Implications of evolving technologies for pricing of distribution services

Consultation Paper

Submissions close: 5pm 2 February 2016

3 November 2015

Executive summary

Evolving technologies will be transformational for consumers

Electricity reaches into almost every home and business in New Zealand. It is an essential part of modern life – lighting, heating and powering our homes, factories, farms, hospitals, towns and cities.

Consumers, particularly households, are often presumed to not have much interest in electricity supply. However, exciting new technologies are starting to give consumers more choice and control over how they use – and even produce – electricity. The benefits could be enormous.

Developments in technology that affect the electricity sector include heat pumps, energy-efficient lighting, solar photovoltaic generation (solar panels), electric vehicles, battery storage, advanced ('smart') metering and internet-connected household appliances. These technologies are becoming more popular and make it easier for consumers to manage when and how they use electricity. For example, the proportion of houses with a heat pump is above 20% and growing.

Evolving technologies will allow consumers to choose whether to get electricity from their local distribution network, or generate it themselves. There are almost 7,000 residential and commercial consumers in New Zealand who have installed solar panels. Over time, these technologies could bring competition to electricity distribution. This would be a fundamental change for distributors, and good for consumers.

The effects of evolving technologies may be different in New Zealand compared with many other countries:

- New Zealand's competitive electricity market means retailers will adapt their charges to evolving circumstances, or risk their competitors overtaking them
- Existing grid connected generators tend to have low operating costs. This means the impact of evolving technologies here may be felt more in reducing prices rather than exit from the industry.

The relatively high proportion of existing renewable generation means that evolving technologies will have different effects on carbon emissions here than they will elsewhere.[1]

[1] Effects on carbon emissions are outside the Authority's statutory objective. These effects are nevertheless relevant considerations for other policy makers and may be relevant considerations for distributors.

Distribution prices affect the way consumers invest in and use these evolving technologies. If prices are designed correctly, consumers' decisions will help all New Zealanders to benefit from the advances in technology. However, most distribution prices for residential and small commercial consumers are poorly designed for this purpose.

Existing pricing makes it unnecessarily costly to operate electric vehicles and use battery storage systems to smooth electricity consumption, and encourages over-investment in solar panels. Making the appropriate changes to pricing structures would avoid those households without access to other energy sources (such as solar and gas) paying more and more for the same distribution service, and would encourage people to use technology in a way that brings long-term benefits to all consumers.

This paper is about the pricing of distribution services

Consumers' decisions to adopt evolving technologies are influenced by the cost of electricity. For most consumers the cost of electricity is the retail price they pay for electricity supplied by their retailer via the local distribution network. For a small but increasing number of consumers, the cost of electricity also includes the cost of onsite generation (most commonly solar panels).

The retail price of grid-delivered electricity comprises four key cost components – generation, transmission, distribution and retailing. Distribution network businesses (distributors) are responsible for providing and maintaining the power lines and associated infrastructure used primarily to deliver electricity from the high voltage transmission network to homes and businesses across New Zealand.

Key services that distributors provide to consumers include:

- transporting electricity to a consumer's premises at a particular level of quality and reliability – most electricity networks were built for this flow of electricity
- transporting electricity from a consumer's premises to neighbours, people living in the area and possibly the wider network – there may be additional costs to reconfigure networks to cope with large quantities of the electricity flows
- keeping a certain amount of distribution network capacity available for the consumer to use at the 'flick of a switch' whenever they want
- acting on a consumer's behalf to manage the consumer's use of the distribution network.

In this last instance, the consumer has given the distributor the right to make a decision on the consumer's behalf. The most common example of this is when a consumer allows the distributor to turn off the power to their hot water cylinder for a certain number of hours of the day. In return the consumer pays a lower retail electricity price.

The vast majority of consumers use the third service listed above on a daily basis to meet their peak demand for electricity within the day. For these consumers this ‘capacity’ service is analogous to a family having a second bathroom, which may only be needed twice a day (in the morning and before bedtime).

Currently, a few consumers are largely self-reliant for their electricity supply and use this capacity service only occasionally, when their demand for electricity exceeds their onsite generation capability, or as a back-up electricity supply if their onsite generation fails. For these consumers the capacity service is analogous to a family having two cars, with the second car kept for occasional use when the daughter is home from university or while the primary car is being serviced or repaired.

Most residential consumers are probably unaware they receive a ‘capacity’ service because it is not apparent from the retail price they pay. For smaller consumers (residential and small non-residential), the service is typically bundled with the ‘transport’ service provided by the distributor. The capacity service only tends to be identifiable in the electricity price that larger commercial and industrial consumers pay.

The distribution services and service levels that consumers need will vary. Some of the main factors that influence what they need are their choices about new technology. For example, a consumer might use a battery in a way that reduces the capacity they need. A consumer with solar panels might need less electricity to be transported to their premises (and one with an electric vehicle might need more). These consumer decisions will also affect distributors. For example, if consumers use technology in a way that does not require as much capacity, distributors may be able to postpone investing in their networks to provide more capacity. That is, consumers’ choices will affect the cost of the distribution services they receive.

Evolving technologies are also enabling consumers to select from a wider range of distribution services and service levels (eg, the consumer injecting electricity into the distribution network; the distributor managing the supply of electricity to the consumer’s ‘smart’ fridge or reverse cycle air conditioner / heat pump).

The prices consumers currently pay are not aligned with the services they buy

Distribution prices should signal to consumers the cost of new capacity in a way that encourages efficient network and consumer investment. They should also recover the common costs of the distribution service in a way that changes consumers’ decisions about investing in technology and using electricity as little as possible.

When the price a consumer pays for a distribution service reflects the cost of providing that service,[2] we call this a “service-based price”. Under this approach

[2] Including an appropriate contribution to costs that are common to all services (common costs).

consumers would pay less for their distribution services if their actions reduced network costs. Conversely, consumers would pay more if their decisions increased the costs of supplying them. Service-based distribution prices encourage consumers to make decisions that not only benefit themselves, but also benefit other consumers using the distribution network (eg, deferred or avoided network investment).

The Electricity Authority (Authority) is considering the implications of evolving technologies for distribution pricing arrangements in order to promote the long-term benefit of consumers.

There is no single ‘right’ pricing structure for all distributors because each distributor faces different circumstances. The appropriate pricing structure for the individual distributor in each location depends on a range of factors including:

- whether the network has only just enough capacity to cope with consumer demand (when it is at its peak) or has substantial spare capacity
- whether consumer demand on any given network is growing or shrinking
- variability and predictability of demand, which may differ between distributors
- the services distributors provide, which are changing over time as they introduce new services and service levels.

However, it is becoming more important that distribution prices reflect the costs of the distribution services provided to consumers. Current distribution pricing structures do not do this very well. In the past this did not have significant adverse economic effects. This is because consumers had few opportunities to respond to prices by making different decisions about electricity use or investment. For example, consumers were unable to invest in solar panels as a response to distributors charging on the basis of the amount of electricity consumed over time (measured in kWh). Also consumers were unable to purchase battery storage systems as a response to charges based on a consumer’s maximum demand (measured in kW) – and in any case, meters which could measure maximum demand were unavailable. Some distributors charged different rates during the night versus during the day. Some used remote control to switch consumers’ hot water cylinders off when demand on the network was at its peak. These practises were effective given the technology available. However, increasing consumers’ investment in new technologies means this is changing.

The Authority has identified that current distribution pricing arrangements in New Zealand are resulting in pricing structures that encourage consumers to make decisions which lead to significant economic costs. Distribution pricing can and should encourage consumers to use technology in ways that have long-term benefits for all consumers.

Distribution pricing structures should encourage consumers to make decisions that bring long-term benefit to all consumers

Most distributors receive the bulk of their revenue from a charge based on electricity consumption over time, measured in kilowatt hours (kWh). They also earn some revenue from charges unrelated to consumption over time (eg, a daily charge).

This pricing structure does not align with the cost structure distributors face when providing distribution services. That is, prevailing distribution prices are not service-based. They do not signal to network users the cost of new capacity. And the reliance on consumption charges to recover a significant proportion of distributors' common costs creates incentives that alter how consumers use the network. Distribution prices should:

- encourage consumers to take actions that reduce current or future network costs (eg, draw electricity for the household from battery storage systems during a period of network congestion, or recharge electric vehicles off-peak instead of during a period of network congestion)
- not encourage consumers to make decisions (eg, over-investing in solar panels or in new gas supply) that increase the price of electricity paid by other consumers.

Prevailing distribution prices do not achieve these objectives.

The Authority has considered the costs and benefits to all consumers of individual consumers' decisions to invest in solar panels, electric vehicles, battery storage systems, heat pumps and light emitting diodes (LEDs). The analysis highlights that prevailing distribution prices are not achieving outcomes for the long-term benefit of consumers – and may cost the economy hundreds of millions of dollars as the result of inefficient investment.

A consequence of distribution prices not being service-based is that the existing distribution pricing arrangements may not be durable. For example, residential investment in solar panels will result in consumers who have not installed solar panels paying more for their electricity. Independent analysis commissioned by the Authority indicates that, in some parts of New Zealand, distribution charges that are based on consumption over time could increase by more than 10% in five years, and by up to 30% in 10 years, as a result of more solar panels being installed.[3] This means retail bills could rise by up to 10% in 10 years.

Over time, more distribution network costs will be recovered from consumers without solar panels (whose numbers will reduce). This will reduce confidence in the distribution pricing arrangements and increase the likelihood of lobbying for change.

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[3] NZIER, September 2015, Effects of distribution charges on household investment in solar, p. 12.

This creates uncertainty, which could undermine efficient investment in the electricity industry.

As a group, solar panel owners are generally better off than consumers who do not own solar panels. So, when distribution prices are not service-based, consumers' investment in solar panels tends to disadvantage lower income consumers. Although the Authority's statutory objective[4] means we haven't focused on these effects, they are nevertheless relevant considerations for other policy makers and therefore relevant considerations for distributors themselves.

Distributors have strong incentives to change their pricing structures

The Authority publishes distribution pricing principles to guide distributors when they are determining the structure of their distribution prices. The pricing principles set out an expectation that distribution pricing structures are to promote the long-term benefit of consumers.

Distributors already face strong incentives to change. In the long-term change may be unavoidable, as the environment will become increasingly competitive due to the falling cost of solar panels and battery storage systems. Distributors will eventually need to reduce their prices in order to compete. Even in the short term, adjustments to pricing structures could help distributors to respond effectively to evolving technology, and to avoid outcomes they may consider undesirable, including spiralling prices for some customer groups. Some distributors are introducing new pricing structures that may prove to be more service-based than their previous structures. However, many have not yet. A number of distributors perceive there to be constraints (in particular, regulatory constraints) on their ability to change pricing structures.

The Authority is seeking comment

The Authority is seeking comment from consumers, industry participants and other interested parties on issues with existing distribution pricing arrangements, particularly the key issues identified in this paper.

The paper does not propose solutions to the issues. The Authority will consider what further development, if any, to the existing distribution pricing arrangements is desirable after taking into account submissions on the paper and other relevant information. The Authority is watching with interest the parallel work that distributors and the Electricity Networks Association are undertaking on distribution pricing.

[4] The Authority's statutory objective is to promote competition in, reliable supply by, and the efficient operation of, the electricity industry for the long-term benefit of consumers. It does not take into account socio-economic factors.

Questions and Answers

Why is the Electricity Authority (Authority) undertaking this review?

Exciting new technologies like battery storage and solar panels are giving consumers more choice and transforming the ways they use electricity – and beginning to compete with electricity networks.

The benefits to consumers could be enormous. However, for consumers to receive these benefits, we have to get the timing right. For electric vehicles, current pricing artificially hampers consumers from taking advantage of New Zealand's abundant renewable electricity to replace petrol engines. For solar panels, current pricing artificially boosts investment before it is economic. This is a waste of resources. It is like spending money to widen a road years in advance of any signs of rush-hour congestion. Even though the investment may eventually be useful, moving too soon is a waste.

The Authority wants to make sure distribution prices are designed correctly, so consumers' decisions will result in the greatest possible benefit to all consumers.

What will the impact be on consumers who have already invested in evolving technologies?

The Authority does not favour one form of generation over another.

We recognise that any changes to distribution pricing structures will impact on consumers who have already invested in household solar generation and other evolving technologies. However, staying with the status quo will eventually create a very uneven playing field for those consumers who have not invested in evolving technologies. If the status quo remains, these consumers will be left paying for more than their share of the network costs.

That's why we believe it is very important distributors consider the issues now and begin discussion of pragmatic options, trade-offs and transition arrangements with their customers (retailers) and, more importantly, with consumers (both households and businesses). We need to avoid a situation where an existing pricing structure is creating detrimental effects for New Zealand consumers and the wider economy. Our focus remains on an electricity market that creates long-term benefits for consumers.

How does this work fit with the Authority's statutory objective?

Evolving technology and innovations are already altering consumer behaviour and leading to changes in the nature of distribution services. Distribution pricing arrangements need to keep up with these changes.

Ultimately, we need distribution prices that reflect the cost of the distribution services consumers are using. So, as the type of distribution services change, distribution prices will also need to change. The extent of changes required will reflect the particular circumstances of each distribution network.

This is about informing people's decision-making, which leads to more efficient investment and lower prices overall. It will also avoid significant costs to the economy. This clearly fits with the Authority's statutory objective, particularly the efficiency limb and the Authority's strategic direction to facilitate efficient price signals for consumers.

Will this lead to higher fixed daily charges?

The consultation paper argues that distributors should provide consumers choice about their level of daily charge. The consultation paper encourages distributors to be clear about the services they're delivering and set their prices to reflect those services. They need to give consumers greater choice over service levels (e.g. choice over the capacity made available to each consumer) and price accordingly. It should be no different than what consumers face for broadband, where consumers have choice about how much broadband capacity they want and the prices associated with each capacity level.

Are retailers and distributors introducing smart meters so they can introduce new pricing structures on consumers to stop them from using evolving technologies to become independent?

No. Smart meters have made evolving technology more viable and helped create new choices for consumers. For example, smart meters are essential for consumers to re-charge their electric cars at lowest cost. They are also essential for consumers to know when they're powering their homes with their own solar panels and to sell their surplus electricity to other consumers or back to the grid.

Once consumers face the correct costs of their decisions, they will still be free to use evolving technologies to become independent if that would make them better off. Smart meters cannot be used to force consumers to keep buying electricity from anyone. In any case the Authority will be alert to any such behaviour (which would be contrary to our pricing principles).

Why hasn't the Authority presented a solution to this issue?

Each distribution business has different network characteristics and different customers and consumers. A far better outcome will result from each distributor talking to its customers (ie retailers), and more importantly, to consumers, about pricing. We think it is important they start this process now, which is why we are creating more visibility of the potential issues that could come from staying with the status quo.

What happens if distributors won't change?

We know several distributors are already considering their options, covering more than 50% of New Zealanders. Ultimately the impact of evolving technology will force all distributors to change. We hope they are proactive and future-focused and act now to exploit opportunities from the new technology to benefit consumers as a whole. The reality is that consumers will drive change if distributors don't take action.

What does this paper mean for the LFC regulations?

This paper is not about the LFC Regulations. The Authority's Retail Advisory Group is looking at the market effects of the LFC Regulations in a separate project. However, we don't think the LFC Regulations prevent distributors from adopting prices that more closely reflect the cost of the services consumers are using.

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1. Introduction and purpose of this paper

1.1 Introduction

1.1.1 Distributors provide the power lines and associated infrastructure used to deliver electricity from the high voltage transmission network to consumers' premises.

1.1.2 When consumers purchase electricity delivered via their local distribution network, they are buying the electricity and the network services required to deliver it.

1.1.3 Evolving technologies, such as solar panels, battery storage systems and household appliances with network connectivity, are giving consumers more options for using and managing electricity. In particular, consumers can select from a wide range of distribution services and service levels, and this range will grow wider over time.

1.1.4 The Authority is reviewing the regulatory arrangements under which distributors structure the prices of their services (distribution pricing review).[5] The pricing structures determine how distributors recover around $2.8 billion of revenue from consumers each year.[6]

1.1.5 The distribution pricing review is looking at whether the regulatory arrangements for electricity distribution pricing are fit-for-purpose and promote efficient price signals, for the long-term benefit of consumers.

1.1.6 The Authority wants distribution prices to more closely reflect the costs of providing distribution services to consumers. In this paper, we refer to this approach as service-based pricing. Service-based prices encourage consumers to make decisions that not only benefit themselves, but also other consumers using the distribution network (eg, deferred or avoided

[5] The 29 distributors are: Alpine Energy, Aurora Energy, Buller Electricity, Centralines, Counties Power, Eastland Network, Electra, Electricity Ashburton, Electricity Invercargill, Horizon Energy Distribution, MainPower NZ, Marlborough Lines, Nelson Electricity, Network Tasman, Network Waitaki, Northpower, Orion New Zealand, OtagoNet, Powerco, Scanpower, The Lines Company, The Power Company, Top Energy, Unison Networks, Vector, Waipa Networks, WEL Networks, Wellington Electricity, Westpower.

These distributors are all regulated by the Commerce Commission under Part 4 of the Commerce Act 1986.

[6] Commerce Commission, ''Electricity-distributors-information-disclosures-2013-2014.xlsm', Section 8(ii) Lines charge revenues by price component, http://www.comcom.govt.nz/regulated-industries/electricity/electricity-information-disclosure/electricity-information-disclosure-summary-and-analysis/information-disclosed-march-2013-august-2014/.

network investment). This will lead to the lowest cost for delivering electricity for all consumers over time.

1.1.7 The distribution pricing review supports the Authority's strategic direction to facilitate efficient price signals for consumers.

1.1.8 The initial focus is on the implications of evolving technologies on distribution pricing. Decisions consumers make about evolving technologies will affect investment in New Zealand's electricity distribution networks, and how the networks are operated.

1.1.9 The opposite is also true: consumers' decisions to use or invest in new technologies will be affected by the pricing of, operation of, and investment in electricity distribution services.

1.1.10 The reason for the Authority's initial focus on distribution services in the face of evolving technologies is that it wants to address some important distribution pricing issues (which are discussed in this paper). If left unaddressed, these issues may result in consumers spending billions of dollars on technologies over the next decade – spending arising from inefficient price signals. The Authority is concerned about the significant economic costs that could result.

1.1.11 The Authority is not looking at certain legacy distribution pricing issues such as the ratio of distribution prices between urban and rural consumers.

1.2 Purpose of this paper

1.2.1 The purpose of this issues paper is to seek comments on current distribution pricing arrangements and the results of those arrangements.

1.2.2 Decisions consumers make about the electricity they use and about investing in electricity-related assets (such as heat pumps and solar panels) have costs and benefits for the consumer, for the distribution network, and for others.

1.2.3 The Authority is particularly interested in whether current distribution pricing arrangements:

(a) encourage consumers to make decisions that impose significant economic costs – because the pricing structures do not accurately signal the costs or benefits to all consumers of an individual consumer's decision to adopt a technology (ie, the distribution pricing structures are not service-based)

(b) provide insufficient incentive for distributors to adopt pricing structures that promote consumers' long-term benefit (including making the pricing structures more service-based).

1.2.4 The paper does not propose solutions. The Authority will consider what further development, if any, of the existing distribution pricing arrangements is desirable after it has considered submissions.

Electricity distributors are also reviewing distribution pricing arrangements

1.2.5 The Electricity Networks Association (ENA), which represents the 29 distributors, has established a distribution pricing working group to:

> *lead, assist and co-ordinate distributor efforts to establish more durable and cost-reflective pricing and to better meet the needs of consumers*.[7]

1.2.6 The objective of the ENA initiative is:

> *to promote sensible and pragmatic, economically sensible and sustainable distribution pricing reform, and which is distributor led, consistent with the current voluntary regulatory framework applying to distribution pricing methodologies*.[8]

1.2.7 The Authority welcomes this initiative to contribute to the development of efficient distribution pricing arrangements for New Zealand. The Authority's preliminary thinking is that distribution pricing structures around the country will best promote the long-term benefit of consumers when design is informed by local knowledge. Distributors can achieve this by actively and effectively engaging with the consumers and retailers on their networks when developing distribution pricing structures.

1.2.8 The Authority sees the Electricity Networks Association initiative as being consistent with such an approach but does not consider it to be a replacement for distributors engaging on this issue with their own customers (ie, retailers) and, more importantly, with consumers.

The Authority does not intend to look at the re-bundling of distribution charges

1.2.9 The Authority is not reviewing the efficiency of retail electricity prices paid by consumers as part of the distribution pricing project.

7 Electricity Networks Association, May 2015, Distribution Pricing: a discussion paper, p. 4.

8 *Ibid*.

1.2.10 Various distributors have informally raised with the Authority their concerns that the information value of distribution charges is lessened when retailers “re-bundle” those charges.

1.2.11 Distributors usually charge retailers the cost of providing distribution network services to consumers. The retailers then typically repackage the distributors’ charges with other charges (eg, the cost of generating and retailing electricity), and include these “re-bundled” charges on consumers’ electricity bills.[9] The structure of re-bundled retail prices are not necessarily related to the structure of distribution prices. The structure of retail prices is frequently cited as weakening the time-of-use price signals that distributors are trying to convey to consumers via their distribution charges.

1.2.12 The re-bundling of distribution charges is a retail pricing matter, and therefore subject to competitive market pressures. If distributors adopt service-based pricing, then retailers will receive the correct price signals, and will face incentives to respond efficiently, through their pricing or in other ways (such as load control measures). As the market is competitive, retailers will have to take into account consumer preferences. Over time retail competition will encourage retailers to make equivalent changes to their prices, to differentiate their product/service offerings from those of their competitors.

1.3 Submissions

1.3.1 The Authority prefers to receive submissions in electronic format (Microsoft Word) in the format shown in appendix A. Submissions in electronic form should be emailed to submissions@ea.govt.nz with ‘Consultation Paper—Implications of evolving technologies for pricing of distribution services’ in the subject line.

1.3.2 If you cannot send your submission electronically, post one hard copy of the submission to either of the addresses provided below, or you can fax it to 04 460 8879. You can call 04 460 8860 if you have any questions.

[9] One distributor, The Lines Company, sends all consumers on its network a bill for distribution services (and transmission services). Some retailers, eg Pulse Energy, currently separate out the costs of distribution and transmission services on their customers’ bills.

Postal address

Submissions
Electricity Authority
PO Box 10041
Wellington 6143

Physical address

Submissions
Electricity Authority
Level 7, ASB Bank Tower
2 Hunter Street
Wellington

1.3.3 Please note the Authority intends to publish all submissions it receives. If you consider that it should not publish any part of your submission, please indicate which part, set out the reasons why you consider the Authority should not publish it, and provide a version of your submission that the Authority can publish (if it agrees not to publish your full submission).

