Advanced metering

Discussion paper

June 2007

Contents

1 Introduction

1.1 This paper is designed to facilitate discussion and feedback from interested parties within the electricity industry, consumers, and suppliers. The intended output of this discussion process will be a set of guidelines for the introduction of advanced metering systems into New Zealand. These guidelines will set out recommendations relating to the introduction of new technology for metering, the supporting infrastructure, and load management. The guidelines will also outline participants' obligations for situations where new meters are installed for new and existing consumers.

1.2 The advanced metering guidelines will not be legally binding, rather are intended to be advisory. In line with its objective to persuade and promote rather than regulate[1], the Electricity Commission (Commission) will recommend that the guidelines be followed.

1.3 This document needs to be read in conjunction with the Electricity Governance Rules 2003 (Rules), which are binding on all electricity participants including retailers, data administrators, distributors, embedded network owners, metering equipment owners, and test houses.

1.4 Developments in new metering technology are moving rapidly, and systems with advanced features are becoming increasingly available. As electricity industry participants consider making investments in these new metering infrastructures, attention must be given to supporting New Zealand's wider national energy objectives and consumer interests, along with those of the electricity sector.

1.5 This paper takes a high-level view of the present trends in metering systems as well as the attributes such systems currently offer. It identifies the benefits that should be expected from these new investments and preferred enduring attributes these systems should provide over time as specific systems are retired or updated.

[1] Paragraph 4 of the Government Policy Statement on Electrical Governance, October 2006.

2 Present and emerging metering environment

New Zealand

2.1 The current metering employed in the vast majority of installations in New Zealand uses stand-alone single or three phase meters which are interrogated manually on site. The metering installations are categorised according to load and required accuracy. These categories are set out in code of practice D1 of schedule D1 of part D of the Rules.

2.2 An information guide on metering installations can be found at the following website address: http://www.electricitycommission.govt.nz/infopapers/index.html#retail.

2.3 Most low voltage consumers pay the same flat rate for each unit of electricity they use for each meter register. This means consumers see no incentive to use less electricity when the cost of production is high, generation capacity is unavailable, or transmission or distribution networks are capacity constrained.

2.4 The current metering arrangements and the structure of the electricity supply process do not provide consumers with a financial incentive to better manage their use and cost of electricity. At best they represent long term averaged costs of production and conveyance of electricity.

2.5 Distributors can control some proportion of load at consumer premises using the ripple relay systems. For all categories of installation on the distribution network a separate remotely-controlled relay is usually installed in the consumer's meter box for load management. Either a discount on the line charge component of the delivered electricity price for controlled load is offered (in which case a separate meter is usually required), or just an average discount is factored into the delivered electricity price for all load.

2.6 The merging of communications and metering is leading to a worldwide trend to include load control capability along with the advanced metering functions into a single device. The inclusion of a local load control capability to influence system peak loads now brings considerable additional value, permitting a "single-box" approach to the equipment required at each supply point.

2.7 The New Zealand transmission, generation, and distribution infrastructure has, and depends on, a well-developed centralised load management system to reduce capacity at peak load or system event times. The introduction of advanced metering should complement and enhance, rather than degrade, the existing centralised load management system.

2.8 Previously, it had not been considered economic to provide more than averaged pricing signals to low voltage consumers. However, mass deployments of advanced meters allow more cost-reflective pricing to be made available. This means that over time direct load control (via ripple relay or advance metering load switching functions) and indirect load control (via well-designed pricing signals) should co-exist and complement each other.

Advanced metering systems

2.9 Advanced metering systems are electronic meters that measure electricity, record consumption, and meter event information electronically, can be remotely read, and may have the following attributes:

a. Remote connection and disconnection;

b. Tamper detection;

c. Outage detection;

d. Quality of supply monitoring;

e. Demand limiting;

f. Communications interface to a range of devices – e.g. in-property display, direct load control equipment, link to a computer in the premises (perhaps via the internet – or perhaps the communications interface enables more external communication beyond the electricity industry);

g. Export metering where applicable; and/or

h. Registers and meter functionality that may be reprogrammable for time period or demand limiting

2.10 There are two distinct types of advanced meters. These are Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI). The functionality of these two types of advanced meters are quite different:

a. AMR – is essentially a meter with remote communications, that may be two-way, for which a remote reading of the meter registers can be obtained and the meter may additionally have remote connection/disconnection ability.

b. AMI – is a meter with functionality beyond that of remote meter reading. Some of these features may be: reprogrammable multi registers, half hour capability, load management capability, ability to connect to other devices internal to the site and power quality monitoring.

Issues with current metering stock

2.11 Retailers can only offer tariffs based on the metering that is installed at the consumer's premises. The standard metering installation configurations and types of meter only provide information on aggregate consumption over a period between meter readings and these limit the products and services that can be offered by a retailer.

2.12 Most consumers do not relate to the measurement of electricity consumption in kWh, and most current metering systems (with the exception of some prepayment systems) present information on invoices only as accumulating kWh registers with consumption averaged over the billing period. The resolution and type of this information does not allow consumers to have a visible "fuel gauge" inside their premise. Ideally, this information should be presented in easy-to-understand formats (e.g. as dollars and not kWh).

2.13 Current metering stock is aging. Although half hour (HH) meters in categories 3 and above are well managed and comply with the Rules, most non half hour (NHH) meters only have what is called “interim compliance”. This compliance expires on 1 April 2010 for category 2 meters and on 1 April 2015 for category 1 meters. Current metering stock is reasonably aged, although by no means inaccurate. However, the need to ensure certificated compliance with the Rules will necessitate the replacement of a large proportion of the existing stock before interim compliance expires.

2.14 Also to be considered is the age of associated equipment that may contribute to a metering installation such as the ripple injection control system. Meter replacement programmes should ideally include upgrading of this equipment at the same time, or the functionality should be integrated into the metering system.

Meter trends in other jurisdictions

2.15 The installation of advanced metering is being increasingly regulated in many overseas jurisdictions. The reasons cited for this are typically;

a. ability to gain frequent meter reads;

b. provide consumers with financial incentives to move the time of consumption;

c. provide remote load control of storage loads; and

d. provide more detailed information on network loadings and issues.

2.16 Some examples outlined below were provided by David Prins at the New Zealand Load Management and Metering Conference in November 2006, while others were obtained directly from websites directly related to the various programmes of work.

Australia

2.17 The Essential Services Commission of Victoria has mandated the installation of 2.5 million meters with remote communication capability. The cost of the installations is being borne by the distributors and recovered through the use of system charges.

2.18 The Council of Australian Governments issued a notice in February 2006 committing all governments to the progressive rollout of advanced (smart) metering technology from 2007.

2.19 The Department of Primary Industry in Victoria (DPI) has been leading a State Government coordinated project to install new interval meters with two-way communications capability for all 2.4 million Victorian electricity consumers. The project is currently trialling various technologies and services to make recommendations to the Government about metering functionality and deployment. The project is on track to see full meter rollout undertaken between 2008 and 2012. The project has broadened from the earlier 2005

Essential Service Commission (ESC) decision to require rollout of manually read interval meters.

Europe

2.20 In Italy the national electricity utility (ENEL) has installed AMI meters for more than 29 million consumers. This was driven by the need to manually change supply limiting circuit breakers and to reduce system losses. The total cost was approximately 2.1 billion Euros (approx 72 Euros per installation) and ENEL estimates that it is receiving operating savings of 500 million Euros per annum and the project claims to have a four year payback. This is a very large project which triggered major changes in the structure of the metering industry and caused both utilities and regulators to think more broadly about the possibilities for the advancement of their metering intentions.

2.21 Scandinavian countries in general are underway with a number of large scale initiatives to install AMR systems driven by a Government requirement to read meters monthly. The Regulator in Sweden has required retailers to move to monthly reading of all meters to avoid the use of estimates in the winter months. This has resulted in a surge in the installation of advanced meters. In Scandinavia there are currently plans to install 10 million meters. However, the degree to which some of these systems would qualify as AMI systems as envisaged in this discussion paper is not clear at this time.

North America

2.22 North America currently has over 45 million AMR meters installed with remote reading capability. Low power radio and power line carrier technologies are strong in this mix, with the field dominated by a few major vendors. The majority of these meters are not “advanced meters” as the term is currently understood, as many read a few registers using drive-by or telephone technology and have little or no load control or other more advanced features.

2.23 However, the situation is now changing with focus moving to installing meters with more advanced functionality. Pacific Gas & Electric is currently installing 9 million AMI meters, with Pennsylvania Power and Light installing 1.4 million AMI meters.

2.24 This change of focus has seen strong lobbying to make these new platforms open, with groups such as OpenAMI (www.openami.org) pushing for open architectures and use of established standards to assist integration of metering and utility automation to drive down costs and increase service offerings.

