Electricity Commission
Te Komihana Hiko

Advanced Metering Infrastructure in New Zealand: Roll-out and Requirements

3 December 2009

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Executive summary

1. Advanced metering infrastructure (AMI) links 'smart' electricity meters into the electricity market via a communications network, creating economic benefits at all points in the chain from generation to end-use. It is critical that AMI systems rolled out in New Zealand allow the full potential of those economic benefits to be realised.

2. The current roll-out of AMI is being undertaken by the industry voluntarily, and at no additional direct cost to consumers. That is different from the roll-out of AMI internationally, which is largely regulated.

3. The Electricity Commission (Commission) is required to:

    - investigate whether the roll-out of AMI should be regulated; and
    - make a recommendation to the Minister of Energy and Resources (Minister) on whether technical standards for AMI systems should be regulated, or whether the voluntary AMI guidelines currently in place (Guidelines) are adequate.

Recommendation to the Minister

4. The Commission's recommendation is that it is not necessary to extensively regulate the roll-out of AMI at this time as the benefits of regulation do not outweigh the costs.

5. There are significant differences between the market structure in New Zealand and market structures in international jurisdictions. Those differences impact on how AMI can add value in New Zealand, and arise from:

    - the fragmented nature of the New Zealand electricity industry and relatively small size of participants in the industry;
    - ownership of networks – there are a large number of very small distributors;
    - ownership of metering components – deregulated ownership of metering components means that there are a large number of meter owners who are not bound to geographic areas or networks, and whose businesses involve investing in and maintaining meters;
    - the fact that New Zealand already has a functioning peak load control system (the ripple control system);
    - the nature of New Zealand's generation assets, which means that load management may not necessarily have a significant impact on greenhouse gas emissions; and
    - the fact that most retailers are vertically integrated with generators and are exposed to wholesale market cost variability in instances only where they are a net buyer.

6. Other reasons why the Commission is recommending that it is not necessary to extensively regulate the roll-out of AMI are that:

   - the current roll-out of AMI is happening within an acceptable timeframe;
   - competition means that the full potential of AMI systems being rolled out is being realised where it is economic to do so, and the financial risk of investment in AMI systems is not currently being met by consumers;
   - AMI technology is not fully developed, creating a risk that regulating now may create additional costs and result in AMI systems becoming obsolete;
   - there is a high level of compliance with the voluntary Guidelines; and
   - AMI is being successfully rolled out at no additional direct cost to consumers, whereas regulation is likely to create costs for consumers.

7. However, the Commission considers that some technical aspects of AMI systems should be regulated. Specifically, the Commission recommends that:

   (a) rules that require each AMI system owner to ensure that its AMI system complies with information exchange formats and protocols that are specified by the Commission, and that require participants to use those information exchange protocols and formats when interfacing with AMI systems be introduced, to ensure that AMI owners' systems are consistent, which makes it easier for participants to efficiently communicate with AMI systems;

   (b) rules relating to access to and security of data collected and stored by AMI be introduced. This will mitigate security risks presented by AMI systems by ensuring that only parties who have been authorised by the consumer or who require information for Electricity Governance Rules 2003 (Rules) purposes are able to access and use AMI data; and

   (c) rules around the operation of AMI systems in pre-pay mode be introduced, to ensure that pre-pay consumers cannot be disconnected without the advanced meter receiving authorisation from the back office server. This will prevent consumers from being disconnected because of a communication error, such as credit added to a consumer's account being recorded by the AMI system but not by the advanced meter, or a system failure that results in consumers being unable to purchase credit.

8. The Commission has been progressing its consideration of regulating those aspects of AMI systems since October 2008, as part of its fundamental review of the electricity market rules relating to metering (part D of the Rules). The Commission has already consulted interested parties on proposed areas of regulation, and signalled that it is likely that the Commission will recommend that the Minister regulate some technical aspects of AMI systems.

9. In addition to the recommendations set out above, the Commission is also recommending that the Guidelines are amended to:

   (a) require AMI owners to ensure that their AMI systems comply with information formats and protocols that are specified by the Commission, and require participants to use those formats and protocols when interfacing with AMI back office systems;[1]

   (b) ensure that where advanced meters operate in pre-pay mode, pre-pay consumers cannot be disconnected without the advanced meter receiving authorisation from the back office server. This will prevent consumers from being disconnected because of a communication error, such as credit added to a consumer's account being recorded by the AMI system but not by the advanced meter, or a system failure that results in consumers being unable to purchase credit;[2] and

   (c) increase the data storage period beyond the normal read cycle from 15 days to 35 days to match international practice, which has evolved since the Guidelines were written.

10. The Commission will continue to monitor the development of AMI standards and technology, and will review its recommendations should standards, technology or, practice change to the extent that further regulation becomes desirable.

[1] This recommendation is being made as both a change to the Guideline and the Rules because an integrated Rule package will take some time to complete.

[2] This recommendation is being made as both a change to the Guidelines and the Rules because an integrated Rule package will take some time to complete.

Glossary of abbreviations and terms

AMI	Advanced metering infrastructure
AMR	Automatic meter reading
Commission	Electricity Commission
GPS	Government Policy Statement
Guidelines	Guidelines on Advanced Metering Infrastructure v2.0
HAN	Home area network
ICP	Installation control point
IHD	In-home display
LAN	Local area network
LECG	Law and Economics Consulting Group
MW	Megawatt
Minister	Minister of Energy and Resources
NZEECS	New Zealand Energy Efficiency and Conservation Strategy
NZIER	New Zealand Institute of Economic Research
PDA	Personal digital assistant
Policy	Advanced Metering Policy
Rules	Electricity Governance Rules 2003
SCADA	System Control and Data Acquisition: means the monitoring and remote control of equipment from a central location using computing technologies.
Smart appliances	Appliances that can reduce electricity consumption in response to signals sent from a HAN controller/hub
Smart grid	Smart grid technology embeds intelligence into the operation of networks, facilitating improvements in the reliability, and availability, security of electricity, and energy efficiency.
TOU	Time of use

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1. Introduction and purpose of this report

1.1 Introduction

1.1.1 ‘Smart’ electricity meters, and the infrastructure that accompanies them, can provide a richer information base with which consumers can make better decisions about electricity use. The functionality in ‘smart’ electricity meters allows consumers to participate in the electricity market by allowing them to respond to market signals by altering their consumption patterns.

1.1.2 Those ‘smarter’ meters can also provide better information to electricity lines companies about network performance and consumers consumption patterns, allowing better management of networks and more informed investment decisions. ‘Smarter’ meters can also allow retailers to offer a range of tariff options to consumers that:

(a) financially incentivises consumers to respond to market signals in the form of tariff pricing by altering their consumption patterns to reduce delivered electricity cost;

(b) allows tariff changes to be carried out remotely. Before smart meter technology, changing tariffs required a site visit and a physical change of meter; and

(c) provides information to consumers that allows them to choose the best pricing plan for them.

1.1.3 These “smarter” electricity meters are called advanced meters. Although the term “smart meters” is often used, the Commission uses the term “advanced meters”, in line with international convention.

1.1.4 Advanced meters are electronic electricity meters that measure and record electricity consumption within programmable time periods (for example how much electricity has been consumed in each half hour, rather than just measuring the total consumed over a month). Advanced meters transmit this information (as well as other useful information) back to the retailer.

1.1.5 In addition, to being able to transmit information to retailers, advanced meters are also capable of receiving information, upgrades and instructions that are sent remotely by the retailer.

1.1.6 Advanced meters are only part of the technology currently being rolled out. The two-way transfer of information is possible because advanced meters are connected to back office systems by way of a communications network. Advanced meters and the communication system that accompanies them are generally known collectively as advanced metering infrastructure (AMI).

1.1.7 Developments in AMI have the potential to allow additional peak demand to be managed, delaying the need for investment in new generation, transmission, and distribution. That creates cost savings for consumers, and may reduce the environmental impact of electricity generation. This was recognised in the New Zealand Energy Efficiency and Conservation Strategy (NZEECS) published in October 2007,[3] which acknowledged that advanced meters can help manage electricity usage and, when coupled with appropriate tariffs, can enable greater consumer participation in the electricity market.

1.1.8 There has been much public discussion in New Zealand over recent months about AMI. Some of these public discussions have attempted to draw comparisons between the roll-out of AMI in New Zealand and the roll-out of AMI in other countries. It has been suggested that solutions that are being implemented overseas should also work in New Zealand.

1.1.9 In particular, it has been suggested that the roll-out of AMI should be extensively regulated, as it is in many other countries.

1.1.10 In 2007, the Commission recognised that advances were occurring in metering technology, and consulted widely with the industry on requirements for AMI. As a result of that consultation, the Commission published the *Advanced Metering Policy* (Policy) and the *Guidelines on Advanced Metering Infrastructure v2.0* (Guidelines) in May 2008.

1.1.11 The Guidelines set out recommended minimum standards for AMI systems being installed in New Zealand. However, the Guidelines are recommendations only. Participants are not required to comply with them.

1.1.12 The Government Policy Statement (GPS) published in May 2009 requires the Commission to report to the Minister of Energy and Resources (Minister) by the end of 2009, on:

(a) whether the roll-out of AMI should be regulated; and

(b) whether technical standards for AMI should be regulated, or whether the voluntary AMI Guidelines currently in place are adequate.

[3] The Commission notes that this document is currently under review by the Government.

1.2 Purpose of this report

1.2.1 The purpose of this report is to:

(a) investigate whether the roll-out of AMI should be regulated; and

(b) make a recommendation to the Minister on whether technical standards for AMI should be regulated, or whether the voluntary AMI Guidelines currently in place are adequate.[4] [5]

1.2.2 This report also:

(a) provides a detailed overview of the evolution of meters and the structure of the New Zealand metering industry;

(b) describes AMI, the benefits, disadvantages and risks of AMI, and how AMI fits with other emerging technologies in the electricity industry;[6]

(c) sets out the results from monitoring compliance of current New Zealand AMI systems with the Guidelines;

(d) recommends changes to the Guidelines; and

(e) responds to the Parliamentary Commissioner for the Environment's report on "Smart Electricity Meters" (see Appendix 6 of this report).[7]

[4] NZEECS, October 2007, clause 5.1

[5] As a result of continued Commission monitoring of participants' compliance with the Guidelines.

[6] Other distinct but emerging related technologies include smart grid and smart house concepts.

[7] *Smart electricity meters: How households and the environment can benefit, Parliamentary Commissioner for the Environment*, June 2008.

2. Background

2.1 Electricity meters and the emergence of advanced meters and AMI

2.1.1 Electricity meters measure the flow of electricity, and are the primary source of information used in the settlement of the wholesale electricity market and in the monthly invoicing of nearly two million electricity consumer connections.[8]

2.1.2 The primary driver for reconsidering the regulatory environment for metering is the recent significant development in metering functionality.

2.1.3 Until recently, meters were simple measuring and recording devices that could only provide basic data on electricity consumption on a periodic basis,[9] and could not show changes and trends of consumption within the meter reading period.

2.1.4 Existing regulation of electricity meters is directed at ensuring meters accurately measure consumption and are read frequently by retailers, so that both consumer invoices and electricity market settlement are as accurate as possible and are not based totally on estimates.

2.1.5 However, technology developments have changed meters from simple measuring and recording devices into complex systems that can link the consumer to the wholesale electricity market. Financial incentives in the form of tariffs can potentially influence consumers' choices as to how or when they use electricity. This creates the potential for cost savings for consumers. These developments have changed the landscape for regulatory intervention in metering.

2.1.6 Advanced meters are just one component of the infrastructure being rolled out. AMI is similar to an office computer system, and comprises: [10]

(a) back office systems (the central computer server);

(b) a two way communications network (the local area network or LAN); and

(c) the advanced meters (the desktop computers).

2.1.7 AMI is a low cost technology that can allow advanced meters to communicate with appliances or equipment in a consumer's premise using one of several different forms of communication, and can remotely control electrical load within

[8] These are usually called installation control points (ICPs).

[9] Depending on the meter read cycle, these periods could range between one and four months.

[10] *Report on international experience with smart meters (energy)*. Prepared for the Parliamentary Commissioner for the Environment, Strata Energy Consulting, May 2008.

premises without requiring expensive changes to the fixed wiring. Different applications can be installed on AMI which, in the future, could benefit consumers by automatically controlling consumption in response to price or a preset supply capacity.

2.1.8 AMI also enables the integration of flexible tariffs and home automation systems that allow consumers to interact with the electricity market. For example, AMI can allow consumers to take advantage of complex time of use (TOU) pricing that was previously available only to larger commercial and industrial consumers. Consumers that change their consumption habits to reflect that pricing can benefit from the costs that are saved.

2.1.9 AMI technology, including the remote read functionality, could be used by other utilities or service providers (e.g. water and gas). That would avoid the need for duplicate communication infrastructures to be developed for each utility. This could result in cost savings to consumers and the industry.

2.1.10 The benefits of advanced meters and AMI systems are discussed in more detail in section 3 of this report. Further information about the evolution of meters in New Zealand, advanced meters and AMI systems and their respective functionalities is set out in Appendices 1, 2, and 3.

2.2 Issues raised by the emergence of AMI

2.2.1 The emergence of AMI raises a number of issues that need to be taken into account when considering whether the roll-out of AMI infrastructure needs to be extensively regulated, and whether aspects of AMI systems currently addressed in the Guidelines should be provided for in regulations.

Security considerations

2.2.2 AMI systems have the potential to create benefits for consumers, electricity market participants, the economy and the environment. Those benefits are discussed in section 3 of this report. However, like any communication system that has an interface with programmable devices, AMI systems present a security risk. Malevolent or mischievous behaviour could result in viruses, fraud or theft, or breaches of privacy.

2.2.3 Security concerns with AMI have been noted internationally. A security breach could destroy the credibility of AMI as a reliable source of consumption and other information that is used for wholesale market settlement and consumer invoicing. That could potentially affect the benefits that AMI technology is able to provide.

2.2.4 The Commission considers that the implementation model the industry is currently following in rolling out AMI will ensure that AMI systems have the

highest integrity. This is achieved by restricting user access to metering information through appropriate fire walling, and by allowing users of the AMI system access to only the back office server of AMI systems, rather than to the meter itself.

2.2.5 However, the Commission has also recommended that rules relating to access to and security of data collected and stored by AMI systems should be introduced, as described in section 6 of this report.

Maximising the potential of AMI

2.2.6 Meters and AMI infrastructure are a substantial capital investment for metering equipment owners. International experience shows that investments in AMI occur where there is either:

(a) minimum regulatory risk to the value of the investment;

(b) a clear benefit to investors that outweighs the cost of the investment; or

(c) funding, either by government or consumers, to meet any shortfall between the cost of the investment and the benefits accruing to the investors.

