 26 and 29MWh to the grid respectively. Laminex New Zealand, which manufactures surfaces used for kitchens and other interior design projects, has installed the solar panels alongside a number of measures to reduce energy consumption – including the use of LED lights in its warehouses as well as light and movement senses. These energy efficiency measures alone have reduced the factory's power bills by 20 percent, demonstrating the value of integrating interventions to reduce consumption as well as remote generation, to reduce industrial emissions – while increasing New Zealand's reliance on renewable generation.

4.2 Lifting the archaic cap on regulated network involvement with connected renewable generation is an opportunity to increase renewable generation, strengthen network optimisation and contribute a new competitive pressure to the wholesale market

There is an opportunity to unlock local network involvement with connected renewable generation to enable networks to invest in connected renewable solutions to offset communities' demand, optimising the network, with scope for any surplus generation to be sold directly into the wholesale market, adding a new competitive pressure.

Current limitations on network ownership of connected generation restrict EDBs' asset management options. This is not a problem-in-principle only. There are EDBs in New Zealand which have already exceeded the cap on connected generation provided for under Part 3 of the Electricity Industry Act - limiting both their capacity to leverage connected generation for network management purposes, as well as end of network solutions, or micro-grids, which can stand in place of traditional poles and wires solutions where the replacement of these traditional assets at their end of life is not economical. Whilst designed to protect emerging markets from competition risks, current limitations on network ownership of connected non-residential generation restrict EDBs' asset management options. If extended into future regulation, this would create a bias towards investment in traditional poles and wires solutions even when these may not be the most efficient or aligned with customer needs or the requirements of a decarbonised energy future. The cost of these investment decisions would last for decades. Conversely, partnering these distributed generation assets with digitally enabled demand side solutions, is an opportunity to optimise the network and increase renewable generation.

There is a need for holistic analysis to unlock the value of these solutions – rather than a perpetuation of the existing, broken, supply side model. For example, remote build transmission increases cost to customers – including from transmission losses – and forgoes the resilience benefits that could be gained through decentralised micro-grids.

As is explained further under the section "Unlocking the value of distributed generation can add an important, needed and new competitive pressure into the supply chain", increasing the uptake of renewable generation – including by way of network owned solar – would contribute new supply into the wholesale market, strengthening rather than hindering competition. The separate yet existing cap on the amount that networks can retail would restrict EDBs entrance into the retail market. This model would not position EDBs as competitors with solar retailers – but rather it would allow networks to add a new competitive pressure to the wholesale market.

The report Economics of Utility-Scale Solar in Aotearoa New Zealand, commissioned by MBIE to identify and assess drivers which contribute to the uptake of 1-200MW solar in order to forecast its uptake to 2060. As highlighted by the report – "Given the large number of forecasted distribution connected solar sites in the Far North it is curious why there are no forecast transmission connected solar systems in the Far North. This is because the GXP in the Far North has limited import capacity. Therefore, the model attempts to 'build' a transmission line to the south which becomes prohibitively expensive." As this finding shows, there is a clear value proposition for network-connected and scaled solar in our solar landscape which may not exist for other market actors. In such cases, allowing networks to invest in and leverage connected non-residential renewable generation is not displacing alternative activity in the market – it is leveraging a network business case to support an investment which would not have occurred otherwise.

As noted by the EPR Panel "stakeholders say there is potential for distributors to cross-subsidise any competitive businesses from the monopoly network businesses. Such activity could disguise a monopoly's true profitability and give an unfair advantage. They cite some distributors' recent investments in new technology such as electric vehicle chargers and batteries – but we are unaware of any proven cross subsidisation". This is unsurprising as cross-subsidisation is prevented by cost allocation rules under Part 4 of the Commerce Act, supported by disclosure obligations and information gathering powers – which make the investment decisions of EDSs highly transparent.

As is discussed further under Chapter "Dynamic optimisation for affordable electrification" New Zealand is on the cusp of the accelerated electrification of transport and process heat, and networks need to be leveraging smart solutions to enable network optimisation and affordable electrification.

A further advantage of integrating micro-grids, or decentralised network design, is increased resilience and a reduction in the number of customers impacted during planned outages. This can be seen in California, where wildfire risks force power companies to de-energise power lines in extreme conditions to reduce the risk of a fire. In parts of Northern California with a traditional centralised network design, all customers downstream of a distribution line have their power shut off even though extreme weather may only be forecasted to impact a part of the region. Conversely, in Southern California, where micro-grids have been strategically deployed since 2013, the utilities are able to selectively shut off power to smaller portions of the grid based on localised weather forecasts resulting in far less customers experiencing outages.

4.3 Our future energy systems should align the objective of strengthening resilience in the context of a changing climate as well as meeting future demand

We support the Commission's inclusion of Principle 6: Increase resilience to Climate Impacts – to guide their advice and transition to a thriving, climate resilient and low emissions Aotearoa. We also support the focus on leveraging co-benefits for customers through our transition. By leveraging distributed solutions we can help to ensure security of supply and support community resilience.

This is even more critical in the context of our increased reliance on electricity for transport, heating and industrial processes. Reducing the diversity of fuel sources that we rely on through our energy system needs to be carefully considered in the context of our gas transition (the value of integrating a range of alternative low emissions fuels is included in Chapter "Gas transition challenges"), as well as the need to ensure that we are integrating a range of distributed solutions through our electricity infrastructure (including, for instance through the NZ Battery Project), and by aligning regulation and incentives towards investment in more decentralised network design.

"The actions Aotearoa takes to reduce emissions should avoid increasing the country's overall exposure to climate risks such as drought, flooding, forest fires and storms. Where possible, actions should increase the country's resilience to the impacts of climate change that are already being experienced and that will increase in the future." – the Climate Change Commission.

We agree – and note that there is an opportunity to both strengthen our emissions reduction pathway and adaptation pathway through distributed energy system design. Resilience of our energy systems is particularly critical given the convergence of the electricity and transport sectors which will increase our reliance on electricity. In its analysis and recommendations there is an opportunity for the Commission to further consider the role of distributed energy systems and micro-grids to support our transition to a low emissions future, and the role for EDBs to increase distributed renewable generation. As mentioned above, greater reliance on decentralised energy systems can gain transmission efficiencies as well – avoiding transmission losses or remote build transmission – which later may result in the removal of transmission lines. There is an opportunity to avoid these unnecessary capital costs through decentralisation.

Network adaptation

Vector commissioned EY in 2017 to model the physical effects of climate change on its electricity network. The report, "The Physical Risks from Climate Change", concluded that the Auckland electricity network will, from a climate modelling perspective, experience more frequent and sustained high wind events in the future. Our analysis shows that if unmitigated this will have a significant impact on, amongst others, wind related outages on the network.

In addition to high wind events, the EY study found a growing impact of longer, drier summers and more frequent occurrences of flooding and inundation must also be managed.

Vector has experienced severe storms in recent years that resulted in extensive damage to the Auckland network and significant disruption to our customers. Vector also manages other climate related risks including bushfire risk during sustained periods of dry weather and the risk of asset flooding due to inundation following storm surges and high tides.

In response to these challenges Vector has adopted the International Energy Agency's (IEA) climate resilience framework which includes a focus on robustness of the network to withstand gradual changes in climate, resourcefulness in how resources are managed during a disruption, as well as a fast recovery and restoration when incidents do occur.

Kawakawa Bay Community Micro-grid

Vector has installed Auckland's first community micro-grid in Kawakawa Bay. Powered by a 1MW battery the micro-grid is designed to be switched on remotely to provide backup power to the area in case of an outage. Power is discharged from the battery for the community until power is restored, minimising outage exposure. The length of the feeder line which connects Kawakawa to the main network, along with the route and geography of the area, means that there has historically been an increased risk of damage from trees or other impacts during storms. Together with other improvements including an additional power supply route, the project is designed to result in improved resilience.

Resilience of our energy systems in the context of a changing climate need to be front and centre. This requires greater decentralisation, as well as the smart digital management of new DER – to avoid system reliability issues and power quality issues. This is discussed further in Chapter "Dynamic optimisation for affordable electrification", section "Efficient integration of new distributed generation".

Localisation and Resilience

Our Asia Pacific neighbours have been leading the way by driving resilience and energy access for remote communities through localisation. We note work being led by Japan and Australia as part of APEC to drive resilience through the localisation of energy systems as discussed at a recent public private dialogue on a proposed framework to increase investment in renewable energy in the region.

Resilience of our energy systems has traditionally been considered in terms of security of supply. However, there is an opportunity to drive greater resilience by turning our focus to the demand side of our energy systems through localisation.

There is also a need for need for a collective solution between Government and industry on how to manage new risk from climate change. This is in recognition of the fact that solar industry participants around the world are increasingly driven to self-insure in the context of climate adaptation risk, creating an additional barrier to investment in resilience-enhancing renewable systems.

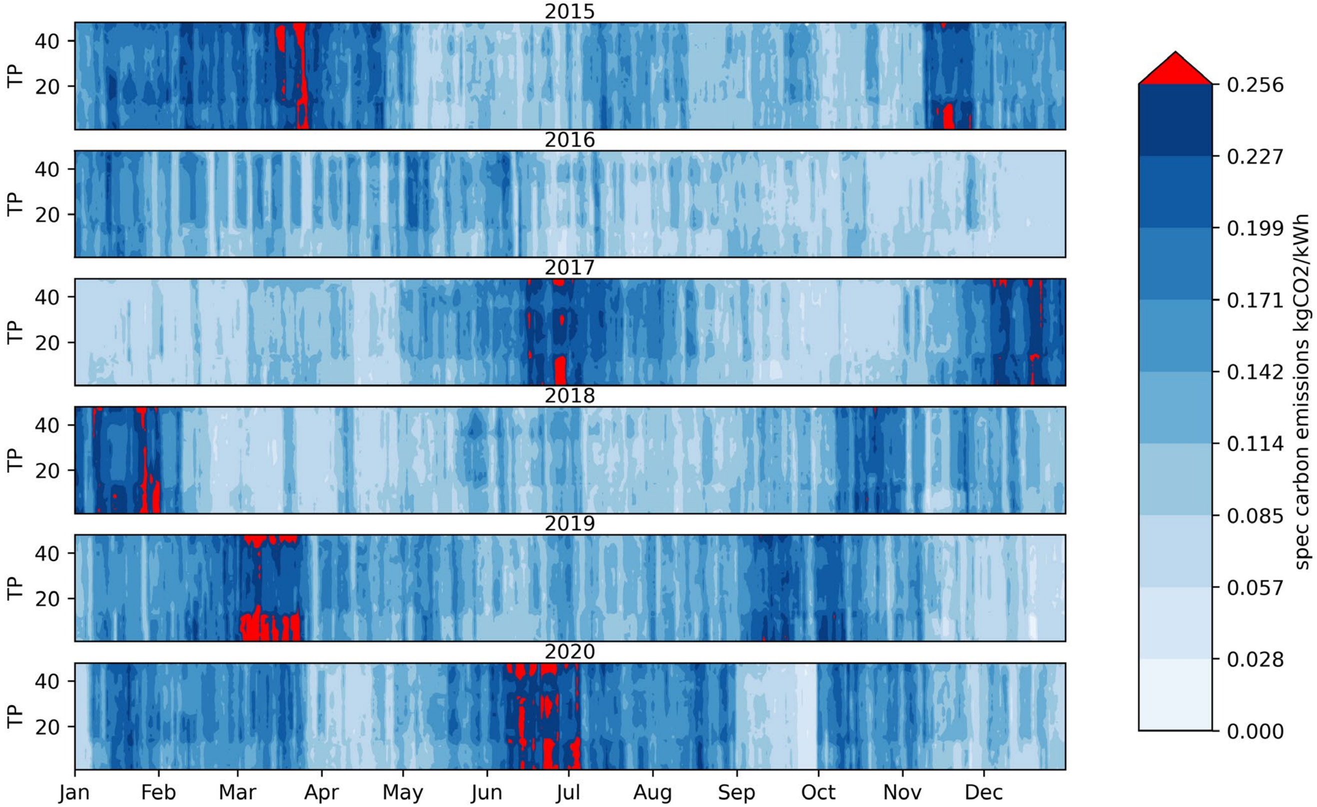
4.4 An urgent spotlight needs to be placed on the potential for solar to displace carbon-intensive generation over New Zealand summer months and enhance existing hydro storage capacity

We strongly support the NZ Battery project and its consideration of the pumped storage scheme at Lake Onslow to overcome the dry year problem. As well as help overcome the dry year risk, storage solutions are an opportunity to increase our reliance on renewables whilst mitigating electricity customers' exposure to wholesale market variation and intermittency. There is an opportunity for the NZ Battery project to consider a range of multi-site storage/battery solutions – including distributed solutions – to increase our ability to rely on renewables while preserving security of supply for NZ communities.

The potential for solar to reduce reliance on gas or other peaking sources is often underestimated given that solar PV generates less output during winter peaks. However, taking a broader systems-view, using solar when the sun is shining reduces the need to use hydro generation storage, keeping reservoirs full for times when it is needed.

The dry year problem is both a challenge of meeting demand peaks and of ensuring there is sufficient energy potential in hydro dams. Adding new solar generation would enable

Emissions per kWh over half hourly trading periods, by month – North Island



hydro generators to better optimise the timing of energy production.

While receiving very little focus to date, gas and coal peaking is used extensively in New Zealand during warmer months, with recent media reports highlighting that New Zealand's use of coal is currently the highest it has been for a decade. The graph below shows the North Island carbon emissions which are generated per kWh hour consumed at each half hourly trading period during the day (down the y axis) by month – the x axis.