2.25 Ontario, in Canada, is actively pursuing the introduction of advanced metering. It has published a final specification for these meters: http://www.energy.gov.on.ca/english/pdf/electricity/smartmeters/Functional_Specification_For_Advanced_Metering_Infrastructure.pdf.

2.26 The Ontario Ministry of Energy has entered into an arrangement with the Independent Electricity System Operator (IESO) where IESO will project

manage the implementation of this Smart Metering Initiative on behalf of the Government. Ontario Hydro is currently installing 4 million advanced meters.

3 Advanced metering strategies and load management

3.1 AMR and AMI systems are being considered for mass deployment at a time when New Zealand (and the world generally) is increasingly focused on energy matters. Pressures to use energy more efficiently and to substantially increase the proportion of electricity supplied from renewable sources means the electricity sector must support wider energy objectives by maximising the benefits these new advanced metering systems can bring.

3.2 The advent of AMR metering in New Zealand will enable more flexible electricity pricing, and the introduction of AMI will enable innovative product development and the potential for consumers to exercise greater control over their electricity usage and costs. This will permit the introduction of more innovative options combining time-variable, stepped and critical peak pricing arrangements providing clear and possibly dynamic financial signals to consumers. These signals are currently muted or absent due to the lack of suitable metering technology.

3.3 There is a price difference between AMR and AMI meters. There will not always be a cost benefit for installing the more expensive AMI meters given the current prices and communications restrictions, and the most economic mass deployment may involve a mix of types and attributes. This suggests that the back office systems and communication platforms that are used will need to be able to communicate with multiple meter and data types.

3.4 This means that, once deployed, retailers and distributors in particular need to support these infrastructures, regardless of who owns and/or operates them. The Commission is seeking views on the attributes retailers and distributors (along with other possible future service providers) would need to see included in these new metering platforms in order to be confident of being able to develop and offer product and pricing options over the long term.

3.5 Well designed and deployed advanced metering systems will help underpin New Zealand's wider national objectives of creating a reliable and resilient electricity industry that is environmentally responsible and delivers energy prices that are efficient, fair, and competitive.

3.6 It is important to distinguish between three key elements of this discussion:

a. objectives (what we want advanced metering to do for New Zealand);

b. benefits (the tangible outputs that are likely to be economically realised);

c. attributes (the features of advanced metering systems seen as desirable).

3.7 Consideration needs to be given to how the wider national energy objectives will be realised so as to deliver an enduring resultant infrastructure that encourages maximum on-going participation by the electricity industry. To do this, the economics (link between benefits and attributes) must be acceptable,

and the incentives on all participants (including consumers) must be appropriate and adequate.

3.8 This requires the alignment of many factors. The metering technology becomes the enabling factor, offering attributes (via system features) that permit objectives to be realised and benefits to be gained. However, system attributes must ensure eventual benefits are sustainable and worth both the cost and risk.

3.9 Often the justification cited for changing en masse to advanced metering is the perceived benefit of collecting much higher volumes of data to generate a more accurate (i.e. finer resolution) wholesale settlement profile. In practice, this volume of data for residential and small business consumers is not required.

3.10 One purpose of the metering data is to ensure that all parties associated with wholesale settlement are happy to see settlement proceed with the consumption profile available for that consumer. Although there are benefits associated with being able to position meter registers to start and stop recording on half hour boundaries for retail pricing option design, this should not be confused with benefits of finer resolution data collection for wholesale settlement purposes. This argument is expanded in Appendix D.

3.11 A key aspect of the deployment of advanced metering infrastructure is the economic risk of under-utilisation. If the existing metering base is swapped over to advanced metering, but no material changes occur either in retail tariffs (inadequate pricing signals or other incentives being offered) or in consumer behaviour, then the investment will not realise all of the benefits that these systems can deliver.

3.12 Prepay systems have tended to lead the way in encapsulating advanced features into consumers' meters. By providing accurate real-time consumption information alongside various payment mechanisms (in some cases including post-payment as well) they effectively calculate the consumer's invoice on site and in real time. While it is not intended to suggest that this functionality is required, consumers do recognise financial signals rather than energy consumption values. The ability for a metering system to quantify amount spent, and to control load in accordance with financial signals may be of high value to consumers who have discretionary load.

3.13 Further, the possibility of residential services emerging to permit co-ordinated control of in-home appliances in response to pricing signals could bring a powerful new layer to the distributed load control picture. This is within technological grasp right now, although there will be further refinement as technology continues to develop. Flexibility in the physical communication layers between advanced meters and appliances will be needed for some period before widespread adoption of appropriate communication standards. Both the logical and physical standards that will eventually emerge as dominant in this area most probably already exist today. This factor could help shape the final form of advance metering over the next decade.

3.14 New Zealand has a well-developed centralised load management system to reduce capacity at peak load or system event times, under the control of the

distributor. Distributors do provide retailers with a basic switching service for meter registers for tariff purposes and also provide load control for pricing purposes by agreement. The difficulty is that if one retailer contracts load control from a distributor, all consumers (including those that belong to other retailers) on that distributor's network, that share that load control channel, receive the same load control signal.

3.15 Advanced metering enables the measurement and control of the consumer's electricity consumption to be integrated in a single unit. The communication capability allows for the central control of load by an authorised operator or local load control by the consumer of the appliances or systems downstream of the meter.

3.16 The introduction of advanced metering may allow retailers to control load at the individual consumer level, and if the full concept of advanced metering is considered, ie retailers have control of the discretionary load within their own consumer's premises only, and other retailers' consumers are not affected. There could be additional load that may be managed such as internal appliances, e.g. dishwashers, driers etc that are discretionary in the time that they run given the appropriate technology being employed.

3.17 This capability opens up opportunities for demand side response to wholesale market prices and better network operations management. It has the potential to:

a. Reduce system losses at times of peak load;

b. Reduce peak demand;

c. Open the market to new players such as demand aggregators and allow more than one player to have control of discretionary load on the consumer's premise;

d. Allow the consumer to participate in demand response through price signals for cost of energy or the cost of delivery; and

e. Reduce wholesale market prices.

3.18 The ability for more than one party to control demand or consumption may introduce competition for any load that can be controlled remotely within the consumer's premise.

3.19 The availability of this controlled load may encourage demand aggregators to enter the market. Demand aggregators may contract either with consumers or retailers to reduce demand under certain circumstances, either automatically, for example frequency drop or as a result of a load signal sent to the advanced meter.

3.20 The price incentive provided by retailers or demand aggregators for controlled load may lead to competition for controllable load where either retailers or load aggregators are prepared to offer a greater financial benefit to consumers for placing managed load under another party than the distributor. This could remove load that is currently under centralised load management control of the

distributor, or make that load unavailable at the time the distributor is expected to manage network or transmission capacity.

3.21 Further to this, financial pricing incentives could cause feeders subject to automatic under-frequency load shedding (AUFLS) to have reduced load at various times of the day as consumers react to the pricing incentives.

3.22 The introduction of advanced metering should complement and enhance, rather than degrade the existing load management capability. Further research will be carried out in this area under the proposed Load Management Metering Technology project that commences in July/August 2007.

3.23 The forward vision for the evolution of advanced metering should not be constrained by any specific advanced metering technology offerings available today. If the correct combination of communications standards is utilised (with flexibility to adapt quickly to a wider emerging picture) and the correct level of openness is designed into the business models for operating these new platforms, these innovative forward directions become very probable long-term outcomes. Those considering deploying advanced metering are encouraged to adopt existing standards likely to encourage maximum openness and interconnectivity of the resultant and evolving systems.

3.24 Attributes required to meet minimum requirements are scheduled in Appendix E. The minimum requirements specify the base level functionality expected, while the other two columns relate to features that the system should or may also be capable of, given the development of programming around the development and functionality of the metering system.

3.25 Some overseas jurisdictions have used cost reflective pricing to encourage consumers using advanced metering systems to change behaviour. This is already done in New Zealand in the majority of cases where HH meters are installed. However it has not historically been the practice for category 1 and 2 meters to have advanced meters installed. Time of day pricing could be used to reflect higher costs when either the conveyance of electricity could impose more cost on the distributor, or the price of electricity in the spot market could impose higher costs on the retailer.

3.26 If all existing meters were changed to advanced meters capable of recording the individual profiles at each point of connection, but despite best efforts no users changed their consumption behaviour, then the investment in the recording feature (and the associated data processing costs) would have been wasted.