2.2.7 Inherent in any technology investment is the risk that functionality will develop that will:

(a) never be used, as the requirement never arises;

(b) become too complex to maintain or operate effectively;

(c) be too complex for consumers to operate;

(d) become technologically redundant relatively quickly; or

(e) limit the range of products that can be used in conjunction with the technology (such as smart appliances not able to use certain bandwidths or protocols).

2.2.8 Consequently, parties investing in advanced metering in New Zealand are taking care to minimise the risk of poor technology investment choices.

2.2.9 New Zealand has a very small percentage of the world's meters (estimated at 0.2%), with a total replacement value probably in the order of NZ$400 million. New Zealand does not have the market scale to materially influence international trends in AMI technologies and standards, and needs to take advantage of progress made internationally in relation to metering and AMI systems.

2.2.10 This is a key consideration in any decision on whether or not the roll-out of AMI in New Zealand should be extensively regulated, and whether the Guidelines are inadequate.

Smart grids

2.2.11 The development of smart grid technology is also relevant.

2.2.12 Smart grids embed intelligence into the operation of networks that may deliver electricity to consumers, facilitate improvements in the reliability, availability, and security of the electricity supply, and in energy efficiency. For example, smart grids that are connected to advanced meters can provide information about network faults to distribution and transmission companies, who can remotely switch supply around faults on the network. This can reduce the amount of time that a consumer is without power.[11]

2.2.13 Both AMI and smart grids allow peak load to be managed. That can allow for investment in generation, distribution and transmission to be delayed, which puts downward pressure on the price of electricity to consumers, and may reduce the environmental effects of electricity production.

2.2.14 However, smart grids are expensive to install, and while large electricity lines companies may be able afford the cost of this technology, smaller electricity lines companies may not.

2.2.15 New Zealand has a large number of these smaller electricity lines companies. Accordingly, the benefits that smart grids could bring to less densely populated areas of New Zealand may be limited by the amount of investment that these companies can make. To fully utilise smart grid technology in the future it may be necessary for electricity lines companies to establish joint co-operatives for the management of smart grids.[12]

2.2.16 A summary of smart grid technology is set out in Appendix 1

2.3 International drivers of advanced meters

2.3.1 The roll-out of advanced meters around the world first began to gather momentum in around 2000. Prior to that, automatic meter reading (AMR) was the primary form of new metering technology being rolled out internationally – largely in the United States.

[11] Provided that the network owner has invested in appropriate remote network switching devices, or has alternative supplies available to most areas of their network.

[12] This could be a similar model to that initiated by the Orion distribution lines company in Christchurch, which manages the load management equipment of several electricity lines companies in the upper South Island in response to heavy electricity flows on the upper South Island portion of the national electricity transmission grid.

2.3.2 The drivers of AMI have not been uniform.[13] Internationally, AMI has been rolled out for one of several reasons:

(a) A need for load control. The majority of AMI systems have been installed because the capacity of generation and transmission systems to supply consumers has been outstripped by consumer demand, typically due to increased demand for air conditioning. Load control systems can defer the need for investment by reducing electricity demand at peak load times, either by providing strong financial signals to which consumers can respond, or by physically reducing the load of particular appliances for short periods of time.[14]

(b) To reduce greenhouse gas emissions. Depending on the nature of generation, limiting peak demand can reduce the requirement for thermal generation, reducing greenhouse gas emissions.

(c) To allow more accurate meter readings, improved billing accuracy, and as a revenue protection measure (reduced theft and fraud). This was a key driver behind the initial advanced meter roll-out in Italy.[15]

2.3.3 Most international roll-outs have occurred as the result of regulation. That is because, with the exception of the United Kingdom, the supply of metering is a monopoly service, and the metering service provider is not directly involved with developments in the electricity market. Where a monopoly for metering services exists, traders (generators and retailers) may not be able to dictate to metering suppliers the attributes that they require. Regulation has therefore been required to ensure that advanced meters are provided, and that their functionality is appropriate for the electricity trading requirements within the relevant country.

2.3.4 However, there are some countries in which commercial drivers have played, or are anticipated to play, a key role in the roll-out of AMI.

2.3.5 In most countries, the provision of AMI has resulted in increased direct costs to consumers, either as an increased rental, or with funding provided by government.

2.3.6 The AMI roll-out in different countries is described in more detail in Appendix 4.

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[13] *Smart Metering with a Focus on Electricity Regulation*, European Regulators' Group for Electricity and Gas, October 2007.

[14] It is important to note that this does not mean a complete cut in power supply; it just means the ability of the appliance to run electricity is interrupted, usually for a such a small period of time that the consumer rarely feels the effects.

[15] *Report on international experience with smart meters (energy)*. Prepared for the Parliamentary Commissioner for the Environment, Strata Energy Consulting, May 2008.

2.4 New Zealand drivers of advanced meters

2.4.1 In considering whether extensive regulation of the roll-out of AMI is necessary, it is useful to consider drivers for the introduction of AMI in New Zealand.

2.4.2 Advanced meters for mass market electricity consumers are a relatively recent innovation in the New Zealand electricity industry, becoming more prominent in the past five years. However, in contrast to international AMI roll-outs, the use of advanced meters in New Zealand is being driven by market forces, rather than by government or regulatory decisions.

2.4.3 That is because the reasons for installing advanced meters in New Zealand differ from the reasons that have applied in other countries.

2.4.4 In particular, New Zealand has had an effective centralised load management system (the ripple control system) in place since the 1950s. Therefore, load management is not a primary driver of AMI in New Zealand, although the ability to enable more controllable load does make AMI systems attractive.

2.4.5 There also appear to be several other drivers behind the AMI roll-out in New Zealand that have not been seen in other countries. These are:

(a) Interim compliance deadline of 2015: The Rules provide that retailers must ensure that meters at residential and small commercial premises are fully certified by 1 April 2015.[16] The deadline was set in 1999, and was agreed and voted on by industry participants under the rules of self governance that applied at the time.

By 1 April 2015, retailers must either:

- ensure that their existing meters are fully certified, by requiring the meter owner to fully certify their meters. That can involve statistical sampling of meter populations to the individual testing of each meter installation, the removal and testing of meters, and the replacement of meters once certified; or
- install or acquire new, fully certified meters.

Many retailers and meter owners have taken the opportunity to install new advanced meters that deliver additional functionality, rather than certify their old meters.[17]

[16] Currently, the Rules grant these meters 'interim' certification provided the meters meet the requirements in the Rules.

[17] An additional benefit that has occurred is that because site visits have been required to roll out AMI, a number very historic metering issues, some related to invoicing of consumers, as well as issues to do with the safety of wiring in consumers' premises have been discovered that would not otherwise have been brought to light.

(b) Lease costs for advanced meters have fallen: The cost of advanced meters and associated communications has fallen in recent years to a level where retailers can lease an advanced meter at a cost approaching the cost of leasing an existing 'basic' meter.

In a 2008 report,[18] LECG noted that the market rate for leasing an advanced meter in New Zealand was approximately $75 per annum where a retailer was prepared to enter into a long term, high volume contract (e.g. for several hundred thousand meters). That is reasonably close to the $55-$60 p.a. cost of leasing a basic meter.

(c) Operational efficiencies that reduce retailers' costs to serve: The benefits associated with obtaining accurate metering information and the corresponding reduction in invoice queries enables reasonable savings in retailer back-office and settlement processes.

(d) Competitive provision of metering assets: Unlike many other countries where the provision of metering is a monopoly activity, in New Zealand, the provision and operation of meter services is a competitive market. Retailers are able to choose metering services from a range of providers, or provide those services themselves, and can replace any meter equipment owner's equipment with another meter owner's equipment.

As some of New Zealand's major electricity retailers do not own meters, they face no stranded metering asset costs if they switch from existing basic meters to advanced meters. Those retailers therefore face a lower financial hurdle to using advanced meters than retailers that own meters.[19]

For a similar reason, meters are usually not replaced when a consumer switches retailers. Provided the meter has the attributes required by the retailer gaining the consumer, the gaining retailer will normally lease the use of the meter from the existing meter owner (which could be the outgoing retailer or a third party supplier).

A roll-out of AMR meters in Christchurch by Meridian Energy via its subsidiary Arc Innovations, appears to have acted as a catalyst for other retailers to roll out advanced meters. This indicates that competition in the deregulated electricity market is producing benefits. Therefore, the roll-out of advanced meters by one retailer appears to have placed competitive pressure on other retailers to do likewise.

2.4.6 These drivers, which allow retailers to lower the cost of servicing consumers, have created a positive business case for the majority of New Zealand's

[18] *Developments in the New Zealand market for Advanced Metering Infrastructure and related services*, LECG, July 2008.

[19] For a fuller discussion of the competitive market motive, see '*Smart metering in New Zealand. A report prepared for the Parliamentary Commissioner for the Environment'* by Concept Consulting, June 2008.

electricity retailers to roll out advanced meters. In fact, retailers have plans in place under which advanced meters will be installed at approximately 80 per cent of New Zealand's almost 2 million electricity metering installations by the end of 2013.[20]

2.4.7 It also appears that other utility services may use the resulting technology infrastructure. The installation of AMI can act as a catalyst by reducing the entry cost of advanced technologies for other utilities. For example:

(a) Retailers supplying both electricity and gas (dual fuel) may implement some additional advanced functionality on gas meters when implementing electricity advanced meters[21], using the AMI as a communication method for gathering gas-meter information.

(b) Distributors may wish to use the enhanced information that could be made available from AMI for integration into smart grid developments.

(c) Further functionality is available if water suppliers wish to use the AMI communications network for gathering water-meter information.

(d) With the development of smart appliances, appliance manufacturers may wish to offer new services such as condition monitoring or fault detection with their appliances.

2.5 Regulatory context for a New Zealand AMI roll-out

2.5.1 Although New Zealand's AMI roll-out is a market-led, unregulated retailer roll-out, Government policy[22] has resulted in the Commission developing the voluntary AMI Guidelines.

2.5.2 The Guidelines provide clear direction to the New Zealand electricity industry as to the Government and the Commission's expectations of the AMI roll-out, but do not require the roll-out of AMI within a specified timeframe.

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[20] *Report on international experience with smart meters (energy). Prepared for the Parliamentary Commissioner for the Environment*, Strata Energy Consulting, May 2008; *Smart metering in New Zealand. A report prepared for the Parliamentary Commissioner for the Environment*, Concept Consulting, June 2008.

[21] *Smart metering in New Zealand. A report prepared for the Parliamentary Commissioner for the Environment*, Concept Consulting, June 2008.

[22] As contained in the following relevant documents:

New Zealand Energy Strategy to 2050; Powering Our Future, Ministry of Economic Development, October 2007 (the Commission notes that this document is currently under review by the Government);

New Zealand Energy Efficiency and Conservation Strategy, Making It Happen: Action plan to maximise energy efficiency and renewable energy, Energy Efficiency and Conservation Authority. October 2007 (the Commission notes that this document is currently under review by the Government); and

Government Policy Statement on Electricity Governance, May 2009 ((the Commission notes that this document is likely to be reviewed once the current Ministerial review is completed).

2.5.3 Key Government expectations of the AMI roll-out include:

(a) facilitating the progressive introduction of advanced/smarter meters for consumers, through publishing technical guidelines;[23] and

(b) that retailers consider whether current meter ownership arrangements are consistent with the deployment of AMI.[24]

2.5.4 Key Commission objectives relating to the introduction of AMI include:

(a) using AMI to promote and facilitate the efficient use of electricity by end users;

(b) encouraging industry participants to establish AMI systems as open and accessible infrastructures allowing multiple service provider access; and

(c) encouraging AMI systems, as they become available, to offer an appropriate minimum set of features to encourage the development of cost-reflective prices (that consumers are likely to respond to) and load control services over the long term.[25]

2.5.5 The Commission is progressing several work streams that directly or indirectly impact the roll-out and ongoing operation of AMI in New Zealand. These include:

(a) A fundamental review of the electricity market rules that relate to metering (part D of the Rules). This work is being progressed because the current Rules are out of date and internally inconsistent, and are inadequate for dealing with new metering and communications technology that has emerged. In some instances, the existing Rules are a barrier to the innovation opportunities presented by this new technology. In other cases, the absence of any regulatory framework leaves the consumer exposed to potential breaches of security in relation to the accuracy, security and privacy of information related to billing.

(b) Clarifying the property rights relating to the control of consumers' electricity loads.

(c) Investigating the merits of consumers' load being offered into the wholesale electricity market, with payment for demand reduction ("dispatchable demand") in a similar manner to electricity generators being paid for supply increases.

(d) Investigating expanding the use of consumers' load to provide additional emergency reserves for the national electricity transmission system.

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[23] *Government Policy Statement on Electricity Governance,* May 2009.

[24] *New Zealand Energy Strategy to 2050; Powering Our Future,* Ministry of Economic Development, October 2007 (the Commission notes that this document is currently under review by the Government).

[25] *Advanced Metering Policy*, Electricity Commission, May 2008.

2.5.6 The Commission has also recently completed a review of metering equipment owners' compliance with the Guidelines. The review showed that there is a high level of compliance with the Guidelines by participants who rolled out AMI systems after the Guidelines were published (AMI systems rolled out before the Guidelines became effective are not expected to comply with the Guidelines).

2.5.7 A summary of the Commission's review of metering equipment owners' compliance with the Guidelines is set out in section 8 of this report.

3. Benefits and risks of AMI

3.1 Key benefits and risks of the current AMI roll-out

3.1.1 As set out in section 2 of this report, AMI can potentially offer a range of benefits to consumers, retailers, generators, electricity lines companies, meter owners, the economy and the environment. This section discusses the benefits and risks for each of these categories.

3.1.2 A perceived risk arising out of an unregulated, industry-led AMI roll-out is that AMI systems will not include functionality required to deliver the full range of benefits that AMI can deliver. There is some concern that retailers who are currently leading the AMI roll-out in New Zealand will focus almost exclusively on AMI functionality that delivers benefits to retailers, possibly foregoing opportunities to deliver additional benefits to consumers, distributors, meter owners, and the broader economy and environment. That is one reason why the Commission has been asked to consider whether the roll-out of AMI should be extensively regulated.

3.1.3 The starting point for considering whether the roll-out of AMI should be extensively regulated is the principle that regulation should only be implemented if the benefit of regulation outweighs the cost. Accordingly, the Commission has analysed:

(a) the benefits (both actual and potential) of and risks associated with AMI;

(b) whether the current, unregulated roll-out of AMI will affect those benefits and risks; and

(c) whether regulating the roll-out of AMI will affect those benefits and risks.