Whilst emissions are more intense during the winter peaks, they are, in many cases almost as intense during the summer months (dark blue and red). In the North Island this is because hydro generation is winter rainfall driven (rather than snow melt). As a result, the highest risk time for the availability of hydro generation is early summer to Autumn when we move from low demand to high winter demand. During this dry period if there are low inflows/storage, the energy deficit effect that can only be mitigated by running thermal generation early to make up the energy during the summer to autumn period. However, and rather crucially, this coincides with the peak in solar generation capacity in the North Island.

4.5 Unleash the value of demand response to meet future electricity demand affordably

We support the Commission's 'Time critical necessary Action 3' to target 60% renewable energy by 2035. In meeting future demand, supply of energy has been the priority and, while there is a need for investment in the supply side, we must introduce the competitive tension of customer actions and assets into the market and provide them with a level playing field. Despite the benefits of unlocking demand and flexibility, there is uncertainty, misunderstanding and lack of confidence in the ability of demand actions and assets to play an important role.

However, there is an opportunity to leverage demand response to meet the Commission's 60% renewables target. That is, by reducing demand through smart solutions we can reduce the need to rely on non-renewable energy from the supply side. The Commission has demonstrated a strategic awareness of the value of demand side management in its recommended approach to reduce emissions from transport – which includes a focus on reducing mileage overall in the recommendation to "Enhance national transport network integration to increase walking, cycling, low emissions public and shared transport, and encourage less travel by private car". Just as reducing kilometres travelled is an opportunity to reduce our emissions from transport, so too can demand side levers be deployed through our energy systems to meet our renewable energy targets.

For too long we have been looking at the system from one end of the supply chain rather than recognising that physics tells us that demand is of equal importance to supply. Fear of unlocking the value of demand-side actions, and of the reliability of demand actions is misplaced. The system already has to predict and manage the weather, which is a lot more unpredictable than customers.

As we transition to greater reliance on more intermittent, renewable sources of generation, managing demand peaks can reduce the need to use gas and coal peaking. This will be particularly valuable in the short term – for example, within the first three emissions budgets – as we manage uncertainty around future electricity demand driven by EV uptake and our transition away from gas. Our system's current response to variation in weather and its approach to managing the dry year risk is to try and change customers' behaviours through the crude deployment of price increases (which, as noted below, sometimes occur even when hydro dams are at normal levels). While the sector has come a long way, the current system design is still primarily shaped around "What can you do for us" rather than "What do you need from us". Rather than seeking to change behaviours which are more predictable than the sun, digitally enabled demand response can unlock new value and reward customers whilst overcoming system risks. Demand response can move from large aggregator systems to new platforms that enable both large and individual responses with minimal customer intervention – that is, demand response can deliver benefits without customers having to take regular actions. By looking across the supply chain – rather than just focusing on supply – we can manage system risks and achieve system objectives in a more customer-centric, sophisticated, and efficient way.

By reducing the need for non-renewable generation, and, by flattening peak demand, helping to overcome variation and intermittency at the supply side of our energy market, demand response can enable us to transition to greater renewables and meet future demand. Demand response can add more value in overcoming variation in supply when it is deployed at a local level – in particular, when deployed in partnership with distributed generation which is responsive to local generation capacity. Granular, fine-grained, demand response can also support customer centric energy systems as described above in Chapter "Future energy systems need to be designed for – and start with – the customer".

In its analysis the Commission has recognised the role for demand response in minimising negative impacts of its proposed changes in the context of electricity bills and we support the recommendation to "Monitor and review to ensure electricity remains affordable and accessible, and measures are in place to keep system costs down, such as demand response management".

However, we consider that demand response can play a greater role in meeting future demand affordably than what has been included in the Commission's analysis. We note that the Commission has been openly conservative in the technology that it has integrated into its pathway. We understand why this is, but as we have noted previously, our future will be determined by the choices that we make today. There is an opportunity to further drive demand response through the Commission's pathway, and it is critical that we move away from conservative rules and regulation which can stifle new markets and elevate costs.

The sector is moving from a few players to the potential of 5 million assets and actions and the value will lie with multiple actors, across blended products and services creating a patchwork of actions. Smart demand response platforms can enable this participation our current market and system to change fundamentally. This is a value that can be added by shifting from a centralised, commodity based market, to a service based model – and it requires us to re-engineer our system around demand, rather than supply. Fundamentally, energy in its centralised form has always started from the wrong end of the "pipe", starting with security of supply rather than sizing the system around optimising and making demand most efficient.

4.6 Unlocking the value of distributed generation can add an important, needed and new competitive pressure into the supply chain

In its modelling path, the Commission has forecast future wholesale energy prices to be a minimum of $81 by 2035. This pathway includes the assumption that when Tiwai exits, there will be a surplus of electricity in the market contributing to lower prices and accelerate electrification even further. As demand increases into the future, this price picks back up (with the upper point of this threshold being the mid-point of today's prices), according to the Commission's analysis.

However, we note that in Australia, where 23% of households have solar battery systems, the price can be much lower – reaching a minimum of $35MWh in South Australia in last year's final quarter.

Distributed solar systems can add a new competitive pressure to the market, reducing prices. This is recognised in the report "Economics of Utility Scale Solar in Aotearoa New Zealand", commissioned by MBIE from Allan Miller Consulting Limited, which assumes that the large-scale uptake of solar would reduce wholesale electricity prices markedly. We believe that solar could be material in reducing electricity prices for customers.

Enabling greater involvement from a wider range of participants – and removing barriers to the trade of this energy through the network (such as for example, the current restriction of one retailer per ICP) – can contribute to lower prices by adding a new competitive pressure to the supply chain through a new demand-side source of renewable generation.

reating the pathway to allow multiple traders on a single ICP can accelerate the deployment of demand response and DER in New Zealand. As well as opening up markets for a wider range of participants (as is described in Chapter "Future energy systems need to be designed for – and start with – the customer"), allowing multi trader relationships would provide EDBs with more awareness and optionality at the edges of their networks to meet the growing demand from electrification with the use of demand side management, which would bring more competition between demand and supply in the electricity markets.

4.7 Rapidly expanding the market for renewable generation to support the Commission's pathway will require market reform in the electricity generation market

We support the Commission's recommendation to:

"introduce measures, such as a disclosure regime, to reduce wholesale electricity market uncertainty over Emission's budgets 1 and 2 and to encourage investment in new renewable generation". – the Climate Change Commission

The EA has stated that:

"Confidence in the industry may be undermined if dominant vertically integrated generator retailers subsidise the cost of electricity to their retail arm, thereby limiting competition and increasing their own profitability". – The Electricity Authority

This was further to concerns raised during the Electricity Price Review (EPR) that gentailers may be stifling retail competition by advantaging their own retailing arms via preferential pricing of electricity and/or cross-subsidisation.

This risk is very real, evidenced by the fact that in the market's 21-year life we have no new retailer of scale, nor any material independent generation. Meanwhile just five gentailers maintain 90% of the market. The EPR recommended a range of measures to increase confidence, certainty and transparency in the wholesale market, and we support their continued implementation. Whilst these are steps in the right direction, meeting the level of ambition set out by the Commission's

pathway requires a redesign rather than a rationalisation of our existing market structure. Our view is that confidence in the market is undermined currently – and there is a need for more credible market monitoring as would be characteristic of a mature market.

The importance of independent renewable generators and innovative, disruptive service offerings to better support affordable electrification further underscore the need to remove many of the barriers arising from the Bradford reforms to ensure greater market competition and innovation.

We note recent public comments that a number of key electricity consumers have lost faith in our wholesale market:

"MEUG is concerned the current high level of spot prices and expected prices through to the third quarter of this year that are flowing through to hedges could drive some small retailers, SMEs, commercial and industrial consumers, through to larger grid-connected consumers out of business. .. the survival of some consumers is on the line right now – they may not be around in 2023 to 2025 to see lower spot prices." – John Harbord, MEUG Chair

The recent UTS revealed a large generator spilling water at hydro dams whilst coal was being burnt at Huntly with the obvious effect of elevating wholesale electricity prices and costing customers an estimated $80 million over a two-week period and indirectly causing 6000 tons of carbon emissions, according to the EA. This is a very clear sign that the market is not functioning effectively in the interests of decarbonisation or affordability.

We support the EA in investigating and responding to this undesirable trading situation and market conduct. However, this signals a need for significant change in our electricity market to strengthen transparency, accountability, competition and growth to reach net zero. This is particularly as anti-completive behaviour in the wholesale market is recurring. Rather than calling a dry year risk to raise prices (whilst water storage remains in normal levels) there is a need to look across the market for more robust solutions to the dry year problem.

Vector's View:

Rapidly expanding markets for new renewable generation and maximising the use of existing generation requires a rapid, and significant shift in our energy market design to allow new independent generators to participate on an even playing field. Our current market is biased against investment in decentralised, renewable generation.

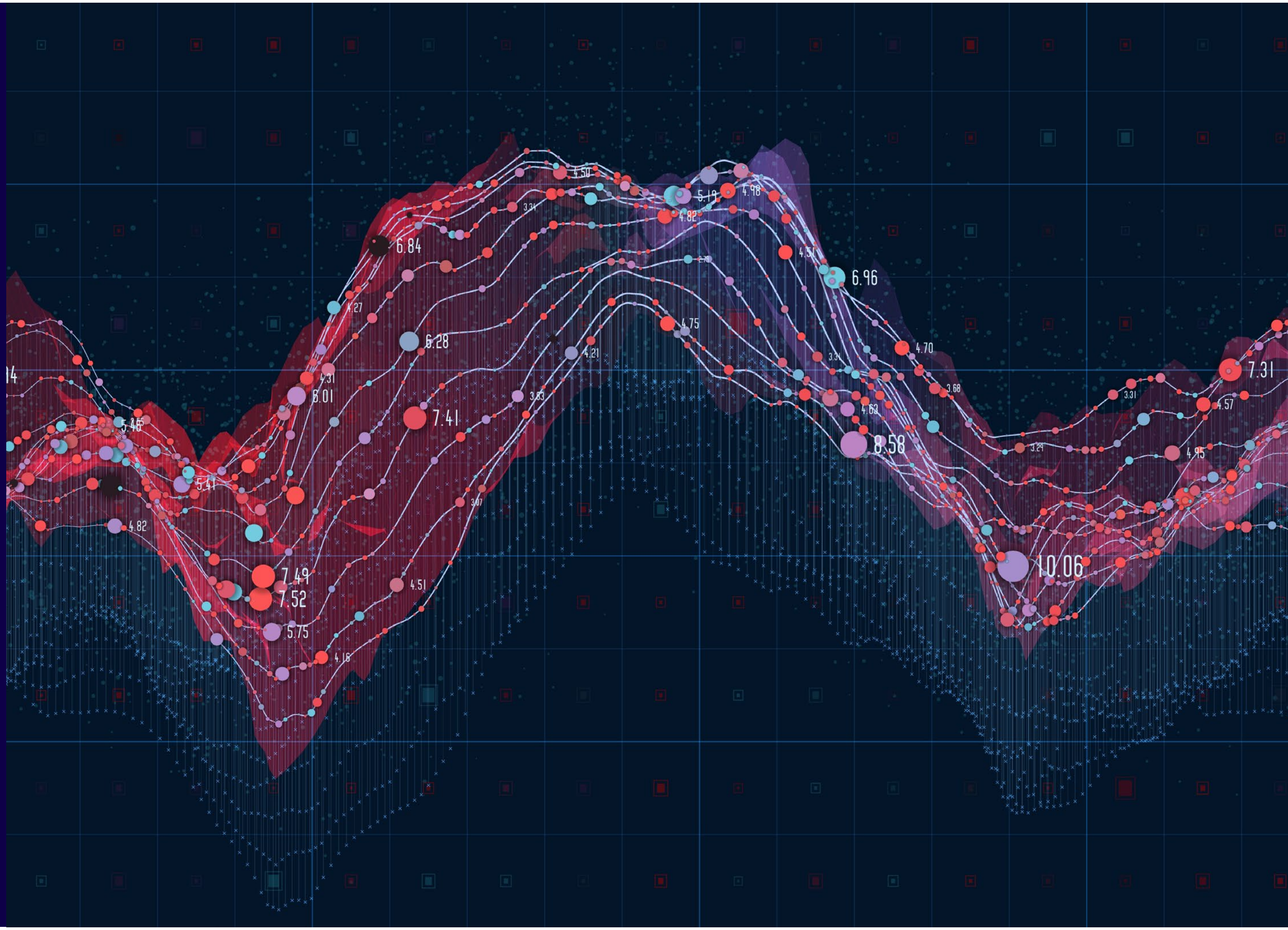
Just as the cap on network involvement with connected generation creates a bias in favour of investments in traditional poles and wires solutions, there are aspects of our market – across the value chain – which create a bias in favour of centralised, supply side investments. Our wholesale market is currently not accessible enough to standalone generators, and regulatory restrictions on multi trader relationships (that is limiting one retailer per ICP) effectively locks out potential markets for distributed renewable generators and inhibits peer-to-peer trading. This bias in favour of the centralised supply side, is at the expense of more efficient demand side investments – including decentralised generation – which deliver greater efficiencies and additional benefits of resilience. There is a need for structural change to our market to enable wider involvement of more participants, adding a new competitive pressure to the supply chain, and ultimately driving greater affordability and resilience.