3.27 It is, therefore, essential that, in order to utilise the functionality available with advanced meters and the development of the advanced metering infrastructure, advanced meters must:

a. record sufficient information to allow the change in the wholesale electricity cost, due to consumer change in behaviour to be identified during the settlement process and passed to the retailer concerned;

b. record sufficient information to allow the change in distributors' cost of supply, due to consumer change in behaviour to be identified during the settlement process and passed to the retailer concerned;

c. record sufficient information to allow the benefit of any aggregated managed load to be identified and passed to the consumer or participant concerned; and

d. be supported by retailers and distributors offering cost reflective tariffs that encourage consumers to take advantage of the functionality and advantages of these devices.

Question 1.	Do you agree with the metering strategy outlined in section 3? Please discuss reasons for agreeing or disagreeing.
Question 2.	Do you agree that competing demands for discretionary load could create a demand management issue for the industry? Please discuss reasons for agreeing or disagreeing. *(section 3: advanced metering and load management)*
Question 3.	Do you agree that certain areas such as consumers on AUFLS feeders, and certain type of controlled load should remain under the centralised load management carried out by distributors? Please discuss reasons for agreeing or disagreeing. *(section 3: advanced metering and load management)*
Question 4.	Do you consider that with the development of distributed load management within advanced meters distributors will have less incentive to maintain a centralised load management system? Please discuss reasons for agreeing or disagreeing. *(section 3: advanced metering and load management)*
Question 5.	Is there additional advanced metering or load management capabilities that should have be included or noted? If yes, please discuss these. *(section 3: advanced metering and load management)*
Question 6.	Do you agree that consumers will react to the price signals that advanced metering systems can deliver? Please discuss reasons for agreeing or disagreeing. *(section 3: advanced metering and load management)*

4 Objectives of advanced metering

4.1 The nature and structure of the first advanced metering infrastructures installed are very likely to shape the nature and success of the systems that follow. Both operational capabilities and the business models under which these new infrastructures are deployed are seen as critical to the long term success of advanced metering adoption in New Zealand.

4.2 Advanced metering systems by themselves will be of little value unless they give rise to material beneficial changes in the way electricity is generated, delivered, and consumed. Provided that they are correctly configured and information that can be made available is used, these new systems should assist to:

a. provide regular and accurate meter readings;

b. reduce network non technical losses by decreasing the incidence of theft or fraud and vacant premise consumption;

c. reduce costs to generate and deliver electricity;

d. improve the reliability of the overall electricity network;

e. minimise barriers to competition in both generation and retail;

f. provide increased and relevant information to electricity users to assist in promoting the efficient use of electricity and enable consumers to make their own decisions on cost conservation;

g. provide a platform for future energy-focused innovation; and

h. provide an increased accuracy in the settlement process, allowing retailers to optimise their contracted positions against consumer load.

4.3 To realise these high-level outcomes, the Commission believes that advanced metering systems installed in New Zealand should share certain common characteristics, such as:

a. open operation (operated to allow multiple parties to concurrently offer services across a single metering infrastructure);

b. established standards for communications (ideally to permit meters from multiple providers to co-exist within the same infrastructure thus providing commercial incentives for least cost deployments; a variety of communication channels may assist to facilitate additional appliance control over time);

c. relevant feature flexibility (able to accommodate a variety of supporting tasks, including assisting consumers to switch between retailers with minimal inconvenience and cost, and the ability to calculate and reconcile distribution line losses);

d. wider localised load control capability (extending load control to other than traditionally controlled loads and allowing load or demand reduction aggregation to encourage demand-side participation in the electricity market);

e. consumer information availability (removing barriers to help electricity consumers better understand their electricity usage patterns and pricing options); and

f. metering information availability (remote communications to allow regular and accurate reading of meters, network, and supply parameters).

4.4 Advanced meters also permit more efficient and cost reflective pricing objectives to be implemented. This gives consumers the incentive to save money through reduced consumption at times of supply constraint. This falls into two broad categories as follows:

a. Time varying energy price: Consumers either pay different prices at different periods of the day, week, month, or season which reflect the purchasing cost of the retailer, or there may be critical energy price periods where the cost of energy may be high to discourage consumption at times of national energy shortage (e.g. dry year pricing).

b. Time varying delivery cost: Consumers pay a higher delivery (line and transmission) prices at certain times reflecting the cost of capacity in the supply system. Reduction of consumption during this higher period of pricing, and increase of consumption in lower periods, encourages consumption away from peak demand periods on the grid and networks and reduces consumer's overall purchase costs. This is sometimes referred to as "Critical Price Periods" (CPP).

4.5 Two-way communication, contained within some advanced metering systems, provides further consumer incentive for capacity management by permitting the introduction of CPPs. It also assists to make cost reflective pricing via time-of-use pricing options much more dynamic.

Question 7.	Do you agree with the objectives outlined in section 4? Please expand with why or why not. *(section 4: objectives of advanced metering)*
Question 8.	Are there additional objectives of advanced metering that should be added? If yes, please discuss these. *(section 4: objectives of advanced metering)*

5 Benefits of advanced metering

5.1 The two primary benefits of advanced metering are:

a. ability to give financial incentives to alter consumer behaviour via suitable pricing signals. Benefits of correctly modelled prices will allow benefits to be recognised in distribution, transmission and generation; and

b. ability to reduce retailer operating costs (meter reading, billing, settlement, payment, network management).

5.2 Other factors relating to system reliability and security are also likely to benefit from improved quality and regularity of data collection and processing.

5.3 New products should emerge, allowing retailers and consumers to interact in new ways. Reducing consumption during high price periods will lead to much more efficient use of capital. Examples of new products and processes are:

a. Use of energy efficient appliances that run during high price periods. The cost reflective pricing would provide consumers with the financial incentive to invest wisely in energy efficiency products;

b. Storage heaters. Where there is insufficient thermal mass in buildings, either limited storage or larger longer term storage systems;

c. Insulation. To retain heat or cool longer at times of high electricity price;

d. Thermostats that may reduce temperature by a few degrees during high price times without noticeably impacting comfort levels; and

e. Disconnecting discretionary load such as spa pools etc at periods of high price as a service to consumers.

5.4 The ability to communicate beyond the meter opens up new load management options and appliance/energy pricing packages that are yet to be explored. Examples of these are:

a. Ability to communicate with appliances or consumer display screens;

b. Delaying or stopping mid-cycle discretionary load such as dishwashers, dryers, and back ground heaters during high price periods;

c. Only running background heating at times of lower prices;

d. A communication link into a consumer's premise, where electricity prices can be updated remotely to the consumer (e.g. regular pricing schedule updates, special week end prices);

e. Passing onto appliances direct warning of high price periods;

f. Ability to signal critical peak pricing and wholesale market prices to the consumer or their appliances; and

g. Demand limiting by shedding of internal discretionary load so that the connected capacity of a consumer's site does not exceed a pre-agreed capacity either as a business rule or when there is a credit issue, or a pre-programmed cost.

5.5 Independent supplier smart house controllers that receive load and price information from the advanced meter may carry out the internal house consumption control. This could be a device purchased by the consumer, leased by a third party provider, or even provided by the retailer in conjunction with its tariffs.

5.6 Programmable business rules would allow price thresholds to be set for the automatic control of appliances.

6 Advanced metering attributes

6.1 To take advantage of the general benefits outlined in section 5 above, it is necessary that an advanced metering infrastructure with appropriate attributes is put in place. There are both consumer and industry benefits for an advanced metering system, provided that the meter installed supports development of desired future attributes. Installation of meters that do not support this development of future attributes may limit the life of the metering system and impose costs on consumers.

6.2 The benefits (whether directly quantifiable in monetary terms or not) need to be weighed against the cost of the features. If a system has too few features, then it may limit the benefits that can be realised over time and possibly need to be replaced early, increasing consumer cost. Alternatively, if the system has too many features, many of which are not used during the life of the system, then the costs of those features have been wasted. The task is to determine the optimum feature set that an advanced metering infrastructure should aspire to, thus maximising overall benefit for users and being the most economic to operate.

6.3 AMI can comprise three distinct interrelated layers of functionality. These areas are measurement of electricity flow, recording of electricity flow, and any added value functionality that the device can be programmed for. To allow remote management of the advanced meter the access to the programming must be restricted as listed below.

Layer	Functionality	Dependencies
One	Measurement programming - measurement of electricity flow, multipliers and other related criteria. This should be site programmable only.	None. This is the basic functionality of a meter.
Two	Recording of electricity flow. Programming of recording registers may be remotely programmable provided that there is a total register within the device that cannot be reset remotely, and continues to accumulate if any of the recording programmes are changed.	Layer one.
Three	Additional functionality. Ability to be programmed freely for other requirements, e.g. the addition of inputs from another metering device, load signal management or frequency response, capacity management, remote displays, and other yet to be defined functionality.	Layer one and layer two

6.4 There may be a benefit in defining a minimum feature set for any advanced metering system installation. If this is not done, it could generate inappropriate churn whereby a new retailer decides to remove an existing advanced meter in favour of a simple “no frills” meter for those consumers not interested in services requiring the more advanced features.