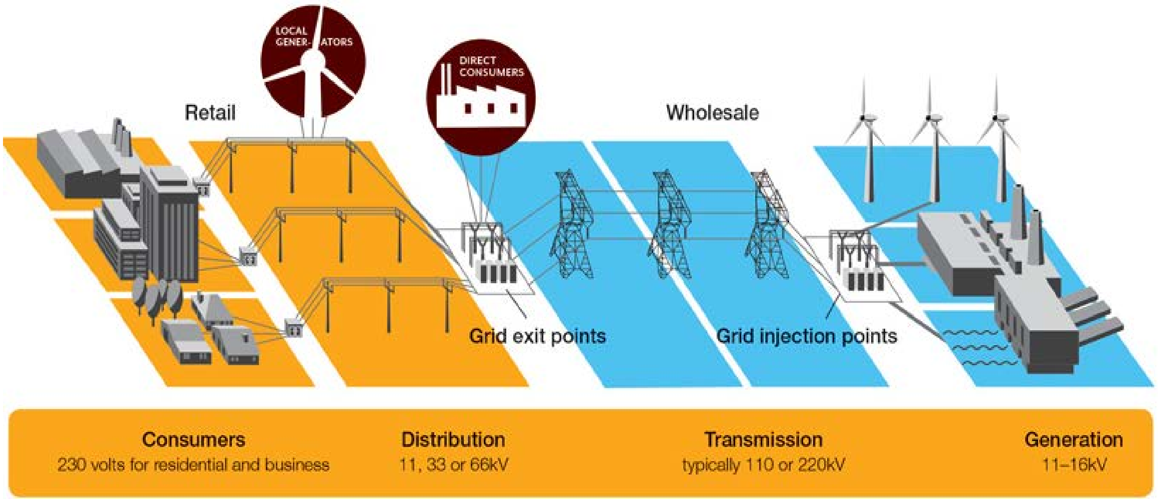
1.3.4 If you indicate there is part of your submission that should not be published, the Authority will discuss it with you before deciding whether to not publish that part of your submission.

1.3.5 However, please note that all submissions the Authority receives, including any parts that it may not publish, can be requested under the Official Information Act 1982. This means the Authority would be required to release them unless good reason existed under the Official Information Act to withhold them. The Authority would normally consult with you before releasing any material that you said should not be published.

2. Distribution pricing is important

2.1 The distribution of electricity is an important part of the electricity supply chain

Figure 1: The electricity supply chain in New Zealand



Source: Electricity Authority

2.1.1 Figure 1 shows how electricity has traditionally been supplied in New Zealand. Most electricity is produced by generation plants connected to high voltage transmission power lines (the national grid). The transmission lines convey electricity to 29 lower-voltage regional distribution networks. Distributors establish connections to consumers' premises, and transport electricity to them.[10]

2.1.2 Services that distributors provide to consumers include:

(a) transporting electricity to/from a consumer's premises at a particular level of quality and reliability

(b) keeping distribution network capacity available for the consumer to use

(c) acting on a consumer's behalf to manage the consumer's use of the distribution network (load management).

2.1.3 The vast majority of consumers use the distributor's capacity service each day at times of peak demand in the morning and evening. For these

[10] Distribution networks also convey electricity to secondary networks (such as airports, apartment complexes, retirement homes, shopping malls), which in turn supply consumers' premises.

consumers, the ‘capacity’ service is like a house with two bathrooms, in which the second bathroom is only needed twice a day.

2.1.4 Some consumers are largely self-reliant for their electricity supply. They use the capacity service only occasionally when they use more electricity than they generate, or as a back-up electricity supply if their onsite generation fails. For these consumers, the capacity service is like a family having two cars, with the second car kept for occasional use when the daughter is home from university or while the primary car is being serviced or repaired.

2.1.5 Most residential consumers are probably unaware they receive a capacity service because it is not apparent from the retail price or from the underlying distribution price that they pay. For smaller consumers (residential and small non-residential), the price of this service is typically bundled with the transport service provided by the distributor. The capacity service tends to be identifiable only in the electricity price that larger non-residential consumers pay (eg, commercial and industrial consumers).

2.1.6 The load management service is provided where the consumer allows the distributor to make a decision on the consumer’s behalf. The most common example of this is a consumer allowing the distributor to turn off the power to the consumer’s hot water cylinder for a certain number of hours of the day. In return, the consumer pays a lower retail electricity price. Consumers can also assign the right to manage their load to a party other than their distributor.

2.1.7 Consumers can choose how much electricity they use, when they use it, and the distribution services and service levels they require. These choices can be seen in each consumer’s load profile, and will influence distributors’ investment in and operation of their networks. That is, consumers’ choices will affect the cost of the distribution services they receive. Evolving technologies are influencing these choices.

2.1.8 Distribution networks are costly to build and connect to consumers’ premises. Distributors collect around $2.8 billion in revenue each year to recover the capital and operating costs of their networks.[11] Distributors incur the majority of these costs regardless of how much electricity is transported across the network. Networks are usually relatively cheap to use, since sending electricity across the wires does not produce much

[11] Commerce Commission, ''Electricity-distributors-information-disclosures-2013-2014.xlsm', Section 8(ii) Lines charge revenues by price component, http://www.comcom.govt.nz/regulated-industries/electricity/electricity-information-disclosure/electricity-information-disclosure-summary-and-analysis/information-disclosed-march-2013-august-2014/.

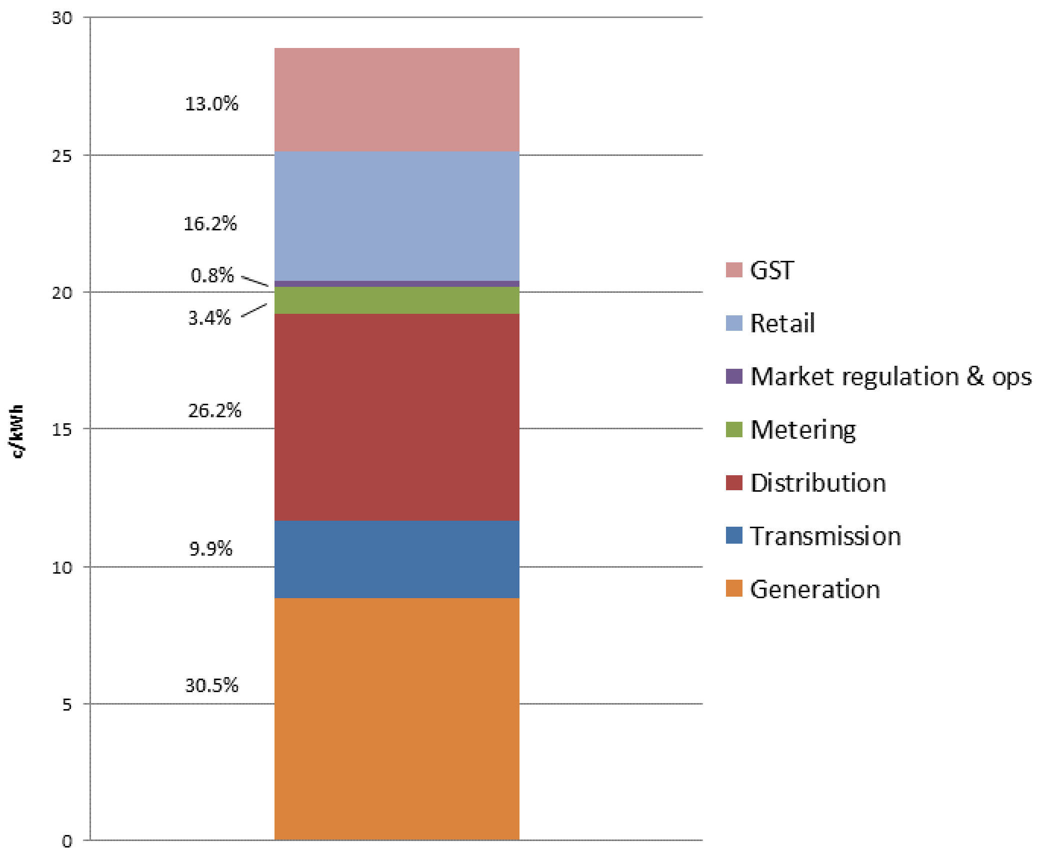
wear and tear. The cost of transporting electricity becomes high only when the network is at full capacity (and is congested). Additional demand for electricity at these times can result in electricity load shedding (blackouts) and require costly new investment to increase the network's capacity.

2.1.9 Distributors determine how they will recover their costs from consumers through their pricing arrangements, by choosing the relative prices of the different services they offer.

2.2 Distribution charges make up a substantial proportion of consumers' electricity bill

2.2.1 Figure 2 shows that, on average, the distribution services component is approximately 25% of the total residential electricity price.

Figure 2: The makeup of residential electricity prices in New Zealand



Source: Electricity Authority

2.3 Distribution charges should convey information about the cost of providing distribution services

2.3.1 In competitive markets, prices convey information about the cost of producing a good or service. Although the electricity distribution sector is not a competitive market, distribution charges are nevertheless a way for distributors to convey information about what it costs to provide services to consumers.

<u>Marginal costs in distribution pricing</u>

When a distributor delivers an additional unit of electricity to a consumer on the network, the cost of doing so is termed the marginal cost. If a distribution network has spare capacity, the marginal cost to deliver another unit of electricity is low. This is the short-run marginal cost of providing distribution services.

However, if the distribution network is at capacity, the marginal cost to deliver another unit of electricity is much higher – investment in new infrastructure will be needed.

The cost of expanding the distribution network's capacity is taken into account as part of the long-run marginal cost of providing distribution services.

Using marginal costs in distribution pricing is desirable because it allows consumers and distributors to make decisions about the consumption / delivery of distribution services that result in economically efficient outcomes. A consumer will purchase a distribution service (or increase consumption of a distribution service) if the additional (marginal) benefit they receive is more than the additional (marginal) price they pay.

A distributor will provide a distribution service (or increase production of a distribution service) if the marginal cost of doing so is less than the price the consumer pays. In this way, resources are allocated within the economy in a manner that maximises the benefit to society.[12]

2.3.2 In practice, the price of a distribution service often exceeds the marginal cost of the service. This is because distributors incur some costs regardless of how much of a service or how many services they provide. The economics literature calls these "common costs". The accounting literature calls them "overhead costs". For example, a large portion of a

[12] In perfectly competitive markets this occurs when the marginal benefit from consuming a good or service equals the price, which equals the marginal cost of supplying/producing the good or service.

distributor's network management costs will be the same regardless of whether they manage one-way flows of electricity on their network or two-way flows. Similarly, the cost of the core infrastructure of a network may not vary greatly regardless of whether there are one-way or two-way flows of electricity.

2.3.3 A distributor's common costs tend to be very high because of the lumpy nature of investments in distribution network assets (eg, power poles, power lines, voltage and current transformers, network management systems). If a distributor does not include these common costs in the price of a distribution service, the distributor will under-recover its costs (ie, it will lose money on the service being provided).

2.3.4 But if a distributor sets its prices too high, consumers may look for other ways to obtain an equivalent or nearly equivalent service elsewhere. For example, a consumer could be better off if they installed solar panels, a battery storage system, and a small gas/diesel generator, and disconnected from the distribution network. The cost of a consumer obtaining electricity from an alternative means is termed the "standalone cost" of the distribution service.

2.3.5 The prices that distributors charge for distribution services therefore should fall somewhere between the marginal (or incremental) cost of the service and the standalone cost.

2.3.6 Care is needed to ensure that the structure of prices for distribution services has some degree of alignment with the structure of the costs of the services. If the cost of a service relates to a consumer's maximum demand over a short time period, then the price of the service should not be entirely based on the consumer's annual consumption. If price influences how consumers behave, they would reduce their annual consumption rather than how much electricity they use at peak times. If peak demand is largely unchanged, distributors may need to increase the network's capacity to meet that demand. The result may be unnecessary or wasteful investment in distribution network services and infrastructure.

2.3.7 If pricing structures and cost structures are misaligned, the result can be suboptimal outcomes for society. In economic terms these are dynamic inefficiency effects.

2.3.8 A service-based price reflects the cost of providing the service. Under service-based distribution prices consumers who cause higher network costs would pay more for their distribution services, and pay less if they reduced network costs. For example, a consumer who generated electricity using solar panels might generate enough electricity to almost never require the transport of electricity to their premises. The consumer should therefore pay a lower price for the distributor's transportation service. However, the consumer should still pay the same price for the distributor's capacity service if the consumer's peak demand for grid-delivered electricity remains unchanged.

2.3.9 For many years, distributors have typically charged the users of their networks using a combination of daily charges and consumption (per unit) charges. Table 1 summarises the four types of charge that the 29 distributors currently use to recover the cost of building, maintaining and operating their networks.

Table 1: Distribution charges used in New Zealand

Distribution charge type	Description	Unit of measure
Daily	A charge that is unrelated to electricity consumption	$/day $/month
Consumption *(per unit)*	A charge levied on each unit of electricity supplied to a premise The charge may be constant or variable across time periods (eg, higher during peak usage periods; lower in other periods)	$/kWh
Maximum demand	A charge based on a consumer's maximum demand in a certain time period (eg, a year)	$/kW/time period
Capacity	A charge based on the maximum amount of electricity that can be supplied to a premise	$/kW

2.4 Distributors' pricing for residential consumers typically combines consumption and daily charges

2.4.1 The distribution charges predominantly used in New Zealand, especially for residential consumers, are the daily/monthly charge and the consumption charge. Most distributors use consumption charges, measured in kWh, to recover the majority of the cost of supplying residential consumers. The maximum demand and capacity charges tend to be used for larger electricity consumers.[13]

2.4.2 Analysis of the structure of distribution charges for New Zealand residential consumers shows the following three approaches:

(a) most distribution charges are made up of a two-part price with a daily price in cents per day and a variable consumption charge in cents per kWh (approximately 1.34 million of a little over 2 million installation control points (ICPs) in New Zealand have this charge structure).[14] There are two subcategories of this two-part price:

(i) ‘low-user’ prices with a daily charge of up to 15 cents per day[15] for ‘low-users’ plus variable consumption charges, in cents per kWh. Charges vary by season, time of day and whether demand can be controlled[16]

(ii) ‘standard user’ prices with the same structure as the low-user prices but with higher daily charges and lower consumption charges

(b) the same as for (a) but variable charges are linked to a consumer’s peak demand (measured in kW), rather than total energy consumption (measured in kWh). An example is the peak demand charge used by The Lines Company. Approximately 50,000 ICPs have this charge structure

(c) charges that are not tailored to consumption at ICPs, but are based on consumption at network supply points,[17] with a daily charge of

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[13] Examples of exceptions to this include: Aurora Energy using capacity charges and demand charges for small non-domestic consumers, including holiday homes; The Lines Company using fixed capacity charges, variable charges on demand during defined periods and specific asset charges (for assets such as meters) for residential electricity consumers.

[14] An ICP is a consumer’s point of connection to an electricity distribution network. Generally this is where electricity is supplied

[15] This is not the case for Nelson Electricity, which charges 1 cent/day.

[16] Under the Electricity (Low Fixed Charge Tariff Option for Domestic Consumers) Regulations 2004 (LFC regulations), a ‘low user’ is:

a) a person with a home in the bottom half of the South Island who purchases or uses less than 9,000 kWh of electricity per year for the home

b) a person with a home elsewhere in New Zealand who purchases or uses less than 8,000 kWh of electricity per year for the home.

[17] A network supply point is a point of connection between the distribution network on which the ICP is located and the electricity network supplying the distribution network.

zero. This is defined as 'wholesale pricing' under the LFC regulations.[18] Around 240,000 ICPs have this charge structure.

2.5 Distributors are guided by various regulatory arrangements in setting their prices

2.5.1 Distributors take into account factors other than network costs when setting distribution prices. Three such factors are:

(a) the Authority's voluntary distribution pricing principles

(b) electricity industry rules and regulations

(c) the Commerce Commission's regulatory arrangements.

The Authority's voluntary distribution pricing principles

2.5.2 The Authority has published a set of distribution pricing principles.

2.5.3 Although the pricing principles are voluntary, the Authority expects that distributors following good industry practice would align their pricing structures with the principles.

2.5.4 A key theme of the pricing principles is that distribution prices should signal the economic costs of service provision by distributors. That is, prices should not involve subsidies, should have regard to available capacity on the network, and should signal the impact of additional consumption on the cost of investment in the network.[19]

Electricity industry rules and regulations

2.5.5 Part 6 of the Electricity Industry Participation Code 2010 (Code) contains provisions relating to the connection of distributed generation to distribution networks.[20] Among other things, Part 6 specifies the pricing principles that distributors are to apply when distributed generation is connected to their distribution networks. This includes the principle that it

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[18] Regulation 17.

[19] Distributors must also take into account other principles, in setting their tariffs. For example, the principle that prices should promote price stability and certainty for stakeholders. There may be tension between principles (eg, between this principle and the principle that prices are to signal the economic costs of service provision).

[20] Distributed generation is generation that is connected directly to local distribution networks rather than to the national transmission network. Distributed generation encompasses a range of technologies and scales, including small-scale systems such as solar panels, small wind turbines and micro-hydro schemes. This generation may be used, for example, as electricity sources for businesses, homes or farms.

must be priced on an incremental basis.[21] This means that a distributor can charge for costs caused by the connection but cannot recover any of the common costs of the network from the distributed generation.[22]

2.5.6 In addition, distributors' pricing arrangements are influenced by the LFC regulations. The objective of the LFC regulations is to:

(a) "ensure that electricity retailers offer a low fixed charge option or options for delivered electricity to domestic consumers at their principal place of residence that will assist low-use consumers and encourage energy conservation; and

(b) regulate electricity distributors so as to assist electricity retailers to deliver low fixed charge options".[23]

2.5.7 The LFC regulations require distributors to offer a price option which has a fixed charge of not more than 15 cents per day (excluding GST), and a variable component set so that the average consumer, as defined in the LFC regulations, pays no more per year on the low fixed charge option than on any alternative pricing structure.

2.5.8 The LFC regulations allow some flexibility for distributors in how they structure their charges. They allow for multiple variable charges and charges on different measures of demand such as "setting different variable charges for controlled or uncontrolled load, or for electricity consumption at different times of the day or year".[24] They do not prevent the use of variable charges based on a consumer's capacity or peak electricity demand or consumption charges that vary based on time of use.

2.5.9 The definition of "average consumer" allows for some flexibility in how it is applied for the purposes of determining whether a variable charge complies with the LFC regulations. The LFC regulations expressly contemplate some variation in the measurement of average consumption.[25] When a peak demand or capacity charge is used, distributors have some flexibility in determining what the average peak

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21 The Authority is considering the Part 6 pricing principles separately in another project.

22 As noted earlier, the common costs of the distribution network are those costs that cannot be attributed to any individual service or connection (for example, the Chief Executive's salary).

23 Regulation 3. The LFC regulations are available at: http://www.legislation.govt.nz/regulation/public/2004/0272/latest/DLM283614.html.

24 See regulation 16(2)(a) of the LFC regulations for distributors.

25 See regulation 23(d) of the LFC regulations.

demand is, and how that aligns with the definition of "average consumer" in the LFC regulations.[26]

2.5.10 Appendix B contains further information on the regulatory arrangements relevant to distribution pricing.

The Commerce Commission

2.5.11 The Commerce Commission regulates distribution revenue and the allowable rate of change to the average level of distribution prices in New Zealand, by setting 'price-quality paths' for 17 of the 29 distributors, in accordance with Part 4 of the Commerce Act 1986.[27] The Commerce Commission regulates the maximum average prices these 17 distributors can charge.[28] The Commission requires the distributors to deliver services at a quality consumers would expect.[29]

2.5.12 There is an interdependency between the Authority's regulation of the structure of distribution prices and the Commerce Commission's price-quality path regulation. This is shown in Figure 3.

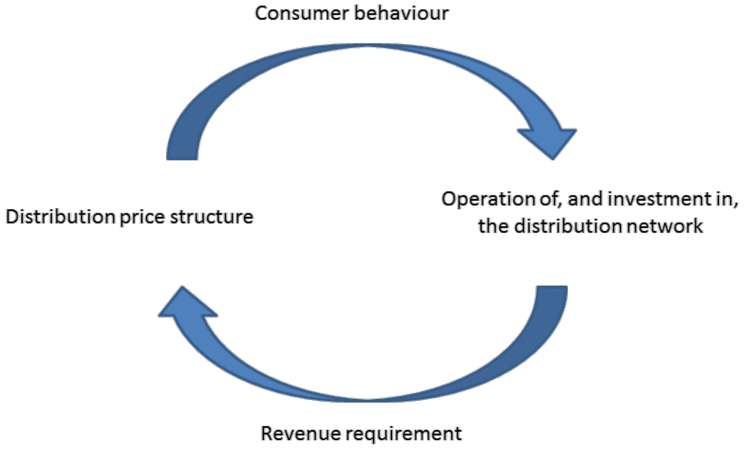
[26] For instance, in implementing a peak (kW) demand tariff, The Lines Company estimates the average peak demand of the average consumer and uses its estimate as the benchmark for determining compliance against the LFC regulations – particularly regulation 15(1).

[27] Twelve distributors are exempt from having their prices regulated by the Commerce Commission, because they meet the 'consumer-owned' exemption criteria set out in the Commerce Act. These distributors' pricing is nevertheless subject to the Authority's pricing principles.

[28] While the price-quality paths set by the Commerce Commission limit total average price increases, they do not constrain prices for individual services, classes of services, or for different customer groups. In other words, the Commerce Commission does not control what the 17 distributors can charge individual consumers or groups of consumers.

[29] Further information is available at www.comcom.govt.nz/regulated-industries/electricity/electricity-role/.

Figure 3: Interdependency between the work of the Authority and the Commerce Commission on distribution pricing



Source: Electricity Authority

2.5.13 The structure of distribution prices (regulated by the Authority) influences consumer behaviour, which influences investment in, and operation of, the distribution network (regulated by the Commerce Commission). This in turn influences the distributors' revenue requirements (regulated by the Commerce Commission), which they seek to recover from consumers via a methodology for structuring their distribution prices (regulated by the Authority).

2.5.14 The Authority and Commerce Commission are each aware of this interdependency and take it into account in their respective deliberations on distribution pricing.

3. Evolving technologies and consumers' electricity-related decisions

Case study: the world of the future electricity consumer

Evolving technologies are already changing consumers' electricity related decisions and the impact will increase. This case study provides a hypothetical but plausible illustration of the world of an electricity consumer in the not too distant future.