3.1.4 In a May 2008 report to the Parliamentary Commissioner for the Environment, Strata Energy Consulting describes some of those benefits and risks.[26] The benefits and risks identified by Strata Energy Consulting, and the Commission's view on the benefits and risks associated with rolling out of AMI, are detailed in the sections below.

[26] *Report on international experience with smart meters (energy). Prepared for the Parliamentary Commissioner for the Environment*, Strata Energy Consulting, May 2008.

3.2 Consumers

3.2.1 There are both current and potential future benefits to consumers arising from the roll-out of AMI.

3.2.2 Current benefits include:

(a) AMI systems reduce the barrier to entry for new entrant retailers, as the AMI information may be in a form that requires less extensive software systems to settle consumer consumption and generation in the electricity market.[27] This can foster retail competition and be of benefit to consumers, because new entrant retailers may:

(i) offer innovative services and tariffs. With the detailed information available from AMI systems, new entrant retailers may develop products and services that will give consumers the incentive to change their consumption patterns; and

(ii) provide electricity at a lower delivered cost, possibly through payments to consumers for altering consumption patterns.

(b) AMI allows retailers to read consumers' meters remotely and provide consumers with an accurate monthly invoice.

Although meters are read at intervals ranging between one and four months, and in some circumstances up to 12 months, retailers issue invoices monthly to consumers. Estimated meter reads are created for each invoice where an actual meter read is not available. Consumers often have concerns about the accuracy of estimated invoices, which can result in consumers spending considerable time trying to resolve issues with estimated invoices that they consider are inaccurate.

(c) Physical access to a meter is not necessary.

At present, gaining physical access to meters creates risks to retailers, (such as meter readers may encounter a dog) and there are difficulties with accessing meters located inside consumer premises that may be secured by burglar alarms or are locked. Even if a key is provided, and if occupants of a house are home during the day, access by meter readers may not be convenient, or may compromise occupants' feeling of security.

[27] Standard meter systems require the development of a complex data processing system for non-half hour consumption information. This is expensive and there are currently no independent service providers that can do this on behalf of new entrant retailers. However, there are independent service providers for processing half hour data, which is how consumption information from AMI can be settled with the reconciliation manager.

(d) AMI systems allow TOU pricing. Three retailers already offer TOU pricing to consumers, allowing them the option of moving electricity consumption to lower cost periods.[28]

(e) Additional services could be provided to consumers through AMI systems, such as:

(i) capacity load limiting to a premise to prevent overload of supply;

(ii) appliance condition monitoring or fault reporting, where smart appliances are used that contain that functionality;

(iii) information about other utility consumption such as gas and water;

(iv) time clock control of appliances;

(v) optimisation of embedded generation;

(vi) payment options that could allow an easier transition between pre-pay and post pay; and

(vii) voltage control.

One retailer has announced a pilot study involving 1,000 consumers to determine what additional services can be made available to consumers via AMI systems.

(f) The availability of meter readings at any time means faster switching is potentially possible.

(g) AMI allows enhanced consumer service. AMI-connected consumers' queries about electricity consumption can be more efficiently resolved, because consumption information at a half-hour level is available.

(h) AMI system will facilitate consumer education. Historically, metering systems do not interact directly with consumers, who are only given information about metering on the retailer-provided invoice (which could be an estimate). A variety of options exist for providing information to consumers via AMI systems, some of which are being trialled. These are discussed in section 4 of this report.

(i) AMI systems can provide consumer protection from inappropriate disconnection when operating in pre-pay mode. AMI systems can be programmed to ensure that disconnection only occurs after the advanced meter has received authorisation from the back office server. This will prevent consumers from being disconnected because of a communication error, such as credit added to a consumer's account being recorded by the AMI system but not by the advanced meter, or a system failure that results in consumers being unable to purchase credit.

[28] Pulse Utilities, Powershop, and Genesis Energy currently offer TOU pricing.

3.2.3 Future benefits include:

(a) Shared infrastructure with other utility providers, such as gas and water service providers, could lead to a significant improvement in the accuracy of invoicing for those utilities.

(b) In-home visual displays linked to an advanced meter could provide accurate, virtually real-time information on electricity usage and costs. Advanced meters fitted with a Home Area Network (HAN) could also relay signals to smart appliances that would respond by switching on or off.

(c) Where a HAN is supplied by a third party provider as a device not linked to the meter, but controls functions within a property, the AMI system would record the results of load decreases or increases that would be reflected in the consumers' invoices.

(d) AMI may provide real time feedback that would allow consumers to change their consumption patterns, if they want to, in order to save cost. Costs are saved either by the consumer shifting the time that they use certain appliances in order to take advantage of lower prices at certain times of day, or by the consumer reducing their total electricity consumption. Retailers are considering communication options such as cellphones, web portals, and computer connections for providing consumers with real time feedback.

(e) The potential to connect smart appliances to AMI infrastructure so that they can automatically respond to pricing signals by, for example, switching on or off.

(f) Smart appliance manufacturers offering consumers remote condition and fault monitoring services for appliances.

3.2.4 Risks associated with the roll-out of AMI include:

(a) Consumers could be required to pay for functionality that they do not require, or that is already provided by third party supplier, or for which there is no or only limited benefit.

(b) While moving to TOU pricing may benefit consumers with discretionary load, the volatile nature of TOU pricing may financially penalise consumers with no discretionary load.

(c) Where a HAN interface is included within an AMI system, the setup for the consumers premise may be unique to a retailer. Transferring this setup through the switching process will add significant complexity and may have unintended consequences for the consumer should operating parameters change.

3.2.5 The current roll-out of AMI has shown that in a small number of cases, the wiring within a consumer's premises is in poor condition and will become unsafe if the

meter is replaced. In those cases, AMI systems cannot be fitted without the consumer incurring significant cost to make the wiring safe.

3.2.6 The Commission considers that the benefits of AMI to consumers described above can be realised under the current, unregulated roll-out of AMI. There are no additional benefits that would be gained by regulating the roll-out of AMI. In fact, while regulation would likely impose some cost on consumers, the current unregulated roll-out of AMI is being achieved at no direct additional cost to consumers.

3.2.7 The Commission also considers that the risks of AMI described above cannot be mitigated by regulating the roll-out of AMI. Where regulation is imposed, there is additional risk that:

(a) AMI systems may become inflexible and comply only with the minimum requirements contained in the regulations; and

(b) innovation by distributors, retailers or generators as a result of market changes or advancing technology will not occur without increased government funding, as regulation moves the technology risk from the metering equipment owner to the regulating body.

3.3 Distributors

3.3.1 There are both current and potential future benefits and risks to distributors arising from AMI. However, not all distributors have expressed an interest in accessing the enhanced information that AMI can and may be able to provide. It is also the case that distributors may be required to pay the owner of the AMI infrastructure (usually the meter owner) to access to the information collected and stored by the AMI that a distributor will need in order to benefit from AMI.

3.3.2 Current benefits include:

(a) Distributors can receive enhanced information about electricity being consumed by customers connected to their network from AMI. That would enable distributors to locate points of connection on their networks that are (or have been) overloaded, and identify premises where line charges should be reviewed.

(b) Distributors can also use the enhanced information to identify transformers or feeders that are either underutilised or overloaded. That can assist the planning and maintenance process, assist in transferring of load within the network, and assess the need for additional distributed generation.

(c) AMI could enable load control to be specific to the capacity of each consumer’s point of connection. That will be important because the development of distributed generation and plug-in electric vehicles will

introduce potential power quality and peak demand issues for distributors at the point of connection to a consumer's premises.

(d) Where networks are constrained, AMI could allow distributors to provide deferral values to consumers to defer upgrades to a network. However, the provision of deferral values could only be a temporary measure. It should also be noted that there are not many known constraint issues in New Zealand for which there would be a deferral value.[29]

(e) AMI could allow power quality and outage information to be made readily available, as meter logs record low or high voltage, current or actual loss, and restoration of electricity. [30] That could enable distributors to identify problem areas for investigation or investment.

(f) AMI will encourage pricing plans that incentivise consumers to change behaviour to help network planning and operation.

(g) Additional load management capability could be made available through AMI infrastructure and HAN, where appliances exist that can be controlled (e.g. apartment blocks where there has been no wiring implemented for separate water heating ripple control).[31]

(h) Subject to the availability of communications between the back-office and the advanced meter, AMI would allow distributors to "poll" meters in real time to see which sites have supply and which do not. Meters without an electricity supply will not be able to respond, and distributors would then know the extent of an outage.

3.3.3 Future benefits that could be realised if additional functionality is added to existing AMI infrastructure include that AMI may allow:

(a) Optimisation of distributed generation within a premise.

(b) Plug-in electric vehicle control to ensure that distribution lines are not overloaded.

(c) Distribution loss reduction with the location of incorrect metering or unmetered load.

(d) Ancillary services and voltage control.

3.3.4 Future benefits may also be realised if changes are made to existing AMI hardware to include last gasp functionality. Last gasp occurs where the power fails, in which case the meter will transmit a signal to the back-office server that

[29] However, The Lines Company currently offers very strong deferral signals for consumers to reduce load at peak network demand times.

[30] The proposed changes to part D of the Rules suggest an AMI structure where distributors can contract directly with metering equipment owners to obtain information.

[31] However, this can also be achieved by using existing ripple injection systems.

power has been lost. There may be an additional cost to distributors in building that functionality into the meter, as well as ongoing maintenance costs.[32]

3.3.5 Disadvantages include:

(a) Distributors may be required to pay to access data stored by AMI infrastructure.

(b) Meter ownership in New Zealand allows any number of meter owners on a network. Obtaining information in a consistent format may be an issue.[33,34]

(c) The number of meter owners on a network will be an issue where a distributor wishes to use an advanced meter or HAN to carry out load control. This will require the development of a process through the distributor's back-office system to the AMI owner's back-office system.[35]

3.3.6 Risks associated with the roll-out of AMI include:

(a) If retailers incentivise consumers to change their consumption habits, there may be capacity swings on the distributors' network to which the consumer is connected. Changes therefore need to be co-ordinated between distributors as the restoration of load may cause subsequent peak demand in the network or the transmission grid, and mean that costs are simply displaced.

(b) Where AMI replaces the existing ripple system relays, distributors may not be able to control the current controllable load in the way they do now. This could be due to load control signals being delayed by the AMI system because of communication faults or delays, or through a change of AMI provider removing distributors' load control ability by reducing system functionality.[36]

3.3.7 The Commission considers that the benefits of AMI to distributors described above can be realised under the current, unregulated roll-out of AMI. There are no benefits that would be gained by regulating the roll-out of AMI without incurring a corresponding cost for last gasp functionality that may not be required.

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[32] Meter owners will provide this functionality if it is required and distributors are willing to pay the capital and operating costs involved. However, the notification is only an indicator that power has failed, from then on meters must be "polled" to see what sites are off.

[33] The proposed changes to part D of the Rules addresses this issue with nominating formats for this data exchange.

[34] A proposed data hub using the current registry (awaiting consultation) will provide a secure and easy process for the exchange of real time information between participants.

[35] The proposed changes to part D of the Rules anticipate this structure with the inclusion of more detailed meter ownership that will make the identity of information owners transparent to distributors' back office systems.

[36] The proposed changes to part D of the Rules address this issue.

3.3.8 The Commission also considers that the risks of AMI described above cannot be mitigated by regulating the roll-out of AMI. Where regulation is imposed, there is additional risk that:

(a) Costs for the provision of information may be charged to the consumer, rather than absorbed into the distributor's operational cost savings, because not all distributors will require the same functionality.

(b) AMI systems may become inflexible and comply only with the minimum requirement contained in the regulations.

(c) Innovation by distributors, retailers or generators as a result of market changes or advancing technology will not occur without increased government funding, as the technology risk has moved to the regulating body.

3.4 Retailers and generators

3.4.1 Current benefits to retailers and generators arising out of AMI include that AMI has the ability to:

(a) create a lower entry cost to the electricity market for new entrant retailers which can foster retail competition. The lower entry cost arises because new entrant retailers do not need to:

(i) arrange for actual site meter reads and manage access or keys, as the meter is read remotely by the AMI owner, and the provision of meter readings is a simple file transfer process; or

(ii) install complex systems to process non half hour meter reads into the required market format. There are no independent service providers available for non half hour data processing and, at present, each retailer must purchase or develop its own complex system. There are however two independent service providers that will process half hour data into the required market format, making processing data from AMI systems significantly easier than with other metering systems.

(b) Provide consumers with improved information on their consumption habits and innovative tariffs that more closely reflect market costs.

However, the existence of short-term spot prices in the electricity market does not necessarily mean that retailers or consumers face those costs when purchasing electricity. Hedging arrangements with generators may stabilise these costs to a single, fixed, purchase price. A vertically integrated generator/retailer may have little or no financial benefit in moving that load under normal generation situations.

(c) Produce actual meter reads for invoicing purposes, which means that estimates will not be required, and there will be a substantial reduction in consumer queries to retailers' call centres.

(d) Provide retailers with information about when a vacant site has residual load (e.g. a water heater) or when a consumer moves into a site.[37]

(e) Allow retailers to attract and retain consumers by offering innovative products and tariffs.[38]

(f) Ensure retailers can benefit from having more accurate settlements and cash flow positions.[39]

3.4.2 Future benefits that could be realised if additional functionality is added to existing AMI infrastructure include that AMI allows:

(a) load aggregators to trade load as another participant class; and

(b) other utilities to communicate gas and water meter readings through a shared infrastructure.

3.4.3 Risks associated with the roll-out of AMI include:

(a) Consumers may not fully understand the risks that are transferred to them when TOU pricing is made available, and this may generate significant call centre queries for retailers.

(b) Greater pricing competition may mean that consumers switch at a greater rate.

(c) Telecommunication network standards mean that real time AMI communications are not currently reliable.

3.4.4 The Commission considers that the benefits of AMI to retailers and generators described above can be realised under the current, unregulated roll-out of AMI. There are no additional benefits that would be gained by regulating the roll-out of AMI. The Commission also considers that the risks of AMI described above cannot be mitigated by regulating the roll-out of AMI.

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[37] Retailers are responsible for purchase of all electricity that is consumed within a site regardless of if they have a consumer contract or not.

[38] This is already the case with Pulse Utilities, Powershop and Genesis Energy, where TOU rates and other services are offered. Meridian Energy has similarly announced a pilot study to determine products of value to consumers.

[39] Traditional non-half hour metering is settled on a monthly basis by profiling until meter reads are available. Typically results only become accurate once meter reads are obtained. As traditional meters are usually read every two to four months (and sometimes only every 12 months), this can take some months and until that time, final settlement is not known. Market revisions continue to occur for a period of 14 months.