6.5 This suggests that the minimum feature set:

a. must have features to provide the basic “no frills” meter functionality without having to also use more advanced features. This would remove the need for retailers to change the meter unnecessarily; and

b. must identify physical features which should be present in the advanced meter to allow a sensible forward migration path to support the wider national objectives (whether or not these are used initially).

6.6 If a retailer elected to use only the “no frills” functionality set, they may be charged a meter usage fee equivalent to that of a basic meter, but all of the advanced functions would be turned off. This suggests an ability to selectively enable and disable features on a meter-by-meter basis and is a desirable attribute of any such system.

6.7 Further, if features to support wider national energy objectives are not at least provided from the outset, services to realise such objectives will never be developed thus locking New Zealand into a similar continuing cycle. The incremental cost for including features to support more sophisticated pricing options are likely to be low, thus justifying their inclusion from the outset even if it takes a while for these services to become established.

6.8 A material activity in the deregulated electricity industry is consumers switching between retailers. Features need to be identified which can help make this process as accurate, timely, smooth and cheap as possible. The ability to take snapshot readings as close as practical to the changeover would be sensible.

6.9 Systems need to be able to demonstrate a clear audit path for metering and other data on which wholesale and retail settlement relies, in accordance with the Rules.

6.10 The ability to remotely read metering registers opens many benefits:

a. the meter reading rule requirements can be easily met, increasing the accuracy in the physical and financial settlement process;

b. the ease and accuracy of collecting multi register meter information introduces the possibility of time of day/week/month pricing for consumers;

c. it encourages efficiency in generation and distribution;

d. it is difficult to lose meters, meter registers, multipliers, and other metering information in the switching process leading to a more accurate reconciliation process;

e. remote disconnection of vacant properties at the time they become vacant, or the timely availability of consumption information will enable more effective revenue protection; and

f. billing queries related to incorrect meter reads or estimates could be significantly reduced, improving the level of service available to consumers.

6.11 System features should permit electricity efficiency to be strongly promoted by retailers and distributors via cost reflective pricing options that give consumers the correct financial incentives to invest in energy conservation through energy efficient appliances and behaviours. Giving consumers a suitable 'fuel gauge' will allow them to take control of their consumption, reduce unnecessary usage, and see the savings. Displaying information relevant to resource utilisation (such as impact on climate change) should also be possible.

7 Issues arising with large scale change to advanced metering

7.1 Implementation

7.1.1 The replacement at a consumer's premise of 'multiple meters with single registers' with a 'single meter with multiple registers' may lead to a significant change to the way mass market consumers are charged for electricity . The introduction of "time of day" pricing to mass market consumers may encourage consumers to self manage their consumption and lead to changes to the structure of line charges calculated by distributors, and energy charges calculated by retailers. Possible significant infrastructure changes are outlined below.

a. Many billing queries relate to differences in opinion on the site's consumption, inaccurate meter reads, or inaccurate estimates. This is due to the manual nature of meter readings, and the difficulty in accessing or reading some meters. The use of accurate meter readings from remote meter reading and more detailed consumption information will reduce queries of this type, and encourage prompt payment for delivered electricity.

b. The way consumers, distributors, and retailers use the flexibility of potential new tariffs could have significant impacts. Many sites have two or more meters. These meters are in place as New Zealand has a well developed centralised load management system which enables meters to be switched to provide pricing signals. Different rates in many network areas are offered with the price reflecting the availability of electricity, e.g. Anytime – high price anytime use, Night Only – the consumer's load is controlled and only available to be used at night.

c. Consumers who have lower consumption, or do not have the ability to move their time of use of electricity could be financially disadvantaged and may require confirmation of averaged tariffs. This could potentially increase the number of tariffs and complicate management of these tariffs.

d. Distributors could be adversely financially affected as using custom potential new tariff structures could cause unpredictability and risk with the rate of return that distributors make for line services. The effect of this needs to be considered.

e. Provided the information can be easily accessed, the increased information available on consumption in near real time and the ability for retailers to remotely control load may enhance the manner in which retailers' hedge with generators.

f. The back office systems used for billing, data collection and reconciliation will be affected due to significant increases in data and information volumes.

g. The formats and transfer methods for the exchange of metering information between participants may need to be developed due to an increase in the volume of meter configuration and site set-up information compared to that of standard non half hour metering.

h. The use of a number of different manufacturer's of metering and data collection systems could raise barriers to competition if common industry communication protocols and model meter lease agreements are not adopted because:

   i. Switching could be constrained where retailers do not support the metering system installed as a gaining retailer may elect to not accept the consumer;

   ii. As disconnection occurs at the meter, there could be difficulties where a retailer does not want to use the advanced meter and just wants the supply of electricity restored.

7.2 Load control

7.2.1 Issues related to load management are detailed in section 3 above. The ability of other parties to offer load management and compete on a financial basis for controllable load may impact on distributors' centralised load management systems and the degree of control a distributor may be able to exert on network and transmission peaks.

7.2.2 Advanced meters may force competition between capacity and wholesale market/generator requirements, and could see over time a degradation of the existing ability to manage network and transmission peaks

Question 9.	Do you consider that there is an issue to be addressed on ownership of discretionary load on a consumer's premise? Please discuss why you agree or disagree. *(section 7.2: load control)*

7.3 Network issues

7.3.1 Distributors should also be seen as users of an advanced metering system, the same as retailers and consumers. For this reason, distributors should not freeload on these systems and should contribute to the costs of these devices either through rebates in the rates charged, or contribution to the meter lease cost.

7.3.2 Distributors could benefit from the use of AMI by using the systems to:

a. check on distribution asset loadings (transformers, cables) and shuffle assets into best locations;

b. track temperatures of distribution transformers and be warned of life-shortening temperatures;

c. identify points of failure on a network;

d. check voltage limits (high and low) on a low voltage feeder to ensure it is within compliance limits;

e. ensure that remote load control signals have been received;

f. offer capacity limited rates to encourage improvement of load factor on their networks; and

g. manage capacity limiting of demand, which could also be used in dry years to share electricity consumption within a region.

7.3.3 As such, distributors should anticipate becoming users of advanced metering systems on similar terms to retailers and consumers

7.3.4 If networks own these advanced metering systems, the network should not "freeload" on the lease of them – they should separate their "ownership" revenue requirements from their "user" costs and pay for access to these services like other users, otherwise other users will be potentially over-contributing to the ROI.

Question 10. Do you consider that the beneficiaries of information from advanced meters should pay for access to the information outlined in section 7.3? Please discuss why you agree or disagree.

7.4 Credit control and vacant premises control

7.4.1 Credit control and the control of consumption in vacant properties are often exercised by removing the supply of electricity. Currently to connect or disconnect a property, a service person must visit the site to manually disconnect the supply.

7.4.2 The ability to remotely connect/disconnect meters has a number of advantages that would be available to retailers and consumers:

a. A service person visiting the site is expensive, particularly if another occupant moves into a property and it has to be reconnected shortly after being disconnected. This expense is eliminated with the ability to connect/disconnect from the retailer's back office system.

b. The initial connection, disconnection, and reconnection of a site are under the retailer's control.

c. The ability to easily disconnect a vacant property enables a retailer to manage its obligations for electricity consumed while the property is vacant.

d. Disconnection of a property may in some instances endanger the disconnection service person. This safety issue is eliminated with the ability to connect/disconnect from the retailer's back office system.

e. Timely disconnectons of electricity may encourage payment of unpaid bills and reduce the level of debt.

7.4.3 The ability to remotely disconnect/reconnect consumers through an advanced meter however has both disadvantages and safety issues that must also be considered:

a. Remote disconnection of a property removes an element of personal checking where the occupant may require sustained electricity access for safety or health reasons, or the consumers may have actually paid the account in dispute and have a receipt, and there has been a delay in processing the payment into the disconnection system.

b. Restoration of electricity may be to an unsafe premise which is visible if manually reconnecting supply, but not visible if remotely reconnecting.

Question 11.	Do you consider that remote disconnections for credit issues should not be carried out? Please discuss why you agree or disagree. *(section 7.4: credit control and vacant premises control)*
Question 12.	Do you consider that remote connections may require the consumer accepting responsibility for the restoration? Please discuss why you agree or disagree. *(section 7.4: credit control and vacant premises control)*

7.5 Costs

7.5.1 It is not the intention of this discussion paper to delve into details regarding costs underlying any specific advanced meter deployment. However, all such programmes will have common factors which will need to be considered in the business model.