On a cold evening (following a sunny day), Finn was driving home from work a little later than normal. A GPS-enabled app on his smartphone triggered when it estimated he was 15 minutes from his home. The app signalled the heat pump in his home to turn on, so that the house would be a pleasant 20 degrees when he arrived.

Because it was a cold evening, lots of people were using the electricity network, which meant that both the price of electricity and the price of network capacity were high. The app assessed the different prices, and chose to power the heat pump in a way that would lead to the cheapest overall electricity supply. This meant the heat pump used previously-stored electricity in Finn's 10kWh battery cell. The electricity had been collected earlier that day from the solar panels on Finn's roof.

Both the solar panels and battery were provided by an energy services company. With the help of this company, Finn was able to manage his electricity use and keep his prices down.

Finn parked his electric car in his garage and plugged it in but it didn't start charging straight away – that would happen later in the night when the price of electricity was lower because of lower wholesale and network prices. The car had come with an app that managed the charging process, so Finn could be confident it would be fully recharged by the morning at the lowest cost available.

Finn never noticed his heat pump switch itself on and off early in the evening in response to a signal from the local distributor, but allowing this remote control meant the prices he paid – and his power bill – were lower overall. It worked well for the distributor too as this option had allowed it to reduce congestion on the network and avoid expensive network upgrades for several years.

3.1 Consumers' electricity-related decisions are affected by evolving technologies

3.1.1 Evolving technologies are enabling consumers to more easily manage and control when they use electricity. Increasingly, consumers can also choose whether they generate their own electricity or get it from the distribution network.

3.1.2 Electricity reaches into virtually every home and business in New Zealand. It has become an essential part of modern life – lighting, heating and powering our homes, factories, farms, hospitals, towns and cities. Electric-powered devices now proliferate in homes and in workplaces.

3.1.3 Consumers' decisions to invest in evolving technologies such as photovoltaic generation (solar panels),[30] energy-efficient lighting and heat pumps are changing how much electricity consumers use.

3.1.4 Meanwhile smart technologies allow consumers to control electrical appliances, manage individual electricity demand in response to prices, and integrate small-scale distributed electricity generation (eg, solar panels) into consumers' energy use.

3.1.5 The internet is increasingly a part of consumers' lives, interfacing readily with mobile communication technologies and offering remote monitoring, and the prospect of remote control, of electrical appliances in the home or workplace.

3.1.6 Data and information storage capacity is also enabling consumers to look at how they might undertake activities that use electricity in a better and more efficient manner.

3.1.7 Evolving technologies will affect each step of the electricity supply chain – from generation to consumption.

3.2 Evolving technologies will affect distribution networks

3.2.1 Evolving technologies will affect the operation of, and/or investment in, distribution networks, along with the range of distribution services and service levels that distributors provide.

[30] Photovoltaic generation (solar panels) is not the only form of technology that uses the sun's energy (eg, solar hot water systems).

3.2.2 On the one hand, distributed generation (like solar panels), solar water heating and energy-efficient technologies are becoming more common, and reduce overall demand for electricity supplied from the grid.

3.2.3 On the other hand, more distributed generation could mean distributors need to invest in their networks to maintain the quality, and possibly reliability, of electricity supply to consumers.

3.2.4 Similarly, more electric vehicles could mean distributors have to invest in additional network capacity if the peak load on the network increases. This would happen if most people charged their cars during the evening (when demand is highest).

3.2.5 Another new technology, battery storage systems, could reduce the need for distributors to invest in additional network capacity. This is because batteries allow electricity to be stored, and used later.

3.2.6 Evolving technologies also let consumers choose from a wider range of distribution services and service levels (eg, by the consumer injecting electricity into the distribution network, or the distributor managing the supply of electricity to the consumer's 'smart' fridge or reverse cycle air conditioner / heat pump).

3.3 Distribution prices should inform consumers of the costs of using evolving technologies

3.3.1 As a general principle, a distributor's charges for use of its distribution network should be service-based.[31] Prices should give consumers accurate information about the costs of the services they use on the network (including any reduced costs). Such prices will encourage consumers to make investment and consumption decisions that will result in the lowest cost provision of electricity for all consumers over time.

3.3.2 How consumers invest in technology and use electricity can affect the way distributors invest in and/or operate distribution networks. This, in turn, affects network costs.[32] Consumers need to be aware of these cost impacts so their decisions about whether to invest in and use a technology maximise the benefit to society.

3.3.3 The Authority considers it is timely to consider what distribution charge structures are most appropriate in New Zealand, given how consumers

[31] This principle must in some cases be balanced against other desirable principles for tariff construction.

[32] The effect may be to exacerbate or reduce actual or potential network costs.

invest in and use evolving technologies. This is consistent with the Authority's market development approach, of enabling efficient pricing arrangements for new technologies.

Q1.	**What are your views on the scope of the Authority's review of distribution pricing in the face of evolving technologies?**

4. A number of evolving technologies are increasing consumers' options

4.1 Consumers have more access to new technologies

4.1.1 Over the past five to ten years, consumers have increasingly had access to technologies that influence:

(a) their demand profiles (ie, how much electricity they use and when they use it)

(b) the distribution services and service levels they require.

4.1.2 These in turn influence distributors' investment in, and operation of, their networks.

4.1.3 The more prominent of these evolving technologies are:

(a) heat pumps / reverse cycle air conditioners

(b) photovoltaic systems

(c) battery storage

(d) electric vehicles

(e) advanced metering infrastructure (AMI)

(f) energy efficient lighting

(g) energy efficient appliances and 'smart' appliances

(h) energy efficient building technologies.

4.1.4 These technologies provide consumers with a range of benefits, including:

(a) being able to generate their own electricity on site and export it back into the grid

(b) being able to store electricity on site, which can be used to reduce their electricity bill by:

(i) enabling them to use, during higher price periods of the day, stored electrical energy supplied from the distribution network during lower price periods, and/or

(ii) enabling them to use more of any electricity generated on site

(c) providing cars with much lower fuel and maintenance costs

(d) providing very efficient, and therefore lower cost, heating, cooling and lighting

(e) enabling consumers to obtain a financial reward from allowing certain appliances to be switched on and off remotely to help manage the amount of electricity being conveyed on the electricity network

(f) giving consumers more information to help them make energy-related decisions, such as whether to defer or curb electricity use in return for financial reward.

4.1.5 This section provides an overview of some evolving technologies. It notes the effects or likely effects that investment in and use of the technologies is having, or may have on:

(a) consumers' demand profiles

(b) the way distributors operate and/or invest in distribution networks

(c) the services and service levels distributors provide.

4.2 There are a range of new technologies available

Heat pump technology[33]

4.2.1 Typically, heat pumps work by drawing heat from the air outside a house and moving it inside the house. The external unit of the heat pump contains liquid refrigerant, which evaporates to become a gas, thereby absorbing energy from the air. The gas is pushed inside the house to the internal heat pump unit where the gas is condensed, thereby releasing heat. When the heat pump operates in cooling mode, the reverse occurs.

4.2.2 Heat pumps are the most efficient form of electrical heating currently available in New Zealand. That is, they produce the most heat for a given amount of electricity consumed.[34]

[33] The text in this sub-section draws heavily on French, L., BRANZ Study Report No. 186 (2008), Active Cooling and Heat Pump Use in New Zealand – Survey Results, pp. 1-2.

[34] See http://www.level.org.nz/energy/space-heating/heat-pumps/.The efficiency of a heat pump is normally expressed as either a Coefficient of Performance (COP) when considering its heating capability, or as an Energy Efficiency Ratio (EER) when considering its cooling capability. The COP represents the amount of heat that a heat pump produces relative to the electricity it uses. So a 2KW heat pump with COP of 3, will produce the equivalent of 6KW of heat (i.e. the same amount of heat that would be produced by a 6KW electrical resistance heater) under optimum conditions. Actual output efficiency depends on the difference in temperatures between the source (usually outside air), and the destination (the room being heated). The colder it is outside, the less efficient the heat pump will be. Typical domestic heat pumps have COPs ranging between 2 and 4.5, although some current heat pump models have COP ratings of up to 5.8.

4.2.3 Even allowing for the improved energy efficiency in heat pump technology, a high penetration of heat pumps will have implications for how distributors operate and invest in distribution networks, as well as the services they offer. For example, more heat pumps could increase peak demand on the network while at the same time providing a source of demand response capability (through being able to turn them down/off remotely).

Photovoltaic technology (solar panels)

4.2.4 In New Zealand, a photovoltaic system is typically a form of distributed generation which uses solar panels to convert sunlight into electricity that a consumer can use on their premises, or export to the distribution network.[35]

4.2.5 The number of solar panels installed in New Zealand has grown rapidly over the past five years, albeit off a low base. There are now more than 6,000 units installed, compared to around 1,000 two years ago. The total installed generation capacity of small photovoltaic panels (less than 10 kW) as at August 2015 is more than 24 megawatts (MW).[36] This represents an increase of about 470% compared with 2013. However, total solar generation remains a small proportion of New Zealand's total electricity generation capacity, at less than 0.1%.

4.2.6 Because they depend on sunlight, solar panels reduce network load during the day, especially from late morning to mid-afternoon, but not during periods of peak load (which in New Zealand are winter evenings). In addition, more solar panels could affect service levels, by causing voltage fluctuation and over-voltage issues on parts of a distribution network. This in turn could increase network operating costs.

4.2.7 Installing solar panels may also change consumers' required distribution services. For example, consumers may wish to inject surplus electricity generated by solar panels into the distribution network.

Battery storage technology

4.2.8 A battery storage system enables electricity to be stored and made available later.

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[35] A solar panel consists of a number of solar cells. A collection of solar panels is known as a solar array.

[36] Electricity Authority data. This was calculated using total numbers of solar panel installations less than 10 kW, and does not include unregistered solar or off-the-grid solar panels. A nationwide installed capacity of 21 MW equates to approximately 20 gigawatt hours of electricity production (75 terajoules), if an estimated utilisation factor of 12% is used for the solar generation.

4.2.9 For many years energy has been stored, at appropriate times and locations, to help balance generation and consumption and to maintain network stability. However, more recently the use of battery storage systems to support the operation of distribution networks with solar panels has gained wide interest.[37]

4.2.10 Battery technology provides benefits to both consumers and distributors. Consumers can use battery technology to reduce the amount they pay their electricity retailer by:

(a) using, during higher price periods of the day, stored electrical energy that was supplied from the distribution network when prices were lower, and/or

(b) if they have onsite generation, using more of the electricity they have generated.

4.2.11 Distributors can benefit from battery technology by reducing demand during periods of congestion on their networks, thereby deferring or avoiding network augmentation. As distributed generation becomes more prevalent, distributors can also use battery technology to help manage high network voltage during periods when network load is low and output from distributed generation is high.

4.2.12 Battery technology may also change consumers' required distribution services. For example, consumers may install enough onsite generation and battery storage to enable them to take little electricity from the network for much of the time. However, while their need for a transportation service may fall, their need for a capacity service may remain unchanged (ie, their peak demand for grid-delivered electricity remains unchanged).

Electric vehicle technology

4.2.13 Electric vehicles, including plug-in hybrid electric vehicles, are now available in New Zealand. However, New Zealand is at an early stage of electric vehicle uptake meaning that demand for electric vehicles is currently very limited.

4.2.14 The main benefit to consumers of an electric vehicle is the substantially lower operating costs – fuel and vehicle maintenance.

4.2.15 Currently, electric vehicle batteries are not very suitable to supply stored electricity to a consumer's premise. This is because they are designed to provide large amounts of electricity very quickly, rather than a lower

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37 Bahadornejad, M. & Nair, N., 2013, Solar PV, Battery Storage and Low Voltage Distribution Network, A Discussion on the Benefits of Distributed Battery Storage.

amount of electricity over a longer time period. Many car batteries are also not capable of discharging electricity outside of the car.[38] However, they can still be used to help households use onsite generation more efficiently (eg, recharging the car battery during the middle of the day using solar panels).

4.2.16 Peak loads on distribution networks are likely to increase if electric vehicle batteries are charged during the evening peak demand period. In this case, distributors may need to invest more in additional distribution network capacity (if the network is capacity constrained).

4.2.17 Electric vehicles may allow distributors (and retailers) to provide new services related to recharging electric vehicle batteries.

AMI technology

4.2.18 AMI comprises multiple technologies, such as smart metering, home area networks,[39] integrated (typically two-way) communications, data management applications and standardised software interfaces.

4.2.19 AMI facilitates demand response by enabling consumers to have more information relevant to their decisions on electricity use.[40] AMI enables electricity pricing to be on a half-hourly or hourly basis,[41] and to be more dynamic than in the past (eg, critical peak pricing).[42] In turn, this facilitates prices that are more closely aligned with the cost of generating and delivering electricity to the consumer. Through service-based prices, consumers can be encouraged to use less electricity during periods of, for

[38] Further technological change is possible in this area.

[39] A network of connected electrical devices in a home, such as energy management devices, in-home displays, computers, smart metering and smart appliances.

[40] For the purposes of this paper, the Authority defines demand response to mean end-use consumers intentionally altering their normal consumption patterns (by changing their instantaneous demand for electricity, the timing of their electricity consumption, or their total consumption of electricity), in response to electricity price changes, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardised.
Demand response is a subset of demand-side management, which, to adopt the International Electrotechnical Commission’s terminology, is ‘a process that is intended to influence the quantity or patterns of use of electric energy consumed by end-use customers’.

[41] In contrast to New Zealand, smart metering in some overseas jurisdictions records electricity on an hourly basis.

[42] Critical peak pricing is where electricity prices are substantially higher during critical events (eg, periods of very high loading on the electricity network).

example, high wholesale electricity prices or capacity congestion on the electricity network.[43]

4.2.20 AMI also has the potential to provide distributors with several operational benefits (which can enable cost savings). These include better detecting and notifying of outages, and better monitoring of voltage and power quality. In addition, if distributors were to adopt AMI, they could greatly improve consumer service by refining network operating and asset management processes based on AMI data.[44]

4.2.21 AMI can enable distributors to provide new services, if consumers assign decision rights to the distributor. For example, the distributor (or any party that secured rights from the consumer) managing the supply of electricity to the consumer's 'smart' fridge or reverse cycle air conditioner / heat pump.

Energy efficient lighting technology

4.2.22 Energy efficient lighting can use substantially less energy than traditional incandescent lighting, while still producing the same amount of light. LEDs are the most efficient and their efficiency is increasing over time. LED lamps last significantly longer than both incandescent bulbs and compact fluorescent lights (CFLs).

4.2.23 Over the past decade there has been a significant move from traditional incandescent lights to more efficient types of light bulbs, including CFLs as well as LEDs. The Authority estimates that perhaps up to approximately 50% of lighting used in New Zealand is now energy efficient.

4.2.24 There has been a significant uptake of more efficient types of light bulbs over recent years. However, there is still the potential for light bulb substitution to lead to a material reduction in the amount of electricity transported across distributors' networks. This is a result of LED lights replacing both incandescent lights and other less energy efficient lights (eg, fluorescent lights). Reducing or slowing the growth in peak demand on networks, which is driven largely by residential consumers, would help to defer or avoid network investment if the network was capacity constrained.

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[43] It also encourages consumers with on-site generation to increase production during periods of high electricity prices.

[44] National Energy Technology Laboratory, 2008, Advanced Metering Infrastructure.

4.3 The uptake of other technologies also affects distribution networks

4.3.1 Consumers' uptake of other technologies also affects how distributors operate and/or invest in distribution networks, and the services and service levels they provide. A couple of more prominent examples are set out below.

Energy efficient appliances and 'smart' appliances

4.3.2 An electrical appliance that is more energy efficient than the appliance it is replacing will reduce load on a distribution network. However, if consumers use more electrical appliances overall, this can more than offset the energy efficiency gains.

4.3.3 Having said this, some appliances are being fitted with technology that allows their electricity demand to be reduced by remote signal. Examples of appliances that are well suited to this technology are heat pumps (referred to earlier), fridges and freezers. These 'smart' appliances can be switched on and off remotely, as is the case for many electric water heaters.

4.3.4 This enables a distributor to extend its load management service offering, whereby consumers allow distributors to manage the supply of electricity to smart appliances.

Energy efficient building technologies

4.3.5 Changes to building technologies are improving the energy efficiency of buildings (eg, better thermal insulation materials in ceilings, walls and under floors; technological advances in insulating glass). These technological advances are reducing the amount of electricity transported across distributors' networks.

4.3.6 As with other energy efficiency technologies, the biggest implication for distributors is that they can defer or avoid the need to augment the network. This is because of reduced growth, or slower growth, in load at times of congestion on the network.

Q2. What other technologies do consumers invest in or use that are likely to have a material effect on investment or operation of distribution networks? Please give reasons for your answer and an estimate of when you expect the technologies will have a material effect.

5. Distribution pricing affects consumers' decisions about technology

5.1 Distributors' existing pricing structures do not give consumers the correct information

5.1.1 The price a consumer pays for a distribution service should be service-based. Service-based prices encourage consumers to make decisions that are best for society as a whole, and lead to the lowest cost provision of electricity for all consumers over time.

5.1.2 It is not necessary for distributors to set prices that perfectly reflect the cost of the services provided. It may not be feasible, for example, for a distributor to measure the exact cost of providing a particular service to a consumer. Also, common network costs must be recovered, which may require prices to be marked up above cost. Distributors must also consider other factors such as the need to charge prices that consumers can understand.

5.1.3 There is no perfect distribution pricing approach that can be applied in all cases. Nevertheless, the structure of distribution prices should not diverge substantially from the structure of the costs of providing distribution services. If a consumer wants to use a certain amount of distribution network capacity during periods of network congestion, then the consumer should pay a relatively high price for the distribution service. If the consumer is instead willing to use grid-delivered electricity when the distribution network has plenty of available capacity, the consumer should pay a much lower price for the distribution service.

5.1.4 Most distributors earn the bulk of their revenue (and recover most of their common network costs) through a charge based on electricity consumption over time, measured in kWh. They also earn some revenue from charges that are not related to consumption over time (eg, a daily or monthly charge). The consumption (kWh) charges do not take into account times of network congestion.

5.1.5 Distributors have used this pricing structure for many years. It is a legacy of the traditional approach to the management of the electricity industry which applied prior to industry restructuring in the 1990s. Some alternative pricing structures for residential consumers (eg maximum demand charges) have been difficult to implement due to limitations on metering technology. However, the prevailing pricing structure does not reflect the costs of the services provided.

5.1.6 It does not take account of the different costs associated with providing different distribution services. It means that prices do not reflect the variation in costs according to time of use or whether or not the network is congested. Aside from a (relatively modest) day/night pricing differential applied by some distributors, consumption charges in New Zealand are generally fairly static over time. With some notable exceptions,[45] rates do not vary according to time of use or network congestion.

5.1.7 Distributors typically recover a much higher proportion of their network costs (common costs) through consumption charges than they would under a service-based distribution pricing structure. In practice, the average share of revenue recovered from consumption charges is around 78%. If charges reflected the cost of the services provided, a significantly lower share of distribution revenue would be raised from consumption charges.[46] Consumption charges are higher, at most times and in most networks, than they would be under a more service-based approach.[47]

5.1.8 In this paper, the prevailing structure for distribution pricing is called consumption-based pricing. The Authority has examined the costs and benefits of some technology-related decisions that may be encouraged by consumption-based pricing. The analysis finds that consumption-based pricing creates incentives for consumers to make decisions that lead to significant economic costs for society. This includes decisions to adopt and use certain technologies. It is particularly the case for technologies that either increase the peak demand for capacity on distribution networks, or which decrease a consumer's off-peak demand for network capacity without lowering the consumer's peak demand for capacity. Consumption-based pricing does not promote the long-term benefit of consumers.

5.1.9 Consumption-based pricing may be contrasted with service-based pricing, under which prices reflect the cost of the services provided by the distributor, with an appropriate mark-up for recovery of common costs. Common costs should be recovered in a way that does not distort consumers' decisions on use of the network or investment. Accordingly, service-based pricing is likely to involve recovering some common costs

[45] The approach used by The Lines Company to set distribution prices is an exception, under which charges vary depending on consumption at defined periods of peak demand on the distribution network.

[46] See attached NZIER report to the Electricity Authority, Effects of distribution tariffs on household investment in solar, p. 4.

[47] Although this is correct in general for consumption charges, it is not true for periods where the network is congested. At such times, a service-based price for consumption would be significantly higher. It may take the form of a peak demand charge, rather than a standard consumption charge.

through charges for capacity and / or peak demand, and recovering a much lower proportion of common costs through consumption charges.

Existing pricing structures are likely to lead to inefficient investment in solar panels

5.1.10 The Authority's preliminary view is that consumption-based pricing will lead to investment in solar panels that does not result in the lowest cost provision of electricity for all consumers over time. This is based on empirical analysis the Authority has undertaken.

5.1.11 The Authority is very supportive of consumers investing in solar panels provided they pay for the cost of the network services they use and contribute to their share of common network costs. They do not, however, with consumption-based pricing. As a result, consumers face incentives which lead to inefficient over-investment in solar panels.

5.1.12 Solar panels result in a consumer not paying the full cost (including an appropriate share of common costs) of the distribution network capacity the consumer needs during their periods of peak demand for grid-delivered electricity. This is because distribution network capacity costs are usually recovered via consumption charges, and solar panels reduce the consumption of grid-delivered electricity over time.

5.1.13 This would be expected to result in more consumers investing in solar panels than would occur if the price of the distribution capacity service reflected the cost of the service.[48] Such investment will result in consumers without solar panels facing higher power prices, as distributors recover network costs from a smaller consumption pool. This may cause these other consumers to use less power, even when it is of high value to them.

5.1.14 To date this effect has been small, since few consumers have installed solar panels. Now that the uptake of solar panels is forecast to increase rapidly, this issue is becoming much more important. It is investigated in section 5.2.

Existing pricing structures may lead to inefficient investment in distribution networks

5.1.15 Consumption-based pricing may lead to inefficient investment in the capacity of distribution networks. One way in which this could occur is

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[48] The non-financial benefits (such as reducing carbon emissions) may also be over-estimated because the solar generation may be displacing grid-delivered electricity from renewable generation sources (hydro, geothermal, wind).

through consumers recharging their electric vehicles during periods of peak demand on the distribution network.

5.1.16 The price of consumption during the evening peak demand period typically does not reflect the higher cost of using the distribution network at that time. This may result in consumers effectively being encouraged to charge their electric vehicles during that peak period (or at least they may not be discouraged from doing so). Recharging electric vehicles during the evening peak would increase the peak load on distribution networks and so could materially increase costs for the distributor (if the network was congested). This would likely raise prices for other consumers.[49] This issue is explored in section 5.3.