3.5 Meter owners

3.5.1 A number of different parties can be meter owners.[40] Meter owners lease metering equipment to retailers and generators, and, in the case of AMI, also provide metering information. Meter owners have a direct relationship with the retailer or generator for a site rather than a consumer. The Rules place obligations on participants regarding the accuracy of meters and the maintenance of meter certification.

3.5.2 Current benefits to meter owners arising out of AMI are that once an AMI system is installed, it is very unlikely to be displaced, provided it meets users' requirements and is software and firmware upgradeable. However, as with existing meters, it is possible to transfer meter leases to different retailers or generators when a consumer switches retailer.

3.5.3 Future benefits that could be realised if additional functionality is added to existing AMI infrastructure include the ability for the AMI infrastructure to be shared among users. A greater number of users potentially provide greater security of investment.

3.5.4 Disadvantages are:

(a) AMI requires a significantly different business model than standard metering systems, as AMI owners are part of the data chain. AMI owners then have more rule requirements than do owners of standard meters.

(b) Telecommunication network standards mean that real time AMI communications are not currently reliable.

3.5.5 Risks associated with the roll-out of AMI include:

(a) Investment in an AMI could be stranded if:

(i) a meter owner's installation at a consumer's site was displaced by another meter owner's installation at the request of the retailer or generator trading at the consumer's site; or

(ii) where a meter installation does not meet the functional or cost requirements of the retailer or generator trading at the consumer's site, the meter owner's installation may be replaced. The removal of the meter owner's system would effectively strand the investment that had been made.

[40] The proposed part D rule changes create a new class of participant called a "meter participant", being the entity that owns the meter. It is proposed that the obligations of "meter participants" include maintaining metering at a point of connection until another meter participant takes over responsibility for the metering obligation, or the point of connection is decommissioned.

However, the risk of asset stranding provides AMI owners with a very strong commercial incentive to ensure that their AMI systems provide the functionality required.

(b) Regulatory intervention could also limit innovation and the adoption of new technology by meter owners.

3.5.6 The Commission considers that the benefits of AMI to meter owners described above can be realised under the current, unregulated roll-out of AMI. There are no benefits that would be gained by regulating the roll-out of AMI. In fact, regulatory intervention could result in AMI owners having to invest in AMI systems that cannot be justified under their current investment model, which may result in additional costs being passed on to consumers.

3.5.7 The Commission also considers that the risks of AMI described above cannot be mitigated by regulating the roll-out of AMI without incurring costs on consumers.

3.6 The economy and the environment

3.6.1 AMI also offers potential benefits to the economy and the environment.

3.6.2 International research on AMI shows that consumers can be encouraged to conserve energy and reduce or shift demand in response to TOU price signals, on a daily, weekly, or seasonal basis. Reducing peak load by reducing or shifting demand can be achieved by remotely managing load, or by giving consumers a financial incentive to voluntarily react to price signals. That has the potential to defer investments in electricity generation, transmission, and distribution assets, and reducing greenhouse gas emissions from coal or gas-fired generation plants that are used for peak supply.

3.6.3 After consulting with the industry, the Commission has estimated the value to New Zealand from reduced consumption leading to deferred investments and reduced greenhouse gas emissions as ranging between $500,000/MW for transmission deferrals,[41] to $120/MW for greenhouse gas reductions.

3.6.4 In its report to the Parliamentary Commissioner for the Environment,[42] Concept Consulting estimated benefits to New Zealand's approximately 1.65 million residential electricity consumers[43] that could result from AMI as ranging from approximately $2.50-$6.00 p.a. from avoided greenhouse gas emissions, to

[41] *Value Pricing Working Panel Report*, Electricity Commission, August 2007

[42] *Smart metering in New Zealand. A report prepared for the Parliamentary Commissioner for the Environment*, Concept Consulting, June 2008.

[43] Defined to mean individual residential households, rather than individuals within each household.

approximately $20.00-$55.00 p.a. from automated and more accurate meter reading and field services.[44]

3.6.5 The roll-out of AMI will, in the future, allow retailers to provide prices to their consumers that include incentives for the consumer to manage their consumption in a manner that benefits the environment. At a future time, and as requirements change or develop, the remote programmability of AMI and the detailed consumption information available means that appropriate financial signals can be easily provided. Importantly, this cannot be done in the same manner and to the same extent with current metering systems.

3.6.6 The Commission considers that economy and environmental issues will be dealt with by consumer pricing, where financial incentives are provided for consumers to change their consumption habits. This is already included within the current AMI roll-out, as advanced meters can be remotely programmed for complex TOU tariffs that can provide appropriate financial signals. Accordingly, the Commission does not consider that regulation is necessary.

3.7 Conclusion

3.7.1 There is a concern that an unregulated, retailer-led AMI roll-out will result in AMI functionality that delivers benefits to retailers, possibly foregoing opportunities for other benefits for consumers, electricity lines companies and the broader economy and environment.

3.7.2 However, that concern appears to be largely unfounded. The AMI systems being rolled-out by Meridian Energy, Contact Energy, Genesis Energy and Mighty River Power provide the full range of benefits described above, with the key exceptions being last gasp functionality and the AMI-HAN interface.

3.7.3 AMI systems with last gasp functionality are able to transmit a signal to the system's back office server when there is a power failure. AMI systems currently being rolled-out do not include last gasp functionality because neither retailers nor distributors are willing to pay the costs of that feature, presumably because the benefits do not outweigh the costs. The Commission is satisfied that it is appropriate that participants should determine whether last gasp functionality is economic, and accordingly does not recommend regulating to require that last gasp functionality be included in AMI systems.

3.7.4 A fuller discussion on the benefits of HAN that may not be met under the current AMI roll-out are described in section 4 of this report.

[44] The figures include GST.

3.7.5 In addition, the Commission considers that the risks that can arise from the roll-out of AMI are not increased under an unregulated AMI roll-out because:

(a) AMI system owners are following the voluntary Guidelines, as described in section 8 of this report.

(b) AMI systems currently being rolled-out are remotely programmable, allowing retailers to provide financial incentives to consumers to change consumption patterns.

(c) AMI systems are collecting detailed consumption information.

(d) Technology risk of AMI systems being rolled-out is being managed appropriately by the AMI system owner.

(e) AMI Systems and processes will allow the switching of consumers between retailers to continue.

3.7.6 The Commission has, however, considered whether certain technical aspects of AMI systems should be regulated, or whether the voluntary AMI Guidelines currently in place are adequate. The Commission has concluded that the following aspects of AMI need to be regulated:

(a) information formats and protocols, for the reasons set out in section 5 of this report;

(b) access to and use of data stored by AMI systems, for the reasons set out in section 6 of this report; and

(c) the disconnection of pre-pay consumers by AMI systems, for the reasons set out in section 3.2.2(i) of this report.

3.7.7 The Commission has also considered whether import/export metering, which is addressed in the Guidelines, needs to be regulated. The Commission considers that import/export metering does not need to be regulated because the parts of the Guidelines that address import/export metering are adequate and are being complied with, for the reasons set out in section 7 of the report.

4. Home area network (HAN) connectivity and In-home Displays (IHD)

4.1 Introduction

4.1.1 A HAN is a system that directly or indirectly controls devices within the home, such as wireless entertainment systems or computer networks.

4.1.2 An IHD is a device that can provide near real time information directly to consumers through a number of different media types. This information could include the price and quantity of electricity being consumed.

4.1.3 HAN and IHD systems are described in more detail in Appendix 5.

4.1.4 The Guidelines state that all AMI should have the capability to retrofit and operate a HAN and IHD. However, the Guidelines do not specifically require a HAN and IHD to be connected to AMI, for the reasons outlined in Appendix 5 and below. It has been suggested that regulations should be introduced that require AMI systems to have a HAN interface

4.2 HAN interface cost/benefit analysis

4.2.1 The Commission engaged the New Zealand Institute of Economic Research (NZIER) to provide an initial high-level analysis of the costs and benefits of requiring AMI infrastructure to include a HAN interface.

4.2.2 NZIER's analysis assessed the costs and benefits of three options for rolling-out AMI with or without HAN and IHD functionality. Full details of assumptions and findings are available in the NZIER document *Cost-benefit analysis of additional advanced meter functionality.*[45]

4.2.3 The three options identified are:

(a) option 1 – include HAN only at the time of rolling out AMI;

(b) option 1a – include HAN only, retrofitted as consumers take up smart appliances (an estimate of five years' time has been used); and

(c) option 2 – include HAN and IHD in AMI infrastructure at the time of rolling-out AMI.

[45] This is available on the Commission's website at http://www.electricitycommission.govt.nz/opdev/retail/metering/index.html.

4.2.4 With discounting to reflect their relative timing, annual costs and benefits imply present value total costs for periods from 2009/10 to 2028/29 of:

(a) $429 million under option 1;

(b) $231 million under option 1a; and

(c) $987 million under option 2.

4.2.5 Although option 1a incurs an additional cost for site visits to retrofit HAN modems, it avoids incurring any costs until HAN is required by smart appliances.

4.2.6 Inclusion of the additional functionalities delivers present value total benefits over the next 20 years of just $1.718 million under option 1 and option 1a, and $727 million under option 2, given the larger demand response to IHD than HAN alone.

4.2.7 The net benefits are therefore:

(a) option 1 = -$427 million;

(b) option 1a = -$229 million; and

(c) option 2 = -$260 million.

4.2.8 Although option 2 achieves greater net benefits, it also incurs larger costs. For each dollar of cost, option 1 and option 1a return less than $0.01 in benefits, while option 2 returns $0.73. None of the options break even within the next 20 years. Although option 2 reaches a point (at 2017/18) where the annual benefits outweigh its annual costs, those benefits are not large enough to cover the initial installation costs within the next 20 years, or even by 2050.

4.2.9 The NZIER report indicates that deferral of the inclusion of the HAN interface to when HAN-enabled appliances are more common in New Zealand is preferable to including the HAN interface as part of the AMI roll-out occurring now. With the rapid rate of technology change, this functionality may be able to be provided more cost effectively in the future by different technologies than those available now. This analysis has been undertaken without estimating cost of the technology risk inherent in the inclusion of a HAN interface now.

4.3 The Commission's view

4.3.1 The Commission's view is that it is premature to require AMI to have a HAN interface at the time of installation now, due to, in summary:

(a) the small size of the metering market in New Zealand;

(b) the speed with which HAN-related technology is evolving;

(c) the costs to consumers of requiring AMI to have a HAN interface at present; and

(d) the limited availability of smart appliances.

4.3.2 Due to the very small size of its consumer market (in international terms), New Zealand has only a very small proportion of the world's electricity meters, and does not have the ability to materially influence international trends. It is very likely that any technology that New Zealand decides to invest in that is different from the rest of the world may become an orphan technology, and will significantly restrict New Zealand's options in the future. Therefore, New Zealand must expect to be a 'technology follower' in respect of HAN communication protocols and technologies.

4.3.3 This view is supported by the Victorian Auditor-General's Report *Towards a smart grid*, November 2009. [46] That report details the Auditor-General's findings on the AMI roll-out in Victoria and considered the following:

(a) if the advice and recommendations provided to the Victorian government have been sound;

(b) the government's project governance;

(c) the robustness of the economic analysis undertaken; and

(d) the technology risk assessment.

4.3.4 Section 4.4.2 of the Victorian Auditor-General's report states that the home interface portion of an AMI system is the least mature of the system components, and that "*it will take several more years for market direction to become clear*."

4.3.5 Requiring AMI to have a HAN interface introduces significant capital and ongoing costs, whereas the current roll-out of AMI is at no additional direct cost to consumers. The inclusion of a HAN would result in costs being incurred that would be passed on to all consumers, regardless of whether consumers ever used the HAN interface. That cost would have to be met, even though consumers would have to wait a significant period, perhaps up to 10 years, before gaining access to that benefit.

4.3.6 While a potential benefit of AMI having a HAN interface is that consumers could be provided with useful real time information or the ability to directly control load, that benefit can be realised only where there is additional discretionary load available.[47]

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[46] http://www.audit.vic.gov.au/reports__publications/reports_by_year/2009-10/20091111_amid.aspx

[47] Some international studies such as the study carried out by Integral Energy found that the provision of an IHD that requires a HAN to operate did not result in significant differences in behaviour compared to providing consumers with hard copy information.

4.3.7 HAN communication protocols and technologies are rapidly evolving. That increases the risk of HAN technology as we know it today becoming obsolete. The risk in requiring that AMI have a HAN interface now is that the HAN technology required by regulations may not prove to be the 'winning' technology. Even if New Zealand does select what turns out to be one of the most widely-adopted technologies, by the time it is able to be used by consumers it may not be the version of that technology that has been widely adopted.[48] The consequence of an incorrect decision on HAN interface protocols and technologies will be the additional cost associated with changing or upgrading the technology in the future.

4.3.8 There is limited availability of HAN-enabled smart appliances. AMI can interface with household hot water heaters and heat pumps, which are the major sources of current demand response in New Zealand, without the need for a HAN interface. This view should be revisited when additional controllable load, such as smart appliances and plug in electric vehicles, become available.

4.3.9 Most AMI currently being rolled-out can have a HAN interface added at relatively low cost. Importantly, if HAN technologies mature in the short term (e.g. the next 12 months), AMI installations installed from that point on can be upgraded by adding a HAN interface, which reduces the incremental cost of installing a HAN interface.

4.3.10 IHDs indicating instantaneous and over-time energy use and costs have been available to consumers for about the last 15 years but, at a cost of between $80 and $200, have not been popular.

4.3.11 HAN is not a requirement for direct load control. New Zealand already has an established load control system that operates effectively and reliably to limit peak demand (the ripple injection system).

4.3.12 An initial high-level analysis of the costs and benefits of including a HAN interface in AMI infrastructure compared with the costs and benefits of including a HAN interface in AMI infrastructure in five years, indicates that deferring the inclusion of the HAN interface to when HAN-enabled appliances are more common in New Zealand is preferable.

4.3.13 For those reasons, the Commission recommends that:

(a) as a minimum requirement, AMI should have the capability to support a HAN in the future;

[48] Already some communications protocols have advanced to the point where they are not backwards compatible, meaning that the earlier version(s) need to be replaced by the latter versions if the user wishes to take advantage of the additional functionality of the more recent version. This is similar to the nature of upgrades to IT operating systems such as Windows XP, Windows Vista and Windows 7.

(b) where a HAN interface is installed, the installation of the HAN interface should not impose costs on a consumer that are greater than the benefit that consumer receives from its operation; and

(c) the standards in the voluntary Guidelines are sufficient for the current AMI roll-out, and regulating the provision of HAN functionality in AMI installations is not required.