Tilting investment in favour of cleaner, smarter solutions to enable decarbonisation Staggeringly, low carbon priorities are not embedded in our electricity market regulation, pivoting investment towards fossil fuel outcomes and allowing the dirtiest flexibility responses to be handsomely rewarded with the important value of flexibility flowing toward fossil fuels rather than decarbonisation options and investment. Taking a wider view of the market and sector – including the movement of global capital – this risks continuing to skew investment and maintenance capital in favour of fossil fuel generation as flexibility at a time when technology and other integrated.

Recommendations

- We recommend that the Commission further consider the role of distributed energy systems and micro-grids to support our transition to a low emissions future, and the valuable role EDBs could play in increasing distributed renewable generation while also enhancing local resilience.
- We recommend that the cap on network involvement with connected renewable generation under Part 3 of the Electricity Industry Act 2010 be removed.
- We recommend that the Commission further consider the role of demand response in meeting the target to reach 60% renewable energy by 2035. This includes granular, real-time, demand response.
- We recommend regulation be aligned with the uptake of community and customer owned distributed solar – including to support the pathway to allow multiple traders on a single ICP (alongside the development of a robust registry of DER, and their integration with digital platforms for secure management and coordination).
- We recommend that the Commission further consider the potential of solar generation to meet future supply needs in their analysis and advice, including an assessment of policy options to increase the uptake of rooftop solar particularly for larger public and commercial and industrial buildings.
- We recommend that the Commission further consider, and reflect, the potential for demand response to counterbalance the new electricity supply which is needed and to overcome variation in supply as a result of greater reliance on renewable generation.
- We recommend that demand response platforms are proactively driven in the Commission’s advice rather than just their progress ‘monitored and reviewed’.

Dynamic optimisation is key for affordable electrification



5.1 The Commission's ambition to electrify transport should be supported by bold policy action

We support the Commission's Necessary Action 3 (accelerate light electric vehicle uptake) and its pathway to electrify 50% of NZ's light vehicle travel and 40% of the light vehicle fleet by 2035, reducing almost all emissions from transport by 2050. We consider that the recommendations made by the Commission – including a focus on integrated urban design to reduce mileage and import standards to prevent New Zealand from becoming a dumping ground for inefficient, emitting vehicles, to be positive steps but that there is a need for stronger policy recommendations to drive EV and hybrid uptake within the necessary timeframes.

We agree with the Commission that:

"It is important to address the real or perceived inequality associated with electric vehicles. Policies that support the transition to a low emissions future should operate by reducing social inequities rather than exacerbating them. Additional benefits of improved air quality and ongoing savings from the lower fuel and maintenance costs that electric vehicles provide can benefit low income households most".

We note that dynamic optimisation – avoiding unnecessary costs by way of the smart management of new demand from EVs – is necessary to achieve savings on the otherwise required network infrastructure build costs, which are shared by all users of the electricity system – not just those who have purchased EVs. If demand overall increases at a rate that is faster than the rate of peak demand growth, this will increase utilisation– in effect reducing per kwh charges benefitting all electricity customers. Ensuring our electrified future is equitable is about socialising savings from smart DER management – without spreading costs that are incurred through their installation or network charges, supporting the goal of affordable electrification.

Within New Zealand's vehicle fleet the average age of cars is 14 years old with churn in sales occurring largely within the domestic second-hand market. Ensuring that customers 'buy up' in terms of EVs and hybrids is a critical element of electrifying the light vehicle fleet. This requires both that customers are able to meet the higher up-front capital cost of EVs and that there is an adequate supply of EVs in New Zealand.

Transitioning our fleet is not just a matter of reducing the import of emitting, inefficient vehicles, but it is also about ensuring there are enough EVs in New Zealand. A robust and varied supply is necessary to ensure that EVs are a relatively attractive option for customers.

This requires EV and hybrid exporters to see New Zealand as a growing and attractive market for EV exports.

case study

EV subsidies and tax incentives for EVs in the European Union

Germany

Germany increased its subsidy for EVs and hybrids by 100% in July 2020 providing €9000 for EVs (which are worth up to €40,000). These subsidies are lower for more expensive EVs and for hybrids. Half of this cost is provided by the Government and half by car manufacturers, supporting Germany's Covid-19 economic stimulus. In 2020 applications for the subsidy increased by 250% from 2019 and applications for hybrid subsidies increased by 470%. Whilst this was originally planned to run until 2021, this has recently been extended to 2025.

The Netherlands

In the Netherlands, where 21% of newly registered cars were EVs last year, EV owners can claim back €4,000 for a new EV, or €2000 when purchasing second hand EVs. This is in addition to an exemption from the one-time registration tax or annual ownership taxes that cars normally incur, (with PHEV buyers receiving a reduction on these). To incentivise the electrification of commercial vehicle fleets, there are tax reductions for companies' EV purchasers and employees using company battery cares privately pay reduced income tax (8% as compared with 22%). In the Netherlands these incentives are supported by robust public charging infrastructure where there is the highest number of public charging points for EVs per 100km in Europe. Some Local Governments offer free charging points for individuals and businesses where home and workplace charging isn't feasible.

5.2 Managing demand driven by the EV uptake in the Commission's pathway requires smart dynamic EV charging to avoid increasing network peaks

Electricity networks are a critical enabler of EV uptake. The Commission's pathway requires local distribution networks in particular to better understand customers and to manage customer demand to localised network capacity constraints. By dynamically staggering the times that EVs draw power from the network to charge whilst plugged in, smart EV charging has an essential role to play managing load to avoid large capital upgrades otherwise required.

EV charging peaks will be driven by customer behaviour and experienced at a local level. Distribution networks are best able to respond to local demand and have a strong incentive to increase utilisation, rather than to sell more power as a commodity product. Optimising charging for affordable electrification requires the coordinated management of charging by a local system operator with an incentive to avoid unnecessary upgrades. There are question marks over the regulatory regime's current alignment with this requirement.

In the Climate Change Commission's assessment of challenges and opportunities related to the electrification of transport the Commission acknowledges that:

"the coordination of EV charging times is a potential challenge for some local lines' networks. There is the risk that people coming home and plugging in the EVs after work at the same time may lead to greater evening peak demand, putting local lines under pressure and pushing up network costs."

The Commission continues:

"conversely pricing encouraging overnight charging could potentially improve network utilisation, reducing overall network costs and improve the economics of wind generation, as well as further reduce costs for EV owners." – the Climate Change Commission

However, our analysis has found that pricing in its traditional form is not likely to be an effective lever to manage demand from widespread EV adoption by itself. This is because pricing in its current form is static – that is, it imposes a higher cost during a set time – such as 6pm in the evening. This can have the impact of simply shifting the peak to a later time. Our smart EV charger trial, described below, found that whilst pricing will have some impact at low EV penetration levels (that is – shifting some customers with EVs away from the peak) due to the inherently unresponsive feedback system, tariffs will not optimise system wide adoption (that is, by shifting everyone away from the peak, they could create a new one). This impact of moving, rather than flattening the peak, tends to occur with schedule-based charging (that is, when a customer manually schedules charging to respond to peak time pricing). Whilst the role of pricing appears limited, the criticality of smart, algorithmic charging management is clear.

In general customers do not respond to complex pricing plans or incentives, rather algorithmic charging offers the ability to seamlessly stagger charging times between customers.

Smart, algorithmic charging requires customers to have the right EV chargers – which are smart – installed. Concerningly, the majority of participants recruited for Vector's smart EV charger trial described below would not have been able to carry out smart charging with their existing home charging infrastructure. It is critical for affordable electrification that future EV chargers which are installed are smart – and that they are connected to a digital platform for smart coordination.

We appreciate the perceived risk of tech lock-in, or picking winners, when it comes to measures to ensure the installation of a particular type of technology. However, this can be mitigated through open standards protocols and we encourage the Commission to consider procurement levers to ensure that EV charger imports are smart.

The value of smart EV charging for New Zealand's infrastructure is demonstrated by the metric of whole energy-system cost (WESC) undertaken by Frontier Economics (mentioned above in the Chapter "Future energy systems need to start with – and be designed for – the customer".) Accounting for the capital cost of residential smart EV chargers, the WESC has found that they add an illustrative net value of ~$174 per MWh (see to worked example opposite).

Not dissimilar from the WESC, Boston Consulting Group built a model of 'generic utility', estimating that the impact of EVs on utility investments and customer prices. Using three different EV adoption rates and three different charging optimisation schemes through to 2030, this analysis found that managed charging delivers $4,100 USD per EV with 91% of these savings from avoided distribution network investments. The significant incremental investment costs from EVs – and the potential savings that can be gained for customers from their smart management by a network – supports their inclusion with network asset management solutions.

Worked example

Worked Example Of The Wesc: Residential Smart EV Charging

Consider a residential electric vehicle which travels 40km per weekday, requiring 6kWh of electricity each time. We assume the EV would be charged between around 17:30 and 19:30, using a 3.3kW connection. The installation of a smart charger could allow this charging to take place overnight, when electricity is cheapest and demand on the network is lowest. Every day, the smart charging reduces peak-time energy consumption by 6kWh – about 1.6MWh per year.

- We assume this requires a smart controller costing around $300. The controller is assumed to last for 30 years: Given the 5% discount rate we use, this corresponds to $19.5 per year. The technology own fixed cost is therefore $19.5 / 1.6MWh = $12/MWh
- We assume that there are no variable costs associated with carrying out DSR. The technology own variable cost is therefore $0/MWh.
- As the EV would otherwise be charged during the peak, it can reduce peak power consumption by 3.3kW. We assume that this is available with 75% reliability (so, across a fleet of EVs, about 2.5kW of power can be relied upon). Our model uses a cost of generation capacity of $82/kW (based on an OCGT's cost of new entry). The EV DSR can therefore save $82 x 2.5kW = $205 of capacity costs per year. Expressed per MWh of peak-time energy avoided, this capacity adequacy benefit is $271 / 1.6MWh = $128/MWh.
- The cost of reinforcing the distribution network is assumed to be $236 per kW. Deferring this reinforcement by a year, based on a discount rate of 5%, would be worth about $11. If the EV was on a portion of the network that may otherwise require reinforcement it might save $11 x 2.5kW - $28, giving a network benefit of $28 / 1.6MWh = $18/MWh.
- By shifting energy from the peak to the off-peak, the DSR means that more expensive generators can reduce their output, saving costs. This displaced generation benefit is $48 per EV per year, so $48 / 1.6MWh = $30/MWh.
- Finally, if the system operator can call on the DSR to address short-term imbalances in power supply and demand (for example briefly interrupting charging if there is insufficient generation on the system), this can reduce the costs of balancing the system. The indicative value fo this benefit from our model is $16, so $16 / 1.6MWh = $10/MWh.

Therefore, in this illustrative example, the benefits to the system of this demand response asset – the smart EV charger– far outweighs its costs, adding a net value to the system of ~$174 NZD per MWh.

Further detail on this model is included below under the section "Unlock the value between silos".

Ensuring the uptake of smart EV charging requires:

- Supply of EV chargers in New Zealand to be smart
- The right standards to ensure that EV chargers which are installed are digitally enabled. Amendments to regulatory settings are often required to accommodate new or updated standards – including Electricity Code amendments.
- Alignment of these standards with building codes and wider regulations
- The integration of smart chargers with a digital platform, like DERMs, to enable optimisation
- Network visibility of EV installations and consumption data to support coordinated management and network planning (this is discussed further under "Access to data is fundamental to managing new demand from EVs".

The cost of widespread EV charging which could not be managed digitally would be dramatic. As reported in EECA's report Electric Vehicle Charging Technology, a managed EV charging future could save customers $6.1 billion by 2050 as compared with a passive charging future – with EV linked peak demand being six times greater under a passive, as compared with a managed, EV charging scenario.

Vector's smart EV charging trial

This ongoing trial – which includes 200 smart EVs connected to Vector's DERMs platform – is to understand both the impact EV adoption can have on our energy systems as well as customer behaviour and preferences. This is because, as the Commission has recognised, customer behaviour is at the heart of our transition.

Our interim findings from the EV charging trial are:

- Charging behaviour is difficult to predict, and, by introducing a new uncertainty, Covid- 19 has made this harder.
- The timing of customers' charging behaviour was not strongly linked with pricing incentives.
- Participants were generally poor at estimating how far they drive.

Upshot: There is a strong need to be agile and responsive to future changes in demand patterns as the light vehicle fleet electrifies. Algorithmic charging – rather than relying on scheduled charging and static price incentives – is needed to flatten peak demand.

- The more EV owners who use smart charging, the wider the scope for dynamic optimisation.
- There is more scope for flexibility than what we initially thought – particularly when customers are plugged in for a long time. The majority of charging sessions in the trial so far have been longer.
- The greater the number of participants with smart EV chargers the lower the after diversity maximum demand (ADMD). Upshot: The efficiency gains that could be made through the widespread uptake of smart EV charging is significant. Increasing demand through EV uptake, whilst flattening peaks through dynamic optimisation, increases network utilisation and efficiency for all electricity customers.
- The home may be the new petrol station with 95% of charging occurring at home.
- Participants charged their vehicles more at home as the trial progressed.
- Participants value convenience – most participants tended to proactively charge

their EVs rather than reactively (that is, they charged for the day ahead, rather than during the evening after).

Upshot: Residential smart EV charging works for customers and relying more on home charging is consistent with international trends – although as mentioned under the section

"Reducing emissions through public transport and urban design" the balance of home vs public

charging depends on a number of variables – including the type of parking that is available with housing.