Installation

7.5.2 There are a number of issues to be considered with the roll out of metering replacements.

a. Remote read meters are more expensive than standard meters with significant cost differentials depending on the systems and options installed.

b. Older installations may not be able to be retrofitted with new metering without consumer expense, where either the location of the meter is unsuitable or unsafe, or the wiring itself is unsafe, particularly if disturbed.

c. Some sites may not be economic for the installation of more expensive devices, and the business case for installation may need to consider how uneconomic sites should be treated.

d. No single method of communication will suit all cases due to the remote nature of some sites.

Stranded assets

7.5.3 One of the major deterrents to the introduction of new technology is the possibility of stranded assets. Stranded assets are a result of meter changes that may occur during the switch process where the winning retailer does not prefer or support the existing meter hardware/AMI or meter supplier. In the case of meter owners, displacement of existing technology is a real risk but the owners of load control equipment, both relays and measurement transformers face the most risk.

Communication protocols

7.5.4 The use of a number of different manufacturers of metering and data collection systems could raise barriers to competition if common industry communication protocols and model meter lease agreements are not adopted.

7.5.5 Feedback is sought on whether the New Zealand electricity industry considers:

a. if a common advanced metering communications protocol would be desirable;

b. if the communications pathways should be specified (i.e. meter to back office, meter to home appliances, other links);

c. the nature of these links;

d. whether existing standards provide the required functionality and are mature enough to consider adopting;

e. whether an industry working panel should be established to pursue the matter of whether standard communication protocols should be developed and make recommendations accordingly; and

f. whether appliance manufacturers should be represented on such a panel to bring their views from a world stage perspective.

Question 13. Do you agree with the discussion on costs outlined in section 7.5? Please discuss why you agree or disagree.

7.5.6 It may be appropriate that the advanced metering guidelines (the end deliverable of this process) express a view on how common costs should be handled to encourage both fair cost allocation and open access to these new platforms.

Question 14. Do you consider that costs should be allocated to the beneficiaries of advanced meter functionality? Please discuss why you agree or disagree. *(section 7.5: costs)*

7.6 Safety

7.6.1 There are safety issues that should be considered as part of a replacement programme for meters:

a. It is suggested that a meter replacement programme should include a check on the wiring condition, safety of the wiring disturbed as part of the replacement or within the switchboard or meter box, and earthing of the consumer's reticulation. Any issues should be brought to the retailer's attention and the retailer should convey these to the consumer.

b. Direct connected meters should preferably have two retaining screws per conductor.

c. Disconnection switches within the meter should not switch the neutral.

Question 15. Do you agree with the discussion on safety issues? Are there any other safety issues that should be considered? Please note and discuss these in your submission. *(section 7.6: safety)*

7.7 Switching issues

7.7.1 AMI is in the process of being added as a meter type within the registry. The selection of the advanced meter type in conjunction with the meter type will indicate to participants that a meter with remote communications is installed at an installation control point (ICP), and the retailer will need to ensure that its data administrator has the appropriate certification for the handling of this information. The selection of HH or NHH in conjunction with AMI will indicate the method of settlement used for the ICP.

7.7.2 Retailers' ICP switch files and some of the electricity information exchange protocols (EIEP) formats will need to be modified to convey the additional metering and register information. This will entail both participant and registry changes.

7.7.3 The existing and amended part E Rules will otherwise function with the switching of advanced metered consumers between retailers.

Question 16. Do you agree with the discussion on switching? Please discuss any issues in your submission. *(section 7.7: switching issues)*
Question 17. Are there any other switching issues that should be discussed? Please discuss these in your submission. *(section 7.7: switching issues)*

7.8 Barriers to competition

7.8.1 Installation of advanced metering systems should not create barriers for consumers to switch. Barriers could be created by:

a. The costs associated with the meter. As the meters may be expensive to purchase or install, meter owners and retailers may decide to enter into

minimum rental period contracts that could preclude replacement of a consumer's metering installation at the time of switch of retailer to a metering installation preferred by the gaining retailer.

b. Lease of the meter. A meter owner choosing not to lease meters to another retailer.

c. Switching costs. Even without minimum rental contracts, change of meters at the time of a retailer switch could become an industry cost that will be averaged into consumers' costs.

d. Meters being contracted for a period of time by a consumer, where only one retailer can use the facilities offered by the meter or the meter service provider.

e. Prohibitive pricing by the meter owner.

7.8.2 Solutions to barriers to competition could be:

a. Model agreement for lease of meters, and meter owners that include conditions that should meters need to be replaced for a change in retailer, that the consumer will not be a charged.

b. Standardisation of the communication protocol or the make of meters.

c. Standardisation of the programming and naming order for the registers where NHH meter registers are programmed into the devices.

Question 18. Do you agree that there is a potential for advanced meters to create barriers to trade? Please discuss why you agree or disagree. *(section 7.8: barriers to competition)*
Question 19. Do you agree with the solutions to barriers to competition outlined in paragraph 7.8.2? Please discuss why you agree or disagree.

8 Submissions

8.1.1 The Commission invites submissions on the proposal by **5.00 pm on Friday, 3 August 2007**.

8.1.2 The Commission's preference is to receive submissions in electronic format (Microsoft Word). Submissions in electronic version should be emailed with 'Advanced Metering Consultation' in the subject header to info@electricitycommission.govt.nz.

8.1.3 If submitters do not wish to send their submission electronically, they should post one hard copy of their submission to the address below.

Jenny Walton
Electricity Commission
Level 7, ASB Bank Tower

2 Hunter Street
P O Box 10041
WELLINGTON
Tel: (04) 460 8860
Fax: (04) 460 8879

8.1.4 The Commission will acknowledge receipt of all submissions electronically. Please contact Jenny Walton if you do not receive electronic acknowledgement of your submission within two business days.

8.1.5 Your submission is likely to be made available to the general public on the Commission's website. Submitters should indicate any documents attached, in support of the submission, in a covering letter and clearly indicate any information that is provided to the Commission on a confidential basis. All information provided to the Commission is subject to the Official Information Act 1982.

8.1.6 The Rules are available on the Commission's website at:

http://www.electricitycommission.govt.nz/rulesandregs/rules.

8.1.7 The presentation by David Prins, CRA, can be found on the Commission's website at:

http://www.electricitycommission.govt.nz/pdfs/opdev/retail/lmgt/ims/David-Prins.pdf

APPENDIX A: ABBREVIATIONS

AMR	**Automatic meter read**
AMI	**Advanced meter infrastructure**
Board	**Electricity Commission Board**
Regulations	**Electricity Governance Regulations 2003**
Rules	**Electricity Governance Rules 2003**
DA	**Data Administrator certified in accordance with the Rules**
Commission	**Electricity Commission**
Rules	**Electricity Governance Rules 2003**
GXP	**Grid Exit Point**
HH	**Half hour**
ICP	**Installation Control Point**
Meter	**Metering Installation certified in accordance with the Rules**
NSP	**Network Supply Point**
NHH	**Non half hour**
RM	**Reconciliation Manager**
UNM	**Unmetered**
UML	**Unmetered Load (Profile Code)**

APPENDIX B: RELEVANT RULES

Issues with the current requirements

1. There are issues with parts D and G of the current Electricity Governance Rules 2003 (Rules) that may need to be addressed to allow the cost effective adoption of new technology.

2. The following rules have been identified by the Commission as issues for discussion to facilitate the implementation of advanced metering installations.

Part A

3. The definition of metering installations in part A of the Rules includes internal and external control devices that impact on the collection or collation of metering information such as time clocks, ripple relays, relays, etc where the information is used in the data administrator or reconciliation process, but excludes communication devices. The argument is where the meter installation stops and the data administration system commences to set the demarcation of where the meter read exists.

> *"**metering installation**" means **meters**, load and **meter** control devices (but not their control signals or means of generation), **data loggers**, test blocks, measuring transformers, error compensation processes, fittings, equipment, wiring and installations used for the measurement and storage of **metering information** that is used for the purposes of the **rules** and which comply with the **metering standards**.*

4. A rule change is suggested to clarify that, in the case of advanced meters, the meter read exists at the point at which it becomes visible. In many cases, this is contained within the meter read software. As the sending device is built into the meter itself, the receiving device is still an integral part of the metering installation – this is consistent with the operation of remote meter reading devices.

5. It is interesting to note in the trials underway in Victoria, Australia, that the definition of metering systems has defined the meter and the communications system as part of the AMI system (but not the back office data processing functions).

6. It is suggested to include within the Rules the wording "communication devices used in sending and receiving meter information to the point of meter read", or similar.

Appendix B, Question 1. Do you agree with changing the metering installation definition in part A of the Rules? Please discuss why you agree or disagree. *(paragraphs 3, 4, 5, and 6)*

Part D

7. The party responsible for reconciliation has ultimate responsibility under the Rules for compliance of the metering installation and the meter read used in the creation of submission information to the reconciliation manager. No changes are proposed to this.