4.3.14 The Commission recognises that meter owners may choose to install a HAN interface at the time of installing AMI infrastructure if they wish. That is likely to occur only where it is economic.

5. Information exchange formats and protocols

5.1.1 The Commission is required to make a recommendation on whether technical standards for AMI should be regulated, or whether the voluntary AMI Guidelines currently in place are adequate. One aspect of AMI systems the Commission considers should be regulated relates to information exchange formats and protocols.

5.1.2 Information needs to be exchanged between the AMI owner's system and the participants who use information from the AMI system. That information includes metrology data such as metered volumes, and may include related information such as power quality and power on/off information. It may also include non-participant information such as gas and water information.

5.1.3 There are at least four AMI owners in New Zealand at present. Where a participant deals with several different AMI owners, there would be considerable inconvenience to and effort required by that participant if each AMI owner required information to be provided in a different format.

5.1.4 The Guidelines state that a common data exchange protocol for AMI is essential. The Guidelines also state that AMI owners must ensure that data exchange protocols are not a barrier to using their AMI system.[49]

5.1.5 There are no standardised AMI information exchange protocols in New Zealand at present. However, voluntary formats and protocols have been in place for some time and are in use for standard exchange of meter and consumer information. These protocols apply to information held by an AMI,[50] although the additional services that AMI can support mean that additional formats will need to develop as those services eventuate. All AMI suppliers support a standard format for information exchange between participants.

5.1.6 The Commission understands that the lack of a standard AMI exchange protocol has not created a barrier to the operation of AMI systems or consumer switching between retailers at present.[51]

5.1.7 However, the Commission expects that each AMI system owner will ensure that the interface between participants and the AMI owners' systems currently being rolled-out complies with information exchange formats and protocols that are specified by the Commission, and that participants use those formats and protocols when interfacing with AMI systems. Standardisation of information formats and protocols is essential for seamless access by all participants to

[49] *Guidelines on Advanced Metering Infrastructure, Version 2.0*, Electricity Commission, January 2009, p.16.

[50] These are known as Electricity Information Exchange Protocols. Copies of these documents and relevant documentation are available on the Commission's website.

[51] Consumer switching is regulated in part E of the Rules.

information about revenue that is held by different AMI system owners.[52] Accordingly, the Commission recommends that regulating that aspect of AMI is necessary.

5.1.8 The Commission is already engaged in developing standard formats and protocols for information exchange with AMI back office systems as part of the review of part D of the Rules, which is considering:

(a) whether standard formats are required for access into the AMI back-office systems to allow the exchange of enhanced AMI information; and

(b) the possibility of developing standard agreements for use between participants if there is an issue with access to information or services.

5.1.9 The Commission has also sought feedback on its proposal to regulate information exchange formats and protocols, to see if there is support in the industry for such a standardised information exchange format.

5.1.10 The Commission will progress regulations to put in place a data exchange protocol or otherwise regulate data access as part of the review of part D.

5.1.11 Because rules relating to information exchange formats and protocols are not likely to be put in place for some time (perhaps approximately 15 months), the Commission is also recommending that the Guidelines be amended to put in place standard information exchange formats and protocols as an interim measure.

[52] This is a product of the fragmented and de-regulated ownership of metering assets in New Zealand.

6. Access and use of AMI data

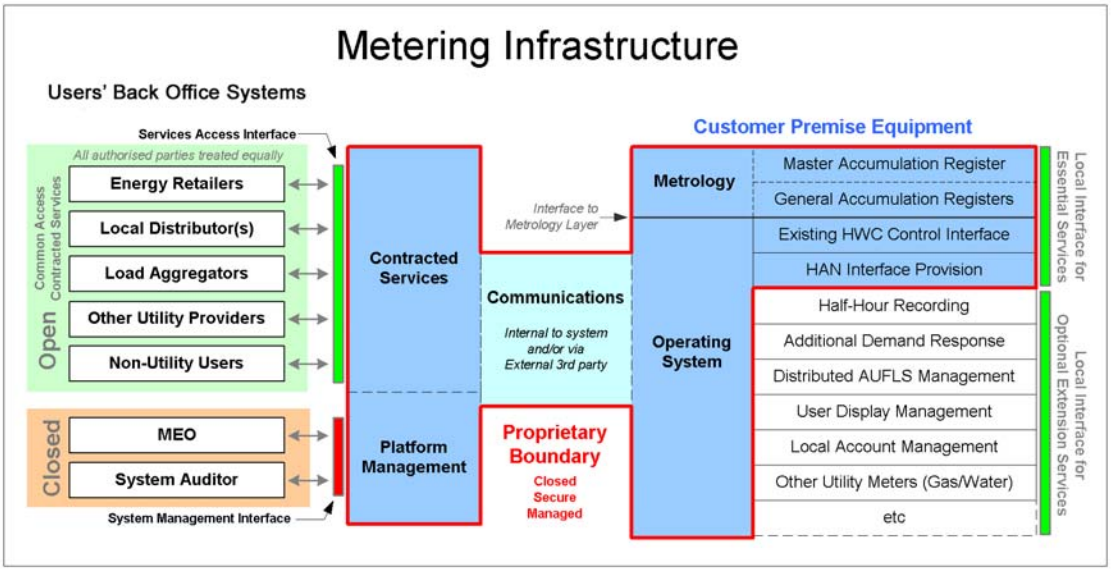
6.1.1 In considering whether technical standards for AMI that are currently addressed in the voluntary Guidelines should be regulated, the Commission has considered whether the parts of the Guidelines that address access to and use of data collected and stored by AMI systems are adequate. The Commission has formed the view that this aspect of AMI systems should be regulated.

6.1.2 There has been considerable debate around "open" access to information collected and stored by advanced meters.

6.1.3 The Commission considers that advanced meter communications and back office systems operate in conjunction with each other to provide an AMI system. AMI systems are very similar to banking systems where access is strictly controlled by the operator of the system.

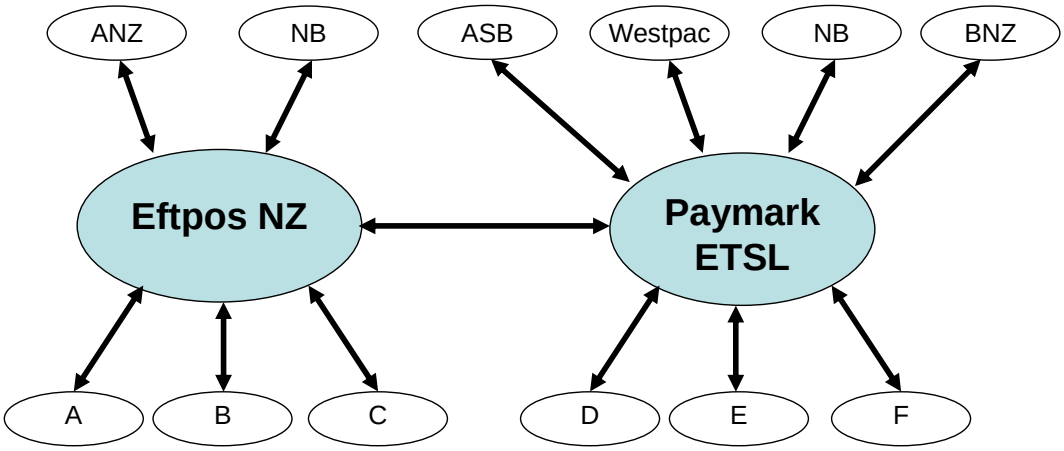
6.1.4 Security of access to the AMI system is a major concern internationally, because of privacy issues relating to the potential for theft, fraud or misuse of information stored by AMI systems, or mischievous use of the meter itself. The security model that the Commission prefers is one where AMI is encapsulated within a functional boundary that includes all of the components that function to provide the AMI system. The encapsulation covers the back-office server, communications between the server and the advanced meter, and the advanced meter itself.

Figure 1: AMI functional boundary



6.1.5 The Eftpos system illustrates how AMI systems can be secured. Merchants can use one of two Eftpos providers, and one of a number of banks. The two Eftpos providers are owned by two groups of banks. As shown below, merchants do not have to use their bank's Eftpos system provider.

Figure 2: New Zealand Eftpos system



6.1.6 The Eftpos system works over closed communication systems that have standard interface protocols.

6.1.7 In New Zealand, AMI systems currently exchange metering information in a similar way to banking systems such as the Eftpos system. Advanced meters do not operate on their own; they are integrated into a back office system. AMI systems are susceptible to viruses and hacking similar to any other computer system, because they are programmable.

6.1.8 If any person were able to access information at the advanced meter connection (on a consumer's premises), two problems could occur:

(a) access to either to the software inside a meter or into the back office server of a meter could cause malfunctions or the incorrect recording of metering data. Providing open access to metering information could also result in persons mischievously controlling a meter, by, for example, disconnecting electricity where disconnection contacts are fitted or where HAN is installed; or

(b) encrypting information from an AMI system would not be possible if open access to meters was provided, because of competing requirements of multiple users.

6.1.9 Once consumers lose confidence in AMI as a reliable source of consumption information, they will have lost confidence in the accuracy of the invoices that they are receiving. To mitigate this, the AMI system would need to be upgraded, or possibly replaced, at a very significant cost.

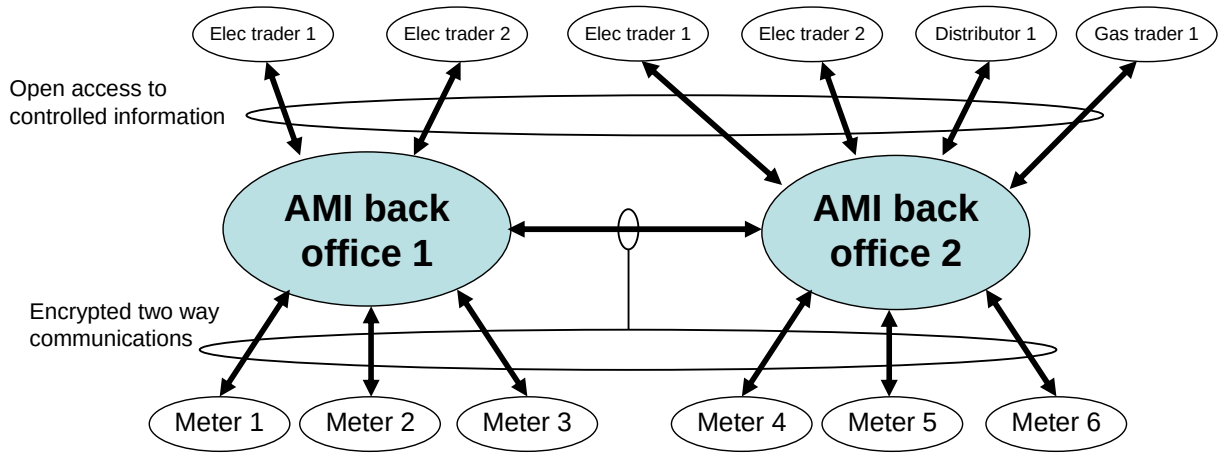
6.1.10 To maintain security of the AMI system, the Commission proposes that regulations be made that provide the following:

(a) Although all participants should be able to access the information collected and stored in an AMI system by using standard, agreed industry formats, that information should be able to be accessed only at the back-office level, where appropriate controls on access and suitable firewalling can be provided.

(b) The proprietary system boundary must include the communication between the back-office system and the meter. That will ensure that only one party is responsible for the compliance, security and operation of a meter. It also means that enhanced and upgradable encryption can be used for this communication, to reduce risk of theft, tampering, inappropriate access or mischievous action.

6.1.11 The Commission's proposal that access to and use of information collected and stored be regulated as illustrated below:

Figure 3: AMI information system



6.1.12 The Commission will progress regulation to put in place rules relating to the access and security of information collected by AMI systems as part of the review of part D of the Rules.

7. Import/export metering

7.1.1 In considering whether technical standards for AMI that are currently addressed in the voluntary Guidelines should be regulated, the Commission has considered whether the aspects of the Guidelines that address import and export metering are adequate.

7.1.2 Where consumers have installed their own generation,[53] premises at a point of connection can both consume and generate electricity. Energy can flow both into and out of the network through the point of connection. Both energy flows must be identified separately in the market settlement process.

7.1.3 Where a premise consumes electricity, energy flows from the network into the premise. That is called the "import" of electricity.

7.1.4 Where a premise generates electricity, energy flows from the premise into the network. That is called the "export" of electricity.

7.1.5 Very few consumers generate electricity, and most advanced meters currently being rolled-out have the import/export functionality that can be remotely enabled as standard. Those that do not have the import/export functionality are capable of having that functionality added, but it would require a site visit.

7.1.6 There has been considerable debate around the requirements for advanced meters to have import/export capability. The requirement that meters have import/export functionality is regulated under the Rules, which state that export metering must be provided for generation unless the generation is being "gifted".

7.1.7 The Guidelines also address the import/export capability of meters. The Guidelines provide that the inclusion of import/export measurement functionality in AMI systems is optional, but recommend that AMI systems have the ability to indicate when power is being exported (reverse power).[54]

7.1.8 Exporting electricity from a site is a complex task, as there are both safety requirements that must be met to prevent bodily harm during maintenance, and market requirements that must be met if the consumer is paid for the generation. Distributors have specific terms and conditions for the connection of generation plant and these are subject to the Electricity Governance (Connection of Distributed Generation) Regulations 2007.

7.1.9 Export indication in an AMI system will notify the AMI operator and the trader of the presence of generation, and an appropriate change to the metering and

[53] Such as micro turbines, or photovoltaics.

[54] The AMI Guidelines, p.14, require this functionality.

commercial arrangements can be made. Some AMI systems achieve this by having a simple remote programme change.

7.1.10 The Commission considers that the current specification in the Guidelines that relate to power exporting in AMI systems currently being rolled-out in New Zealand is appropriate and at low cost to consumers. Accordingly, the Commission considers that the requirement for import/export functionality of AMI systems does not need to be provided for in regulations.

8. Monitoring compliance with the "Guidelines on advanced metering infrastructure v2.0"

8.1 Introduction

8.1.1 In May 2008, the Commission published the Policy and the Guidelines following extensive consultation with the industry and other stakeholders. [55]

8.1.2 The Guidelines set out recommendations relating to the introduction of new technology for metering and the supporting infrastructure. The Guidelines also outline recommendations for participants who are installing advanced meters for new and existing consumers.

8.1.3 In line with paragraph 2 of the May 2009 GPS (and previous versions), the Commission routinely monitors participants' "*compliance with guidelines and model arrangements and is required to recommend regulations or rules if voluntary arrangements prove unsatisfactory*."