Customers enjoy managed charging – more than 90% of customers rated the speed of charging, ease of usage, and overall satisfaction with their current charging situation as positive, providing a score between 8-10 for each of these aspects of managed charging (from an overall scale of 0-10 – zero being the lowest). Participants in the trial also demonstrated an awareness of, and responsiveness to, the value of avoiding capital upgrade costs for all electricity customers through managed charging.

We support the Commission's thinking in Chapter 4b – which appreciates the need for integrated systems and policies to be working well together to reduce emissions from transport. Supporting the affordable uptake of EVs requires us to consider their smart integration within our wider electricity systems – including the system wide and customer co-benefits which can be gained for example, through V2H technology, and their integration with distributed generation and storage.

The counterfactual to the smart, digital management of EVs and DERs is the slow down, or halting, of efficient system wide EV adoption.

Vector's View:

Access to data is fundamental to managing new demand from EVs

Just as digitalisation is key to the smart electrification of transport, so too is access to data. Network access to data will be key to efficient management of transport electrification – including smart meter consumption and EV charging installation data – to ensure visibility of new demand patterns on the network. Understanding these new demand patterns needs to start with customer behaviours – rather than taking a macro-central planning view of the system. We note early EV adoption has revealed clustered patterns of EV uptake with outer suburbs in Auckland tending to be early adopters of EVs. This may be because customers who need to undertake significant amounts of travel to work in the CBD are more likely to respond to whole-of-life savings of EV ownership, including greater savings from avoided fuel costs - rather than just sticker price parity which the Commission has identified as a key driver of EV uptake.

Vector is working with key industry partners to make information related to network capacity more accessible to new market participants. Whilst much of this information is already available on Vector's website we are working to make it more accessible through our open data portal – including the provision of information such as the distance of potential charging locations to high voltage cables.

Ensuring that infrastructure is ready for EV integration proactively is key to driving the uptake included in the Commission's pathway. Building a roadmap based on data and forecasts of EV uptake is an opportunity to target network investment and charging infrastructure. This requires both network access to data and the ability to integrate dynamic managed smart EV charging. In developing the charging infrastructure plan mentioned below, and considering building standards, these should be key considerations – with the need to ensure that future charging installations are smart, a top priority.

Reducing emissions through public transport, urban design and planning

We agree with the Commission that local government is at the 'coal face' of our transition – and we support the Commission's focus on reducing emissions from transport through better urban design, public transport, and making alternative modes of transport more accessible. Principles of urban design and transport integration also need to be embedded in the RMA.

Vector actively works with transport providers, developers and city planners to support the reduction of emissions from transport through smart urban design and the integration of electric charging.

Vector and Auckland Council strategic partnership

Vector and Auckland Council – including council-controlled organisations – will continue to work together to enable the electrification of transport and to strengthen community resilience in Auckland. This partnership is key to support future ready infrastructure for decarbonisation. For example, Vector has undertaken work for Auckland Transport (AT) to assess the electricity network reinforcement required at each bus depot as AT progresses plans to completely electrify their bus fleet by 2030. Vector worked with AT to also understand the fleet's energy consumption, as well as demand peaks. Vector has partnered with Auckland Transport to install public EV chargers on Waiheke and is looking to extend this work into the future. Collaboration between electricity networks and local Government will be key to developing and delivering the

charging infrastructure plan recommended by the Commission. There is a need to realise the potential of these partnerships urgently – particularly to drive the electrification of public transport.

We support the Commission's recommendation to develop a charging infrastructure plan for the 'rapid uptake of EVs to ensure greater coverage, multiple points of access and rapid charging, and to continue to support the practical roll out of charging infrastructure'. The location of EV charging in the future – including the balance of home vs public charging, is still uncertain – and designing this plan needs to be strongly and continually informed by behavioural data and insights about how customers wish to charge their EVs. These preferences may vary regionally, and even within cities and communities, and that they are likely to intersect with other urban design elements and available housing. Consequently, a national charging infrastructure plan will need to be to responsive to these variations in time and space.

A key element of our future infrastructure planning will be the nature of existing and future housing. In Auckland a reliance on on-street parking in many urban areas may increase the need for public charging in some spaces. A key element of future charging infrastructure will be ensuring that there are the right building regulations to ensure smart charging facilities are incorporated into new builds. Installation of home chargers may face barriers, particularly within older homes. Carrying out the smart EV charger trial has also been revealing of the following potential costs currently associated with installing chargers in customers' homes:

- 'Trenching' required to place an EV charger near the vehicle's parking spot
- Upgrades required to the Distribution Board and,
- Older homes having wiring which no longer meets current WorkSafe standards and must be repaired prior to an EV charger installation by a qualified electrician.

Whether charging occurs at home or in public smart digital integration, customer preferences and integration with network infrastructure, need to be key considerations. Alignment of the RMA is important for this process – to ensure that building and urban design regulations are supportive of affordable electrification, and, to ensure that infrastructure providers are able to respond to new demand quickly (including for instance to enable network upgrades which may be required).

Our future charging systems need to be underpinned by modernised systems of data flow between local government bodies and infrastructure providers, and across the electricity supply chain – including transmission, distribution and retail. Achieving this requires a change to the siloed approach through which data is currently attempted to be shared within our electricity system. As noted above, it took several years for networks to access data which is needed for operational performance including outage response.

Recommendations

- We support the 'Time critical necessary action 2: accelerate light EV uptake' and recommend that the draft advice consider the introduction of an EV feebate/subsidy until EVs reach sticker price parity.
- We recommend that the Commission strongly support measures to ensure EV chargers which are installed in the future, are smart – and that they are connected to a digital platform for operation in a dynamic optimisation environment. Just as the Commission has proposed import standards for vehicles themselves, we recommend that the Commission consider procurement standards to ensure that new EV chargers coming into New Zealand are smart. This should be partnered with open standards protocols to avoid the risk of tech lock-in or 'picking winners' for the entrance of this new technology to market. We note existing market actors – including EVNEX – are already working towards the development of open standards protocols.
- We recommend that the Commission's recommended charging infrastructure plan is explicitly anticipated to be heavily and continually informed by behavioural customer data, developed with input from Local Government and infrastructure providers, and recognises necessary changes to building regulation and district plans that may be required. We also recommend that principles of urban design and transport integration also need to be embedded in the RMA.
- We recommend the modernisation of systems which enable the flow of data – including data flows across the electricity supply chain, and between local government and infrastructure providers.
- As the commission has noted, the technology needed to electrify transport within its pathways already exists. This positions the challenge of EV uptake as an integration challenge. We recommend that the Commission continue to work to understand integration barriers and opportunities to support the integration of smart demand management technologies and services to manage future demand effectively.

5.3 Dynamic optimisation is about delivering more with less, not more with more and offers a self-reinforcing pathway to decarbonisation

Investing in future ready energy systems which can meet future demand is not just a matter of over versus under-investment. Rather it is about the right type of investments and ensuring regulation supports the level and type of investment in new technology

We agree with the approach of the Commission – to identify the enabling investments that need to be made now in our energy systems to create a platform for emissions reductions over the next 15 and 50 years – to ensure that we can electrify transport and process heat affordably. But these enabling investments are not just hard or centralised – they are also distributed and digitalised. This is about shifting from a centralised supply side mindset towards a technology system that enables the integration of demand side value and distributed generation.

The Commission has said –

"The challenge is delivering a timely, reliable and affordable build out of the electricity system, while managing the opposing risks of under or over-investing in the system. Continuing to build new electricity generation and transmission infrastructure throughout the 2020s would avoid construction bottlenecks and potential delays to wider decarbonisation in the 2030s. Over-investment could result in sunk assets or increase the delivered cost of electricity and disincentivise electrification. Underinvestment could delay progress on wider decarbonisation efforts in transport, industry and buildings." – the Climate Change Commission

Avoiding over investment is not just about optimisation to support transmission and distribution deferral. It is also about demand response to avoid unnecessary generation investment. Achieving this requires the right type of investments. Focusing on the kind of enabling investments our future needs, rather than the perceived trade-off between 'over vs underinvestment' is the best way to deliver the customer-centric transition for Aotearoa New Zealand envisioned by the Commission – and to achieve the Commission's principle to 'avoid cost'.

We strongly support the Commission's inclusion of Avoid Unnecessary Cost as a key principle. However, the Commission needs to ensure that avoided costs and co benefits are appropriately integrated into and valued within our market and regulatory framework to incentivise investments that deliver to this principle.

Vector has modelled the impact of different demand inputs and network management approaches to inform our asset management approach. In 2018 Vector developed three scenarios – Pop, Rock, and Symphony – to represent potential future pathways in navigating uncertainties around the future uptake of customer technologies and the network response to these technologies, to inform our asset management approach.

The table on the next page describes each of these scenarios as well as the load impact on the network which we projected in 2018.

The value of proactive network management of new customer assets was demonstrated clearly by this 2018 analysis – leading to the adoption of Symphony as our electricity network asset management approach – and, we have continued to update our future demand pathway integrating different variables and our continued Symphony approach. As an asset management approach, Symphony was grounded in agility – and a need to adapt quickly to changing network dynamics – 'this is a key part of efficiently responding to uncertain and rapidly changing demand patterns'.

In 2018 we found that whilst the investment required in the short term for both Rock and Symphony was similar, under Symphony, the creation of an active, rather than passive, network which can respond to demand through digital assets and IoT technology resulted in nearly $200m less in system growth compared to Rock and $140m less as compared with Pop. Just as the Commission is concerned with the investments that need to be made in the next five years to enable us to reduce emissions in the next 15 – and eventually the next 30, we know that managing new demand affordably into the future is about making the right investments at the right time. We discuss the importance of the right investment settings for networks to deliver affordable electrification further under the Chapter "Rethink Regulation".

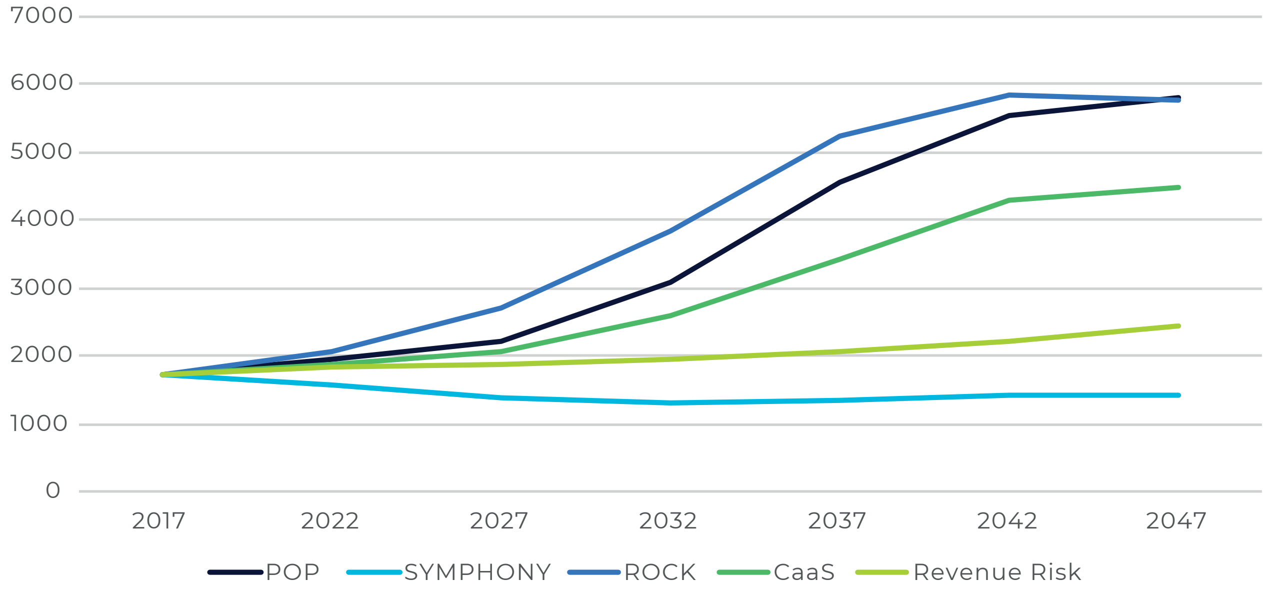
Scenario models used in Vector's 2018 AMP

Scenario	Assumptions	Projected load impact by 2027
Pop	·Steady customer uptake of new energy technology ·Network responds by becoming granularly more intelligent	28% total network demand growth
Rock	·This is the counterfactual ·Customers aggressively adopt new technology ·The network relies primarily on physical assets to meet growing demand	56% total network demand growth
Symphony	· The network proactively facilitates customer engagement and technology uptake leading to low voltage network and customer integration · Results in the alignment between technology, incentives and customer behaviour.	21% total network demand reduction