5.1.17 Another way current pricing could lead to inefficient distribution networks is if consumers do not use battery storage systems in the most efficient way. Existing pricing does not reflect the high cost of using the network during times of congestion. So it does not encourage consumers to discharge their batteries at this time. If they did, distributors might be able to defer or avoid investment to augment the network, and reduce future network costs. This issue is explored in section 5.4.

5.1.18 Consumption-based pricing may not encourage consumers to make investment decisions about heat pumps and energy-efficient lighting that reduce future distribution network costs. For example, consumers who install energy-efficient lighting may lessen the need for additional investment in the capacity of the distribution network. If so, this would reduce costs for the distributor (and potentially for other consumers on the network). Distributors need to ensure their pricing does not discourage consumers from making decisions that have this type of beneficial outcome for society. These issues are discussed in section 5.5.

The Authority is concerned about whether existing distribution pricing structures are durable

5.1.19 The Authority is concerned that consumption-based pricing may be unsustainable. Section 5.2 highlights that investment in solar panels is subsidised by those consumers without solar panels.[50] This can create a spiral effect, leading to more investment in solar panels than would maximise the benefit to society.

5.1.20 If consumption-based pricing is retained, more distribution network costs will be recovered from consumers without solar panels. The number of consumers without solar panels will reduce over time as more consumers install solar panels. The gap between the cost of providing distribution

[49] Depending on the pricing methodology they are subject to.

services to consumers with solar panels and the prices paid by those consumers will become larger.

5.1.21 This has a couple of key effects:

(a) First, consumers' decisions about consumption and investment will be distorted. This is because decisions are made based on prices that do not reflect the cost of services provided. For example, an excessively high consumption charge could cause consumers to use less grid-delivered electricity, even when it is of high value to them (for example, heating in winter). It could also cause distortions to investment (which are discussed in section 5).

(b) Second, consumers and electricity industry participants may lose confidence in the distribution pricing arrangements. This would increase the likelihood of consumers lobbying for change, which:

(i) creates uncertainty, which is harmful to investment in the electricity industry and any industries affected by the uncertainty (eg, installers of solar panels)

(ii) harms the efficient operation of the electricity industry, because of the significant costs of lobbying (both in respect of the lobbyists and the recipients of the lobbying).

5.1.22 The issue of durability is also one of the Authority's key concerns with the current transmission pricing arrangements.[51]

5.2 Consumption-based pricing will lead to significant inefficient investment in solar panels

5.2.1 This section investigates whether consumption-based pricing will lead to inefficient investment in solar panels, and concludes that it will. This means that investment in solar panels will not lead to the lowest cost provision of electricity for all consumers over time.

5.2.2 Uptake of solar panels is increasing rapidly. The analysis in this section indicates that consumption-based pricing provides incentives for consumers to over-invest in solar panels. It demonstrates that:

(a) consumption-based pricing will lead to major additional investment in solar panels, compared to what would occur with pricing that more closely reflected the cost of the services provided

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[50] This scenario is also illustrated in the case study in the Executive Summary.

[51] Refer to the Authority's recently published working paper 'Transmission Pricing Methodology Review: TPM options', available at www.ea.govt.nz/dmsdocument/19472.

(b) investment in solar panels is subsidised by those without it, creating a spiral leading to more investment in solar panels

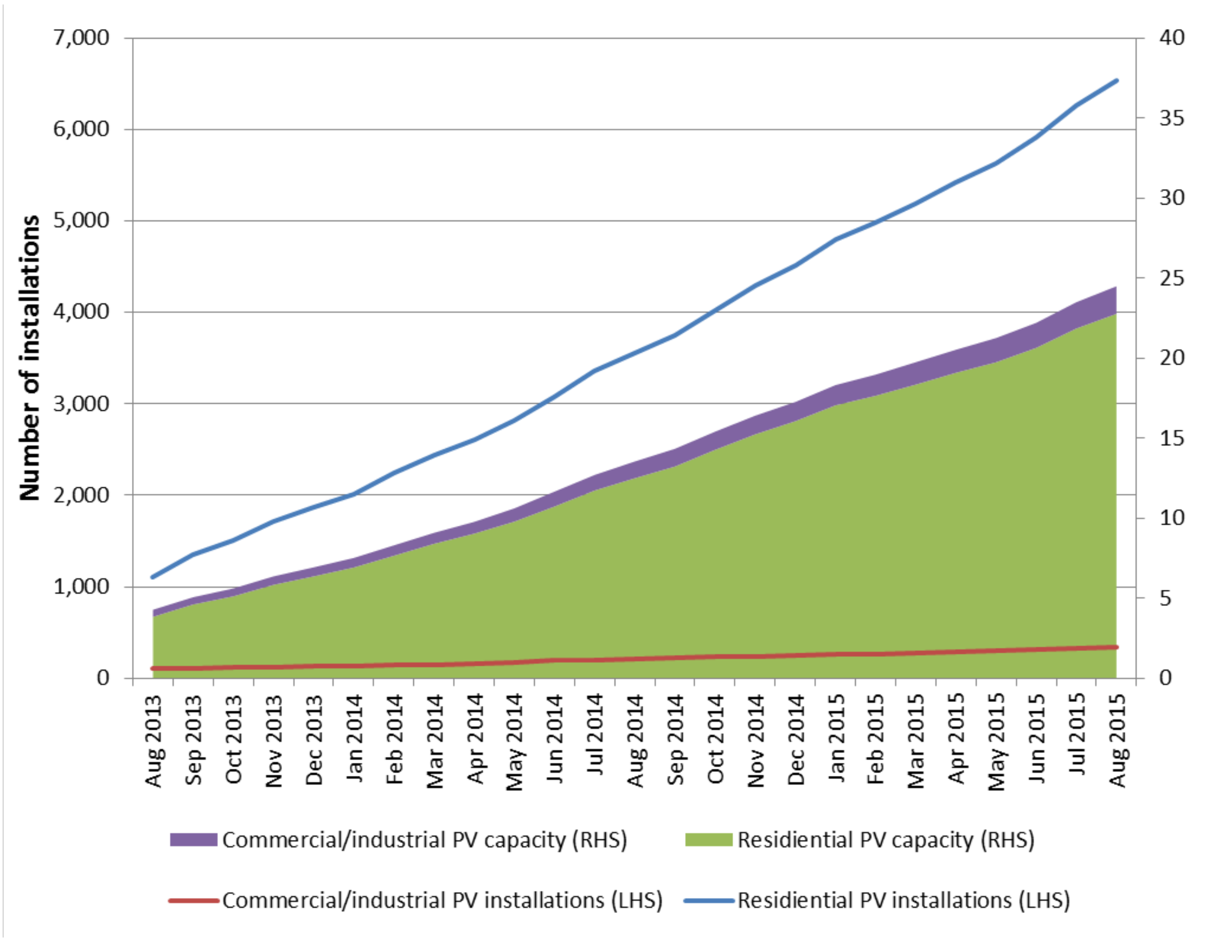
(c) solar generation displaces grid connected generation which can produce electricity at a lower cost to society.

5.2.3 Each of these points is discussed below.

Uptake of solar panels is increasing rapidly

5.2.4 Installation of solar panels in New Zealand is increasing rapidly, as illustrated in Figure 4. In two years the number of solar panel installations in New Zealand has increased from around 1,000 to almost 7,000 (amounting to more than 24 MW of installed capacity).

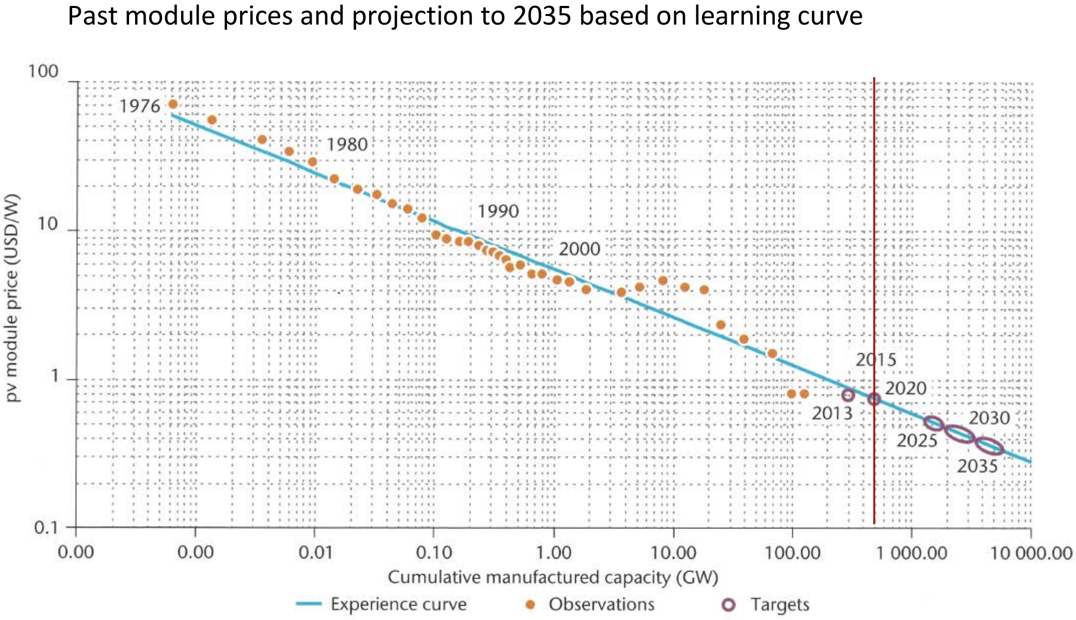
Figure 4 Solar installed generation capacity and ICP uptake



Source: Electricity Authority

5.2.5 One of the key drivers of this trend is the significant reduction in the cost of solar panels. In recent years, the cost of solar panels has fallen low enough to make residential investment economic for some consumers.[52] As Figure 5 illustrates, solar panel module prices have fallen to under US$1/watt within the last couple of years.

Figure 5 Historic and projected decrease in cost of solar panels



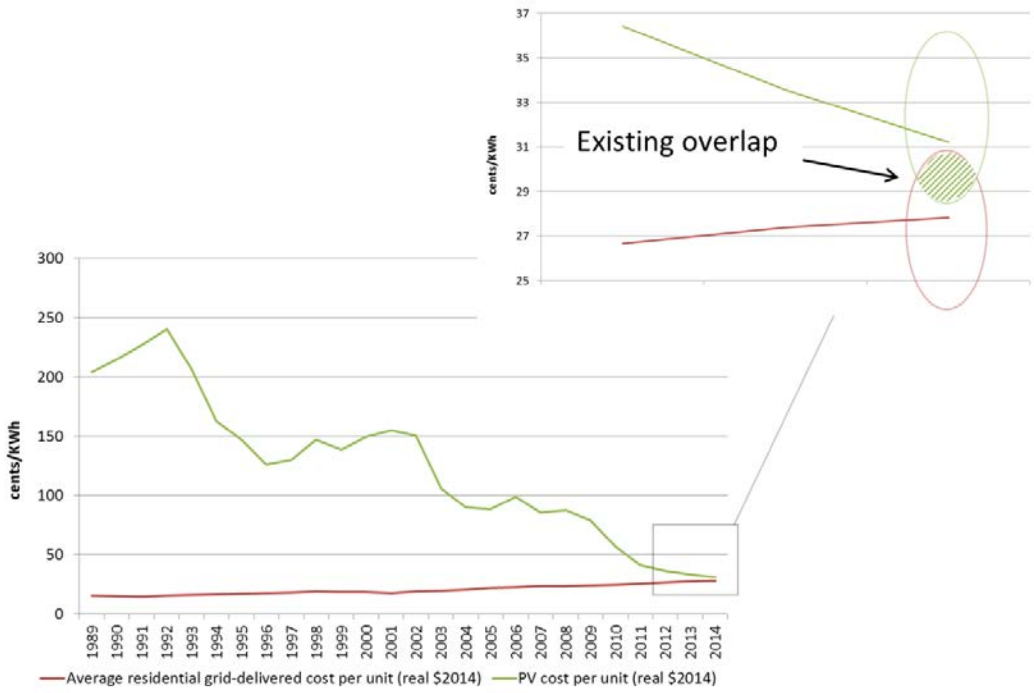
Source: International Energy Agency

5.2.6 The economics of solar panels will differ between consumers depending on a range of factors, such as the amount of sunshine and usage patterns. This means that installing solar panels will be worthwhile for some consumers,[53] but not for others. This is illustrated in Figure 6. The number of consumers for whom this is true will increase as the costs of solar panels continue to decline. So the level of installed generation capacity of solar panels will also grow over time. However, the rate of growth will also be influenced by distribution prices (as discussed in the next section).

52 Consumers may also choose to install solar panels for non-economic reasons, such as perceived environmental benefits.

53 Likely those consumers living in a sunny location, with high usage during daylight hours.

Figure 6 Solar generation costs vs average cost of grid-delivered generation



Source: Electricity Authority

Notes: Solar generation cost is made up of several components: modules (ie, panels), inverters and installation costs.

Consumption-based pricing will lead to inefficient investment in solar panels

5.2.7 Consumption-based pricing produces a higher private rate of return on a consumer's investment in solar panels, compared to service-based pricing. This leads to a higher rate of installation. Under consumption-based pricing an investment in solar panels may save the household a large proportion of the amount they pay their electricity retailer.[54] However, this "saving" is actually just shifting distribution network costs onto other consumers.

5.2.8 The Authority commissioned NZIER to investigate the potential effects of distribution pricing on household investment in solar panels. Private returns on investment in solar panels are higher with consumption-based

[54] This will depend in part on whether the location is sunny and whether the household has someone home during the day.

pricing than with service-based pricing. NZIER's analysis indicates that high consumption charges could increase returns to investment in solar panels by 3.4 percentage points, from -0.4% to 3.0%, in one scenario.[55] This occurs because consumption-based pricing results in solar panel owners not paying the full cost (including an appropriate share of common costs) of the distribution network capacity the consumer needs during their periods of peak demand for grid-delivered electricity.[56]

5.2.9 As a result, consumption-based pricing encourages more consumers to buy solar panels, compared to a scenario with lower consumption charges (service-based pricing). This effect was not very significant in the past because the cost of solar panels was so high. Now that solar panel costs have reduced sharply (and continue to do so), the impact of consumption-based pricing on uptake is likely to become significant.

5.2.10 Consumers invest in solar panels for many reasons, including perceived environmental benefits and a desire to be self-sufficient. Nevertheless, "reductions in power bills" (savings on payments to electricity retailers) have been identified as a very important incentive.[57] It follows that consumption-based pricing (which leads to higher financial benefits from solar panels) is likely to push many (but not all) consumers towards a decision to invest in solar panels.

5.2.11 NZIER has analysed the level of household investment in solar panels under current prices compared to an alternative scenario with a lower consumption charge.[58] A lower consumption charge is more consistent with a service-based approach compared to the relatively high consumption charges that are typical for most distributors.[59]

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55 NZIER, p. 10. This result is in the scenario with low future growth in grid supply costs.

56 They also avoid paying the variable costs which are required to meet their peak electricity demand.

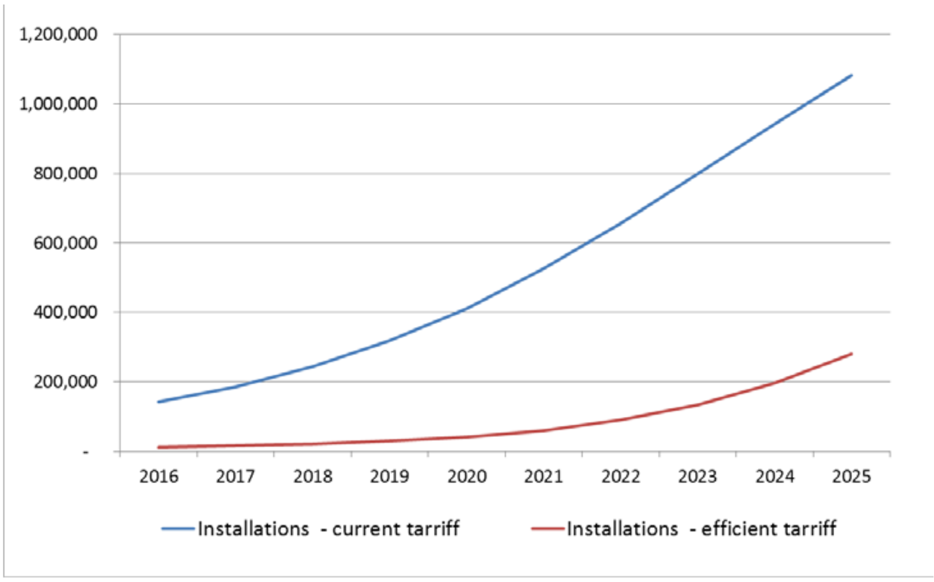
57 Ford, R., Stephenson, J., Scott, M., Williams, J., Wooliscroft, B., King, G. & Miller, A. (2014). PV in New Zealand: The story so far.

58 NZIER, op cit.

59 While the pricing structure adopted by NZIER has a higher daily charge compared to prevailing prices, the Authority does not endorse this (or any) particular pricing structure. The right pricing structure likely depends on the circumstances of an individual network and so may differ between distributors. The key feature of prices used by NZIER for the purpose of analysing investment in solar panels is the lower consumption charge compared to existing prices. This feature is likely to be shared by alternative efficient pricing structures. The distribution network costs which are not recovered through a consumption charge might alternatively be recovered through other charge types which are not considered by NZIER (for example, capacity charges or peak demand charges).

5.2.12 The analysis indicates that consumption-based pricing could result in more than three times the number of installed solar panels, compared to a scenario with a lower consumption charge.[60] Figure 7 illustrates the difference.

Figure 7 Solar panel installations: current prices (high consumption charge) vs a scenario with a lower consumption charge



Source: Electricity Authority, based on NZIER analysis.

5.2.13 NZIER's analysis suggests that consumption-based pricing for residential consumers is likely to bring forward a substantial volume of investment in solar panels.[61] The difference in the value of investment over 25 years is estimated at between $2.7 billion[62] and $5.0 billion[63] dollars (discounted present value).[64]

[60] This analysis is based on a number of assumptions, which are set out in the attached NZIER paper. The Authority recognises that ultimately the level of uptake may differ from forecast levels, since forecasting is an inexact science (and submitters may prefer alternative assumptions). Nevertheless, the direction of the effect of consumption-based pricing on solar panel uptake is very clear.

[61] NZIER, section 3.

[62] In a scenario with high solar panel costs and low cost grid-delivered electricity.

[63] In a scenario with low solar panel costs and high cost grid-delivered electricity.

[64] Note that the model is simplified and focusses on averages to understand potential effects. For example, the analysis does not take into account potential constraints on uptake such as the number of apartment-dwellers and tenants (who may be unable to install solar panels). Also it does not consider factors such as roof pitch and shading which may prevent installation on certain buildings. These factors would reduce the estimates presented here.

5.2.14 A large proportion of this impact on investment in solar panels is likely to occur in the near future. NZIER estimates that after 5 years with consumption-based pricing, investment in solar panels could increase by $2.6 billion (compared to only $0.2 billion in a scenario with lower consumption charges), and after 10 years, by $3.1 billion (compared to only $1.2 billion).[65]

Investment in solar panels is subsidised by those without them, leading to a spiral effect

5.2.15 Under consumption-based pricing, a household with solar panels installed does not pay the full cost (including an appropriate share of common costs) of the distribution network capacity it needs during the periods of peak demand for grid-delivered electricity. Distributors recover the shortfall from consumers without solar panels.

5.2.16 Distribution networks are built to serve peak demand. On most of New Zealand's distribution networks, peak demand occurs on winter evenings when residential demand for heating is highest. However, solar panels typically do not generate electricity during the network peak, which usually occurs after sunset in winter.[66]

5.2.17 Figure 8 shows an illustrative scenario where solar generation (blue shaded area) serves around 13% of network energy demand. Even though this is a substantial proportion of demand, it has no effect on the peak, which occurs after 6pm. In this scenario the installation of solar panels would not reduce future network costs (although there are some circumstances in which solar panels could contribute towards a reduction in the peak demand on the distribution network).[67]

5.2.18 The amount of grid-delivered electricity the household consumes will reduce substantially after solar panels are installed. So the amount the household pays its electricity retailer will also decrease substantially. This private financial benefit arises because owners of solar panels make a

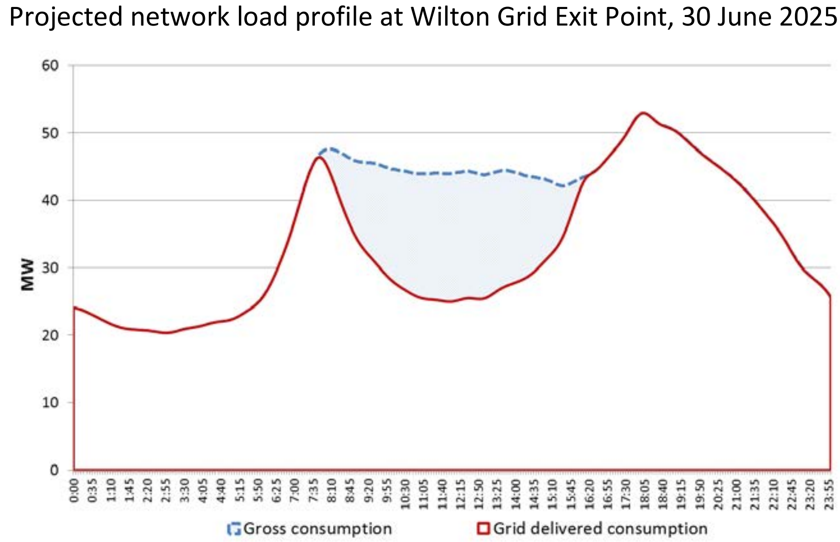
[65] NZIER, section 5, figure 8.These are averages across four scenarios around changes to the cost of solar panels and of reticulated electricity over time.

[66] Solar generation is also at its lowest level during winter, due to lower solar radiation.

[67] Peak demand might change to some extent if the consumer's behaviour changed, for example if the consumer began shifting to off-peak use of appliances, to increase self-consumption of solar panel output. Peak demand could also change if the consumer had a home battery to store the solar panel output. Consumers could potentially reduce future network costs, in a congested network, by using a combination of solar panels and batteries. It is assumed that neither of these effects is substantial. Consumer investment in batteries is assumed to be low because the private return from installing solar panels would be reduced if the consumer also had to incur the cost of installing batteries.

reduced contribution to network costs. This occurs because network costs are recovered from consumers primarily through consumption charges.[68]

Figure 8 Solar generation impact on load profile at network level



Source: Electricity Authority

Notes:

- Total load profile (before solar generation) based on offtake at Wilton grid exit point, 30 June 2014: assumed unchanged by 2025. A grid exit point is the point where electricity is supplied from the national transmission network to the local distribution network. Wilton is a grid exit point in Wellington serving a mainly residential area.
- Solar generation assumptions based on an estimated 56.5% of 15,000 households installing 3 kW units. This results in an estimated 13% of total demand served by solar panels at Wilton.
- Assumes no home battery storage systems or other peak-shifting behaviour.