8.1.4 Although the Policy and the Guidelines are voluntary, participants must comply with the Rules.

8.1.5 Part D of the Rules relates to metering standards. In conjunction with industry, the Commission is currently undertaking a fundamental review of part D. The purpose of that review is to ensure the metering rules are fit for purpose and future-proofed.[56] That is necessary to ensure that technology advances can be rolled-out without needing to revisit the regulatory scheme, which avoids inhibiting the potential benefits available from AMI and other future innovations and, importantly, protects electricity consumers.[57]

8.2 Monitoring compliance with the Guidelines

8.2.1 The Commission has had regular dialogue with all AMI providers on their compliance with the Guidelines, and carried out formal monitoring of the Guidelines in September and October 2009.

8.2.2 Fourteen responses were received on the Guidelines, which included comments on compliance with the Guidelines as well as retailers, distributors, and AMI owner's comments on the Guidelines. Table 1 shows a summary of the submitting parties and their participant type.

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55 http://www.electricitycommission.govt.nz/opdev/retail/ami/index.html

56 This provides regulatory certainty for investors.

57 *Consultation Paper: Part D Review – Issues and Proposed Options*, Electricity Commission, 23 September 2009

Table 1: Summary of submitting parties

Submitter	Meter owner	AMI owner	Network owner	Retailer
Arc Innovations		X		
Genesis Energy				X
Meridian Energy				X
Mighty River Power Limited	X	X		X
Pulse Utilities		X		X
TrustPower Limited	X			X
Vector (on behalf of NGC metering)	X	X	X	
WEL Networks			X	
Northpower	X		X	
Powerco	X		X	
Stream	X			
Contact Energy	X			X
Powershop New Zealand				X
Unison			X	
Counties Power	X		X	

8.2.3 The Commission's monitoring of compliance with the Guidelines shows:

(a) there is a high level of compliance with the Guidelines with AMI systems currently being installed;

(b) only three of the seven retailers that responded currently provide TOU tariffs for consumers via AMI systems, although all of the AMI systems could easily be remotely configured to do so at the retailer's request;

(c) a number of submitters noted that the required 15 days of data storage within the meter beyond the normal read cycle was insufficient and should be extended;

(d) in most cases, the existing ripple relay was not being displaced by AMI; the existing ripple control devices remained. Where the ripple relay was displaced it was replaced with internal functionality in the advanced meter;

(e) advanced meters are not being wired in series with the existing ripple relay, meaning that the AMI device could not, in the future, replace the ripple relay function without a site visit by an electrical contractor;

(f) there is support for the registry recording the sites that have electrical safety issues regarding meter replacement, to prevent duplicated site visits by subsequent retailers;

(g) submitters supported the production of standard interface protocols and formats; and

(h) only one submitter (a distributor) recommended that HAN interfaces should be installed in AMI systems currently being rolled-out.

8.2.4 Submissions noted that:

(a) the Guidelines were not complied with where the AMI system was rolled-out before the Guidelines were published. There are a reasonable number of older systems that do not comply with the Guidelines because they are not capable of running a HAN, although a significant number of wired IHDs have already been provided by this AMI owner on request of consumers. However, as a metering system, these systems provide all other benefits of AMI systems noted in this report;

(b) one AMI provider does not currently offer AMI that operates in a pre-pay mode, but intends to do so in the future;

(c) one AMI provider did not support the storage of event logs, although it is suspected that this is the provider's opinion only, and not the result of an attribute issue with its AMI system; and

(d) one AMI provider did not meet the data storage minimum requirement of 15 days, but is modifying its equipment to do so. The number of non-compliant devices installed is very small.

8.2.5 The areas of non-compliance are being discussed directly with the relevant providers.

8.2.6 Informally, the Commission also understands that problems have been identified during the roll-out of AMI that are not addressed by either the Rules or the Guidelines, but have affected consumers. Those problems are:

(a) issues with consumer invoicing where historically tariffs had been incorrectly assigned to meter registers. The correction of this has a direct cost impact on consumers;

(b) installation safety issues, where either the installation has been electrically unsafe, or where replacing the meter would create an unsafe situation; and

(c) Energy Safety Services has dealt with cases where installations have been incorrectly connected, resulting in consumers receiving shocks. Installation processes have now been corrected to prevent further instances.

8.3 Conclusion

8.3.1 The Commission's review has shown that there is high level of compliance with the Guidelines by participants who have rolled-out AMI systems after the Guidelines became effective.

8.3.2 AMI systems that were rolled out before the Guidelines became effective are not expected to comply with the Guidelines. However, it is expected that those older systems will become technologically redundant if and when the inclusion of HAN functionality in AMI systems becomes cost-effective. For clarification, the financial risk for this is currently carried by the AMI owner and not the consumers that have these meters installed on their premises.

8.3.3 The Commission has recommended that some technical aspects of AMI systems that are addressed in the Guidelines should be regulated, as set out in sections 5 and 6 of this report. Such regulation will be complex and requires significant restructuring of the rules that govern metering.

8.3.4 However, the Commission does not consider that there is a need to regulate other aspects of AMI covered in the Guidelines because compliance with the Guidelines is high.

8.3.5 In addition, there is a significant commercial driver for AMI owners to ensure that their systems meet the minimum requirements of users. One of the many advantages of the deregulated structure of metering within New Zealand is that meters can be easily replaced by another AMI owner at the request of a retailer. This ensures that retailers can always negotiate to obtain the functionality and cost that they desire, as the losing AMI owner (and not the consumer) has the financial risk of an unutilised asset.

8.3.6 However, the Commission is recommending that three parts of the Guidelines be amended.

8.3.7 Firstly, it is recommended that the data storage period specified in the Guidelines be increased from 15 days to 35 days. That change is necessary because international practice in the storage and processing of metering information has evolved. This amendment will ensure that data storage requirements are consistent with Australian requirements.

8.3.8 The other amendments to the Guidelines relate to technical aspects of AMI that the Commission has recommended should be regulated. The Commission is also recommending that the parts of the Guidelines that relate to those aspects of

AMI be amended, because an integrated rule package will take some time to complete. Accordingly, it is recommended that the Guidelines be amended to:

(a) require AMI operating in pre-pay mode to ensure that pre-pay consumers cannot be disconnected without the advanced meter receiving authorisation from the back office server. That will add functionality to AMI systems that will provide a further degree of protection to consumers;[58] and

(b) require each AMI system owner to ensure that its AMI system complies with information exchange formats and protocols that are specified by the Commission, and that require participants to use those information exchange protocols and formats when interfacing with AMI systems. The Commission is developing standard information exchange formats and protocols as an addition to the large number of standard formats the Commission already has in place for the industry.[59]

8.3.9 The Commission will continue to monitor compliance with the Guidelines and the relevance of the Guidelines.

[58] This recommendation is being made as both a change to both the Guideline and the Rules because an integrated rule package will take some time to complete.

[59] This recommendation is being made as both a change to the Guideline and the Rules because an integrated rule package will take some time to complete.

9. Recommendation to the Minister

9.1 Requirement to recommend

9.1.1 The Commission is required to:

(a) investigate whether the roll-out of AMI should be regulated; and

(b) make a recommendation to the Minister on whether technical standards for AMI should be regulated, or whether the voluntary AMI Guidelines currently in place are adequate.[60] [61]

9.2 Should the roll-out of AMI be regulated?

9.2.1 The Commission's recommendation is that it is not currently necessary to extensively regulate the roll-out of AMI because the benefits of regulation do not outweigh the costs. That is because:

- the current roll-out of AMI is happening within an acceptable timeframe;
- competition means that the full potential of AMI systems being rolled-out is being realised, where it is economic to do so, and the financial risk investments in AMI systems is not currently being met by consumers;
- AMI technology is not fully developed, creating a risk that regulating now may create additional costs and result in AMI systems becoming obsolete;
- there is a high level of compliance with the voluntary Guidelines; and
- AMI is being successfully rolled-out at no additional direct cost to consumers, whereas regulation is likely to create costs for consumers.

[60] NZEECS, October 2007, clause 5.1.

[61] As a result of continued Commission monitoring of participants' compliance with the Guidelines.

9.3 Should regulation providing for mandatory technical standards be implemented if the voluntary AMI Guidelines prove inadequate?

9.3.1 The Commission recommends that the following aspects of AMI should be regulated:

(a) rules should be introduced that require each AMI system owner to ensure that its AMI system complies with information exchange formats and protocols that are specified by the Commission, and that require participants to use those information exchange protocols and formats when interfacing with AMI systems, to ensure that AMI providers' systems are consistent, which makes it easier for participants to efficiently communicate with AMI systems;

(b) rules relating to access to and security of data collected and stored by AMI should be introduced. This will mitigate security risks presented by AMI systems by ensuring that only parties who have been authorised by the consumer or who require information for Rule purposes are able to access and use AMI data; and

(c) rules around the operation of advanced meters in pre-pay mode should be introduced to ensure that pre-pay consumers cannot be disconnected without the advanced meter receiving authorisation from the back office server. This will prevent consumers from being disconnected because of a communication error, such as credit added to a consumer's account being recorded by the AMI system but not by the advanced meter, or a system failure that results in consumers being unable to purchase credit.

9.4 Other recommendations

9.4.1 In addition to these recommendations:

(a) The Commission is reviewing the Guidelines and intends to amend the Guidelines to:

(i) require AMI owners to ensure that their AMI systems comply with information formats and protocols that are specified by the Commission, and require participants to use those formats and protocols when interfacing with AMI back office systems;[62]

[62] This recommendation is being made as both a change to the Guideline and the Rules because an integrated Rule package will take some time to complete.

(ii) ensure that, where advanced meters operate in pre-pay mode, pre-pay consumers cannot be disconnected without the advanced meter receiving authorisation from the back office server. This will prevent consumers from being disconnected because of a communication error, such as credit added to a consumer's account being recorded by the AMI system but not by the advanced meter, or a system failure that results in consumers being unable to purchase credit;[63] and

(iii) increase the data storage period beyond the normal read cycle from 15 days to 35 days to match international practice, which has evolved since the Guidelines were written.

(b) The Commission will continue to monitor the development of standards and technology and will review this advice to the Minister should standards or technology or practice change to the extent that further regulation becomes desirable.

[63] This recommendation is being made as both a change to the Guideline and the Rules because an integrated Rule package will take some time to complete.

Appendices

Appendix 1 Electricity meters, advanced meters, AMI, and smart grids

1.1 The evolution of electricity meters

1.1.1 International technology developments in electricity metering are changing electricity meters from being simple measuring and recording devices into complex systems that can link the consumer into the wholesale electricity market.

1.1.2 For more than a century, electricity consumption has been measured and recorded by electro-mechanical meters that convey just a single accumulation meter reading.[64] Meter reading periods have varied between one and four months although consumers have been invoiced monthly. Where a meter reading has not been available, estimates for the purpose of invoicing have been generated.

1.1.3 More frequent recording (in particular, half-hour recording) of electricity was possible, but expensive.[65] This cost, coupled with the complexity of handling large volumes of information (on paper tape), limited the use of more frequent meter reads to large industrial consumers connected directly to the national transmission grid.

1.1.4 In the 1980s, more frequent recording using electronic data loggers became available, although this was still at relatively high cost and so was limited to grid connection points and large consumers. The advent of modems meant that these data loggers could, at significant cost, be read remotely via telecommunication land lines.

1.1.5 In the early 1990s, advances in electronics reduced data logger costs sufficiently so that data loggers could be used in conjunction with the electro-mechanical meters for mass-market purposes.[66] However, many were unreliable and prone to error.

1.1.6 By the late 1990s, electronic meters and reliable data loggers[67] began to replace mass-market electro-mechanical meters. In some instances, communication devices were installed at the meter and data logger, enabling remote reads by

[64] The meter register continues to increment the volume of electricity consumed over a period, which is the difference between the end read and the start read. It operates in a similar manner to a car odometer. As such, there is no detail of consumption history apart from the total volume.

[65] This was achieved using electro-mechanical devices known as printometers that were attached to the meter, and could record and log the measured electricity consumption at regular intervals. The measured electricity consumption data was recorded on a paper tape.

[66] This was achieved using devices attached to the meter known as data loggers that could record and log measured electricity consumption at regular intervals.

[67] In this case, data loggers recorded volume information from the electricity meters.

various technologies (e.g. landline, cellular telecommunications network, radio) to occur (known as automated meter reading AMR).

1.2 Advanced meters

1.2.1 Many countries and publications talk about “smart meters”. However, in line with international convention, the Commission usually refers to ‘advanced’ meters. The Commission considers an electricity meter to be “advanced” where the meter contains functionality that, as a minimum:

(a) enables time of use (TOU) measurement and recording of electricity;

(b) enables two-way communication between the meter and the energy supplier;

(c) allows the installation of upgradeable firmware,[68]

(d) records when power to the meter is on or off (known simply as power on/off recording);

(e) provides an on board time clock;

(f) allows remote programming; and

(g) allows the running of programs (called applications) to be run that may or may not be part of the measurement of electricity.

1.2.2 A meter can be considered “smart” when it has the ability to be programmed to carry out actions dependant on price, consumption, or some other attribute.

1.2.3 Additional advanced meter attributes may include:

(a) the ability to remotely connect and disconnect the supply of electricity to the property;

(b) the ability to detect when the meter has been, or is being, tampered with (this is a mechanism to detect fraud and theft of electricity);

(c) a communications interface with devices at the property (e.g. direct load control of hot water heating; or an in-home visual display of electricity usage); and

(d) the ability to record electricity flowing into and out of the premises.

1.2.4 Further developments in international technology have allowed advanced meters to be linked into an “intelligent” communication mesh. This is a complex system that can link the consumer into the wholesale electricity market. This is described further below.

[68] Firmware is defined as computer programming instructions that are stored in a read-only memory unit rather than being implemented via a hardware change.

1.3 Advanced metering infrastructure

1.3.1 With the implementation of AMI, advanced meters may have the capability to communicate to appliances or equipment within homes or businesses, using one of several different forms of communication. This advanced meter functionality can be attractive to participants in the electricity industry, as it allows electrical load within premises to be remotely controlled without requiring expensive changes to the fixed wiring[69]. That communication is called a Home Area Network (HAN) and is discussed further in Appendix 5 of this report.

1.3.2 AMI costs significantly less to operate than a computer LAN, and advanced meters are about 1/8 of the cost of a desktop computer. In reality, an advanced meter costs about the same as a mid-range cell phone, and the management cost associated with an advanced meter is equivalent to the cost of sending about two text messages a day on a cell phone.

1.3.3 An advanced meter operates in a manner similar to a desktop computer. Additional applications can be installed at any time remotely via the server, provided there sufficient memory and processor bandwidth. Few applications are available at the moment. However, as with other technologies, these applications will emerge over time as uses and benefits become available to the industry and consumers. Provided that the advanced meter has sufficient memory and processing speed, there is probably little to limit what the device can do.