> Rule 3 of part D – each direct consumer, retailer, embedded generator, or embedded network owner is responsible for the metering installation at a point of connection for which it is responsible for.
>
> *Rule 6 of part D – Each **participant** responsible for providing a **metering installation** will ensure that the **metering installation** meets the requirements of the **codes of practice**.*

Appendix B, Question 2. Do you agree with not having any changes to rules 3 and 6 of part D of the Rules? Please discuss why you agree or disagree. *(paragraph 7)*

Code of practice D3 of schedule D1 of part D

8. With the introduction of multi register single meters the position of risk changes. Currently, bridging out of a control device exposes the distributor to transmission cost risk, but places no risk on the consumer or retailer.

> Advanced metering, that uses time of day distribution pricing, exposes the consumer to increased load at high cost periods, where load control is bridged out or fails to occur.
>
> *Rule 3.8 of code of practice D3 – Where a load or **meter** control device has malfunctioned, it may be bridged out by a person who is not an employee or subcontractor of an **approved test house**, provided that the **retailer** and the **metering equipment owner** have in place appropriate procedures for ensuring that such activities are carried out only by persons so authorised by the **retailer** and **metering equipment owner**. Such procedures shall also ensure that notification to the **retailer** and remedial work by an **approved test house** are handled in a timely manner.*

9. It is suggested that this rule is changed to also include authorisation by the consumer as the consumer may be financially affected.

10. It is essential that systems are installed in environments that are suitable, consideration must be given to harmonics, earthing, etc.

> *Rule 5.2.4 of code of practice D3 – Any **data logger** will comply with the requirements of **code of practice** D4 and will (as part of the design report) have been confirmed by the designer of the **metering installation** to be*

*compatible with the **meter** and communications network to which it is connected and suitable for the electrical and environmental site conditions in which it will be installed.*

11. Metering installations for categories 1 and 2 can have inspection intervals increased from 10 to 15 years provided annual non invasive inspections are carried out

    *Rule 7.1 of code of practice D3 – All **metering installations** will be subject to non-invasive inspections by a suitably qualified person appointed by the **metering equipment owner**. A copy of the signed inspection report, which will confirm that the **metering installations** continue to comply with the requirements of the **rules**, will be kept with the **certification** records.*

12. Regularly visiting the site imposes a cost. There are advantages with regular site visits as it does tend to act as a tamper deterrent, and also ensures that if the installation is damaged or unsafe that it is noticed.

13. Should appropriate controls be placed within the advanced metering installation, and provided that suitable and approved sample testing is used, it may be reasonable to extend the non invasive inspection period beyond the one year requirement.

Appendix B, Question 3.	Do you agree to changing rule 3.8 of code of practice D3 of part D of the Rules? Please discuss why you agree or disagree. *(paragraphs 8 and 9)*
Appendix B, Question 4.	Do you agree that appropriate controls be placed within advanced metering installations and that it is reasonable to extend the inspection period beyond one year? Please discuss why you agree or disagree. *(paragraphs 11, 12, and 13)*

Code of practice D4 part D

14. Advanced metering devices may be able to have the operating program remotely or locally replaced. Any subsequent upgrades or changes to hardware or software are subject to type test control and recertification of the site. This rule is proposed to remain as is.

    *Rule 3 of code of practice D4 – If at any time there are any modifications to the specification, hardware or resident (ROM) software of a particular type and model of **data logger**, it will be regarded as a new model and will require repeat **type-tests** to be satisfactorily carried out before it will be considered to be **certified***

15. It may be necessary to distinguish between the operating program that influences the base metering functionality, and “application programs” which could be loaded and unloaded at retailer, distributor or consumer request to support data presentation, billing or other downstream processing of the data. The latter should be encouraged and not subject to type testing requirements provided it is unrelated to the functionality of the core metering capability.

Appendix B, Question 5.	Do you agree with not changing rule 3 of code of practice D4 of part D of the Rules? Please discuss why you agree or disagree. *(paragraphs 14 and 15)*

Code of practice G1 schedule G8 part G

16. Depending on how the advanced meter returns information, these devices may function under the Rules definitions as non half hour, or half hour, or be a hybrid.

17. The following definition is used within the Rules:

    a. Half hour – the metering installation returns half hour information and this information is used in the preparation of half hour submission information to the reconciliation manager. In this instance the certification of the installation and the handling of the metering installation are under the Rules for half hour metering installations and data handling.

18. It is proposed to add the following definitions to the advanced metering guidelines:

    a. Hybrid – this is where the metering installation records volumes by trading period, and the trading period information is aggregated into either absolute or accumulating registers within the metering installation and these registers are then used in the preparation of non half hour submission information to the reconciliation manager. In this instance the certification of the installation and the handling of the metering installation are under the Rules for half hour metering installations and data handling.

    b. Non half hour – the metering installation returns non half hour information and this information is used in the preparation of non half hour submission information to the reconciliation manager. In this instance the certification of the installation and the handling of the metering installation are under the Rules for non half hour metering installations and data handling.

Appendix B, Question 6.	Do you agree with the definitions in paragraph 18 being incorporated in the advanced metering guidelines? If not, what other suggestions do you have for improvement?

19. The current rules require stringent time keeping that, given delays in the transmission of information to and from advanced meters, may not be achievable.

20. Rule 5.1.7 of code of practice G1 of schedule G8 – data loggers must have their clocks synchronised in accordance with table 1.

21. Achievement of the permitted time errors specified within rule 5.1.7 of code of practice G1 of schedule G8 of part G may incur considerable expense. It is proposed to review the permitted time errors for meters within category 1, and determine the overall accuracy effect of wide scale implementation, with a wider tolerance band.

Appendix B, Question 7.	Do you agree with the proposed changes to rule 5.1.7 of code of practice G1 of schedule G8 of the Rules? Please discuss why you agree or disagree. *(paragraphs 18, 19, and 20)*
Appendix B, Question 8.	Are there any other rules that you consider constrains the introduction of advanced metering infrastructure or technology that require changes? Please discuss any other rule changes you see as necessary.

APPENDIX C: METER DATA FOR RETAIL PRICING AND WHOLESALE SETTLEMENT

1. This Appendix discusses two different aspects of data requirement for the key functions carried out by advanced meter:
   a. providing data into the wholesale market settlement process; and
   b. providing data into consumer-retailer pricing arrangement process.

Wholesale settlement

2. Wholesale settlement is the process by which generators are paid by electricity retailers for the electricity purchased on the wholesale market. The market prices change every half hour, so to calculate how much each retailer owes the market (hence onto the generators) it is necessary to know how much electricity each retailer purchased in each half hour.

3. Since the majority of smaller users (residential and business) do not currently have meters which record every half hour, a process known as “profiling” is used. The profile is a consumption pattern “shape” used to describe a typical consumer in a class of consumers. Each consumer class may have its own profile, or the default profile (GXP residual) is used. Profiles are subject to Electricity Commission approval and their application can be audited.

Profiling settlement

4. Profiling settlement works because, with more than a few thousand similar consumers, the average is very accurate. Curiously, it can be more accurate than the result obtained if each consumer is fitted with their own half hour recording meter and this data used to generate a specific profile. The accuracy of the averaged profile improves the more consumers are included, whereas the accuracy of the half hour meter on each consumer is limited to the inherent meter accuracy.

5. Profiling is a very effective and cost efficient mechanism for handling large numbers of smaller electricity users. Provided the input profile is representative for the consumer class, profiling generates an accurate result for each retailer.

6. For example: The meter is read in the normal way (yielding one number, say 1000 units per month) then the profile shape is applied. Some half hour periods will increase and some will decrease. The result is a half hour profile for that consumer which still represents 1000 units in the month, but is now shaped to be representative of that consumer on average.

7. This highlights the real purpose of a meter, which is not as obvious as it may first appear. A meter is required to ensure that all parties involved in the settlement process (either wholesale or retail) are happy with the profile being used in the settlement process.

8. Profiling has the disadvantage that the process of allocating volumes into calendar months is an approximation only, and the process is complex. While the profiled volumes will match exactly the meter registers over a period time, the individual consumer responses within any time period become averaged.

9. The problem with profiling is not with settlement for the consumer class as a whole. A problem arises when a retailer wishes to incentivise a group of consumers to alter their consumption behaviour in response to a pricing option. Some consumers may change, some may not. With profiling, it is not possible to determine which consumers changed consumption (and by how much they changed) without recording this change in a separate register.

Half hour settlement

10. Half hour settlement is a less complicated process, but involves handling significantly more information. With half hour settlement, the actual contribution made by each metering installation is aggregated at a half hour level at each network supply point and recognised in the settlement process.

11. The management of half hour metering systems is more complex than the management of non half hour metering systems.

Encouraging user behaviour changes

12. If all existing meters were changed to advanced meters capable of recording their individual profiles, but despite best efforts no users changed their consumption behaviour, then the investment in the recording feature of the advanced meters (and the associated data processing costs) would have been wasted.