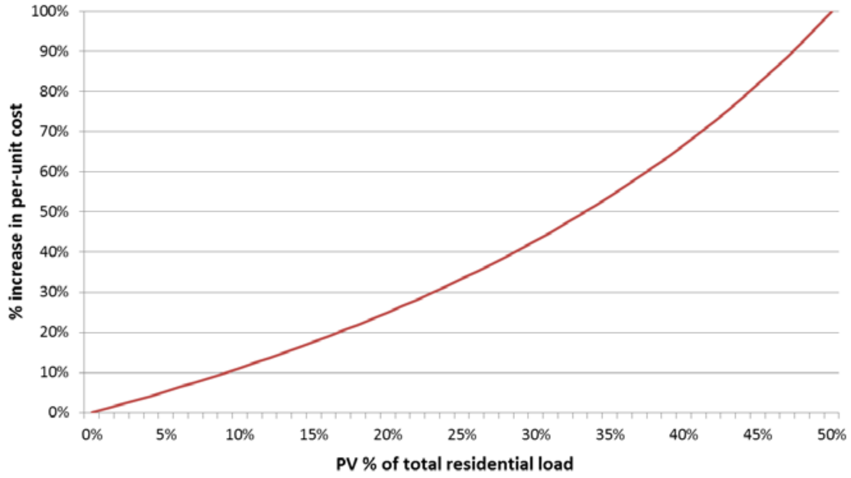
5.2.19 Solar panel owners use less grid-delivered energy, so the cost of the distribution network must be spread over fewer units of energy.[69] With consumption-based pricing, this means the consumption charge will increase. Figure 9 shows that the consumption charge must rise as the

[68] That is, under consumption-based pricing.

[69] This assumes all other things equal. It is also possible that overall consumption of electricity might rise or fall as a result of other developments, unrelated to solar panels. For example, overall consumption might rise if electric vehicles became more widespread, or fall as a result of greater use of energy efficient appliances and building materials.

proportion of electricity supplied via solar panels increases. When this proportion reaches 50%, consumption charges would double.[70]

Figure 9 Increase in consumption charge for grid-delivered electricity as a proportion of solar generation increases



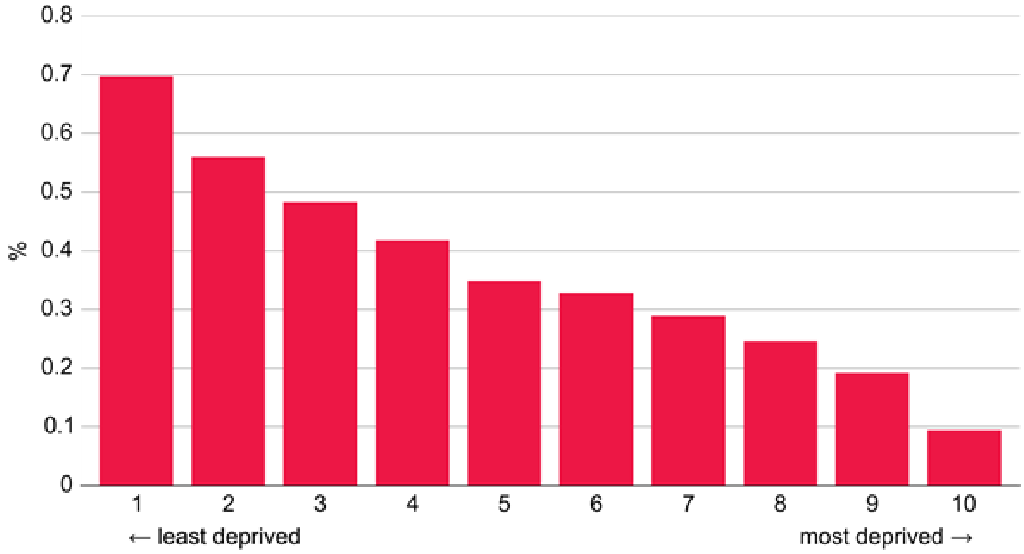
Source: Electricity Authority

5.2.20 This means that consumers who do not own solar panels would pay more towards network costs through higher consumption-based prices, and solar panel owners would pay less.

5.2.21 As a group, solar panel owners are likely to be relatively advantaged on various socioeconomic measures, compared to consumers who do not own solar panels. Figure 10 shows that the proportion of homes with solar panels in the least deprived (most well-off) areas of New Zealand is around seven times the proportion in the most deprived areas. Similarly, there is a clear positive relationship between solar panel ownership and home ownership. While uptake is still low, we expect these patterns to be broadly representative of the patterns of uptake which will occur in future.

70 This assumes the missing revenue is recovered through consumption charges, consistent with current practice (and all other things are held constant).

Figure 10 Uptake of solar panels by uptake by deprivation index



Source: Electricity Authority

Notes:

- The Index of Deprivation is a measure of the level of socioeconomic deprivation in small geographic areas of New Zealand. It uses 2013 census data on income, home ownership, employment, qualifications, family structure, housing, access to transport and communications. It categorises areas into ten deciles, each with a similar population.
- Solar panel uptake data is at September 2015

5.2.22 However, the Authority's statutory objective (to promote efficiency for the long-term benefit of consumers) does not take into account socio-economic factors (such as the distribution of benefits and costs by deprivation or housing status) so the Authority will not rely on the socioeconomic data discussed above. Nevertheless, it may be a relevant consideration for other policy makers. It may also be useful information for distributors to take into account.

5.2.23 The Authority has considered the efficiency costs and benefits to all consumers of individual consumers' decisions to invest in solar panels. The analysis highlights that prevailing distribution prices are not achieving outcomes for the long-term benefit of consumers. The case study below provides an example of the causes and effects, and the costs and benefits, of this issue.

Case study: residential investment in solar

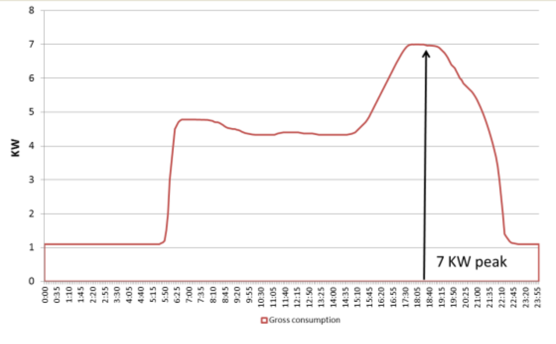
Brenda has installed 3 kilowatts (kW) of solar panels on her roof. This reduces the annual amount of electricity Brenda requires her local distribution network to deliver, from 8,000 kWh per annum to 4,300 kWh per annum. However, it does not change Brenda's maximum demand for electricity from the distribution network, which occurs on cold winter evenings. (In this case study Brenda has no ability to store electricity produced by her solar panels, for use at night.)

After installing the solar panels, the amount Brenda pays her retailer falls from $2,100 per annum to $1,200 per annum. This is because the amount Brenda pays for electricity from the distribution network is mainly determined by how much of this delivered electricity she consumes over time, rather than being determined by how much network capacity she uses.

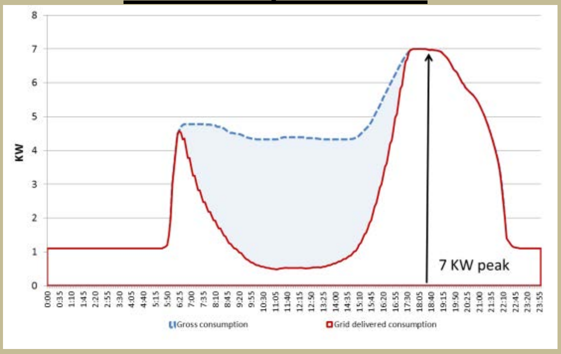
Carla, who lives next door to Brenda, hasn't installed solar panels. Carla uses the same amount of electricity from the distribution network that Brenda used before, and pays $2,100 per annum. Carla has the same maximum demand for electricity from the network as Brenda does, and this is also on cold winter evenings.

The distribution network supplying Brenda and Carla is built to serve their peak demand for electricity from the network. Since this is the same for both Brenda and Carla, they each need the same amount of network infrastructure (poles and wires). But Brenda no longer pays the same amount as Carla towards the investment in the poles and wires to meet her peak demand.

Carla's power use



Brenda's power use



Some of Brenda's neighbours have also installed solar panels, so they too are paying their retailers less. But the local distributor still needs to recover the cost of building its network to supply the peak demand of consumers like Brenda and her neighbours. The distributor recovers its costs largely through consumption charges. So now it raises its consumption charge to cover the cost of providing enough peak capacity. Each unit of power from the network costs more, but Brenda will still pay her retailer less than she did before she installed solar panels.

Since Brenda pays less, Carla pays more, to make up the difference. This makes solar panels even more attractive to anyone who doesn't have them. For Carla, however, solar panels are not an option because her landlord is unwilling to install them. In any case, her roof space is unsuitable, since it is shaded and south facing. Over time, Brenda's other neighbours all install solar panels, to the extent they can. This pushes up Carla's power bills even more.

5.2.24 Figure 11 compares a consumption-based pricing scenario with a scenario with lower consumption charges.[71, 72] Under consumption-based pricing, it is estimated that a consumer without solar panels would pay approximately $150 per annum more than they would in a scenario with lower consumption charges. In contrast, a consumer with solar panels would pay approximately $250 less per annum than they would in a scenario with lower consumption charges.[73] This analysis takes into account both installation costs for solar panels as well as retail electricity charges.

5.2.25 Under service-based pricing, households with solar panels would face a higher overall cost for their electricity (comprising solar panel costs and distribution network charges) than consumers who used only grid-delivered electricity. This reflects the fact that installing solar panels does not reduce the cost of grid-delivered electricity as much as consumption-based pricing indicates.

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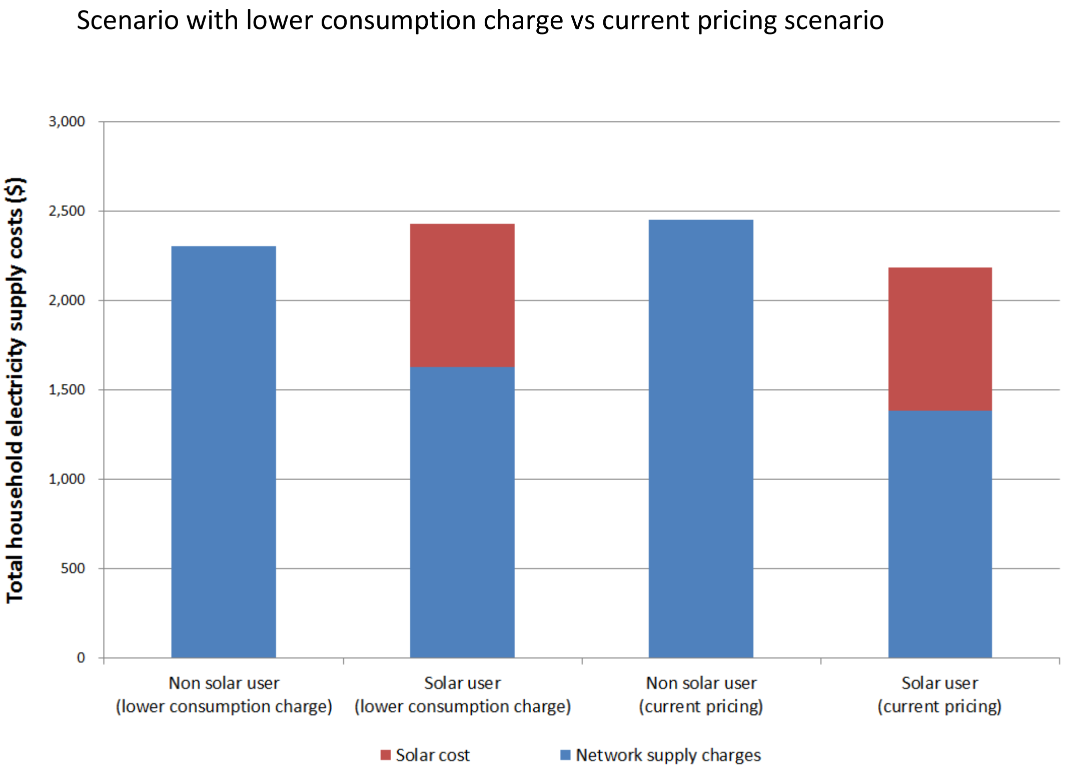
71 The scenario with lower consumption charges is the alternative pricing structure designed by NZIER. NZIER, section 2.

72 The consumption-based pricing scenario has relatively high uptake of solar panels and the scenario with lower consumption charges has lower uptake.

73 These estimates are made for the year 2025 and include GST.

Figure 11 Household electricity payments



Source: Electricity Authority

Notes:

- Based on estimated retail charges (rather than underlying cost of delivering power).
  - These are illustrative scenarios based on assumptions on future costs of solar panels and retail charging. Actual results may vary significantly.
  - Assumes an average solar panel installation. Depending on location and other factors, the economics would differ for a given individual.
  - Assumptions for scenario with lower consumption charges: retail charges of $2.00 per day plus 16 cents/kWh (excluding GST). The daily rate is based on NZIER analysis.[74] 16 cents is the national average consumption charge required to recover total electricity supply costs, given the efficient fixed rate ($2.00 excluding GST) identified by NZIER.
- "Current pricing" assumptions: retail charges of $0.30 per day plus 25c/kWh (excluding GST) Assumes annual usage of 8,000 kWh.
- Assumes no underlying increase in real grid-delivered electricity costs to 2025 (network costs and generation costs are scaled proportionally to ICP numbers and usage)
- "Solar user" is a consumer with solar panels, who consumes all solar output onsite

74 NZIER, section 2.

5.2.26 With consumption-based pricing, investment in solar panels has the potential to create a spiral effect. This occurs in the following way:

(a) high consumption charges stimulate investment in solar panels

(b) this reduces the revenue distributors earn from solar panel owners

(c) this leads distributors to raise consumption charges

(d) which stimulates further household investment in solar panels

(e) which further reduces revenue from solar panel owners

(f) which leads to even higher consumption charges

(g) which begins the cycle again.

5.2.27 It is difficult to predict when or how the spiral might end, or the ultimate level of investment in solar panels. However, it seems unlikely that consumption-based pricing could be sustainable if solar panels became widespread.

5.2.28 As a result of investment in solar panels, an increase in consumption charges of more than 25% would be required in some scenarios within 10 years, to ensure distribution network costs were recovered.[75] This would particularly affect retail electricity bills for non-solar owning consumers, who are unable to avoid consumption charges by generating their own electricity.

Solar panels are not yet an efficient source of electricity for most people

5.2.29 Consumers will benefit, in the long run, if electricity is generated at the lowest possible cost (all other things equal). However, solar panels are still a relatively high-cost way to generate electricity. Substantial investment in solar panels at this time will not lead to the lowest cost provision of electricity for all consumers over time, and therefore the greatest benefit to society.

5.2.30 Currently, electricity generation from solar panels is significantly more costly than the alternative forms of generation that would be displaced by the solar panels.[76] Solar generation is estimated to have a long run

[75] NZIER, table 6.

[76] Whilst the cost of generation from solar panels is reducing over time, it is not yet as low cost as grid-delivered generation for most consumers.

marginal cost of approximately $200/MWh.[77] If demand grows, the investment in solar panels may save the cost of new generators being built that have a long run marginal cost of approximately $81/MWh.[78,79] If demand does not grow, solar panels could be assumed (as a lower bound) to save the running costs of existing generators. The assumed short run marginal cost of existing generation is $55/MWh.[80]

5.2.31 This assumption is conservative and may result in an overestimate of the short run marginal cost. In some circumstances solar panels will displace renewable generation with a very low short run marginal cost. If uptake reaches the levels indicated by some scenarios over the next 10-15 years,[81] it is likely that in certain weather conditions,[82] solar generation will cause wind generators to be "constrained off".[83] It could also lead to increased spillage of water from hydroelectric reservoirs.

5.2.32 Figure 12 shows the potential productive inefficiency resulting from investment in solar panels in New Zealand over the next 10 years.[84] The graph compares the total cost of generating electricity via solar panels over 10 years,[85] with the total cost of generating the same volume of grid-delivered electricity at remote generation sites. The graph considers two scenarios, one in which demand is growing and one in which it is not. The

[77] Long run marginal cost means the cost of additional production when capacity is able to be increased. The long run marginal cost of solar generation varies as installation costs reduce over time. The average for a modelled 10 year period is $200/MWh.

[78] This estimate assumes a 475 MW Combined Cycle Gas Turbine generator. Cost data is sourced from the Ministry of Business, Innovation and Employment's Electricity Demand and Generation scenarios.

[79] This is roughly consistent with long term hedge prices which have averaged $75 over the past two years. Long term hedge prices were examined using a simple average of the 4 quarterly prices for hedges traded on the Australian stock exchange.

[80] Short run marginal cost is the cost of additional production when capacity is held constant. This estimate also assumes a 475 MW Combined Cycle Gas Turbine generator. Cost data is again sourced from MBIE's Electricity Demand and Generation scenarios.

[81] NZIER, section 4, table 7.

[82] That is, when the weather is both windy and sunny.

[83] This means the wind generator could be instructed by the system operator not to generate electricity even though the wind is blowing. Alternatively, it could be instructed to generate less electricity than the maximum output it is able and willing to produce.

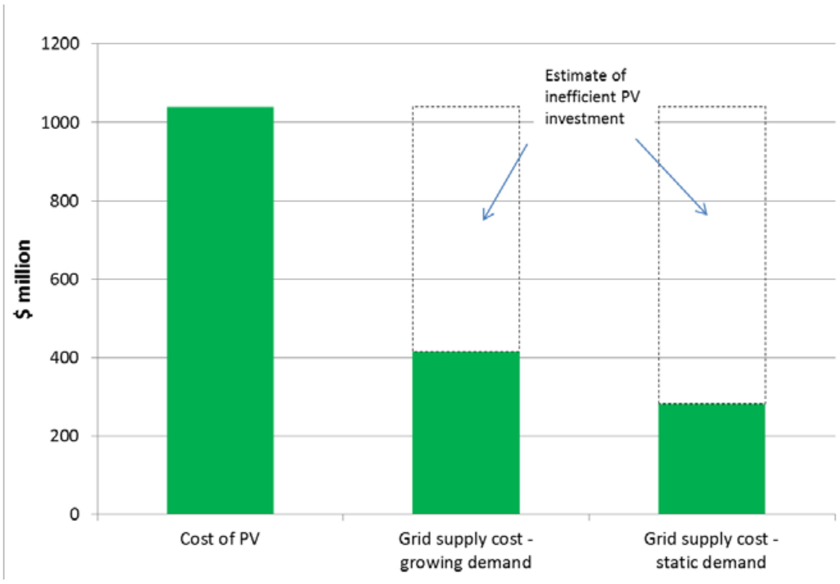
[84] Productive efficiency means society getting the most output from the volume of inputs available to it. This involves choosing the most efficient (lowest cost) production method. In this case, solar panels are not the lowest cost production method. The productive inefficiency is the unnecessary additional cost incurred by society as a result.

[85] This assumes 56.5% average uptake. This is a high uptake scenario derived from NZIER analysis.

difference between the cost of solar generation and the cost of grid-delivered electricity generation shown in the graph is an unnecessary additional cost incurred by society.

Figure 12 Relative cost of solar panels vs grid-delivered generation

High uptake scenario



Source: Electricity Authority

Notes:

- High uptake case (56.5% average uptake for typical current charges): productive efficiency loss (over 10 years) of $638–$773 million (present value, 2015 dollars).
  - These are illustrative scenarios based on assumed future costs of solar generation and grid-based generation costs (with a short run marginal cost of $55/MWh and a long run marginal cost of $81).
- Figure 11 shows bounds (eg, the actual outcome may be a mix where some solar panels offsets what would otherwise be load growth and some results in displacement of existing plant).
- The long run marginal cost and short run marginal cost estimates include the cost of CO_2 emissions under the New Zealand Emissions Trading Scheme.

5.2.33 In either case, it is clear that generating electricity via solar panels over the next 10 years will cost New Zealand hundreds of millions of dollars more than generating the same amount of electricity in other ways. This waste of resources will occur because consumption-based pricing encourages consumers to make investment decisions which do not take into account the broader costs and benefits to all consumers.

Solar panels might result in voltage problems

5.2.34 An increase in solar generation might cause voltage quality problems for distribution networks. At a certain level, solar generation can lead to over/under voltage issues that can affect quality of supply.[86]

5.2.35 Voltage issues may also increase network costs. The Code allows distributors to recoup reasonable costs from distributed generators.[87] More generally, a distributor could charge causers of voltage problems if these can be measured (for example, using AMI). Depending on the pricing practices of any given distributor, solar panel owners may or may not have to meet these potential costs. If not, they would be passed on to all consumers through higher prices for distribution services.

5.2.36 A recent Australian study examined voltage issues caused by increasing penetration of solar panels and other distributed energy resources.[88] The study found that solar panels could cause problems, particularly in some areas with older distribution network. In these areas, voltage regulation requirements could limit solar generation to 25% of households.

5.2.37 The study noted that distributors could fix voltage regulation issues relatively cheaply. One potential solution noted in the study was that distributors could manage voltage regulation at the upstream substation (where this was possible). It also noted that distributors might be required to proactively monitor substations which were at risk of noncompliance with voltage regulations as solar panel numbers increase.

5.2.38 Further, a joint Australia/NZ standard is currently being developed that addresses voltage issues.[89] Power inverters which meet the new standard will be able to assist in mitigating voltage quality problems caused by increasing numbers of solar panels. The GREEN Grid project's network analysis group is also developing a set of deployment guidelines for solar panels.[90] The guidelines will help distributors comply with Code obligations in areas where increasing numbers of solar panels could cause problems.

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[86] Eg, damage to electrical equipment, unplanned outages.

[87] Schedule 6.4.

[88] Browne et al, 2015, Impact of Increasing Distributed Energy Resource Penetration on Quality of Supply in an Australian Distribution System.

[89] DR AS/NZS 4777.2 Grid connection of energy systems via inverters – Part 2: Inverter requirements. The GREEN Grid project's network analysis group made a submission on this standard.