1.3.4 AMI has the potential to be a shared infrastructure with other utilities or service providers. Internationally, AMI is also being used in trials to convey metering information for gas and water meters in addition to electricity information. This shared infrastructure could develop in New Zealand as gas and water suppliers move towards remote and secure meter readings.

1.3.5 The development of an “intelligent” communication mesh is analogous to an office computer system that works as “distributed intelligence”, i.e. where desk top computers operate independently, handling complex tasks and stand alone programmes, but rely on both a communications link and a remote server that manages the programs running in a multitude of desktop computers. The remote server stores and validates information, and can make that information available to other selected users, download new programmes or change in programs on the desktop computer. Other similar examples include ATM machines, security systems, and medical systems.

[69] The existing ripple control system relies on the controllable load within a consumer’s premises being physically wired to the ripple relay receiver. Technology that can connect appliances with load control systems remotely without needing to change fixed wiring within a consumer’s premises, represents a significant cost saving.

1.3.6 AMI and, to an extent, smart grids have adopted similar “distributed intelligence” technology structures. In the case of AMI, the system comprises:

(a) a computerised end-user device;[70]

(b) a two-way communications network;[71] and

(c) back-office systems (the central computer server).[72]

1.3.7 This evolving technology is changing industry processes and systems that have remained unchanged for decades, enabling significant benefits to consumers and the industry.[73]

1.4 Smart grids

1.4.1 Rapid technology development is occurring in the energy industry internationally, over a number of related technologies which when linked become ‘smart grids’. There are differing views both within and outside the energy industry as to what exactly a smart grid comprises.

1.4.2 Smart grids can be defined as technology that embeds intelligence into the operation of networks that deliver electricity to consumers, and facilitates improvements in the reliability, availability, and security of electricity supply, as well as improvements in energy efficiency. The ability for software to deduce where a network fault is, as a result of information received from advanced meters, and to remotely switch supply around faults on the network can reduce the amount of time that a consumer is without power.

1.4.3 However, this will not happen rapidly. Smart grid will not be a revolution; it will be a gradual transformation of the systems and processes that supply electricity as technology becomes economically viable.

1.4.4 Smart grids are expensive to install, and while large electricity lines companies may be able afford the cost of this technology, smaller electricity lines companies may not.

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[70] In the case of AMI, this is a programmable electronic meter. In the case of smart grids, this is a remote terminal unit that measures either an electrical parameter or controlling equipment.

[71] This can take a variety of forms depending on the geographic location (communication possibilities differ with geographic location) including, for example, GPRS (cell phone network), mesh radio, power line carrier, and broadband.

[72] This system runs and controls all of the end user devices and the communication system. It will remotely install new programmes and collect information from the end user devices.

[73] In the case of AMI, systems developing are being implemented in New Zealand in a style similar to banking systems. This is appropriate as AMI is effectively a cash handling system transacting many billions of dollars a year.

1.4.5 New Zealand has a large number of these smaller electricity lines companies. Therefore the benefits that smart grids could bring to less densely populated areas of New Zealand may be limited by the amount of investment that these companies can make. To fully utilise technology, it may be necessary for New Zealand's electricity lines companies to establish joint co-operatives for the management of smart grids in the future.

1.4.6 This could be a similar model to that initiated by the Orion distribution lines company in Christchurch, which manages the load management equipment of several electricity lines companies in the upper South Island in response to heavy electricity flows on the upper South Island portion of the national electricity transmission grid.

Appendix 2 Advanced meter functionality

2.1 International comparison of functionality

2.1.1 The table below summarises the advanced meter functionality contained in the New Zealand AMI Guidelines, the Australian National Minimum Functionality and a compilation of typical specifications listed by a number of energy utilities in the USA.[74]

Table 2 International comparison of advanced meter functionality

Functionality	New Zealand	Australia	USA
Measurement and recording of time-stamped consumption data to at least 30 minute intervals	✓[75]	✓	✓
Tamper detection	✓	✓	✓
Remote disconnect/connect	✓	✓	✓
Quality of supply monitoring	✓	✓	✓
Notification of outages	✓	✓	✓
Provision for a HAN	✓[76]	✓	✓
Remote upgrade of meter software and firmware[77]	✓	✓	✓
Minimum meter reading storage	15 days	35 days	7-45 days
Support pre-pay metering	✓	✓[78]	✓

[74] *Report on international experience with smart meters (energy). Prepared for the Parliamentary Commissioner for the Environment*, Strata Energy Consulting, May 2008; *Assessment of Demand Response and Advanced Metering*, Staff Report, Federal Energy Regulatory Commission, December 2008.

[75] While the AMI Guidelines require smart meters to measure and record consumption data to 30 minute intervals, the AMI Guidelines do not require smart meters to store the metered data in 30 minute intervals. Instead, the Guidelines require such data to be stored in a minimum of six time periods within any 24 hour time period. Therefore, a smart meter in New Zealand may meet the requirements of the AMI Guidelines but not be capable of submitting half-hour metering data into the wholesale market reconciliation and settlement process.

[76] While the AMI Guidelines require smart meters to make provision for a HAN, the Guidelines do not require the meters to have a HAN interface installed. This contrasts with countries such as Australia which may require smart meters to have an interface that uses an open standard.

[77] Firmware is defined as computer programming instructions that are stored in a read-only memory unit, rather than being implemented via a hardware change. See *Assessment of Demand Response and Advanced Metering 2007*, Staff Report, Federal Energy Regulatory Commission, September 2007.

[78] While support for pre-pay metering is not explicitly listed in the Minimum National Functionality for Australia, the remote connect/disconnect functionality included in the national specification is considered to support pre-

Functionality	New Zealand	Australia	USA
Communications and data security	✓	✓	
Remote reading on demand	✓		✓
Daily reading		✓	✓
Local reading using visual display	✓	✓	
Export/import metering	✓	✓	
Remote load management	✓	✓	
Limit power to consumers	✓	✓	
Provision for an interface to an in-home display	✓	✓[79]	
Remote changing of meter settings (e.g. supply capacity control)	✓	✓	
Remote time clock synchronisation	✓	✓	
Use of common protocols	✓		
Reactive energy measurement		✓	
Remote registration and activation of new meters		✓	
Voltage interval reading			✓

2.1.2 As can be seen, there is a large degree of commonality between the New Zealand and Australian smart meter functionality specifications.

pay metering through back office systems and the like – i.e. system disconnects, reconnects or supply limits based on product and credit status.

[79] As the Australian National Minimum Functionality requires a HAN interface to be included in the smart meter, the only additional step required to enable the interfacing of the smart meter with the in-home display is for the smart meter owner/operator to authorise connection of the in-home display to the smart meter. In contrast, connectivity between the smart meter and the HAN in New Zealand would need to be established before an in-home display could be connected to the smart meter.

Appendix 3 AMI functionality

3.1.1 AMI functionality that is currently included in AMI systems being rolled-out, or could be included in those systems is below.

Affected party	AMI attribute	Status	Commissions recommendation
Consumer	Supports complex tariffs	Supported in all systems	Leave as guideline
	Consumption feedback to consumers	Supported in all systems	Leave as guideline
	Rapid switch of retailer	Supported in all systems	Leave as guideline
	HAN	New systems capable but not fitted for technology reasons	Leave as guideline
	IHD	New systems capable but not fitted for technology reasons	Leave as guideline
	Operation in pre-pay mode	New systems capable but functionality has not been fitted	Leave as guideline until part D review is complete
Consumer and trader	Provides remote reads scheduled and on demand	Supported in all systems	Leave as guideline
	Security of information	Access only to information that parties are authorised by consumers to have access to	Regulation already considered within part D fundamental review
	Accurate invoicing (no estimates)	Supported in all systems	Leave as guideline
Retailer and generator	Provides vacant consumption warning	Supported in all systems	Leave as guideline
	Records HH and NHH consumption information	Supported in all new systems	Leave as guideline
	Import/export metering	All systems capable	Leave as guideline
	Standardised formats for information exchange	Critical that each meter provider uses the same format	Regulation already considered within part D fundamental review
	Access to information	Standard formats for information exchange	Regulation required

Affected party	AMI attribute	Status	Commissions recommendation
Load management	Capacity control	All systems capable but will require HAN to operate	Leave as guideline
	Total site disconnection	All systems capable but for most systems tending to be fitted where required only	Leave as guideline
	Load control	All systems capable but will require HAN to operate as controlled load contacts are not being wired in	Leave as guideline
	Ripple control	Only one system capable of receiving ripple control. Remainder are leaving existing relays in place	Leave as guideline
AMI owner	System technical standards	Systems must be accurate	Regulation already considered within part D fundamental review
	Open access to system	This is where access to information is provided to users from the AMI system	Regulation already considered within part D fundamental review
	Standardised formats for information exchange	Critical that each meter provider uses the same format	Regulation already considered within part D fundamental review
Distributor	Last gasp functionality	Not supported in any system	Leave as guidelines, fitted if distributors willing to fund investment and operational management
	Information for network loss management	Supported in all systems	Leave as guideline
	Standardised formats for information exchange	Critical that each meter provider uses the same format	Regulation already considered within part D fundamental review
	Poll for meters without electricity	Supported in all systems	Leave as guideline
	Voltage and current measurement	Supported in new systems, not supported in legacy systems	Leave as guideline

Affected party	AMI attribute	Status	Commissions recommendation
	Access to information	Standard formats for information exchange	Regulation already considered within part D fundamental review
	Frequency measurement	We think it may be supported in new systems, but internationally AMI has not been used for this purpose	Leave as guideline

Appendix 4 Overseas experiences of AMI roll-outs

4.1 Regulatory influence on overseas roll-outs

4.1.1 Most AMI roll-outs overseas have tended to be driven by government or regulatory decisions.

(a) In the UK, the Government has publicly stated that all electricity and gas consumers are to have advanced meters by 2020.[80]

(b) In Victoria, Australia, the state Government has regulated the roll-out of advanced meters to Victoria's electricity consumers, to be completed by the end of 2013.[81]

(c) In Ontario, Canada, the provincial Government has set a deadline for the roll-out of AMI to be completed by the end of 2010.

(d) In California, the regulator[82] has been at the forefront in the state's move towards AMI for electricity and gas, although it has permitted the three major investor-owned utilities[83] supplying most of the state's electricity to determine their own implementation timeframes.[84]

4.1.2 However, there are some overseas jurisdictions in which commercial drivers have played, or are anticipated to play, a key role in the roll-out of AMI.

(a) In Italy, the regulator[85]-required roll-out of AMI to all low-voltage consumers between 2008-2011[86] was pre-empted by Enel, Italy's largest power company, which installed more than 30 million early versions of advanced meters between 2001 and 2008. Enel's business case was based primarily on revenue protection and reducing bad debts, as well as lowering the cost of consumer service and improving service standards.[87]

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80 *GB Smart Meter Roll-out Moves Forward*, Department of Energy and Climate Change, 11 May 2009.

81 However the report of the Victorian Auditor-General *Towards a smart Grid*, November 2009, criticises some of the issues around cost benefit analysis and governance, and may delay the roll-out.

82 California Public Utilities Commission.

83 Pacific Gas and Electric, Southern California Edison and San Diego Gas and Electric.

84 *Smart Metering for Electricity Consumers in Selected Jurisdictions: A Report for the AEMC*, NERA Economic Consulting, June 2008.

85 Autorità per l'energia elettrica e il gas.

86 *Smart Metering with a Focus on Electricity Regulation*, European Regulators' Group for Electricity and Gas, October 2007.

87 *Report on international experience with smart meters (energy)*. Prepared for the Parliamentary Commissioner for the Environment, Strata Energy Consulting, May 2008.

(b) This was also the case in Spain, with the Government announcing a timeframe for rolling out AMI within the year following a roll-out announcement by Spain's largest electricity company.[88]

(c) In New York State, the regulator has played a key role by directing electric utilities to prepare and submit comprehensive plans for AMI development and installation. However, the regulator has indicated it is unlikely the State will legislate or regulate roll-out of AMI – leaving utilities to make the decision as to whether it is cost-effective to do so.[89]

4.1.3 It appears that the more active involvement of regulatory agencies overseas reflects the differing institutional and market arrangements in those countries. In particular, metering is owned predominantly by electricity lines companies or integrated[90] electricity supply companies, and is a monopoly service not directly linked to the provision of contestable services to consumers. Although metering ownership and maintenance are contestable to varying degrees in a number of jurisdictions, legacy ownership arrangements mean that lines companies or integrated supply companies often continue to fulfil this role, and remain subject to regulation.

[88] *Report on international experience with smart meters (energy)*. Prepared for the Parliamentary Commissioner for the Environment, Strata Energy Consulting, May 2008.

[89] *Smart Metering for Electricity Consumers in Selected Jurisdictions: A Report for the AEMC*, NERA Economic Consulting, June 2008.

[90] Consisting of, at a minimum, distribution and retail businesses, but in some cases also a generation business.

Appendix 5 Home Area Networks and In-home Displays

5.1 The evolution of HAN communication protocols/technologies

5.1.1 A Home Area Network (HAN) is a system that directly or indirectly controls devices within the home, such as wireless entertainment systems or computer networks.

5.1.2 An in-home display (IHD) is a device that can provide near real time information directly to consumers through a number of different media types. This information could include the price and quantity of electricity being consumed.

5.1.3 A number of HAN communication protocols/technologies are competing for prominence internationally, including for example, ZigBee, WiFi and low power WiFi, Bluetooth Low Energy, Z-Wave, IPv6LoWPAN, WirelessHART, Enocean, KNX, LonWorks, X10, ONE-NET and HomePlug.[91] To date, none of these HAN communication protocols/technologies has established itself as the dominant technology internationally, although there does seem to be some preference in Australasia for the use of Zigbee.

5.1.4 Internationally Nokia is introducing a "Home Control Centre" system utilising cell phone and web based control of home appliances and Google Powermeter and Microsoft Hohm both offer internet based advanced meter products.

5.1.5 Australia provides an insight into the difficulty of picking a 'HAN technology winner'. The Victorian Auditor-General's Report titled *Towards a smart grid*, November 2009 notes at section 4.4 that the home interface portion of an AMI system is the least mature of the system components and that "*it will take several more years for market direction to become clear*".

5.1.6 Victoria has chosen ZigBee[92] as the HAN interface protocol for 2.8 million meters to be rolled-out across the state by the end of 2013. Initially, Victoria investigated options for locating the HAN interface outside the meter via a 'plug-in' arrangement, but this proved to be too expensive[93] because of the need to comply with Australian metering standards in respect of dust, water-proofing, security, and other metering issues, and because of the need to incorporate a separate power supply.[94,95] After

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91 *Home Area Network Research Study v0.7*, NSMP Business Requirements Work Stream, October 2009; Smart Metering. AlertMe Whitepaper, Phillips, A., December 2008.