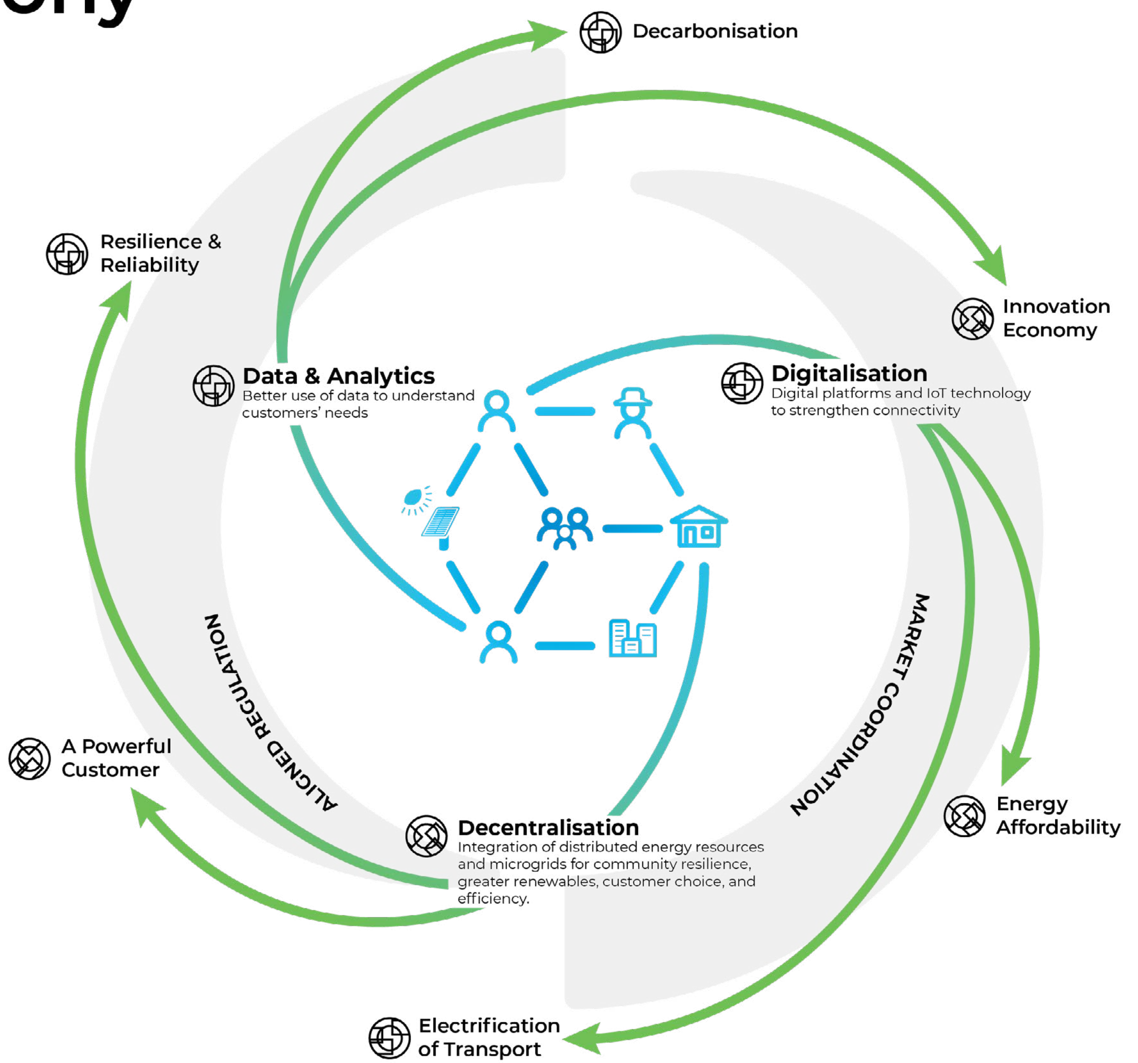
Symphony has now evolved to become our Group Strategy – reflecting the fact that delivering customer centric energy systems which enable our transition to a low emissions future is about leveraging and integrating a range of value streams to respond to change and customer needs. Symphony reflects our belief as articulated in our published 2020 Asset Management Plan – that "in order to enable a transition to low emissions energy at an affordable price, technology and innovation must play a leading role".

It has been clear to us for some time that delivering future energy systems, including the integration of more distributed assets, can be done more affordably and effectively through dynamic optimisation. This requires us to invest for the future – rather than based on approaches of the past.

Network load all scenarios

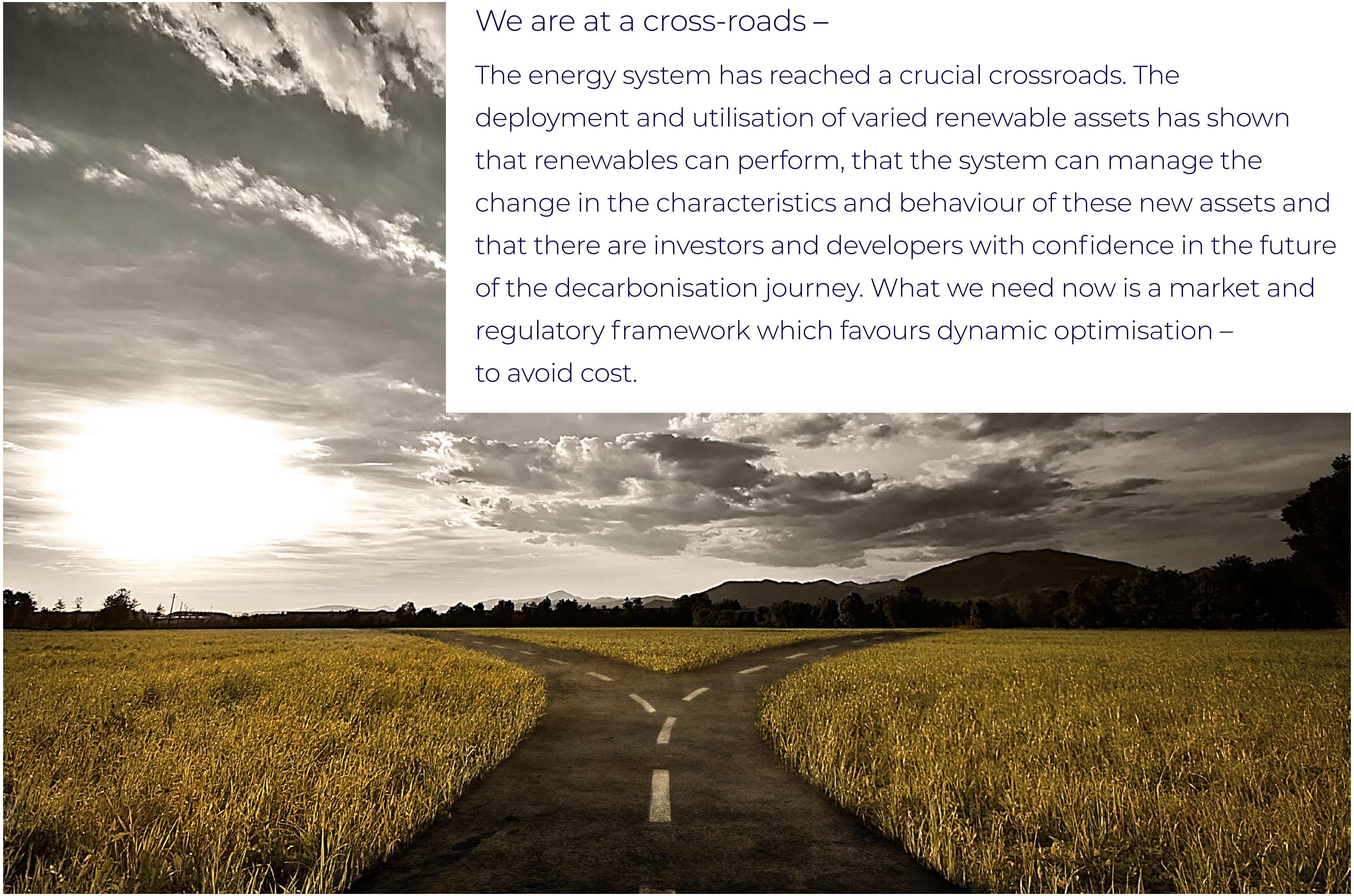


Symphony


Decarbonisation
Resilience & Reliability
Innovation Economy
Data & Analytics
Better use of data to understand customers' needs
Digitalisation
Digital platforms and IoT technology to strengthen connectivity
ALIGNED REGULATION
MARKET COORDINATION
A Powerful Customer
Energy Affordability
Decentralisation
Integration of distributed energy resources and microgrids for community resilience, greater renewables, customer choice, and efficiency.
Electrification of Transport

We are at a cross-roads –

The energy system has reached a crucial crossroads. The deployment and utilisation of varied renewable assets has shown that renewables can perform, that the system can manage the change in the characteristics and behaviour of these new assets and that there are investors and developers with confidence in the future of the decarbonisation journey. What we need now is a market and regulatory framework which favours dynamic optimisation – to avoid cost.



5.4 Let's learn from others regarding the need for smart integration of new distributed generation

As highlighted above there is a strong case to be made for network involvement with distributed solutions to increase our reliance on renewable generation in meeting future demand. This greater network involvement is also grounded in a need to manage new complexity on the network in support of dynamic optimisation – enabled by digital platforms such as Vector's DERMs solution.

In the case of Australia – where there is high DER penetration – there is also a reduction in power quality and reliability experienced. This is because high export levels during the same time of day increase voltage on the LV network resulting in quality issues, as well as causing power to flow back upstream which can risk exceeding the thermal limits on DER assets:

"if (voltages) rise sufficiently, then PV systems (i.e., their 'inverters') can automatically shut down the PV generation, causing sudden losses of supply along distribution networks" – Dr Meade, The Role of Customer-Owned EDBs in Accelerating Distributed Renewables Uptake – Implications for Policy and Regulation

This reflects that networks were traditionally designed to facilitate unidirectional flows of power. Enabling networks to manage bi-directional power flows and greater complexity, requires counter-frequency provided through the integration of new digital platforms.

Enabling the smart management of new complexity is about having the right settings in place proactively – including the right standards to ensure that smart, export-enabled inverters are integrated to enable two way flows of power, as well as to ensure that EV chargers which are installed are smart and able to be connected to a DERMs platform.

In Australia LV network capacity constraints are becoming an increasing barrier to DER integration with parts of some networks having already reached their hosting capacity. Limits on export capacity are also becoming increasingly common. As highlighted by Dr Meade in the above report, in Australia this is leading to "network operators – absent other solutions – to limit new DER connections or existing DER exports as reverse flow capacities are reached".

In Australia, consensus is emerging on the need to move to dynamic load management to flatten export peaks, enabling Distribution Network Service Providers (DNSPs – the Australian equivalent of EDBs) to manage new export peaks resulting from increased bi-directional flows of power.

We know from the Australian experience that as the uptake of distributed solar increases, load patterns change – and there is a need for networks to dynamically manage these changes and complexity. The transition from a conventional energy system to one based on more diverse sources of intermittent renewables entails more than just swapping one set of energy sources for another; it demands rethinking and restructuring the entire energy system.

New Zealand's position as a fast follower of new technology integration provides us with an opportunity to learn from overseas jurisdictions such as Australia and Germany and to optimise our own approach – which would include proactive digital network coordination of distributed assets. This is key to affordable electrification and continued system reliability.

5.5 Unlock the value that sits between historic regulatory-imposed silos

Work done with the Australian Renewable Energy Agency (ARENA) to assess the maturity of DER technology integration in Australia has found that whilst there are a lot of current projects in Australia to accelerate the uptake and integration of DER 'the main problem is a lack of coordination and visibility'. The report DER Technology Integration: Functional Framework (developed by GridWise Energy Solutions and farrierswier, commissioned by ARENA) presents a functional framework to undertake a maturity assessment of DER integration, choosing to use a capabilities focus, rather than a segmented supply-chain focus, in understanding DER maturity:

"So much of Australia's energy policy and regulation is framed by reference to the component parts of the traditional supply chain, e.g., the wholesale market for and transmission system for, bulk power supply, distribution, retail, metering, and behind the meter. However, perpetuating this framing can be unhelpful when the supply chain participants, their scope, and with whom, how and when they need to interact has to change to enable effective DER integration.

Realising the full range of benefits in the DER value stack could encompass services with benefits that may accrue to a particular participant in the traditional linear supply chain. However, the functional capabilities to realise these mostly involve a one-to-many integration that breaks the linear chain (e.g., data communication, DER visibility and predictability, and access to control or dispatch DER devices). This means that the linear supply chain view, while appealing where it works for benefits (and some problems), is not as useful for considering integration and coordination in a future of high DER penetration and improved integration. Indeed, not forcing stakeholders to recognise this feature of transformation could perpetuate the frustration of dealing with the traditional supply chain paradigm and a legacy regulatory regime inherently founded on that paradigm and the physics of its operation." – ARENA, DER Technology Integration: Functional Framework

The potential value of distributed assets – including solar, batteries, and smart EV chargers – through our whole supply chain, is significant. We note that the Commission does not ascribe a value to these 'co-benefits' in their pathway. However, just as we recommended that the concept of co-benefits' be broadened to include a wider range of customers – including resilience and affordability, we recommend that it be 'deepened' to reflect the value of these assets through the supply chain. We have developed our own metric of whole-system cost, or 'net value' of assets for the whole system. As highlighted by Frontier Economics in the report "Whole electricity system costs" commissioned by Vector to provide evidence responding to the Climate Change Commission's draft advice (Annex 3):

"As New Zealand transitions to a low-carbon economy, the electricity sector will play an important role by allowing other sectors (notably heat and transport) to electrify and reduce carbon emissions. The Climate Change Commission's draft advice to the Government has carried out high-level modelling to show which investments in generation may be required. In the future, more detailed modelling of the sector will be required (for example, to feed into the national energy strategy that the Commission recommends is developed). It is important that this work:

- *Accounts for actions on the demand side (such as demand-side response, energy efficiency, and storage) which may reduce the need for investments in generation; and*
- *Adopts a whole-system approach which accounts for the way different forms of generation of demand-side action can affect the costs of building and running the entire power system.*

Frontier Economics previously carried out work for the UK Government to produce a "Whole Electricity System Cost" (WESC) metric. This extends the commonly used Levelized Cost of Electricity (LCOE) measure to incorporate wider impacts on the system, and can allow demand-side technologies to be compared alongside generation. Vector has engaged Frontier Economics to produce an illustrative WESC for different technologies in New Zealand to show the additional costs (or, if negative, reduced costs) that the technology imposes on different parts of the power system... these elements are expressed, like a levelized cost, on a $/MWh basis.