[90] The GREEN Grid project is a wide-ranging investigation into how New Zealanders use power, how this demand can best be met using renewable sources, and how the national grid can be made smarter and more efficient. It involves researchers from the Universities of

5.2.39 On this basis, it appears that the voltage issues which might be caused by solar panels are being managed within the industry and are unlikely to have significant effects on competition, reliability or efficiency.

5.3 Distribution pricing could limit increases in peak demand caused by recharging electric vehicles

5.3.1 This section investigates whether consumption-based pricing may lead to inefficient investment in distribution network capacity. It concludes that it could. This is because the price of consumption during the evening peak demand period does not reflect the higher cost of using the distribution network at that time. Consumers may therefore have little incentive to avoid recharging their electric vehicles during the peak demand period.

5.3.2 Service-based pricing could encourage consumers to recharge electric vehicles during off-peak demand periods. This may lessen the need for additional investment in the network.

Distribution pricing unlikely to affect the uptake of electric vehicles

5.3.3 Distribution pricing is unlikely to materially affect the uptake of electric vehicles, even if distributors reduce consumption charges. This is because any variation in the price of electricity used to recharge an electric vehicle is low compared to the capital cost of electric vehicles.[91]

5.3.4 Currently, off-peak controlled electricity charges are available from some retailers at around 13 cents/kWh. A lower bound on this charge would be the baseload energy charge plus a margin,[92] giving a price of perhaps 10 cents/kWh.[93] The difference of 3 cents/kWh amounts to 13.5 cents per day for the average daily travel distance in New Zealand of approximately 40 kilometres. Capitalised, this amounts to approximately $615. This is not a significant sum compared to the electric vehicle cost of $30,000–$40,000.

5.3.5 It is likely that electric vehicle uptake will be significant in the medium term, regardless of distribution pricing structures. To date, few New Zealanders

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Canterbury, Auckland and Otago and includes measuring current household energy use and renewable generation, as well as undertaking extensive modelling and simulation of future power systems and electricity demand.

[91] Further, distribution pricing makes up only part of total delivered electricity costs.

[92] The baseload energy charge is the cost of generating electricity to meet the minimum demand for electricity in New Zealand.

[93] Consumers can already access wholesale market prices, through a new entrant retailer (Flick Electric Co).

have purchased electric vehicles. Uptake is restrained since electric vehicles currently cost more than equivalent conventional vehicles with an internal combustion engine.[94] Electric and plug-in hybrid cars make up between 0.15% and 0.2% of all light vehicle registrations, according to Ministry of Transport data.[95] However, the cost of electric vehicles is declining, driven by lower battery costs and scale economies as more are produced.[96] More New Zealanders are expected to buy electric vehicles as the price of owning and operating them declines.

5.3.6 According to Ministry of Business, Innovation, and Employment (MBIE) forecasts, there will be up to 150,000 electric vehicles in New Zealand by 2025.[97]

Timing of electric vehicle recharging can affect network costs

5.3.7 Consumers' decisions about how they recharge their electric vehicles could potentially impose substantial costs on electricity distribution networks (to the extent that networks are congested at times of peak demand). On the other hand, if electric vehicle users decided to recharge their vehicles off-peak, the impact on distribution network costs would be much lower.

5.3.8 Electric vehicles will be a significant new source of demand for electricity. If all cars in New Zealand were electric, total electricity use would be around 4,500 GWh per annum, or about 11% greater than now.

5.3.9 Distribution network costs could be affected by the time of day that electric vehicle owners recharge their vehicle batteries. Electric vehicles could have a very significant effect on the level of peak demand if electric vehicle owners recharge them during the evening peak. If half of the

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94 An example in New Zealand is the Nissan Leaf (electric vehicle) at about $40,000 compared with the Nissan Pulsar (internal combustion engine) at about $30,000. A significant driver of the price differential is the cost of the battery pack. Recent research from the GREEN Grid research project indicates that the price of electric vehicles was the most important consideration for people considering electric vehicle purchase. Ford, R., Stephenson, J., Scott, M., Williams, J., Rees, D. & Wooliscroft, B. (2015). Keen on EVs: Kiwi perspectives on electric vehicles, and opportunities to stimulate uptake. Published by the Centre for Sustainability, University of Otago. Other factors include lack of charging infrastructure and anxiety about electric vehicles' limited range/distance.

95 Ministry of Transport, Monthly Light Vehicle Registrations, June 2015, http://transport.govt.nz/assets/Uploads/Research/Documents/Monthly-light-vehicle-registrations-201506-final.pdf.

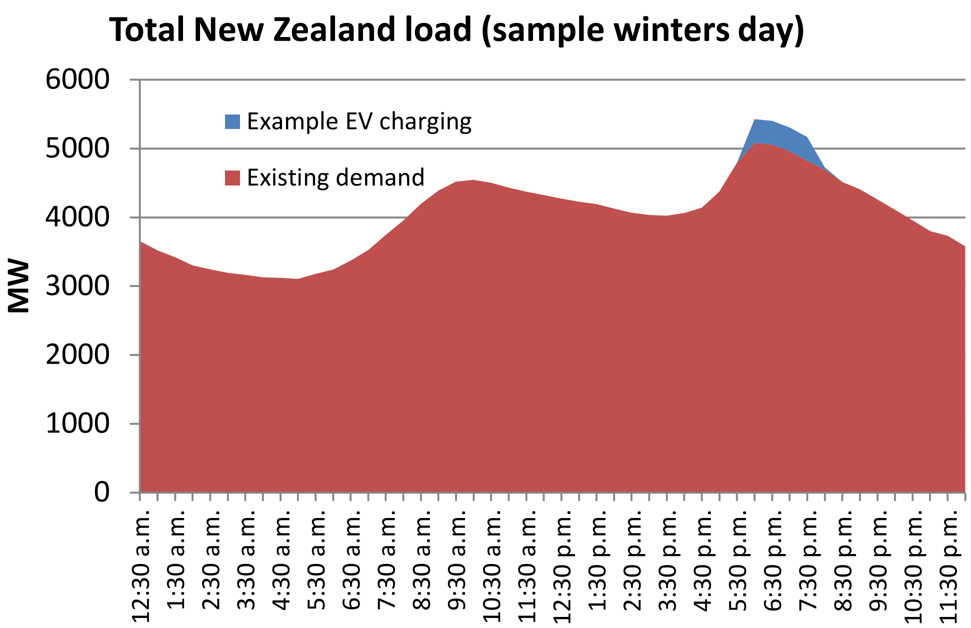
96 http://www.carbonbrief.org/blog/2015/03/electric-vehicle-batteries-already-cheaper-than-2020-projections/.

97 Ministry of Business, Innovation and Employment, 2015, Projections of Electric Vehicle Fleet Size: Method description for the Draft Electricity Demand Generation Scenarios 2015.

country's 2.7 million light vehicles were replaced by plug-in electric vehicles, simultaneous recharging could potentially contribute about 4 GW to peak demand.[98] With 150,000 electric vehicles (consistent with MBIE forecasts for 2025),[99] simultaneous peak-time recharging could still increase the peak by around 5%, as Figure 13 illustrates. Where the network is congested at times of peak use, growth in peak demand would require very substantial investment in distribution networks.

Figure 13 Effect of electric vehicles on load profile: peak recharging

MBIE electric vehicle forecast scenario



Source: Electricity Authority, Ministry of Business, Innovation and Employment, 2015, Projections of Electric Vehicle Fleet Size, Method description for the Draft Electricity Demand and Generation Scenarios

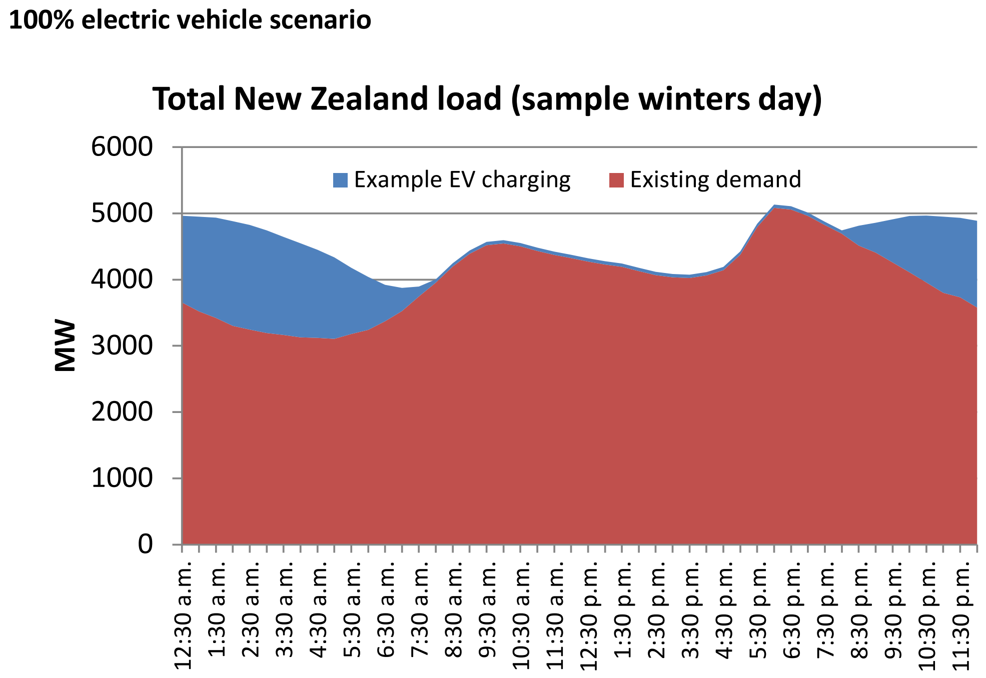
5.3.10 However, if electric vehicle owners were to recharge their vehicle batteries in off-peak periods, then the effect on network costs could be very low (at best close to zero). If electric vehicles were recharged overnight, then for the foreseeable future, recharging could occur without increasing peak demand. In this case there would be little additional demand for network capacity.

[98] Miller, A., 27 May 2015, What if... we all drove electric vehicles? Available at: https://www.youtube.com/watch?v=9gRS7PK6TP0&index=3&list=PL1D0DE06F56864BA4

[99] Ministry of Business, Innovation and Employment, 2015, Projections of Electric Vehicle Fleet Size, Method description for the Draft Electricity Demand and Generation Scenarios.

5.3.11 Figure 14 illustrates the effect of off-peak recharging of electric vehicles, which shows a different scenario from the previous one. In the Figure 14 scenario all 2.7 million light passenger vehicles in New Zealand are electric. Even in this extreme 100% scenario, off-peak recharging need not significantly increase the level of peak demand.

Figure 14 Effect of electric vehicles on load profile: off-peak charging



Source: Electricity Authority

Distribution pricing affects when electric vehicles are recharged

5.3.12 For consumer decisions to be made on an informed basis, distribution prices should reflect the cost of recharging an electric vehicle when the distribution network is congested. Pricing structures can provide consumers with an incentive to recharge their electric vehicles off peak (eg, having a differential between peak and off-peak energy consumption charges).

5.3.13 Some current pricing structures provide modest network usage incentives by differentiating between day-time and night-time rates. If electric vehicle users faced a daytime rate of 23.4 cents/kWh and a night rate of 13.4 cents/kWh, then they could achieve a cost reduction of 47 cents per day or $170 per annum by choosing to recharge at night.[100] This is consistent with a recent study on methods for recharging a plug-in vehicle which showed that taking advantage of the night rate would be the best option economically.[101] The study found that benefits from recharging on the night rate ranged between $70 a year in the North Island and up to $337 in the South Island. This relatively modest difference may not adequately signal to the consumer the high costs potentially imposed on the distribution network if electric vehicles are recharged at a time of network congestion.[102]

5.3.14 As noted in section 5.1, consumption charges in New Zealand are generally fairly static. With some exceptions,[103] and aside from the (relatively modest) day/night pricing differential applied by some distributors, distribution rates do not vary according to location, time of use or network congestion.

5.3.15 Prices for electricity use at times of network congestion[104] are unlikely to fully reflect the costs of the service provided. Such prices may not provide a sufficiently strong signal to influence the time that consumers choose to charge their electric vehicles. Service-based prices would more accurately signal the much more substantial distribution network costs caused by recharging their electric vehicles at a time of network congestion. If owners of electric vehicles respond to this price signal by changing the time they recharge,[105] then this could reduce the need for distributors to make costly investments in their networks.

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[100] This estimate is based on 4.7 kWh/day being the typical amount of charging needed (based on average car travel).

[101] Hwang, M., Wood, A., Watson, N., Miller, A., June 2015, Electric Vehicles and Demand Response: An Economic Perspective.

[102] There are different retail offerings which are relevant to this issue. One retailer (Mercury Energy) has introduced an electric vehicle charging scheme that applies during off-peak hours and is 30% cheaper than normal pricing. There is an additional source of variation in the pricing of electricity based on time of use: wholesale prices for energy vary on a half hourly basis. At least one retailer (Flick Energy) sells energy to consumers at a price based on the wholesale price. So consumers who are with Flick Energy will have an additional incentive to avoid charging at peak times. The variation in the price of wholesale energy reflects differences in the cost of generation and transmission for different times of use, but does not reflect differences in the cost of distribution for different times of use.

[103] The approach used by The Lines Company to set distribution prices is an exception, under which charges vary depending on consumption at certain defined peak periods.

[104] Network congestion may coincide with the network demand peak.

[105] It is possible that early adopters may not be highly sensitive to the difference between night and day rates, given that the fuel cost for an electric vehicle is so much lower than fuel for an internal combustion engine. They may prefer the convenience of plugging the car into

Other effects of electric vehicles

5.3.16 There may be other effects on distribution networks from increased numbers of electric vehicles being charged simultaneously, in addition to the need to build additional capacity. A 2010 study found that technical problems in the network could emerge if more than 40% of households were simultaneously operating electric vehicle rechargers. However these may be addressed by mandating standards for recharging equipment.

5.3.17 A 2015 paper reports on studies performed on different low voltage networks to identify the penetration level of electric vehicle chargers that a typical system can withstand without adverse effects. The results showed that the New Zealand distribution system is able to cope with the future foreseeable electric vehicle penetration levels with few problems. With some type of load control the electrical system can cope with even reasonably high levels of electric vehicle penetration.[106] On this basis, these voltage issues are not considered further in this paper.

5.4 Distribution pricing could encourage more efficient use of battery technology

5.4.1 Battery technology has the potential to defer or avoid investment to augment distribution networks. It will be important that consumers recharge and discharge their battery storage systems at the right times for this potential benefit to emerge. Service-based distribution pricing could play a role in encouraging consumers to do this.

Distribution pricing could encourage investment in batteries

5.4.2 Battery technology can provide financial benefits to consumers, as noted in section 4.2. However, very few residential consumers have invested in battery storage systems to date. This is because the financial benefits have so far been outweighed by the costs of battery technology.

5.4.3 Consumers can use batteries to recharge when the electricity price is low, to avoid buying electricity when the price is high. However, the difference between daytime and night-time consumption rates is currently not enough to justify the cost of the investment, for most consumers. The Authority estimates that currently available day/night differentials allow residential

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the charger immediately after they return home. However, consumers may find it more convenient to respond to price differentials if technology is developed which automates the commencement of recharging at the most cost-effective time of day.

[106] Watson, N., Watson, J., Watson, R., Sharma, K. and Miller, A., 2015, Impact of Electric Vehicle Chargers on a Low Voltage Distribution System.

consumers to save around $150-$300 annually using a 7 kWh battery.[107] For most consumers currently these potential savings are insufficient to provide a positive return on investment, assuming the costs of a 7 kWh battery are around $6,500 including installation.[108]

5.4.4 Savings can potentially be made in another way by consumers with onsite generation, who can use the batteries to store the electricity they generate for later use, instead of exporting it.[109] Again, these benefits are unlikely to be sufficient, in purely financial terms, to justify the cost of the investment for most consumers at this time.

5.4.5 There are also significant non-financial reasons for investment in battery technology, such as security against power cuts and the desire to be self-sufficient.[110] A high proportion of those consumers who have invested so far are likely to have done so for non-financial reasons.

5.4.6 The cost of battery technology is expected to reduce significantly in the coming years, which will improve the return on investment. It follows that investment in batteries is likely to increase over time.

5.4.7 Changes to distribution pricing could encourage investment in batteries. This is particularly likely if distributors introduce larger differences between consumption rates applying at different times of use. If differentials become larger then the financial benefits of an investment in batteries will rise. Similarly, if distributors introduce a separate price component based on electricity demand at a particular time (a demand charge) then consumers would have a greater incentive to invest in batteries. For networks that are close to full capacity, service-based pricing may involve time of use pricing and/or demand charges (as discussed elsewhere in

[107] The Authority estimates that a consumer on a standard tariff consuming 9,100 kWh/year could save $167 to $184/year, and a consumer on a low fixed charge tariff option consuming 7,300 kWh/year could save $280 to $292/year. These figures also take into account differentials in time of use due to wholesale rates (for Flick customers) and the losses associated with charging and discharging the battery. The recently announced Tesla Powerwall has a declared round-trip efficiency of 92%. If the 7kWh version of this battery was fully discharged and recharged each day, a total of 204 kWh would be added to total annual household consumption. Losses at the inverter might add an additional 1-2% to this amount. Inverter losses were not considered in calculating these savings figures.

[108] Proposed pricing for the Tesla Powerwall battery (7 kWh) is US$3,000, or $NZ4,615 at an exchange rate of 0.65 US/NZ. It is assumed that installation costs are around $1,000 and an inverter costs around $1,000.

[109] Instead of receiving a feed-in price for export, the consumer can use the electricity later and so avoid paying consumption charges. This may result in financial benefits since consumption charges are generally higher than feed-in rates.

[110] This may encourage investment in both solar panels and batteries, in some cases for the purpose of enabling the consumer to be independent of the grid.

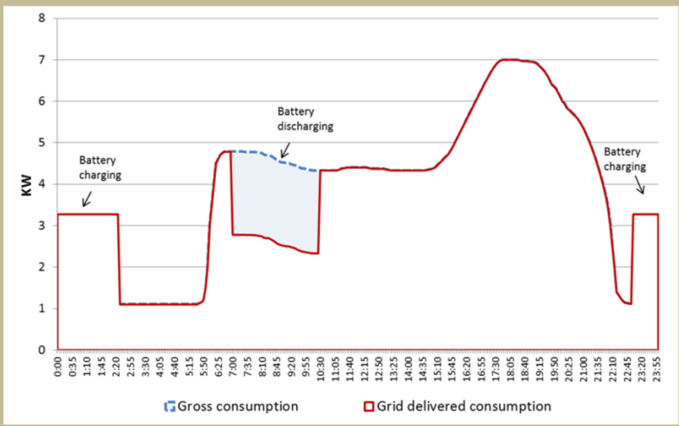
this paper). So a move towards more service-based pricing may result in greater levels of investment in battery technology.

Case study: residential battery technology

Johanna has installed a battery in her home that can store 7 kWh of electricity.

Johanna's retailer offers different rates for day-time and night-time use. She can save up to $300 a year by recharging her battery during the night when the rate is low and then using the stored electricity in the morning when the rate is higher.

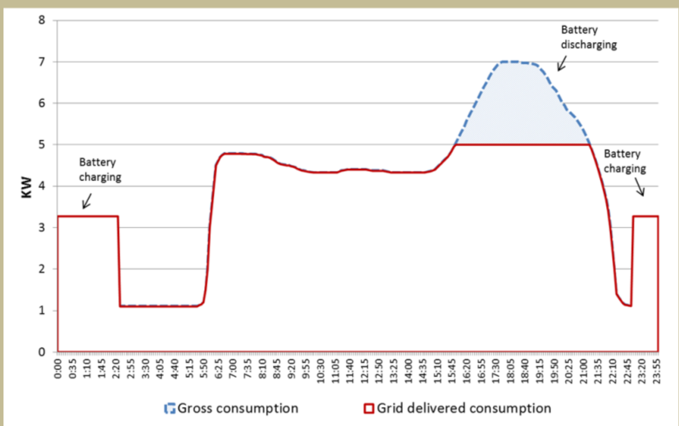
Using a battery to get low night-time rates



Johanna is not using the battery to reduce her peak demand for electricity from the network. So the amount of network infrastructure (poles and wires) needed to supply her doesn't change.

Another retailer offers Johanna a new pricing plan. Under the new plan, Johanna is charged a lower rate most of the day and night, and a higher rate that applies only during the evening peak (between 4pm and 9pm). She realises she can save much more money if she uses the stored electricity from her battery at that time, to reduce her peak demand from 7 kW to 5 kW.

Using a battery to avoid the peak



As a result, less network infrastructure is required to supply Johanna. If most of her neighbours start using batteries in the same way, the local distributor might be able to postpone a planned upgrade to the network. That will keep everyone's power bills down.

The time at which batteries are recharged can affect network costs

5.4.8 Consumers' decisions about when they recharge and discharge their home batteries can result in savings for all consumers. This is because distribution networks may not require as much capacity if batteries are used to reduce peak demand.

5.4.9 If a consumer can draw electricity from a household battery during the network peak, this can substantially reduce the household's peak demand on network capacity. The consumer in the case study above is able to reduce her own peak demand from 7 kW to 5 kW by drawing electricity from a 7 kWh battery over a period of several hours.

5.4.10 If a large proportion of consumers were to invest in batteries and use them as a source of electricity during the network peak, this would substantially reduce the peak demand on the network. In turn this would reduce the aggregate network capacity required to satisfy that peak demand.

5.4.11 Widespread consumer use of batteries in this way during periods of network congestion could allow a distributor to defer or avoid investment that would otherwise have been required to augment the network's capacity. If so, future network costs (and so electricity charges) could be substantially lower than they would otherwise have been.

5.4.12 For this result to occur, consumers would need to reduce consumption during the network peak, rather than the household's individual peak demand. The latter does not necessarily coincide with the former.

5.4.13 Although this potential benefit is real, it is not necessarily substantial enough to justify immediate action to encourage investment in batteries. The cost of consumers' investment in batteries may be greater than the resulting reduction in network costs. On the other hand, if consumers will invest in batteries in any case, it would be sensible to encourage them to use their batteries efficiently, and so produce benefits for all consumers. Distribution pricing can assist with encouraging efficient use.

Distribution pricing affects when batteries are recharged

5.4.14 Distribution pricing can encourage consumers who own a battery to use it more efficiently, by recharging at a time when the network has spare capacity, and discharging during a period of network congestion.

5.4.15 Consumers will have an incentive to use their battery in this way to the extent that the retail price of network-delivered electricity is differentiated by time of use.[111] In the case study above, the consumer is encouraged by a relatively modest day/night pricing differential to recharge at night and discharge during the day. However, this pricing scheme does not encourage the consumer to discharge during the network peak because the consumption charge is the same throughout the day.