13. This means the recording feature in an advanced meter must achieve two things:

    a. it must record sufficient information to allow the change in wholesale cost due to that user's behaviour change to be identified during the settlement process and passed to the retailer concerned;

    b. the cost of inclusion and operation of this feature must not on average exceed the benefit arising from the user behaviour changes, otherwise the feature is uneconomic.

14. As an example, assume some consumers reduced their consumption by 50 per cent for 10 of the most expensive wholesale market half hours in the last month. If these had been separately recorded, the retailer could submit this data in two parts, specifically extracting and presenting the reduced consumption periods in order to obtain the benefit of the lower costs. Part of the benefit would then be handed onto the consumer who made this change. Clearly, if this data was not recorded, the retailer could not receive the benefit and hence pass it on.

15. However, discovering this benefit (the reduced wholesale cost to the retailer caused by a specific consumer) has an associated cost: the provision of the more sophisticated meter to record the data and the supporting data handling processes. To become established as a sustainable pricing option, the retailer must ensure that the consumer changes their consumption behaviour by a sufficient margin to earn a wholesale market benefit at least exceeding the cost of providing the special meter and its downstream data handling.

16. This implies that there is a "threshold" behaviour change which, for a given class of consumers on such a pricing option, must be exceeded on average for the service to be sustainable. If not, the special meter has provided no net benefit and the existing meter (settled using profiling) will continue to be the best option.

17. Stated another way, consumers earn the right to have a special meter by changing their behaviour more than a set threshold. This threshold is a function of the nature of the behaviour change (when it happens, how much it changes) and the cost of providing the process to recover the reduced cost from the wholesale market (the meter and related support costs). Users not prepared to change their behaviour by more than this threshold amount will cost more than they earn, making the service uneconomic.

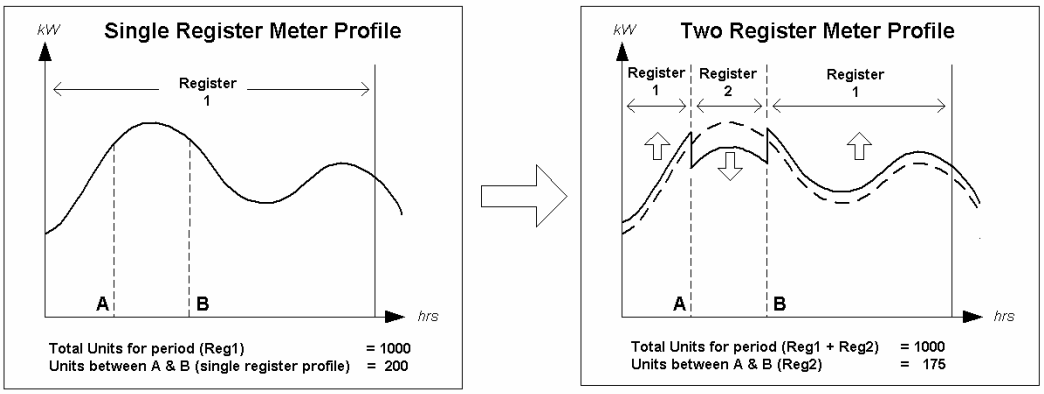
18. The amount of information required to identify changes in consumer behaviour for accurate wholesale settlement is remarkably small. This is important, since collecting and processing large amounts of information (such as half hour data for all users) is unnecessary if a simpler and cheaper approach is just as effective.

19. In fact, it turns out that a straightforward extension of the existing profiling system already operating in New Zealand is all that is required. It is clearly possible to have a meter which uses 1440 registers per month (i.e. one every half hour) but collecting data in this fashion is solving the wrong problem.

20. The real question to be answered is this: How much additional data must be collected to ensure that profile used for wholesale settlement is adjusted so as to accurately reflect the modified user consumption pattern to at least metering accuracy.

21. This can be done by having one or more additional registers to record the consumption during periods of interest. These are the periods when the retailer is incentivising the user to alter consumption (peak demand periods, night periods, weekends, etc.). The profile can be clipped at the start and end of the period concerned, and moved vertically to ensure the area of the profile in that time slot equals the reading on the register for that period. This can be done for each such period, and then the original remaining profile adjusted to reflect the balance.

22. The diagram below indicates this profile scaling principle. The information available from the second register allows a straightforward scaling which permits wholesale market costs during the time interval A–B to be more accurately determined and hence the benefit passed back to the retailer for sharing with the consumer who caused the shift.



23. In principle, any number of intervals can be added into the settlement process this way, each bringing greater precision in allocation of wholesale costs. The optimum number of such additional profile timeslot registers is generally considered to be somewhere between six (6) and ten (10).

24. Although the same outcome could be achieved using half-hour data collection at residential and small business level by summing the relevant half hours, collecting and processing half hour data is likely to be much more expensive than having a smaller number of targeted cost allocation slots as above. Although half hour capable meters could be used to gain the flexibility to position the register slot boundaries at convenient times (each retailer being different if they wished) this is not the same as requiring that all this data be submitted for settlement.

25. To ensure an economic outcome eventuates, retailers should be charged varying data processing costs in relation to the volume of data they submit for settlement. This will fairly allocate the data processing cost, and the outcome would be expected to match meter data capability with consumer response. Meters having fewer registers would be lower cost (factoring in all downstream data processing costs) and may provide in excess of 90% of the gains compared with capturing and processing all half hour data.

APPENDIX D: REMOTE METER READING CONSIDERATIONS

Remote read meters (RRM) (Current)

1. In recent years there has been a gradual introduction of newer technology and at least one major retailer has committed to meters that have the functionality of AMR and AMI meters, and can be described generically as remote read meters (RRM).

2. These are meters that have a system that allows remote meter reading and one or two way communication. There is a large variety of systems available with various stages of complexity. A number of these systems are installed worldwide. The meter communication may be one-way or two-way depending on the development stage and complexity of the meter. Approximately 30 million of similar devices are installed worldwide using GPRS, PLC, and modem communication methodology. Such metering systems may have the following attributes:

    a. Meter may be read both on site manually, or on site or remotely via a recognised electronic communication system.

    b. May have more than one register.

    c. Electronic meter readings will collect cumulative meter register readings and may even collect half hourly cumulative meter readings information. (Note that if half hour absolute values are collected it is a half hour meter and not a non half hour meter).

    d. Remote meter reading may include metering system diagnostics to indicate tamper or fraud.

    e. May be two way prepay or register type meter and may be remotely configurable to move between prepay and non-prepay options.

    f. May be half hour or non half hour or both.

    g. For load control or register switching for time of use tariffs, requires an external or internal switching device such as a ripple relay or time clock.

    h. Variety of different communications can vary between simple drive or walk by radio, to longer distance radio, modem/land line, internet, power line carrier, or GPRS.

    i. Some devices have the ability to remotely allow suppliers to disconnect/reconnect supply to a site.

Advantages of remote meter reading

3. The advantages of remote meter reading are as follows:

    a. Only necessary to access the meter for annual inspections. For read purposes, reading is obtained automatically.

    b. Reading cycles can be automated at frequent intervals (known as automatic meter reading or AMR).

c. More complex rates may be used to provide financial incentive to change consumer behaviour. It is not necessary for a “regular” meter reading visit, although site inspections are still required.

d. Many systems will in addition remotely disconnect and reconnect supply.

e. Depending on the system, may have enhanced consumer information available such as outage and tamper detection and remote warning.

f. Usually will an have internal switching device such as a ripple relay or time clock for tariff rate switching.

g. Incentivise the consumer to shift load into cheaper times of the day.

h. Decrease in the number of consumer complaints related to metering.

i. Ability to log other inputs e.g. gas meters, water meters, etc.

j. Some models have internal display panels allowing consumers to view information about their energy consumption to a very fine level.

k. Some models are remotely configurable between prepay and postpay options.

Disadvantages of remote meter reading

4. The disadvantages of remote meter reading are as follows:

   a. Expected life of the system is unknown.

   b. Site is not visited regularly raising possibility of increased theft through meter bypass.

   c. Some RRM with remote supply reconnect does not have the facility that the consumer must reconnect after the supplier enables. This means that supply could be reconnected remotely without the consumer being present. This is quite different from restoration after a “power outage”. Reconnection should be remotely enabled by the retailer but requires consumer intervention to complete the reconnect cycle.

   d. Difficult for a consumer to know the cost of electricity that they are using but does allow the possibility of user access via web or SMS service to their current and past meter readings

   e. If meters do not disconnect from the communication system there could be capacity issues.

   f. Requires batteries for support when power is off and this is a maintenance issue that limits the life of the meter.