The light blue line, which is the sum of these components, is the overall system impact. It represents the change in the total costs of the electricity system when a technology is added that has a lifetime output of 1 MWh (and the *rest of the system adjusts accordingly). When the blue line is below \$0/MWh, adding a technology such that it produces 1 MWh over its lifetime reduces total system costs. When the blue line is above \$0/MWh, it indicates that adding the technology with a lifetime output of 1 MWh increases total system costs. Technologies with lower figures will add greater benefits to the system for each MWh of energy they produce"*

While illustrative, this analysis demonstrates that:

- *Accounting for the wider impacts of technologies on the power system affects their value-for-money. It is therefore important that comparisons between technologies are not made on the narrow basis of LCOE.*
- *There are many demand-side measures which do have the potential to be more cost effective (on a MWh for MWh basis) than generation technologies). Energy efficiency technologies in particular may offer a particularly compelling alternative to baseload generation.*

Going forward, policymakers should ensure that demand-side technologies are considered alongside generation. This may require gathering additional data on the costs and capacities of these technologies, and ensuring that all actors in the market have incentives that accord with their overall impact on the system (as shown by metrics such as the WESC). Two technologies can have the same LCOE (i.e. the same "direct" costs) but dissimilar impacts on the power system. Consider, for example, two generators with the same LCOE, but one can be dispatched flexibly, and the other produces electricity intermittently. All else equal, the flexible generator adds more value to the system – or, in other words, leads to a greater reduction in the costs of operating the system – since:

- *If it can be relied upon to produce electricity during the system peak or during periods of low hydro inflows, it can reduce the amount of capacity needed to be kept on standby;*
- *If its output can be reliably and rapidly increased or decreased it may reduce the costs of balancing the system (i.e. keeping electrical demand and supply equal to one another); and*
- *If it can be dispatched when electricity prices are highest, it will displace forms of generation with higher variable costs.*

The Whole Electricity System Cost (WESC) metric takes these wider impacts on the power system into account... This framework was originally developed for the UK's Department of Energy and Climate Change with further work carried out for the Energy Technologies Institute. The UK's Department for Business, Energy and Industrial Strategy has adopted this type of framework to calculate what it calls "enhanced levelized costs".

Specifically, the above graph demonstrates for instance that smart EV chargers add a negative cost to the system – that is, taking into account their cost, they add overall value of around ~$174 NZD per MWh as an illustrative example.

The current value sits between the silos and the value is restricted from flowing from one silo to another. This will need to change to truly optimise the system and support affordable electrification.

Whilst grounded in competition concerns for new emerging markets, provisions and regulatory mindsets which limit network access to emerging technologies could compromise the expansion of the very markets they were designed to protect – both in terms of distributed generation and demand response.

We note that much of the benefit for our energy supply chain which can be gained by emerging value streams – is an avoided cost. It is not a finite additional value that can only be captured by one party at the expense of another.

We also note that the integration of new platforms, business models and technologies is key to allowing the creation of new markets to emerge. For example, the digitalisation of cell-phones has created a platform to enable the development of new products, services and markets – which have in turn disrupted further industries and services, creating opportunity for new industry players and start-ups to succeed. The mobile phone market moved from commodities to products and service contracts, unlocking exciting products while also reducing overall consumption of the data and telephony commodity (with customers increasingly purchasing unlimited plans as a service, rather than mega-bytes, texts, or minutes). Similarly digitalising our energy systems and shifting from commodities to services can both optimise network services as well as create a platform for the emergence of new distributed and digital energy service providers.

<u>Recommendations</u>

- We recommend investment settings are aligned to the provision of future ready infrastructure – supporting networks to make the right level of investment, in the right type of solutions, at the right time
- We recommend that our wider electricity market's investment approach is refocused from the centralised supply side of our market, to value demand side actions and assets as equal to supply
- We recommend the integration of a whole energy-system cost metric (WESC) in future energy planning to account for the net cost or value of assets through the whole system – creating a basis to compare demand assets with generation
- We recommend that regulation aligns with network integration of digital platforms and data for efficient integration of DER, and the stable management of new complexity.

6. Rethink regulation

6.1 Our regulatory framework and decision making needs an urgent mindset shift to deliver decarbonisation

The Commission's report challenges the electricity sector to accelerate the investment, technology and operational changes needed to enable decarbonisation. This entails a dramatic change to the status quo over the coming years. But that change will not happen without a future-focused, enabling approach from the frameworks governing key sector regulators such as the Commerce Commission and Electricity Authority. We are not confident that current regulatory settings will enable the transition and transformation that is required.

The regulatory frameworks administered by the Electricity Authority and Commerce Commission are principally focused on driving constant marginal efficiency gains via market mechanisms and incentives-based regulation. In a mature operating and technology environment, that mode of regulation increases consumer welfare incrementally over time. However, it does not enable rapid or transformational change in the industry. For example, the regulatory framework for setting expenditure allowances assumes that the best evidence of future expenditure is past expenditure and sets a very high bar to justify innovation-focused investment. The EA's regulatory framework leads to a focus on refinements to existing electricity market mechanisms, rather than enabling wholesale change in the industry. Frameworks that focus on incremental efficiency risks only delivering reactive and backward-looking approaches, rather than a proactive and future-focused stance.

The Commission has recognised the need for regulation to change:

"The regulatory regime must continue to adapt and respond to innovations, to ensure it can deliver access to abundant, affordable, and reliable low emissions electricity. It must be able to deliver the services needed to underpin electrifying the vehicle fleet and industry. The capacity and capability of electricity distribution businesses will be an important consideration. The Electricity Price Review and others have called for more innovation to be led by these businesses"
- the Climate Change Commission

We agree that regulatory frameworks must be able to deliver the services needed to underpin electrifying vehicle fleet and industry. However, we do not believe that this can be achieved through adaptation or minor amendments within existing regulatory frameworks. In facing the challenge of climate change ahead we cannot afford to be reactive in ensuring that our regulation is fit for purpose. A change to existing regulatory frameworks is required.

Vector's View

A change is required to ensure the regulatory settings enable decarbonisation. We recommend that the regulatory frameworks governing the Electricity Authority and Commerce Commission be reconsidered in light of decarbonisation to ensure regulation supports, rather than hinders, the decarbonisation pathway. the change required is shifting from a framework which was responding to risk of the Bradford era reforms – to one which puts customers and decarbonisation at the centre.

We agree with the Commission that there is a need to ‘mainstream’ decarbonisation considerations across government policies and procedures. And we support the recommendation:

“in the first budget period, the Government make progress on…Providing consistent signalling across investments, policy statements, direction to officials, internal policies and directives to ensure that all regulatory and policy frameworks are aligned with low emissions and climate resilience objectives.” – the Climate Change Commission

Just as the Commission has identified a need to align funding mechanisms for the public sector around the goal of decarbonisation, through the recommended Vote Climate Change multi-agency appropriation, there is a need to align funding and investment mechanisms for key industry enablers – including regulated utilities.

6.2 Dynamic optimisation requires coordination and the right type of investments

It is critical for the Climate Change Commission’s pathway that regulatory change aligns with the objective of enabling network involvement with emerging technologies to manage new demand and the integration of new distributed assets – as well as providing networks with certainty to make investments which are needed for affordable electrification.

The Electricity Price Review (EPR) recognised that current regulatory settings are out of step with emerging technologies. Perpetuating the regulatory approach of market segmentation by its design risks promoting a siloed understanding of the market rather than seeing the system as a whole. The cost of this approach is coordination failure – whereby the integration of technology which is necessary for affordable electrification is compromised. This is because innovation tends to cut across artificial market segments – being designed around customer needs and values rather than regulation.

We strongly support the Commissions’ recommendation that:

“the government assess whether electricity distributors are equipped, resourced and incentivised to innovate and support the adoption on their networks of new technologies, platforms and business models, including the successful integration of EVs to implement their necessary action – maximise the use of electricity as a low emissions fuel”. – the Climate Change Commission

Networks have a natural incentive to innovate and support the adoption on their networks of new technologies, platforms and business models as this avoids the risk of stranded assets – whereby customers would continue to pay for investments even whilst they no longer deliver value. Networks which are majority owned by their customers have an even stronger incentive to avoid cost and deliver value for customers. However, we suggest that questioning the extent to which EDBs are “equipped and resourced’ is too narrow a focus. What is necessary is a full review of the regulation that governs the way utilities and EDBs in particular are funded and are able to invest with confidence in new technology.

case study

Lack of regulatory funding for cyber security and innovation

In the last Commerce Commission Default Price Pathway - a regulatory determination setting out the allowable revenue for regulated networks through to 2025, networks received no new funding for cyber security in the five year period to 2025. We question whether this decision would have been made after the cyber-attack on the NZX – demonstrating the lack of alignment between our rapidly changing technological environment and the unchanging application of a historic-based regulatory approach.

When it comes to the provision of electricity as an essential service and lifeline utility, we cannot afford to wait for an incident to change the direction of our regulators' approach to investments of regulated utilities. The Commission's decarbonisation pathway has made the need for investments for the future even clearer.

Despite the failure to lift cyber security allowances, Vector has partnered with world-class experts to develop its own Security Operations Centre (SOC) and cyber security capability to suit its need for adequate, fit-for-purpose cyber protection. This required a strengthening of its IT and OT assets to build a robust solution that detects and responds to cyber-attacks, while scaling and adapting to its environment. As more users leverage the SOC, more data will be generated informing the system making it more intelligent.

Given the interconnectivity of the New Zealand energy networks, the electricity sector is only as strong as its weakest link. The relative number of EBDs to New Zealand's population size increases the inefficiency of 're-inventing the wheel' in terms of the development and use of a SOC cyber security solution. However, this will not occur if networks are not provided with the regulatory allowances to support the need for greater investment in cyber security platforms. Funding for cyber security is critical for electricity system resilience, and current lack of funding for cyber security is strongly misaligned with the greater reliance on electricity for transport and industrial processes included in the Commission's pathway, as well as the accelerated digitalisation of our economy and infrastructure driven by Covid-19.

A further example of an out-of-step regulatory decision making was the regulatory determination to provide an innovation allowance of 0.1% of forecast allowable revenue for networks. For the majority of EDBs this provides an avenue to apply for special funding up to a maximum sum of $150,000 per annum to pursue innovation. While the concept of an allowance is right, the quantum is woefully inadequate to deliver any meaningful innovation.

6.3 Driving competition and decarbonisation requires a fundamental shift to the regulatory approach of the energy sector

As demonstrated above through our scenario modelling, managing new future demand affordably through dynamic optimisation requires the right type and level of investment to be made at the right time. In 2019 Vector's forecast capex was $1.216b for RY21-25. However, the allowance in the last default price pathway (DPP3) cut this by $175m for the same period. Furthermore, our analysis has found that a persistent inflation forecasting error will result in an additional $250m in lost value for all EDBs subject to the DPP during the regulatory years 2021-2025, as compared to what recovery would have been with the current Treasury CPI forecast. This persistent error demonstrates an issue with regulatory performance within our framework.

The Climate Change Commission has a strong interest in ensuring electricity networks are appropriately funded to enable an electrification pathway. We strongly encourage the Commission to raise this important issue with Government and catalyse growing support for a fundamental rethink of regulation to ensure that it supports the acceleration of electrification rather than constrain and slow network transformation.

Rethinking regulation so that it supports, and importantly funds, network involvement and investment in emerging technologies and innovation will better enable, and ultimately drive, affordable electrification. This will require a fresh starting point for our regulatory framework and decision making – based on a future focused, rather than backward looking, conservative mindset.

This question – of what investments need to be made today to deliver for a transformed future – is reflected in the Climate Change Commission's own emissions reduction pathway – which considers what investments need to be made in the next five years to enable emissions reductions through the next 15 and our longer-term transformation out to 2050.

Conversely, our regulatory framework has only focussed on the administration of a revenue reduction objective, reflecting an understanding competition as reducing revenue as much as possible, whilst ensuring a minimum standard of essential services is delivered, within the next five years. This approach has long been out of step with the investment required for Auckland growth. However, its misalignment with the future of decarbonisation urgently needs to be resolved.

The UK energy regulator – the Office of Gas and Electricity Markets (Ofgem) has recognised that:

"within that (regulatory) framework, Ofgem, the energy regulator has a crucial role to play in helping the UK decarbonise its economy... decarbonising the energy system at lowest cost to consumers is one of [its] three priorities in coming years, alongside protecting consumers and enabling competition and innovation." – Ofgem

Last year Ofgem released a decarbonisation programme and action plan. We advocate for proactive efforts to align regulation with decarbonisation in New Zealand.

Investment settings for Net Zero

- **Fully costed system – from silos to whole system**

A fully costed system methodology must be used by all regulated assets, regulation and policy to uncover the knock-on costs and reveal the value sitting between customer silos....there is a need to fully value all assets on the system providing a level playing field between demand and supply.