5.4.16 Pricing must reflect the high cost of using the network during times of congestion (which occur during the network peak) in order to encourage consumers to discharge their batteries at this time. The second part of the case study illustrates how a consumer's use of a battery may change in response to higher peak-time pricing.

5.4.17 Another risk is that pricing might "over-signal" the peak. Prices above cost could encourage inefficient over-investment in batteries. By contrast, prices that reflect the cost of the service provided should encourage efficient investment in and use of battery technology.

5.4.18 Distributors could also potentially encourage consumers who own a battery to use it more efficiently by designing new services to make best use of this technology. Distributors could offer consumers a financial incentive to assign rights of use (control) over the battery to another party (potentially the distributor). The other party could aggregate a large number of batteries in this way and provide a demand reduction service. It could control the batteries remotely and assign them all to recharge at a time when the network has spare capacity, and discharge during a period of network congestion.

5.5 Distribution pricing could promote efficient investment in other technologies

5.5.1 This section considers the relationship of distribution pricing to efficient investment in heat pumps and energy-efficient lighting (such as LEDs). It finds that service-based distribution pricing could encourage consumers to make investment decisions about both of these technologies that reduce future distribution network costs.

[111] The retail price of network-delivered electricity includes the energy component as well as the distribution and transmission network components. If the consumer is exposed to the wholesale market (ie they are a Flick customer) then wholesale price fluctuation will provide an additional source of differential between the costs of consumption at different times of day. In this paper we focus on the distribution pricing component.

Distribution pricing could promote efficient investment in heat pumps which takes account of any effect on peak demand

5.5.2 Heat pumps are becoming a very popular heating/cooling source in New Zealand, largely because of their energy efficiency.[112] In 2009, approximately 21% of New Zealand houses had a heat pump compared with 4% in 2005.[113] A 2009 study undertaken for Transpower estimated that 60% of North Island houses and 80% of South Island houses will have heat pumps by 2041.[114]

5.5.3 The use of heat pumps is relevant to network congestion, since heat pumps are likely to be in use during peak times when the network is most likely to be congested (winter evenings).

5.5.4 For an individual consumer, the decision to install and use a heat pump might either increase or decrease network congestion. Where a heat pump replaces other heating (wood, coal or gas) this increases demand for electricity. Where a heat pump replaces existing traditional electric heating this may decrease demand (given the superior efficiency of heat pumps). This assumes consumers do not also change how much heating they use. However, if after installing a heat pump the consumer decides to heat more of the house and/or to a higher temperature, their energy use might stay constant or even increase.

5.5.5 If the network was becoming congested, a consumer's decision to install and use a heat pump might either increase or decrease the need for additional investment in distribution networks. So it may affect other consumers by causing distribution prices to either increase or reduce.

5.5.6 As noted in section 5.1, consumption charges in New Zealand are generally fairly static. With some exceptions, and aside from a (relatively modest) day/night pricing differential applied by some distributors, distribution rates do not vary based on network congestion or time of use. It follows that prevailing distribution prices are unlikely to accurately signal any potential benefits to society from consumers' decisions about installing heat pumps and using them at times of distribution network congestion.

5.5.7 Service-based distribution pricing would signal any potential network costs imposed (or saved) by installing a heat pump, and encourage the

[112] Other key reasons include convenience/ease-of-use, and the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 causing consumers to switch away from solid fuels.

[113] Burrough, L.J., 2010, Conference Paper CP152, Heat Pumps in New Zealand Houses, p. 2.

[114] Page, I., 2009, Regional heat pump energy loads, p. 11.

consumer to take such costs into account when making their decision. This would help the consumer to make an investment decision where the benefits to society outweighed the costs to society.[115]

Distribution pricing could promote efficient investment in LEDs and significantly reduce peak demand

5.5.8 The uptake of LEDs is likely to increase in the near future, due to their superior lifetime, relatively low running costs and rapidly reducing price.

5.5.9 Consumer investments in LEDs will significantly reduce demand, and peak demand, for electricity. Lighting is estimated to comprise 10–15% of electrical load in New Zealand.[116] There has already been a significant uptake of more efficient types of light bulbs over recent years. However, there is still the potential for a material reduction in the amount of electricity transported across distributors' networks, as LED lights replace both incandescent lights and other less energy efficient lights (eg, fluorescent lights).

5.5.10 If the network was becoming congested, a consumer's decision to install LEDs could reduce the need for additional investment in the capacity of the distribution network and so could benefit other consumers.

5.5.11 Given the generally static nature of prevailing distribution prices, they are unlikely to provide accurate information about any reduction in future network costs potentially caused by consumer decisions to install LEDs.

5.5.12 Distribution pricing which signalled any potential network cost savings resulting from a consumer's decision to install LEDs would encourage consumers to make decisions about the installation and use of lighting that maximised the benefit to society.[117]

Q3. What is your view of the Authority's concerns that existing distribution pricing structures do not reflect the costs of the different distribution services provided and may not be durable?

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[115] Benefits to society include any benefits in terms of network costs, as well as the value the consumer derives from the heat pump.

[116] BRANZ Study Report, Energy Use in New Zealand Households, SR 133 (2004) http://www.branz.co.nz/cms_show_download.php?id=e3fb50e5420bf7132a8512e6247bc33a8e5dd6d4 and SR 155 (2006) http://www.branz.co.nz/cms_show_download.php?id=b1ab61dd06f50e83e6a184b29b68a989472502ed.

[117] Due to their superior lifetime, relatively low running costs and rapidly reducing price, LEDs are likely to become more prevalent over time regardless of distribution prices. Nevertheless, distribution prices can still affect the rate of uptake.

Q4.	**What is your view of the potential for a significant amount of inefficient investment in solar panels if distribution pricing structures continue to be based primarily on a consumption-based approach?**
Q5.	**What is your view of the potential for inefficient investment in distribution networks if there is a high uptake of electric vehicles and distribution pricing structures continue to be based primarily on a consumption-based approach?**
Q6.	**What is your view of the potential for battery technology to defer or avoid investment to augment distribution networks?**
Q7.	**What is your view of the potential for alternative distribution pricing structures to promote more efficient investment by consumers in heat pumps and / or LEDs?**

6. Distributors have options for structuring pricing

6.1 Distributors have options for structuring their pricing in response to evolving technologies

6.1.1 Prices should inform consumers about the costs of the choices available so they can assess those choices. Consumers using distribution services can specify how much network capacity they use at certain times (eg, by choosing to allow the distributor to manage their hot water load). They also have the option to obtain electricity from the network or from a solar panel.

6.1.2 There is no 'right' pricing structure or set of pricing options because each distributor faces different circumstances. For example, each distributor will have different customers and consumer groups, those customers and consumers may respond differently to price signals, and their costs of supply will be different. However, generally speaking, distribution pricing should be based on the costs of providing services (service-based pricing) and should achieve the following two objectives:

(a) signal to users the cost of new capacity in a way that encourages efficient network and consumer investment

(b) recover the common costs of the distribution service.

6.1.3 There are likely to be trade-offs between competing objectives. Prices which signal the cost of new capacity are likely to be insufficient to recover all of the common network costs. So prices that recover all of the cost must be marked up above incremental cost.

6.1.4 These markups could result in changes (distortions) to consumers' decisions about how they use the network or make investments. For example, consumers will generally respond to a price increase by reducing consumption. However, a markup on the price of one service could cause a greater consumption response (distortion) than the same markup on the price of a different service.

6.1.5 Also, a markup on the price of one service could cause a consumer to respond by making a (possibly inefficient) investment, whereas a markup on the price of a different service might not have that effect. Markups should be set in a way that minimises these distortions.

6.1.6 Pricing needs to change because the prevailing two-part pricing structure does not do these two things:

(a) there is no price signal to network users of the marginal cost of new capacity

(b) the reliance on consumption charges to recover a significant proportion of distributors' common costs is altering how consumers use the network, particularly by creating a strong incentive to inefficiently invest in solar panels.

6.1.7 There is not a one-size-fits-all approach. Signalling the cost of new capacity involves pricing approaches that reflect the cost of supplying more capacity at times a network is congested (at which time demand on the network will be at its peak).

6.1.8 Recovering common costs requires approaches that minimise distortion of consumption and investment decisions. Recovering most common costs through flat consumption charges risks encouraging inefficient over-investment in solar panels and inefficiencies in relation to other technologies such as batteries. Other approaches may affect consumers' consumption or investment decisions in other ways.

6.1.9 Finally, distributors should consider consumer preferences. Assuming consumers would prefer to have control over the size of their power bill, this might indicate that they need charges which vary in response to consumer choices about use of the network.

6.1.10 Charging approaches which may meet these objectives include variable capacity charges, peak demand charges and consumption charges which vary by time-of-use. The Authority will assess distributors' progress towards meeting these objectives with reference to its Economic and Decision Making Framework for distribution pricing.[118]

6.2 Distributors need to talk to consumers about pricing structure options

6.2.1 Distributors need to talk to consumers about pricing structure options to try to identify what pricing structure works for both the distributor and the consumers connected to its network.

6.2.2 Consumer engagement is a critical part of the development of future pricing structures. Distributors should not surprise consumers with

[118] The Economic and Decision Making Framework for distribution pricing is available on the Authority's website: https://www.ea.govt.nz/development/work-programme/transmission-distribution/distribution-pricing-review/development/decision-making-and-economic-framework-for-distribution-pricing-methodology/

changes to pricing structures. This means that distributors should communicate early and clearly the reasons for changing pricing structures.

6.2.3 Deciding on a pricing structure requires trade-offs, taking into account: consumer expectations of price and service; the likely consumer impacts of different pricing options; and the revenue required.

6.2.4 Perhaps as importantly, consumers should have information and tools to respond to new pricing signals. This means that pricing options that involve a demand component should not be introduced unless the appropriate technology is available. For example, if the distributor intends using a peak demand pricing option then the metering technology used by the distributor should be capable of measuring and displaying the amount of power (measured in kW) being used at any given time.

6.3 There can be a gradual transition

6.3.1 The likely implications of evolving technologies are starting to become evident, but there can be a gradual transition to future pricing structures, provided the ultimate end-point is clear. Distributors should signal clearly in advance the direction of the transition and should identify the pricing structures they intend to apply once the transition is complete.

6.3.2 Distributors could start by offering service-based pricing to consumers that are newly connected to their network or those that change their connection status by installing small scale distributed generation (eg, solar panels). In the medium to long term, all consumers can be moved to pricing that signals the marginal cost of new capacity and allocates common costs in a way that minimises distortion to how consumers use the network and make investments.

Q8. What is your view of distributors’ options for structuring their pricing?

7. Distributors face strong incentives to change their pricing structures

7.1 Distributors are expected to have service-based prices

7.1.1 The Authority's voluntary distribution pricing principles set out an expectation that distribution prices should signal the economic costs of providing key distribution services. That is, prices should be service-based. This does not mean that prices must be exactly equal to long run marginal cost. Common costs must also be recovered. These costs should be recovered in a way that minimises distortions to consumers' decisions about consumption and investment. In some cases, distributors may need to give further thought to developing the services they provide, and to appropriate options for service levels, in order to keep pace with evolving technologies.

7.1.2 The distribution pricing principles also set out expectations for the development of distribution prices. For example, the development of prices should be transparent, promote price stability and certainty for stakeholders; and changes to prices should have regard to how they will affect stakeholders.

7.2 Distribution pricing structures have not changed in a long time

7.2.1 For many years, distributors have used a pricing approach for residential consumers based on consumption charges and daily/monthly charges.

7.2.2 Alternative charges which reflect the cost of the service provided (eg, demand charges) have been proposed as far back as 1892.[119] Distributors have adopted such charges for large commercial and industrial customers. However, distributors have generally not used such charges for residential consumers, primarily because of technology limitations. Until recently, metering technology that enabled a consumer's maximum demand to be measured was too costly to be used for the mass market. This is now much less of an impediment to service-based distribution pricing, because of the advent of AMI. The number of smart meters deployed in New

[119] In 1892, John Hopkinson, an engineer, proposed a two-part tariff with components based on usage and connected kW demand (later modified to actual maximum demand).

Zealand is now more than 1.2 million (approximately 60% of all meters) and growing.

7.2.3 The Authority understands some distributors have updated their pricing methodologies since 2013 to more closely align with the pricing principles. Some distributors have developed new pricing methodologies that are more service-based. Aurora, for example, explains its preferred pricing approach as follows:

> *… Aurora adopts a tariff structure that is intended to reflect the impact of customers' consumption (and other) decisions on the key drivers of Aurora's costs.*[120]

7.2.4 For smaller non-domestic consumers, including for holiday homes, Aurora's pricing includes capacity charges (based on assessed capacity) and kW demand charges (based on assessed demand during a period when Aurora is able to control the consumer's demand for electricity).[121] Aurora explains its approach to this consumer group as follows:

> *Aurora considers that capacity and peak demand are the key drivers of cost for these consumers and therefore prices determined on this basis are reflective of the costs (particularly the standalone costs) of these load groups…* [122]

7.2.5 However, a review of distributors' charges shows that a predominantly consumption-based charge is still the prevailing pricing structure. For example, Aurora uses per-kWh consumption charges and daily charges for standard residential consumers. It notes that this pricing structure is not its preferred approach, but "has been partially forced upon Aurora" in order to comply with the LFC regulations.[123] The Authority has a different view of the requirements of the LFC Regulations.[124]

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[120] Aurora Energy Limited, Use-of-System Pricing Methodology, Effective: 1 April 2015, p. 14. Aurora also notes it has adopted regional pricing on the grounds of cost reflectivity.

[121] Control Period Demand (CPD) is measured as the average level of demand during the (high demand) period when Aurora is managing demand. Aurora currently assesses consumers' contribution to CPD following the winter months of May to August, annually.

[122] Aurora Energy Limited, p. 14.

[123] Aurora Energy Limited, p. 15.

[124] See discussion in sections 2.5 and 7.4.3.

7.3 Distributors have incentives to adopt more service-based distribution prices

7.3.1 Distributors appear to face a number of incentives to adopt more efficient (service-based) distribution prices.

7.3.2 One important incentive would be the desire to avoid stranded assets.[125] Distributors operate in a changing environment that involves flat or falling load volumes. As the cost of solar panels and battery storage falls, consumers will adopt these technologies in greater numbers and an ever-decreasing share of the energy they consume will be delivered across distributors' networks. Similarly, consumers are increasingly adopting practices and technologies that reduce the volumes of electricity they use – better home insulation, double glazing and more energy efficient devices.

7.3.3 At some point, the cost of these competing technologies may fall so low that significant numbers of consumers may consider disconnecting from the network, causing distributors' assets to become stranded. The Authority is aware of this potential outcome. Such developments may be to the long-term benefit of consumers, if they result from changes in cost rather than distortionary pricing structures. Nevertheless, mass disconnection is not likely to occur in New Zealand for many years. This is because distribution networks and most electricity generation in this country have very low operating costs. As a result, electricity generators and distributors can reduce their prices in response to competition from other technologies. Although they would suffer large losses in asset values, staying in business would preserve some value whereas closing the business would reduce their asset values to close to zero.[126]

7.3.4 While it is clear that distributors will face an increasing level of competition from evolving technologies over time, the speed of this transition is uncertain. It is difficult to make accurate predictions about how many years it will be before distributors can be said to operate in a workably competitive environment. The important factor is the *rate* of uptake rather than *level* of uptake. Even at a low level of uptake, evolving technologies can still place reasonably strong competitive pressure on distributors. Distributors will be aware that large numbers of consumers can often adopt new technology very rapidly after an initial period of low uptake. This

[125] Stranded assets are assets that suffer an unanticipated loss of value.

[126] The situation in New Zealand is different from many other countries, as discussed in section 8.

will provide distributors with strong incentives to respond early, to anticipate the coming shift.

7.3.5 In the near term distributors have some choices about how they respond to this reality.

7.3.6 An easy response would be to raise consumption charges (so that overall revenue does not fall). However, this response may be counter-productive. Raising consumption charges will make solar panels more financially attractive, so will only exacerbate the volume decline and require further price rises. Distributors may find a pattern of spiralling consumption charges to be ultimately unsustainable, since it may create a backlash among consumers that constrains further price rises.

7.3.7 Alternatively, distributors could leave prices unchanged. The Commerce Commission's price cap regime sets maximum prices for distributors. However, distributors are free to choose prices below the regulated level. This would avoid creating a spiral. It would also lead to lower revenue (and partially stranded assets) for distributors. Arguably, this is consistent with outcomes in a workably competitive market.

7.3.8 Finally, distributors could respond to competition from evolving technologies by shifting to a service-based pricing structure (as some are already beginning to do). Service-based pricing is likely to involve recovering some common costs through charges for capacity and / or peak demand, and significantly lower consumption charges. A price structure of this type would significantly reduce the current artificial stimulus to investment in solar panels. As a result, it would slow down the rate of investment in this competing technology and the resulting decline in energy volumes transported across distributors' networks (at least in the short to medium term). At some point in the future, however, continuing falls in the cost of competing technology might still make voluntary price reductions necessary. This is similar to any business in a workably competitive market which must set prices at the level of alternatives offered by its competitors.

7.3.9 Distributors may also face pressure from their retailer customers to adopt more efficient pricing structures. Retailers have ways of exerting pressure on distributors, for example, retailers may choose not to operate in particular network areas. Retailers have traditionally paid little attention to distribution pricing since consumer responsiveness to price has been relatively low. However, retailers will likely become more concerned as the level of competition from competing technologies increases. This may lead them to negotiate with distributors and demand more efficient (and/or lower) price structures which will reduce the artificial stimulus for solar panels and allow competition on a level playing field.

7.3.10 A desire to avoid the cost of network augmentation might provide another incentive to adopt efficient pricing. If distributors are able to recover the cost of network augmentation through rising prices, they may have little incentive to avoid it. However, some distributors may be concerned about rising prices. For example, if their catchment area has a declining population with low average income, distributors may consider that their customer base would be unable to afford significant price rises. If such distributors have a network close to full capacity, they may perceive benefit in discouraging consumers from consuming distribution services at peak times, by charging prices that more closely reflect the cost of providing services at that time.

7.3.11 Further, distributors with a high proportion of holiday homes and/or solar panel owners in their customer base may face incentives to introduce service-based pricing. Under consumption-based pricing, owners of holiday homes and solar panel installations will not pay the full cost of the distribution network capacity they use when their demand for grid-delivered electricity is highest.

7.3.12 Rather than raising prices for other disadvantaged customer groups (who are likely to be less able to afford price rises), distributors may prefer that owners of holiday homes and solar panels pay for the cost of the network capacity they use. This would require introducing prices that more closely reflect the cost of the capacity service (and/or recovering some common costs from capacity charges rather than consumption charges).

7.3.13 Finally, regulatory arrangements could encourage distributors to introduce more service-based pricing. Distributors may see advantages in demonstrating compliance with the distribution pricing principles. For example, they may perceive a risk that non-compliance with this relatively light-handed regulatory measure could lead to its replacement with more prescriptive regulation.

7.3.14 However, the pricing principles are to some extent conflicting (as discussed in the next section), which reduces their ability to influence distributors’ pricing. The form of price control used by the Commerce Commission to regulate distributor revenue might either encourage or discourage distributors from adopting more efficient pricing. The

Commerce Commission is currently reviewing the form of price control it applies to distributors.[127]

7.4 Some distributors say there are constraints to adopting service-based distribution prices

7.4.1 Some distributors say they face constraints which prevent them adopting more service-based distribution prices.

7.4.2 As noted above, limitations in metering technology have made it difficult for distributors to measure consumer demand at a point in time. However, the increasing penetration of smart meters means that this is becoming less of an impediment.

7.4.3 Regulation could constrain distributors' options in reforming their price structures, if it ruled out options they would otherwise select. The ENA stated in its recent discussion paper that 'regulation' limits appropriate pricing responses and compromises cost reflective distribution pricing outcomes. For example, in its paper, the ENA discusses Part 6 of the Code, which sets out requirements for calculating connection charges for distributed generation.[128]

7.4.4 The ENA also identifies the LFC regulations (which require distributors to offer a low fixed charge price option) as a potential constraint. The Authority considers that the LFC regulations do not prevent distributors from moving to more service-based distribution pricing structures. As noted in section 2.5, the LFC regulations allow some flexibility for distributors in how they structure their charges, and do not prevent use of variable charges based on capacity or peak demand, or consumption charges that vary based on time of use.

7.4.5 The Authority considers that demand charges and capacity charges (both of which are measured using kW), and volumetric charges (which are measured using kWh) are variable charges under the LFC regulations. The LFC regulations are clear that:

[127] The form of price control is one of the topics in the Commerce Commission's current review of the Input Methodologies it uses for regulation under Part 4 of the Commerce Act 1986. A key question under this topic is whether the form of price control should change from a weighted average price cap to a revenue cap.

[128] The Authority has initiated a project to review the pricing principles for connection of distributed generation contained in Schedule 6.4 of the Code.

(a) a fixed charge is a charge levied for each consumer connection to a distribution network that is in currency per time period (eg, cents per day, dollars per month, etc)

(b) a variable charge is a charge that varies according to the amount of electricity consumed (eg, cents per kWh).

7.4.6 Furthermore, the Authority notes that its view, particularly about demand charges and volumetric charges, expressed in paragraphs 7.4.4 and 7.4.5 is not inconsistent with the original policy intent behind the LFC regulations.

7.4.7 Regulatory compliance concerns may deter distributors from changing their pricing. Distributors may be concerned that a change in their pricing structures could expose them to compliance risk under the Commerce Commission's regulatory regime. They may consider that it would be more difficult to confidently predict or demonstrate compliance with the price caps set by the Commerce Commission if they were to change their pricing structure.

7.4.8 The Authority considers that these concerns are manageable, and should not prevent distributors from changing their pricing structures. For example, distributors could adopt a gradual approach, initially making only small changes to their pricing (while clearly signalling the expected end point of the changes).

7.4.9 The distribution pricing principles may be providing insufficient guidance to distributors. In the 2013 distribution pricing alignment review, Castalia Limited noted there was no hierarchy to resolve any conflicts that arise between principles. For example, the principle that prices should promote price stability could conflict with the principle that prices are to signal the economic costs of service provision. Castalia recommended the Authority explain what each principle meant and how alignment could be achieved, and give greater prominence to those principles that mattered most.[129]

7.4.10 Finally, there may be a number of other factors which make distributors reluctant to change their pricing structures. For example:

(a) distributors might perceive that their customers or consumers would not be willing to embrace change

(b) cultural factors within the distributors' business may impede change

(c) distributors might wish to avoid the administrative costs involved in making the change.

[129] Castalia's recommendations are discussed further in Appendix B.