92 Refer *Advanced Metering Infrastructure Minimum AMI Functionality Specification (Victoria) Release 1.1*, Department of Primary Industries, September 2008.

93 Cost estimates were approximately A$40-50 per meter

94 *Meeting Notes*, Home Area Network Working Group, 24 July 2008.

deliberation, it was decided instead to select a communications standard for the HAN. An investigation determined that Victorian needs were similar to those of companies in Southern California, and for that reason a decision was made to collaborate with those companies on common requirements for the communications protocol. ZigBee proved to be the only technology which matched all of the common requirements at the time of the investigation.[96] However, there were various reservations expressed at the time about the use of ZigBee[97], which have persisted.[98]

5.1.7 Victoria's lead has not as yet been followed by the remaining Australian jurisdictions. The Ministerial Council on Energy[99] has instead decided that the HAN interface "should use an internationally-supported, nationally-consistent open standard which can be integrated easily into many types of devices".[100] When making this decision in June 2008, the Ministerial Council on Energy requested advice from Australia's national smart meter steering committee by the end of 2008, on the specific standard to be adopted.[101]

5.1.8 However, as at October 2009, no national standard for Australia has been recommended. Instead, a HAN research study has been proposed to assess competing solutions, although this was deferred following the discovery of a much larger overseas study which failed to arrive at a clear winning technology.[102] This larger study was undertaken in the UK by a working group comprising more than 130 members.[103]

5.1.9 The working group investigating the issue of a HAN standard for Australia has concluded that "it is assumed that HAN standards will continue to develop rapidly with a large number of changes within existing standards and even the potential emergence of new standards." The working group instead is recommending that Australia develops a comprehensive set of requirements for its HAN interface, as

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95 *Meeting Notes*, Home Area Network Working Group, 15 August 2008.

96 *Meeting Notes*, Home Area Network Working Group, 15 August 2008.

97 *Meeting Notes*, Home Area Network Working Group, 24 July 2008.

98 *AMI HAN Functionality Guideline Response*, Version 1, SP AusNet, January 2009.

99 The Ministerial Council on Energy is the national policy and governance body for the Australian Energy Market.

100 *Smart Meter Decision Paper*, Ministerial Council on Energy, June 2008, p. 5.

101 The National Stakeholder Steering Committee.

102 *Smart Meter National Minimum Functional Specification Executive Briefing Paper v0.2*, National Smart Metering Project Business Requirements Work Stream, 2 October 2009.

103 *Local Communications Development Report Summar*y, Energy Retail Association, January 2009.

well as continuing to monitor evolving open HAN standards and undertaking field testing of available solutions".[104]

5.2 Responsibility for the HAN

5.2.1 To operate, a HAN needs programming to instruct the IHD or appliances on what they should do or information that should be presented.

5.2.2 This means that where a HAN is used, programming of the AMI system is required to provide functionality. This programming may present the following risks:

(a) AMI owners and retailers may not be keen to be the operator of a HAN for each individual household in New Zealand, and integrating the HAN into the advanced meter may complicate the switching process of consumers between retailers.

(b) The development of a full "smart house concept" may require individual consumer requirements to be programmed into the HAN. This means that unique programming could be required for each consumer's premise. Allowing consumers to have programming access into an advanced meter is not a good idea, as it can significantly increase the risk of cyber theft.

5.2.3 Programming of the HAN and IHD could vary between retailers, as it may be related to the prices in an offer. Where this occurs, the change of retailer could require transferring the HAN set up to the gaining retailer. This could significantly complicate the switching process.

5.3 Limited availability or uptake of HAN-enabled devices

5.3.1 The uptake of HAN-connected IHDs and "smart" appliances needs to be considered in deciding whether to require the installation of a HAN interface in New Zealand's AMI.

In-home displays

5.3.2 IHDs can provide consumers with near real-time information, such as the price and quantity of electricity being consumed. Studies have shown that IHDs have the potential to reduce consumption, although a relatively recent literature review noted

[104] *UK Retailers HAN Research Study Gap Analysis v0.2*, National Smart Metering Project Business Requirements Work Stream, October 2009, p.13.

that the evidence of the impact of IHDs on consumers electricity demand was "very mixed".[105,106]

5.3.3 The types of IHDs available include:

(a) dedicated and connected to the meter;

(b) dedicated and not connected to the meter but instead measure electricity via its own measurement device;

(c) web portal interfaces where consumers can access their consumption and billing information. However this is not real time and updates generally occur daily;

(d) cell phones or personal digital assistants (PDA) where information can be obtained by sending a request, or price alerts can be sent by text message to the consumer; and

(e) consumption and billing information displayed on TVs.

5.3.4 A common misconception is that IHDs are new, and must be connected to an advanced meter to provide real-time information. In fact, IHDs indicating instantaneous and over-time energy use and costs have been available for about the last 15 years. However, at a cost of between $80 and $200, they have not been popular.

5.3.5 Anecdotal evidence suggests consumers purchasing these IHDs have used them for a few weeks in order to reduce their overall electricity consumption, but having made the adjustment then lose interest. In part this is due to existing prices not offering consumers a suitable on-going cost benefit. Further, this does not address the value that the industry is seeking from changes in consumer behaviour, which is not necessarily just an overall reduction in consumer demand, but specific reduction at peak times, as it is peak loading that drives the need for new investment in generation and network investment.

5.3.6 When made available free of charge, there is a suggestion that IHDs have a relatively short life span. One supplier commented that, on average, IHDs last about three years, and a new IHD often requires a site visit to ensure that it is connected correctly to the meter.

5.3.7 While TOU pricing has been available for the last two decades in the form of separate day/night tariffs, very few consumers have elected to accept this tariff,[107] and many distributors have now removed this option.

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[105] *Cost Benefit Analysis of Smart Metering and Direct Load Control*, Workstream 4: Consumer Impacts, Phase 2 Consultation Report, NERA Economic Consulting, February 2008, p.59.

[106] IHDs do not require an interface with a advanced meter. For example, consumption information could be sent from the advanced meter to the retailer, and then from the retailer to the in-home display via the telecommunications network.

5.3.8 Various trials of the impact of IHDs on electricity demand have recently been undertaken or are being undertaken internationally.[108][109] The Commission notes that the Parliamentary Commission for the Environment support for a trial in New Zealand.

5.3.9 An extensive IHD study undertaken by Integral Energy Australia (the "Western Sydney Pricing Trial") which was characterised by a large difference in price between high and low-cost time periods. The trial found that education of consumers had a significant effect on energy consumption. However, the provision of an IHD had only marginally higher consumer response than that achieved by education.

5.3.10 Nearly all of the AMI systems being rolled-out in New Zealand have the capability to connect IHDs at a later date if a value proposition supports that implementation.[110]

"Smart" appliances

5.3.11 "Smart" appliances are appliances with the ability to reduce electricity consumption in response to signals sent from the HAN controller/hub. An example is an air conditioner that switches off and on, a dryer that reduces its drying temperature, and a fridge that delays its defrost cycle.

5.3.12 Although whiteware manufacturers are considering producing smart appliances, they are awaiting the creation and adoption of international standards and protocols for HAN interface technology before committing to including this technology in their product lines.[111]

5.3.13 Smart appliances require a "network controller" to provide control of the smart appliance. There is significant debate around where the controller should be, and who has responsibility for it. For example, it is not clear who would be held responsible if a smart appliance fails to react to a price signal; the appliance manufacturer, the AMI owner, the retailer, or the supplier of other in-home products such as home entertainment systems. Using an AMI system as a controller will

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[107] TOU pricing usually requires the installation of a new meter set up. The consumer generally has to pay for any wiring changes necessary, but usually does not pay for the installation of the meter. This may also have contributed to the lack of uptake of this pricing option.

[108] For example, trials undertaken by EnergyAustralia and Integral Energy in New South Wales, Australia (2006-2008).

[109] For example, a trial currently being overseen by the United Kingdom's energy regulator, Ofgem.

[110] One of the systems that was rolled out prior to the Guidelines supports wired IHDs, and a large number of these IHDs have been installed.

[111] See for example: *Fisher & Paykel doubts smart meter value*, stuff.co.nz, July 2009; *The Smart Appliance: Waiting for the Market to Choose Communication Standards*, Greentech Media, June 2009; *Whirlpool Plans Smart Appliances by 2015*, The Green Economy Post, May 2009; *Whirlpool scoops stimulus money for 'smart' dryers*, BusinessGreen, November 2009.

introduce significant management costs into AMI systems that will be passed to consumers.

5.3.14 The lead time associated with incorporating this new technology in appliances and the incremental uptake by consumers, leads the Commission to believe that it may be at least five years before smart appliances begin penetrating the New Zealand market in a significant manner.[112] It is potentially at least ten years before there is sufficient capacity available for economic HAN operation.

5.3.15 Until then, the cost of a providing a HAN interface is likely to outweigh the benefits retailers could gain from offering it to their consumers at this stage and the risk of obsolence by the time the HAN is to be used may be high. In that case, the supply of a HAN interface is likely to need to be met through increased costs to consumers or provided by government funding.

5.4 Direct load control possible without a HAN interface

5.4.1 HAN is not needed to manage load control. New Zealand already has an established load control system that operates effectively and reliably to limit peak demand; the ripple injection system. However HAN could enable additional load to be available for load control, should there be an economic benefit in doing so.

5.4.2 The most common example of appliances that use ripple injection are the traditional electric hot water cylinder and thermal storage heaters, which are usually able to be switched on and off via a signal sent from the local lines company.

5.4.3 Lines companies have a well managed system of ripple load control that cycles appliances off and on to ensure that consumers do not receive a reduction in storage services under normal circumstances. The ripple injection, load control system is critical to the security of supply in New Zealand at times of generation, transmission, or distribution system constraint. Cost benefits to consumers are already built into distributor prices that are passed to consumers through retail tariffs.[113]

5.4.4 Many other appliances that do not have electronic controllers or time clocks can use this signal. Standard plug-in receivers[114] have been on the market for quite some

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[112] Some HAN-enabled whiteware goods may be available in the market as soon as 2010-2011 (e.g. Whirlpool and General Electric), however these will represent only a small percentage of total whiteware goods available. Moreover, there will be the question of which communications protocol(s) these whiteware goods are compatible with.

[113] Although different distributors place different values on this ability, and so offer different ranges of price differential between a controllable, as opposed to a non-controllable supply.

[114] http://www.eeca.govt.nz/standards-and-ratings. The Commission understands that The Lines Company, in particular, promotes such devices to its consumers.

time that can control heaters, air conditioners (which will be required to have a stepped demand response capability from April 2012) or similar appliances.

5.4.5 Plug-in time clocks have been available for several decades, and can also be used by consumers to schedule when load is to be controlled within their premises. Many modern appliances (e.g. dishwashers) already incorporate a delayed start feature.

5.4.6 HAN capability is then not necessary for consumer load shifting or control, although it can be convenient to use as a medium for this. However, consumers expect a financial benefit if they reduce consumption at certain times. AMI that meets the minimum requirements set out in the Guidelines can measure this benefit, and can be used in conjunction with financial signals through retail prices to return financial benefits to consumers.

5.4.7 The Guidelines refer to load control, but do not state how this should occur. Use of the existing ripple relay system achieves this as effectively as introducing control directly through the meter. In addition, the existing ripple relay system is already integrated into distributor's back office processes, is operational, and may also be faster. It is an area where innovation in new products and services can occur and placing requirements around this may limit the scope for innovation and also remove the current security of supply benefits.

5.5 What HAN interface capability is currently being rolled-out?

5.5.1 Although AMI systems being rolled-out at present do not include a HAN interface or HAN back-office software, almost all are capable of being HAN enabled when the technology comes into consumer use.

5.5.2 Early advanced meters rolled-out prior to the Guidelines, and the evolution of HAN are an exception. These devices may not be HAN capable, but can provide most of the other benefits associated with AMI, such as half hour data and TOU pricing.

Appendix 6 Parliamentary Commissioner for the Environment's recommendations

6.1.1 The Commission wishes to respond to recommendations made by the Parliamentary Commissioner for the Environment (PCE) in the report "*Smart electricity meters: How households and the environment can benefit*". The PCE report covers a wide range of issues apart from AMI itself, which are discussed individually below.

6.1.2 The PCE appears to have addressed the roll-out of AMI as being a roll-out of a meter, and not an integrated system.

6.1.3 Not all of the recommendations made in the PCE's report fall within the scope of this report. In the Commission's view, only the PCE's first, second and fifth recommendations relate to the roll-out of AMI, including whether technical standards for AMI systems should be regulated, or whether the voluntary AMI Guidelines currently in place are adequate.

6.1.4 *Parliamentary Commissioner for the Environment Recommendation 1: "*The Minister of Infrastructure, the Minister of Energy and Resources, and the Minister of Consumer Affairs urgently require power companies to only install smart meters that will not need the capability for home area network communication retrofitted, by making the relevant Electricity Commission guidelines mandatory."

(a) The Commission disagrees with this recommendation and considers that there is financial risk to consumers and the industry in installing a HAN interface at this time, for the reasons set out in this report (particularly sections 3 and 4). Requiring AMI systems to include a HAN interface will either add cost to consumers or will need to be funded by the government.

6.1.5 *Parliamentary Commissioner for the Environment Recommendation 2: "*The Minister of Infrastructure, the Minister of Energy and Resources, and the Minister of Consumer Affairs require the protocols used in all smart meters and smart appliances to be either the same or 'open access' in order to avoid a potential barrier to consumers switching between retailers."

(a) The Commission disagrees. The PCE appears to consider that open access should be provided at the meter. However, as noted in this report (particularly section 6), this introduces many security and data access issues.

(b) The Commission considers that open access should be provided not at the advanced meter level, but at the AMI system interface and is considering recommending regulation about how users interface with the AMI system and around access to and security of data shared by AMI systems, as outlined in section 9 of this report.

6.1.6 *Parliamentary Commissioner for the Environment Recommendation 5: "*The Minister of Energy and Resources requires retailers to provide export and import functionality in smart meters if micro generation is contracted between a retailer and its consumer, by making the relevant Electricity Commission guidelines mandatory."

(a) The Commission agrees that import/export functionality is important, and notes that this is already contained within the AMI Guidelines, and the Commission's review has shown that there is high level of compliance with this aspect of the Guidelines by participants who have rolled out AMI systems after the Guidelines became effective[115]. Therefore, the Commission does not consider that regulation of this aspect of the Guidelines is necessary.

[115] Refer to section 8 of this report.