- **Deep digitalisation – from Brawn to Brain**

Develop a smart responsive, network of energy and information to deliver a more productive, stable and optimised system releasing value across the varied, diverse actors' assets and actions.

- **The Citizens' dividend: From the few to the Many**

Design the system for citizens, offering opportunity and rewards, as equal actors in building a decarbonised system.

- **Start the heavy lifting: From mature to immature technologies**

Focus Government support on immature technologies and customer assets to accelerate decarbonisation.

Recommendations

- We recommend the Commission raise with Government the urgent need to rethink regulation to ensure that regulation supports and appropriately funds network transformation, innovation and investment in emerging technologies.
- We recommend that our electricity regulation appropriately values avoided cost, and incentivise investments which can deliver it.
- We recommend bold reform of our current electricity regulation to ensure that our regulatory regime - and the way that it is implemented - is strongly aligned with the needs of decarbonisation.
- We recommend that any change which is being progressed now or which is proposed for the future which will impact future network involvement with new technologies be urgently assessed in the context of the Commission's proposed pathway to ensure that it aligns with the need for networks to affordably manage new demand – particularly which is driven by EVs. Amended statutory powers are needed to ensure that regulatory decisions of the Commerce Commission and the EA encourage rather than inhibit network transformation and involvement with new emerging technologies.

Achieving the pathway set out by the Commission requires us to take a whole systems approach

7.1 Avoid cost by urgently coordinating our regulatory regime around the goal of decarbonisation

The electricity sector will fail to make a least-cost transition to a low emissions future without an integrated plan of action. We support the recommendation of the Commission to develop “a long-term national energy strategy that provides clear objectives and a predictable pathway away from fossil fuels and towards low emissions fuels, and the infrastructure to support delivery”. Such a strategy requires urgency, and clear inclusion of our regulatory regime – to send a clear and aligned signal to create a basis for a coordinated approach. As recently highlighted by a Cortexo article “The clock is ticking on electricity sector flexibility: how long have we got?”:

“People, the economy and the environment will be worse off unless a clear plan is quickly developed to guide the upgrade to the regulatory settings needed to have an electricity system and market able to cope with the heavy lifting…the absence of a clear plan to coordinate the transition puts Aotearoa at risk of making the same mistakes as Australia and other jurisdictions and needing to play regulatory catchup to evolve policy and market settings to reflect fundamental changes to the technology and consumer landscape”. - Craig Evans of CTQ Advisors

As this work goes on to acknowledge, the Commission’s recommended strategy to achieve 60% renewables by 2035, is recommended to be in place by June 2023. However, there are a number of key regulatory choices to be made before then.

- The Commerce Commission will commence an input methodology (IM) review. The IM review will be critical input to ensure electricity networks can meet the electrification challenge. A cut and paste exercise will not be sufficient given the current settings for electricity and gas networks are increasingly inadequate for dealing with the changing environment.
- The 2025-2030 price quality path decision by the Commerce Commission due around late 2024 will also play a fundamental role in whether electricity networks can meet the electrification challenge. The 2025-2030 price-quality path will determine the nature and level of investment by distributors through to 2030. The Climate Change Commission sees this as a critical period for investment in networks to deliver affordable accelerated electrification from 2030.
- Finally, a flexibility market needs to be up and running by April 2025 to coincide with the start of the 2025-2030 price-quality path. Employing flexible DER to support network and whole-of-system stability and resilience is the least regrets approach for affordable electrification, decarbonisation and a stable and robust electricity system. The UK flexibility market has taken over 4 years to get to where it is. It’s hard to see how a market with sufficient liquidity and low emissions characteristics to give networks operators confidence in using flexibility to maintain reliability can emerge fully formed by 1 April 2025.

As we have highlighted above, the market regime overseen by the EA is similarly not designed for a system with lots of distributed resources, and affordable electrification.

“We have until 2023 to identify the regulatory settings needed to put the electricity sector on the path to least regrets and least cost electrification. The clock is ticking and we don’t have much time left…at the top of the list must be upgrading network regulation to provide the right incentives for networks to be ready to meet the surge in electrification …with a particular focus on developing functioning flexibility markets that can help to maximise the value of DER”. - Craig Evans

Avoiding cost is not just about avoiding the wrong investments – it is about driving the right ones. This requires more than adjustments to our existing regulatory regime

We support the Commission’s inclusion of ‘avoid unnecessary cost’, as a principle of their analysis. In describing this principle, the Commission has included a focus on ensuring that assets are replaced on as natural a cycle as possible. However, avoiding cost through our transition is not just about avoiding the wrong investments, it is about driving the right ones. This will not be achieved through minor adjustments to our regime – or just the removal of barriers. It requires a proactive signal to support necessary investments and a significant change to regulation.

7.2 We consider a Ministry for Energy and Decarbonisation to be a key enabler of the Commission's pathway

We support the Commission's thinking around a need to strengthen coordination across Government workstreams to drive decarbonisation. Our decarbonisation journey is characterised by complex interdependencies across industry and Government, and requires a coordinated, whole systems approach. It is clear that we cannot achieve the Commission's pathway in silos. We agree with the Commission's recognition that:

"Coherent policy is important to ensure that government sends clear and consistent signals to households, business and communities about the transition to low emissions, and the nature and speed of change required….The current siloed nature of Aotearoa government machinery presents a challenge…Another challenge is the lack of 'mainstreaming' of climate change considerations across government policies and procedures." – the Climate Change Commission

As noted above, we support the Commission's recommendation to develop a National Energy Strategy and we also support the recommendation to 'mainstream' climate change considerations across Government policies and procedures.

However, we consider the bridge between the recommended National Energy Strategy, the aligned funding of workstreams, and the integration of climate change considerations across Government to be a Ministry for Energy and Decarbonisation. We see this as a key opportunity to help overcome "The current siloed nature of Aotearoa government machinery".

The EPR recommended that new institutional arrangements for energy policy and regulation be explored, holding that:

"the Government should consider alternative ways for government agencies to co-ordinate energy policies, regulations and programmes. Its purpose should be to better organise resources to face challenges spanning multiple areas of agency responsibility. This could be achieved in various ways, including the following…Establishing a Ministry for Energy, bringing together parts of the Ministry for the Environment, Ministry of Civil Defence and Emergency Management, Ministry of Transport and Ministry of Business Innovation and Employment" – EPR Final Report, May 2019

Both the EPR and the Climate Change Commission's draft advice are sending a clear signal on the need for stronger coordination through Government – and institutional change which is needed to achieve this. As highlighted by the University of Exeter's Energy Policy Group:

"we do need to reset our energy governance for coordination; to expand and reveal value… from new energy and system resources created or enabled by digitalisation and new technologies, and , to speed up the GHG reduction". – University of Exeter Energy Policy Group

This review argues for one new energy governance institution. As we noted in our submission responding to the Accelerated Renewables and Energy Efficiency workstream, there are a very large number of policy and regulatory institutions with a shared role to deliver decarbonisation.

Recommendations:

- We support the recommendation for a national energy strategy to help align the 'siloed machinery of Aotearoa's government' the Commission has described.
- We recommend the establishment of a new Ministry for Energy and Decarbonisation

to lead the national energy strategy, to implement the Commission's pathway and to ensure policy and regulatory alignment.

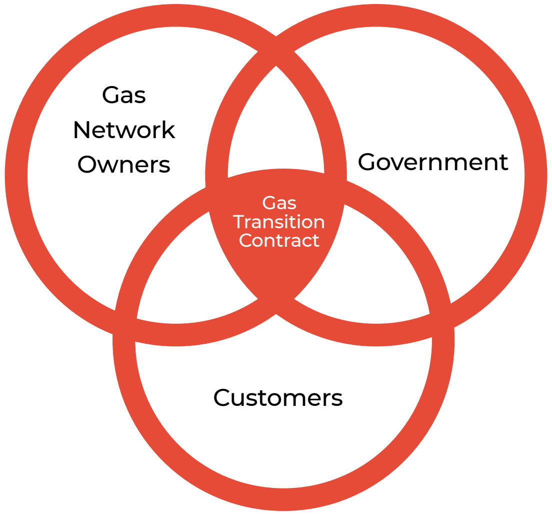
- We support the Commission's recommendation to create a Vote Climate Change within the budget allocation process. Just as we need to ensure funding within the public sector is aligned to decarbonisation so too do we need to ensure that funding of key industry enablers is also aligned. As described in the chapter "Regulatory Rethink" above, our electricity market framework is increasingly out of step with what is required to deliver decarbonisation affordably to customers.

Gas transition challenges

8.1 A Gas Transition Contract is needed to establish an agreed and managed transition to meet the objectives of Government, customers and gas infrastructure owners

The current "Regulatory Compact" for gas network infrastructure owners is founded on the basis of a gas network being delivered in perpetuity. However, the Commission's proposal to effectively curtail use of gas network infrastructure over time fundamentally breaks the regulatory compact and the basis upon infrastructure owners have historically, and in good faith, invested. A fundamental aspect of such a regulatory compact is that capital returns on such assets are matched to the 40-50 year lives of the assets. With the Commission's proposal now threatening to break the regulatory compact, Vector is calling for a new Gas Transition Contract to be agreed between gas infrastructure owners and the Government as a means to maintain investor and customer confidence in our transition and ensure customer choice, reduced economic impacts, and investor confidence are all maintained through the transition.

Whilst industry is responding to the strong policy signals about the future of gas, there is an opportunity for constructive dialogue to define a sensible managed transition path that meets the objectives of each of Government, customers and gas network infrastructure owners.



We encourage the Commission to support such a dialogue in its recommendations to Government so that the government, regulators and gas infrastructure owners can collectively explore a sensible managed transition where the objectives of each party align, and which constructively supports the broader decarbonisation objective.

8.2 Achieving the most efficient net reduction in emissions from gas requires us to assess the use of gas across the energy supply chain – including both generation and its end use

Industrial process heat accounts for a significant share of NZ's total emissions – and of this, natural gas accounts for the greatest share of emissions - 37%. The Commission's focus on the use of gas is consequently understandable. The Commission's budgets include a steep reduction in emissions from buildings driven by the transition of the end use from gas.

However, we note that in the Commission's pathway natural gas use is retained as a peaking solution:

"Although the share of gas generation decreases in all four modelled scenarios, gas generation remains a critical part of the electricity system for meeting peak requirements and dry year needs. Most importantly, in these scenarios, gas provides cover for dry year conditions which reduce the energy resource for hydro generation". – the Climate Change Commission

Burning gas for electricity generation and then heating with the electricity generated is between two-three times as carbon intensive as using gas at home directly. From a net emissions reduction perspective, it is critical that reducing the use of gas from buildings does not result in an increase in its use for electricity generation during peak electricity demand. The interplay between gas usage in buildings and electricity generation is dependent on a range of factors which are still uncertain including our future supply of low emissions electricity generation, as well as the impact of demand management. Whilst storage schemes which are deployed to overcome the dry year problem could reduce the need for gas peaking, as the Commission's analysis of the impact of the proposed pumped hydro scheme at Lake Onslow has found, meeting future electricity demand may well still require the use of natural gas even with such a solution. From a net emissions perspective, we question the removal of natural gas from end users if it would increase its use in peaking by contributing towards peak demand.

In achieving the emissions reductions in the Commission's pathway, costs to customers should be a central consideration – and there are hidden costs to customers associated with a transition away from gas connections which have not been factored into the Commission's analysis.

Vector's View:

When it comes to making trade-offs within our emissions budgets it should not be customers who carry the risk or potential cost. Consequently, we recommend that the impact on affordability to customers – and in particular residential and small commercial customers – be carefully assessed in the context of the need to reduce emissions from the use of gas.

As highlighted by Minister Woods in February, residential and commercial gas customers only account for nine percent of our total use of gas. Ministry for the Environment emissions data also shows that substituting customers' use of gas for electricity would result in a net emissions saving of 400kg of Co2e per kwh per annum – this is on a kwh for kwh substitution basis and assumes that there is enough low emissions electricity to meet this demand without gas or coal peaking. If this substitution were to occur today given our generation mix it is likely to result in an increase in emissions, contingent on a number of factors mentioned in the discussion on emissions intensity of gas for peaking above. Whilst the emissions reduction gains from this transition are at best uncertain, if it were to occur within a short time frame, in a number of the Commission's scenarios, customers would bear a significant cost.

Hidden customer costs from the Commission's recommendation to end new gas connections from 2025

The Commission has recommended: "setting a date by when no new natural gas connections are permitted, and where feasible, all new or replacement heating systems installed are electric or bioenergy. This should be no later than 2025 and earlier if possible".

We appreciate that the intent of the recommendation is to avoid future capital costs by avoiding investments made in the short term which either lock in emissions for the future – or which would need to be reversed. We support this intention but, as explained further under the below section "Options to efficiently achieve the Commission's emission reduction pathway at least customer cost", there are other options which are not included in the Commission's draft advice which could better achieve this – including the integration of new low emission fuels.

Customers currently use gas as an essential service for hot water heating, cooking and a range of appliances. The Commission has noted that the changes included in their pathway are likely to result in an increase in costs for households that use natural gas of around $150 per annum. However, the Commission has not factored in capital costs associated with structural changes that would undoubtedly need to be made to accommodate a customers' switch from gas (households which use reticulated and bottled LPG connected to buildings, as well as natural gas) to electricity. Gas hot water heaters typically are located on the outside of a home. Replacing this with an internal hot water heater would require at a minimum capital costs which are additional to the new appliance itself, potential structural changes to housing, and loss of internal liveable areas potentially impacting housing value.