7.5 The Authority wishes to understand more about these incentives and constraints

7.5.1 The Authority wishes to understand the incentives and constraints on distributors which affect their adoption of more efficient distribution prices.

7.5.2 The Authority's view is that distributors face strong incentives to change their pricing structures towards service-based pricing, and that the constraints are manageable. Accordingly, the Authority expects distributors to start making changes in the near future and to clearly signal future prices. However, the Authority will be keeping distribution pricing under close scrutiny to ensure that the expected change does occur. If there is significant delay in undertaking these actions, this raises the risk that significant inefficient investment may take place in the period before changes occur.

7.5.3 The Authority would welcome submissions on how the incentives for change to more service-based prices could be strengthened or how new and more powerful incentives could be introduced. Stakeholders may consider that constraints are holding back changes that would otherwise be made. It would improve the Authority's understanding if parties responding to this issues paper could identify and explain any perceived constraints on distributors in more detail.

7.5.4 Where constraints are identified, it would be particularly useful if respondents could explain exactly how those constraints operate to prevent a move to more service-based distribution pricing. For example, stakeholders should include in their submissions a detailed explanation of how the LFC regulations prevent distributors from shifting to more service-based pricing, if this is their view.

Q9. What needs to occur for distributors to amend their distribution pricing structures to introduce more service-based pricing?

Q10. Would a change to the applicable rules encourage change to pricing structures?

Q11. What incentives could be introduced to encourage change?

Q12. What other options would ensure distribution pricing structures are service-based?

Q13. Do you have any suggested improvements to the distribution pricing principles in Appendix B? What are your views on the recommendations made by Castalia noted above and in Appendix B?

Q14.	**Do you have any suggested improvements to the distribution pricing information disclosure requirements in Appendix B?**
Q15.	**What other issues with the current distribution pricing arrangements should the Authority address?**

8. New Zealand’s circumstances are different from other countries

8.1 Evolving technologies may have different effects in New Zealand

8.1.1 The developments in technologies considered in this paper are happening worldwide. The electricity industry in all countries will be affected. However, the implications of evolving technologies may be different in New Zealand compared with the effects in many other countries. This is because New Zealand's circumstances differ from many other countries in a number of relevant ways.

8.2 New Zealand has a competitive electricity market

8.2.1 New Zealand has a highly competitive electricity retail market compared with what most other countries have. There are a large number of independent retailers. This highly competitive retail market will facilitate rapid evolution to more efficient tariff plans. In contrast, in many other countries retail prices are controlled by government and consumers have no choice of retailer. New Zealand consumers can freely choose to buy electricity from retailers offering pricing plans that suit their particular circumstances. The competitive process places considerable pressure on retailers to adapt their tariff structures to evolving circumstances, otherwise they risk their competitors over-taking them.

8.2.2 Electricity retailers in New Zealand will respond to differences in the cost of wholesale electricity by introducing similar price differentials into their retail pricing. For example, Flick Energy passes through wholesale price differences directly into retail pricing. Other retailers offer pricing with different rates for daytime and night-time consumption. Mercury Energy offers a lower rate for electric vehicle recharging during off-peak hours.

8.2.3 Similarly, New Zealand retailers are more likely than overseas retailers to “pass through” efficient distribution pricing structures to consumers. They will face competitive pressure to do so.

8.2.4 If a distributor introduces more efficient pricing structures, but a retailer continues to use a traditional consumption-based pricing structure, that retailer would risk losing customers to competitors. This is because the retailer would be paying a higher cost (than reflected in its charges) to the distributor for serving certain customers (eg, those with a high peak load), and a lower cost for serving other customers, but effectively charging them all an "averaged" price. Retail competitors would be able to target the low-cost customers with prices that more closely reflect the distributor's more efficient pricing structure (and recognises the low cost of serving that customer).

8.2.5 Over time, low-cost customers would switch away from the first retailer, who would be left with only the higher-cost customers. It would then be forced to raise its "averaged" price and so would lose further customers to competition. This competitive pressure gives retailers strong incentives to pass through the distributors' efficient pricing structures. This incentive would be weaker in some overseas electricity markets where there is less competitive pressure on retailers.

8.2.6 New Zealand's highly competitive electricity retail market brings many benefits to consumers. There is open retail contestability and a wide range of retail options compared to some other countries. To some extent, the wide range of retailer choice may reduce consumers' distrust of electricity companies and so reduce their desire to install distributed generation for reasons of distrust.

8.2.7 Retailers (and generators) will begin to lose business as distributed generation becomes less costly and some consumers reduce their demand for network-delivered electricity or potentially "go off-grid". Retailers (and generator-retailers) will have a strong incentive to take action to avoid this outcome. If they perceive that pricing structures (either distributors' pricing or their own pricing) are exacerbating the problem (eg by encouraging over-investment in solar panels), they will act to change those structures.

8.2.8 Where distributor pricing structures are perceived to be an issue, retailers will likely exert pressure on distributors to change their pricing. Even though distributors are regulated monopoly businesses, retailers still have ways of exerting pressure on distributors. For example, retailers may choose not to operate in particular network areas.

8.2.9 The major retailer-generators are particularly well motivated and well placed to bring pressure to bear on distributors. The structure of the New Zealand electricity industry is different from the structure in many overseas jurisdictions. Retailers are separate from distributors. Most distributors do not have a direct relationship with more than a handful of large end consumers. The major customers of the distributors are large retailers. In New Zealand as a result of history most major retailers are also generators. This means they have at stake not only their retail business but also their generation business, should consumers adopt distributed generation in large numbers. Industry structures in other countries are often different: distributors may face many small consumers.

8.3 Existing grid-connected generators in New Zealand have low operating costs

8.3.1 The costs of distributed generation and battery storage systems are continuing to decline, globally. In the future, the economic costs of a distributed electricity system for a significant proportion of consumers will probably be low enough to compete with network-delivered electricity. When that happens, generators, distributors and retailers will face pressure to offer lower prices, in order to compete. All parties in the electricity supply chain will continue to operate provided the revenue they earn is enough to cover their operating costs.

8.3.2 Although the total costs of electricity generation in New Zealand are not dissimilar to those in many developed economies, a high proportion of New Zealand's electricity generators have unusually low operating costs, compared to generators in most other countries. This is because a high proportion of New Zealand's generation is powered by renewable energy sources (around 80% in 2014)[130], which have low or no opportunity costs arising from their use. By contrast, in other countries generation is predominantly fuelled by more costly fossil fuels. Coal, oil and gas made up around 67% of all generation in OECD countries, on average, in 2010.[131]

8.3.3 In general, renewable generation has substantially lower operating costs compared to fossil fuel generation. For example, the operating costs of coal-fired generators are around ten times higher than those of hydroelectric generators in New Zealand.[132] Further, the capital invested

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[130] In 2014, hydroelectric was 57% of New Zealand's generation, geothermal was 16%, wind-powered generation was 5% and coal, oil and gas made up only around 16% of generation. These figures predate the recently announced decommissioning of gas and coal generation at Otahuhu, Southdown and Huntly. Energy and Building Trends, MBIE

[131] Hydroelectric generation made up around 16% of generation in the OECD. Nuclear made up around 13%. OECD Factbook 2013: Economic, Environmental and Social Statistics http://www.oecd-ilibrary.org/sites/factbook-2013-en/06/01/03/welecgen_f1.html?itemId=/content/chapter/factbook-2013-43-en&_csp_=86f956bfbefd92c860a081e6b75e95ce

[132] In New Zealand the variable operating costs of hydroelectric generation are around $1/MWh or less, and the fixed operating costs are around $6/kWh/year; the variable operating costs of coal-fired generation are around $10/MWh and the (additional) annual operating costs are around $70/kWh/year. Electricity Demand and Generation Scenarios,

in renewable (eg, hydroelectric and geothermal) generation cannot easily be relocated to service supply in other countries or be adapted to produce other outputs.

8.3.4 It follows that it will be commercially sensible for existing generators in New Zealand to continue to operate at lower levels of revenue (and electricity price) than most overseas generators. This means that many overseas generators may be forced to shut down at an earlier stage in the process. Electricity generators in New Zealand will be forced to reduce their prices in response to competition from other technologies. However, they will continue to operate – provided revenue continues to cover their relatively low operating costs.

8.3.5 The ultimate outcome will depend on how low the cost of distributed generation and storage eventually falls. If it falls to a very low level, even low-operating-cost generators could be forced to shut down. However, one possible outcome is that evolving technologies will result in the shutdown of grid-connected generation in many parts of the world, but in New Zealand the impact will be felt more in prices (and reduced shareholder value) rather than exit from the industry.

8.4 Evolving technologies will have different effects on carbon emissions in New Zealand

8.4.1 New Zealand's atypical generation mix is also relevant to carbon emissions. Effects on carbon emissions are outside the Authority's statutory objective but are nevertheless relevant considerations for other policy makers and may be relevant considerations for distributors.

8.4.2 Compared with most other countries, New Zealand has a high proportion of renewable generation with low carbon emissions. Coal, oil and gas already make up a much smaller proportion of generation in New Zealand (16% in 2014) compared with other countries.[133] This proportion is set to decrease over the next few years due to recently announced decommissioning of gas and potentially coal generation. Further, a number of proposed investments in renewable generation have already received consent to proceed, which, if progressed, would further increase the proportion of renewables.

MBIE. Note that hydroelectric generation has higher fixed (capital) costs compared to thermal generation.

[133] Coal, oil and gas made up around 67% of all generation in OECD countries, on average, in 2010, as noted above.

8.4.3 As a result, when a consumer switches from an internal combustion engine vehicle to an electric vehicle in New Zealand, a reduction in carbon emissions is a very likely result. This is because the electricity used to recharge the battery is most likely to have been generated from a renewable source. This is particularly so if the electric vehicle battery is recharged during an off-peak period when gas-fired peaking generation is unlikely to be in operation. This is not always the case in other countries, where a similar switch might instead result in higher emissions caused by the increased operation of fossil fuelled electricity generators.

8.4.4 Another consequence of New Zealand's low-carbon generation mix relates to solar panels. When an overseas consumer installs solar panels, electricity output from those panels often displaces fossil-fuelled generation and so reduce overall carbon emissions in that country. In New Zealand, however, any such reduction in carbon emissions is likely to be relatively small. In most circumstances electricity output from solar panels will displace low-emission grid connected renewable generation. Increased solar generation may cause wind generators to be "constrained off" or result in water stored in hydroelectric reservoirs to be spilled, as discussed in section 5.2.

Q16. How will New Zealand-specific circumstances influence the effects of evolving technologies in this country?

Glossary of abbreviations and terms

AMI	Advanced metering infrastructure
Authority	Electricity Authority
CFL	Compact fluorescent light
CO2	Carbon dioxide
Code	Electricity Industry Participation Code 2010
GW	Gigawatt
GWh	Gigawatt hour
kW	Kilowatt
kWh	Kilowatt hour
LED	Light emitting diode
LFC regulations	Electricity (Low Fixed Charge Option for Domestic Users) Regulations 2004
MBIE	Ministry of Business, Innovation and Employment
MW	Megawatt

Appendix A Format for submissions

Question No.	Question	Response
Q1.	What are your views on the scope of the Authority's review? Please give reasons for your answer.	
Q2.	What other technologies do consumers invest in or use that are likely to have a material effect on investment or operation of distribution networks? Please give reasons for your answer and an estimate of when you expect the technologies will have a material effect.	
Q3.	What do you think about the Authority's concerns that existing distribution pricing structures do not reflect the costs of the different distribution services provided and may not be durable?	
Q4.	What is your view of the potential for a significant amount of inefficient investment in solar panels if distribution pricing structures continue to be based primarily on a consumption-based approach?	
Q5.	What is your view of the potential for inefficient investment in distribution networks if there is a high uptake of electric vehicles and distribution pricing structures continue to be based primarily on a consumption-based approach?	

Q6.	What is your view of the potential for battery technology to defer or avoid investment to augment distribution networks?	
Q7.	What is your view of the potential for alternative distribution pricing structures to promote more efficient investment by consumers in heat pumps and / or LEDs?	
Q8.	What is your view of distributors' options for structuring their pricing?	
Q9.	What needs to occur for distributors to amend their distribution pricing structures to introduce more service-based pricing?	
Q10.	Would a change to the applicable rules encourage change to pricing structures?	
Q11.	What incentives could be introduced to encourage change?	
Q12.	What other options would ensure distribution pricing structures are service-based?	
Q13.	Do you have any suggested improvements to the distribution pricing principles in Appendix B? What are your views on the recommendations made by Castalia noted above and in Appendix B?	

Q14.	Do you have any suggested improvements to the distribution pricing information disclosure requirements in Appendix B?	
Q15.	What other issues with the current distribution pricing arrangements should the Authority address?	
Q16.	How will New Zealand-specific circumstances influence the effects of evolving technologies in this country?	

Appendix B Regulatory guidance on distribution pricing

Distribution pricing is subject to regulation

B.1 In New Zealand regulation is used to incentivise distributors to deliver economic outcomes consistent with workable competition.[134]

B.2 The regulation of prices charged by electricity distributors can be simplified into ensuring two outcomes are achieved:

(a) the level of distribution prices is consistent with what would be expected in a workably competitive market

(b) the structure of distribution prices is consistent with what would be expected in a workably competitive market.

B.3 The Commerce Commission is responsible for regulating the level of distribution prices for 17 of the 29 distributors in New Zealand, under Part 4 of the Commerce Act. It does this by specifying limits that apply to average prices distributors charge across all consumers. The limits do not apply to the prices charged to individual consumers or groups of consumers, and therefore are unlikely to directly translate into corresponding changes in the prices that consumers pay.[135]

B.4 The Authority is responsible for regulating the structure of distribution prices, under section 32(2)(b) of the Electricity Industry Act 2010. The Authority may regulate the methodologies distributors use to set the prices of individual goods or services, or classes of goods or services, including methodologies for setting different prices for different customer groups.[136]

Distributors are guided by voluntary distribution pricing principles and information disclosure guidelines

B.5 Currently, when developing methodologies for determining the structure of their charges, distributors are guided by a set of distribution pricing principles published by the Authority. Although these pricing principles are voluntary, the Authority expects distributors who are following good practice would align their pricing methodologies with the principles.

[134] Under workable competition, for example, suppliers compete on price, quality, location and/or service. They might also compete by differentiating their goods or services from their rivals, or through their sales and marketing effort. Alternatively, suppliers might compete via a combination of these activities. Refer to the Authority's interpretation of its statutory objective, available at www.ea.govt.nz/dmsdocument/9494.

[135] Further information is available at www.comcom.govt.nz/dmsdocument/12058.

[136] Refer to section 52C of the Commerce Act.

B.6 The Authority initiates periodic reviews of the extent to which distributors' pricing methodologies align with the distribution pricing principles. To do this the Authority relies on information disclosed by distributors in accordance with a set of information disclosure guidelines published by the Authority.

Pricing principles

(a)	Prices are to signal the economic costs of service provision, by: (i) being subsidy free (equal to or greater than incremental costs, and less than or equal to standalone costs), except where subsidies arise from compliance with legislation and/or other regulation (ii) having regard, to the extent practicable, to the level of available service capacity (iii) signalling, to the extent practicable, the impact of additional usage on future investment costs.
(b)	Where prices based on 'efficient' incremental costs would under-recover allowed revenues, the shortfall should be made up by setting prices in a manner that has regard to consumers' demand responsiveness, to the extent practicable.
(c)	Provided that prices satisfy (a) above, prices should be responsive to the requirements and circumstances of stakeholders in order to: (i) discourage uneconomic bypass (ii) allow for negotiation to better reflect the economic value of services and enable stakeholders to make price/quality trade-offs or non-standard arrangements for services (iii) where network economics warrant, and to the extent practicable, encourage investment in transmission and distribution alternatives (eg, distributed generation or demand response) and technology innovation.
(d)	Development of prices should be transparent, promote price stability and certainty for stakeholders, and changes to prices should have regard to the impact on stakeholders.
(e)	Development of prices should have regard to the impact of transaction costs on retailers, consumers and other stakeholders and should be economically equivalent across retailers.

B.6.1 In the 2013 distribution pricing alignment review, Castalia recommended that the Authority:

(a) provide distributors with a detailed explanation of what each distribution pricing principle means and how alignment can be achieved

(b) rationalise the distribution pricing principles and information disclosure guidelines, reducing the number of pricing principles from nine to six

(c) give greater prominence to those distribution pricing principles that matter most

(d) require distributors to clearly state their approach to capital contributions.

B.6.2 Castalia's recommendations are discussed below.

Provide a detailed explanation of what each distribution pricing principle requires

B.6.3 The distribution pricing principles contain a lot of economic content and therefore distributors need to understand them. For the principles to be usefully applied, distributors need to have a correct understanding of what each principle means.

B.6.4 The Authority could provide information to help distributors with this.

Reduce the number of distribution pricing principles from nine to six, and rationalise the guidelines

B.6.5 The distribution pricing principles (which are set out in Appendix D) could be streamlined to make them more focused on explaining what matters most to consumers, retailers and regulators.

B.6.6 For example, principles a(i), (b) and c(i) could be grouped together to deal with the recovery of fixed network costs, while principles a(ii) and a(iii) could be grouped together to deal with the physical characteristics of the network.

Give greater prominence to the distribution pricing principles that matter most

B.6.7 The distribution pricing principles have no hierarchy to resolve any conflicts that arise between them. For example, principle a(iii) might encourage a distributor to charge more when approaching peak capacity constraints, while this might conflict with the price stability promoted under principle (d).

B.6.8 The Authority's decision-making and economic framework for distribution pricing could be used as a starting point for placing the distribution pricing principles in order of importance.[137]

Require distributors to clearly state their approach to capital contributions

B.6.9 The Commerce Commission's Electricity Distribution Information Disclosure Determination 2012 requires each distributor to disclose a description of its current policy or methodology for determining capital contributions.[138]

B.6.10 The 2013 distribution pricing alignment review undertaken by Castalia found that many distributors' pricing methodologies did not provide a complete description of how and when the distributors charged capital contributions. The alignment review found that approaches to capital contributions could vary across the electricity industry. Many distributors were recovering the full cost of new connections through capital contributions, while others were allowing customers (consumers) to pay back initial connection costs over time

B.6.11 Capital contributions are relevant to understanding how distributors recover the fixed costs of providing network services and for establishing the right benchmark for subsidy free prices.

B.6.12 Hence, the Authority's distribution pricing information disclosure guidelines could be amended to require that distributors' pricing methodologies provide a full description of:

(a) when distribution customers (consumers) are required to make capital contributions, and

(b) how any remaining costs (net of capital contributions) are recovered through distribution prices.

B.6.13 Disclosing information on capital contributions would enable consumers to understand how all of a distributor's fixed costs were recovered, including those that were directly reimbursed to the distributor by consumers.

[137] This is available on the Authority's website. http://www.ea.govt.nz/development/work-programme/transmission-distribution/distribution-pricing-review/development/decision-making-and-economic-framework-for-distribution-pricing-methodology/

[138] Clause 2.4.6. The determination is available on the Commerce Commission's website at: www.comcom.govt.nz/dmsdocument/9534.

Information disclosure guidelines

(a)	Prices should be based on a well-defined, clearly explained and published methodology, with any material revisions to the methodology notified and clearly marked.
(b)	The pricing methodology disclosed should demonstrate: (i) how the methodology links to the pricing principles and any non-compliance (ii) the rationale for consumer groupings and the method for determining the allocation of consumers to the consumer groupings (iii) quantification of key components of costs and revenues (iv) an explanation of the cost allocation methodology and the rationale for the allocation to each consumer grouping (v) an explanation of the derivation of the tariffs to be charged to each consumer group and the rationale for the tariff design (vi) pricing arrangements that will be used to share the value of any deferral of investment in distribution and transmission assets, with the investors in alternatives such as distributed generation or load management, where alternatives are practicable and where network economics warrant.
(c)	The pricing methodology should: (i) employ industry standard terminology, where possible (ii) where a change to the previous pricing methodology is implemented, describe the impact on consumer classes and the transition arrangements implemented to introduce the new methodology.

B.7 The distribution pricing principles and the information disclosure guidelines are an example of a market facilitation measure, which the Authority may undertake instead of, or in addition to, making rules in the Code.

Distributors are guided by the Code

B.8 Part 6 of the Code contains provisions relating to the connection of distributed generation to distribution networks. Among other things Part 6 specifies the pricing principles to be applied when distributed generation is connected to a distribution network.

B.9 The pricing principles are as follows:

> *Charges to be based on recovery of reasonable costs incurred by distributor to connect the distributed generator and to comply with connection and operation standards within the distribution network,*

and must include consideration of any identifiable avoided or avoidable costs.

B.10 Unless multiple distributed generators are sharing an investment, a distributor must charge a distributed generation connection no more than the incremental cost of providing connection services to the distributed generation.

B.11 The incremental cost is net of transmission and distribution costs that an efficient distributor would be able to avoid as a result of the connection of the distributed generation.

Distributors are also guided by the Low Fixed Charge regulations

B.12 In addition to the Authority's distribution pricing principles, distributors' pricing arrangements are influenced by the LFC regulations.

B.13 The objective of the LFC regulations is to:

(a) ensure that electricity retailers offer a low fixed charge tariff option or options for delivered electricity to domestic consumers at their principal place of residence that will assist low-use consumers and encourage energy conservation, and

(b) regulate electricity distributors so as to assist electricity retailers to deliver low fixed charge tariff options.[139]

B.14 The LFC regulations override any provision in the Code or any market facilitation measure which the Authority has undertaken – in this case the distribution pricing principles and information disclosure guidelines.[140]

B.15 Under the LFC regulations a distributor must ensure that it complies with the following minimum requirements:

(a) it must not charge more than one fixed charge for the line function services supplied to a home, and

(b) that fixed charge must be not more than 15 cents per day (excluding Goods and Services Tax), and

(c) the distributor may not recover any charges associated with the delivered electricity supplied to the home other than by all or any of the following:

(i) the fixed charge referred to above in (b)

[139] Regulation 3. The LFC regulations are available at: http://www.legislation.govt.nz/regulation/public/2004/0272/latest/DLM283614.html.

[140] Section 33(2) of the Act.

(ii) a variable charge or charges

(iii) any fees for special services

(iv) a fee payable for providing or reading any meter that the distributor owns

(v) a fee payable for providing any relay that the distributor owns.

B.16 If a home is not on a low fixed charge tariff option, the distributor's arrangement with the electricity retailer for that home must treat the home as not being on a regulated distributor tariff option (unless the electricity distributor has only regulated distributor tariff options).[141]

B.17 The primary effect of the LFC regulations is to constrain distributors’ ability to use fixed charges to recover fixed distribution costs.

[141] Regulation 14.