Analysis jointly commissioned by Vector has found that accounting for these capital costs – including appliance, labour and renovation costs, the true cost of transitioning a gas customer to electricity would be ~$2,000 (assuming that the customer uses gas for water heating and cooking) to ~$5,000 (if the customer uses gas for water heating, cooking and space heating). These costs are currently excluded from the Commission's estimated $150 per household per annum.

Furthermore, the Commission has assumed that a natural substitution would occur between existing gas units with new electricity or bioenergy units within the timeframes proposed. That is, if no new gas connections were made from 2025 then there would be an opportunity for these assets to come to their end of natural life before they needed to be replaced under the Commission's pathway. However, this depends on when our complete phase out from gas to electricity or bio energy would occur. The Commission's pathway includes a phase out from gas to occur from 2030 for existing buildings – whether or not there is time for a natural substitution to occur depends on the pace of this transition including beyond the first three budgets. The Commission's more ambitious 'tailwinds' and 'further behaviour' scenarios include a complete reduction in the end use of gas by 2030. This would not allow a natural substitution to occur.

Because the recommendation specifically includes the replacement of existing heating systems (not just referring to new installations) this significant capital cost could impact some households – i.e., those who have a heating system which needs replacing soon – well before the 2030 phase out for existing buildings.

As highlighted by analysis undertaken by Oakley Greenwood on the Commission's process for modelling residential energy/gas use – Response to Climate Change Commission's Draft Advice (Annex 4) :

"...the CCC's phase out profile (2030-2050 in the central pathway) transitions the remaining gas use in a smooth manner, rather than modelling this fuel switching dynamic in detail. Given the relatively minor contribution switching from gas to electricity by residential and commercial customers makes to NZ's overall emissions reduction profile, it is understandable why the CCC may have made this simplifying assumption. That said, this switching profile is important in the context of New Zealand's gas industry, its economics, and its broader ability to continue to service the needs of gas consumers over the forecast horizon modelled by the CCC". – Oakley Greenwood "Response to the Climate Change Commission's Draft Advice"

Even if a natural substitution does occur between existing gas units with new electricity or bioenergy units, the Commission's modelled costs for households do not account for the additional capital costs mentioned.

In the case of transitioning gas customers to electricity (which, within the timeframes proposed would be the most likely alternative for households), additional costs could be higher considering higher electricity prices which could occur as a result of increased load on the network.

8.3 Transitioning gas to electricity would have a significant, and currently unaccounted for, impact on the electricity network

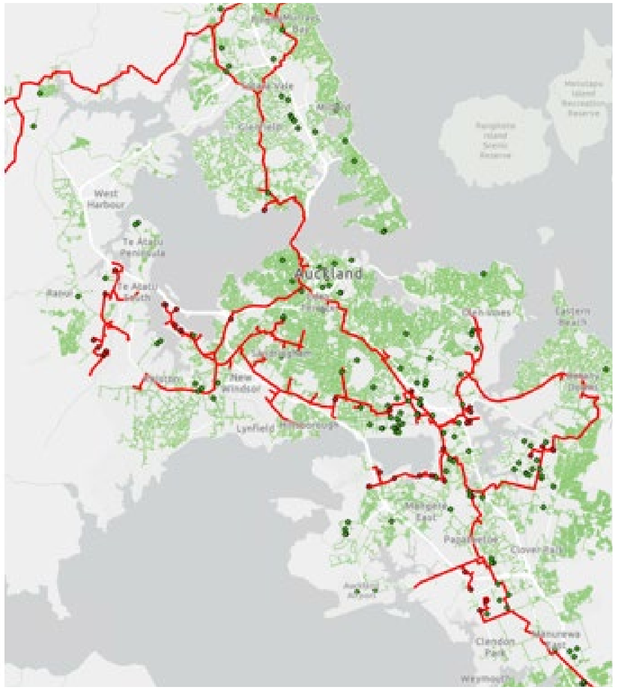
We note that the Commission has not included in its analysis, the impact to the electricity network of between moving gas demand to electricity demand within the timeframes proposed. As noted above, the potential for our gas transition to increase electricity peak demand needs to be carefully considered from a net emissions perspective, ensuring that the transition does not increase the need to use gas for peaking. The potential impact on peak demand also needs to be considered in terms of electricity affordability – accounting for potential electricity network costs.

Our current estimate of the equivalent peak electricity load of all gas customer who could transition to gas today (excluding high temperature process heat users) is about 15-20% of our current electricity peak. Our modelling has found that the impact of gas substitution on peak demand would be about the same as the impact caused by EV uptake within the Commission's pathway by 2030, if this substitution happened quickly. The impact of this new demand on the network would likely be concentrated as our residential and commercial gas customers tend to be clustered on the network.

We share the Commission's desire to avoid investing in infrastructure which locks in cost for future generations – but which may no longer deliver value. For network management reducing the risk of stranded assets is about avoiding large network upgrades in the context of future demand uncertainty. This both increases the importance of dynamic optimisation – however this also increases the importance of avoiding a sudden transition of gas customers to electricity. Affordable electrification will be critical to the Commission's wider 'necessary action' to maximise the use of electricity.

8.4 Not all gas users would be able to electrify within this budget period. However, the viability of keeping the gas network available only to them, if all other users transitioned to electricity, is uncertain

As noted by the Commission, some gas users – particularly high temperature process heat users – would need to continue using gas under its pathway as there are currently no alternatives for some industry applications. We have spoken to a number of high-volume gas users on our network – many of whom do not see technology alternatives which are economically viable. Of those who do, the value of optionality around alternative fuel substitutes to suit different applications of the gas users and the value of an incremental transition have emerged as common themes. Many have



Location of Auckland's high temperature process heat users on the gas network

(high temperature process heat users are represented as green dots, and the high-pressure steel backbone network is the red line).

reported that any significant changes in the cost of energy would impact the viability of their businesses leading to reductions or shutting down operations. We are concerned about the wider economic impact that this would have.

The Commission – and as articulated by the Minister – appears to accept that there will need to be some 'exceptions' around the continued use of reticulated gas.

"The CCC recommends that the specified date (to prevent new gas connections and the replacement and installation of heating systems which are not electric or bioenergy fuelled) should be no later than 2025, and earlier if possible. This results in the CCC forecasting gas consumption to decline under the various scenarios that the CCC has modelled, with the CCC modelling a relatively gradual transition away from gas for residential and commercial customers. Notwithstanding this, the CCC is still forecasting that gas will be consumed beyond 2050 under all modelled scenarios, primarily by customers who are in what are generally termed 'hard-to-abate' sectors (such as peaking electricity generation and high-temperature process heat)." - Oakley Greenwood, Response to NZ Climate Change Commission's Draft Advice

However, there are a number of factors to consider when assessing the technical and economic feasibility of allowing the use of gas for some users, but not others. Our preliminary analysis is that there are ~250 customers that may have difficultly substituting from gas due to high heat or large energy requirements. If as assumed by the Commission, other consumers decline, a significant reconfiguration of the network would be required to ensure all these customers are connected either to an adjacent higher-pressure steel "backbone" network or nearest medium pressure network. In some cases, the removal of a 'meshed' network configuration, will result in additional costs to ensure sufficient pipeline capacity – increasing the risk of stranded assets, as alternative fuels may become viable for high temperature process in the future.

Location of Auckland's high temperature process heat users on the gas network

(high temperature process heat users are represented as green dots, and the high-pressure steel backbone network is the red line).

Our initial analysis has found that concentrating cost allocation across this smaller group of customers would translate into a ~600% price increase for those customers who remain on the network. It is critical that the Climate Change Commission's recommendations are internally consistent, with a particular emphasis on whether the adverse impacts on the economic viability of gas supply for some hard-to-abate industry participants has been adequately considered – particularly when the Commission's pathway itself includes a continued supply out to 2050.

We appreciate the complexity that both the Commission, the Minister and MBIE are navigating to transition away from the use of gas. We acknowledge the work of the GIC to analyse the readiness of market, commercial and regulatory settings to support this transition.

The CCC considers that its recommendations have "created options" and to have "kept them open for as long as possible". However, this is not strictly true. The prime example of which is the CCC's recommendations that relate to gas usage, which explicitly have the effect of banning new gas connections, and implicitly, are likely to have the effect of foreclosing on longer term options that might be able to leverage off the existing gas infrastructure, given the significant uncertainties that its policies create for the on-going financial viability of these businesses.

8.5 Options to efficiently achieve the Commission's emission reduction pathway at least customer cost

Many of the costs described above stem from transitioning gas customers to electricity within the timeframes proposed. The key considerations to achieving a managed transition and the most efficient net reduction in emissions from gas are timing – and focusing on the replacement fuel that is used in place of gas.

Many of the costs mentioned above would be avoided by integrating a bio-gas fuel or green hydrogen.

For example, from a customer cost perspective, analysis jointly commissioned by Vector (in the report Response to NZ Climate Change Commission's Draft Advice, Oakley Greenwood) has found that transitioning natural gas to biomethane or hydrogen would be far more efficient, accounting for hidden customer costs and the cost of the fuel, than transitioning natural gas to electricity.

Their analysis shows that households that need to spend more that ~$1,447 on new electric appliances (as a result of our transition from gas) and associated installation costs (plumbing, wiring, reinstatements etc) would be better off using renewable methane (at $17.60/GJ). If hydrogen costs fall to $2/kg then they would only have $344 to spend before the alternative –hydrogen – was more economical than electricity.

The viability of these fuels for existing infrastructure depends on their composition – but this can be ensured by the right standards and the alignment of different fuel types with different reticulated infrastructure. For example, bio LPG is the best substitution for reticulated LPG.

Green hydrogen can currently be integrated with natural gas at 20% blend without causing embrittlement to pipes or health and safety risks. We recommend that the Commission consider the integration of these fuels over time to offset emissions from gas, rather than preventing new gas connections from 2025.

Setting an obligation for a proportion of gas used in buildings to come from renewable (non-fossil fuel) sources is an opportunity to:

- Reduce emissions under the Commission's pathway
- Strengthen public commitment to decarbonisation by enabling consumer choice
- Retain a viable gas industry to service the needs of 'hard to abate' emissions (electricity, process heat); and,
- Preserve value in existing networks and household plumbing systems, reducing unnecessary customer cost and stranded assets
- Enable the emergence of new markets for bio fuels to create employment opportunities for transferable roles currently in the gas industry

This could achieve the Commission's sought reductions in emissions caused by the end use of gas, particularly if new connections were able to be progressed through an offset certification scheme. This would be implemented by a retailer to achieve carbon emissions reductions by way of low emissions fuel integration. Further analysis of potential bio-fuel options, and the costs and benefits of these alternative policy options, is included in the report Response to NZ Climate Change Commission's Draft Advice, Oakley Greenwood.

In the UK, where heating and hot water for buildings make up around 40% of the UK's total energy demand, and 20% of its total GHG emissions, the Net Zero Infrastructure Industry Coalition has called for a heat decarbonisation roadmap – which considers the whole infrastructure value chain from energy transmission, distribution and use and draws our key infrastructure components, timescales, challenges and requirements. In New Zealand, enabling a managed transition requires us to make similar considerations across the whole gas value stream – including both upstream considerations (ensuring that levels of upstream supply support the path of lowest emissions for industrial process heat users), and downstream (considering distribution infrastructure and customer impacts).

The pathway of integrating new low emissions fuels would allow a lower cost substitution to occur for customers by providing customers with unreasonably high capital cost associated with structural upgrades, the option of transitioning from gas to electricity, or the option of transitioning to a lower emission fuel. This would also allow for the creation of new markets for bio-fuels, protecting jobs in the energy sector and avoiding stranded gas assets. We note that the Commission envisions a role for bio-fuels referring to a potential transition from gas to biomass. However, within the recommendation to end new gas connections by 2025 it is unlikely that such new fuels or markets would have the time or investment to emerge. We note that in the Commission's policy reference case, bio-gas is modelled to make up 6% of total demand in 2030 and 74% of total demand in 2050. Work commissioned by BECA has suggested that bio-fuels are likely to play an even greater role than this, under the 'all being equal' scenario. However, should the Commission's recommendation to end all new gas connections by 2025 be progressed, our view is that this demand for bio-fuels would be much lower – particularly given that high growth is projected to occur after 2030. It is unlikely that these markets would have an opportunity to emerge to this extent further to this recommendation.

Ensuring the right incentives are in place to allow investment in low emission fuels should be a key consideration for the Commission, not least because it is consistent with Principle 3 of creating options and does not result in complete reliance on electrification

Recommendations

- We recommend that the Commission calls for a constructive dialogue between government, regulators (as proxy for the customer) and gas network owners to identify a pathway that meets each parties' objectives and delivers a sensible managed transition pathway for gas.
- In reducing emissions from gas we support an efficient net reduction in emissions and question the transition from the end use of gas if this would increase the use of gas for peaking – where it is 2-3 times more emissions

intensive – or the cost of electricity. We recommend that the Commission consider the impact of co optimisation between the gas and electricity networks and the potential impact on electricity demand of a sudden transition from gas to electricity.

- We recommend that the Commission reconsider their analysis around likely customer cost of the transition from gas proposed in their pathway, reflecting the true capital costs which would be required of customers.

- We recommend that rather than pursue the recommendation to end all new gas connections or replacement gas heating systems by 2025, the Commission recommends an emissions offset scheme which would support the emissions reduction that they are targeting whilst allowing scope for new bio fuel markets to emerge as well as lower cost to customers from the transition.

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