APPENDIX E: ADVANCED METER INFRASTRUCTURE MINIMUM ATTRIBUTE SET

1. The following is considered the minimum attribute set for any new advanced metering installation in New Zealand:

    a. Ability to provide a “no frills” meter function consisting of a single register meter operating continuously. All other functionality should be able to be disabled if not required.

    b. A load control switch if the current ripple control system is basically obsolete or the distributor agrees to the internal meter device.

    c. Ability to perform a meter reading as close as practical to changes in the retailer – consumer relationship.

    d. Remote disconnection of the premise when vacated.

    e. Ability to offer prepayment service, including the ability to move smoothly between prepayment and post payment (with addition of a suitable premium).

2. The key attributes are listed below.

    a. Back office shall:

        i. collect data in accordance with the Electricity Governance Rules 2003 (Rules);

        ii. keep time correction and meter event logs;

        iii. obtain data certification in accordance with the Rules (Half hour data Administrator (HHDA) or Non half hour data administrator (NHHDA) as appropriate);

        iv. ensure that meter clocks are within the accuracy set out in the Rules;

        v. monitor the event logs for abnormal meter events and pass this information to the retailer;

        vi. initiate remote disconnects and reconnects;

        vii. issue load management instructions; and

        viii. update meter with any program parameter changes, e.g. register or demand periods, price periods, or even prices themselves.

    b. Meter installation shall:

        i. comply with all of parts D and G of the Rules (including event logs and minimum data retention period);and

        ii. be installed and certified by an approved test house in accordance with the Rules to good industry practices.

    c. Meter operator shall:

i. operate the installation within the requirements of all parts D and G of the Rules;

ii. ensure that absolute recorded data is verified against cumulative meter registers at regular intervals;

iii. establish and maintain an approved data management plan, including contingency action in event of data loss;

iv. ensure that meter clocks are within the accuracy set out in the Rules;

v. ensure that meter parameter change procedures are robust and password protected as required by the Rules; and

vi. disconnect and reconnect only under the instructions of the retailer.

d. Retailers shall:

i. take responsibility for the operation and the certification of the data chain to the point of submission of information to the reconciliation manager; and

ii. give instructions for disconnection and reconnection of supply, only under the industry protocols that are agreed to.

Advanced metering attributes

		Must have	Preferred	Optional
Back office	1. Time correction records	✔		
	2. Meter event logs	✔		
	3. Power loss logs		✔	
	4. Collection of raw meter data in accordance with the Rules	✔		
	5. Rules certification as HH or NHHDA as applicable to metering information	✔		
Installation	6. Installed and certified by an approved test house	✔		
	7. Dust proof	✔		
	8. Installed a dry situation	✔		
	9. Complies with part D of the Rules	✔		
	10. Assess wiring condition before installing	✔		
	11. Ensure load control contacts are capacity and short circuit protected.	✔		
Data retention	12. Minimum period of data retention in accordance with the Rules	✔		
	13. Non volatile memory or battery backup + management plan	✔		
Load control	14. Remote total disconnection		✔	
	15. Disconnection devices must not disconnect the neutral	✔		
	16. Lifeline disconnection			✔
	17. Capacity control capability	✔		
	18. User programming of capacity control via internal display			✔
	19. Confirmation of main and discretionary load control switches.		✔	
	20. Remote connect/disconnect with PB consumer final connect		✔	
	21. Automatic under frequency load control		✔	
Detection	22. Real time outage detection			✔
	23. Tamper detection, phase neutral imbalance, meter open etc	✔		
Volume registers	24. Programmable number of accumulating registers	✔		
	25. Half hour consumption information	✔		
	26. Hosting of read output of other metering devices	✔		
	27. Remote display of accumulating registers used in settlement			✔
	28. Meter display of accumulating registers used in settlement	✔		
	29. Import/export measurement functionality			✔
	30. Reverse power (export) indication	✔		
Remote display	31. Ability to set user programmable automatic price rate, budget $, or capacity business rules to allow the meter to control load			✔
	32. Manual over-ride of user programmable automatic price or capacity business rules			✔
	33. Display of peak, average use, current use for the day in consumed $ and kWh			✔
	34. Ability to show consumption trends either via the display or internet			✔
	35. Show current retailers phone number			✔
Price registers	36. Remotely programmable price information/registers.			✔
	37. Remote display of pricing registers			✔
	38. Meter display of pricing registers			✔
	39. Remote pricing plan management			✔
	40. Display of consumption value in $			✔
	41. Display of price specials			✔
Meter reading	42. Routine read (scheduled)	✔		
	43. Special read (unscheduled)	✔		
	44. Precision of reads	✔		
Operation	45. Power off/restore flag		✔	
	46. Supply capacity control			✔
	47. External load control capability			✔

	48. Programming for measurement within the meter separated from the programming ability for cumulative registers and other load control or added value functionality	✔		
	49. Low frequency load shed capability		✔	
Prepay/Postpay	50. Remote switch from prepayment/post payment capable		✔	
Operation	51. Time synchronisation from back office software in accordance with the Rules	✔		
	52. Non remote programmable multipliers	✔		
	53. Common protocol with other meters	✔		
Technical	54. Available as 1, 2 or 3 phase direct connected	✔		
	55. Available as CT connected			✔
	56. Internal watch dog on critical components	✔		
	57. On site connectable/programmable	✔		
	58. Password protected in accordance with Schedule D2 security requirements for inbound communications	✔		
	59. Common data read protocol	✔		
Connections to other devices	60. Remote appliance control			✔
	61. Remote control manual override			✔
	62. Connectability to external controllers	✔		
	63. Connectability to/from other meters	✔		

Appendix E, Question 1. Do you agree with the minimum attributes listed in the advanced metering attributes table? Please discuss why you agree or disagree.
Appendix E, Question 2. Are there any other attributes that you consider should be included within any of the columns of the advanced metering attributes table? Please give reasons and discuss why you consider they should be included.

APPENDIX F: SUMMARY OF DISCUSSION POINTS

Question 1	Do you agree with the metering strategy outlined in section 3? Please discuss reasons for agreeing or disagreeing.
Question 2	Do you agree that competing demands for discretionary load could create a demand management issue for the industry? Please discuss reasons for agreeing or disagreeing. *(section 3: advanced metering and load management)*
Question 3	Do you agree that certain areas such as consumers on AUFLS feeders, and certain type of controlled load should remain under the centralised load management carried out by distributors? Please discuss reasons for agreeing or disagreeing. *(section 3: advanced metering and load management)*
Question 4	Do you consider that with the development of distributed load management within advanced meters distributors will have less incentive to maintain a centralised load management system? Please discuss reasons for agreeing or disagreeing. *(section 3: advanced metering and load management)*
Question 5	Is there additional advanced metering or load management capabilities that should have been included or noted? If yes, please discuss these. *(section 3: advanced metering and load management)*
Question 6	Do you agree that consumers will react to the price signals that advanced metering systems can deliver? Please discuss reasons for agreeing or disagreeing. *(section 3: advanced metering and load management)*
Question 7	Do you agree with the objectives outlined in section 4? Please expand with why or why not. *(section 4: objectives of advanced metering)*
Question 8	Are there additional objectives of advanced metering that should be added? If yes, please discuss these. *(section 4: objectives of advanced metering)*
Question 9	Do you consider that there is an issue to be addressed on ownership of discretionary load on a consumer's premise? Please discuss why you agree or disagree. *(section 7.2: load control)*
Question 10	Do you consider that the beneficiaries of information from advanced meters should pay for access to the information outlined in section 7.3? Please discuss why you agree or disagree.
Question 11	Do you consider that remote disconnections for credit issues should not be carried out? Please discuss why you agree or disagree. *(section 7.4: credit control and vacant premises control)*

Question 12	Do you consider that remote connections may require the consumer accepting responsibility for the restoration? Please discuss why you agree or disagree. *(section 7.4: credit control and vacant premises control)*
Question 13	Do you agree with the discussion on costs outlined in section 7.5? Please discuss why you agree or disagree.
Question 14	Do you consider that costs should be allocated to the beneficiaries of advanced meter functionality? Please discuss why you agree or disagree. *(section 7.5: costs)*
Question 15	Do you agree with the discussion on safety issues? Are there any other safety issues that should be considered? Please note and discuss these in your submission. *(section 7.6: safety)*
Question 16	Do you agree with the discussion on switching? Please discuss any issues in your submission. *(section 7.7: switching issues)*
Question 17	Are there any other switching issues that should be discussed? Please discuss these in your submission. *(section 7.7: switching issues)*
Question 18	Do you agree that there is a potential for advanced meters to create barriers to trade? Please discuss why you agree or disagree. *(section 7.8: barriers to competition)*
Question 19	Do you agree with the solutions to barriers to competition outlined in section 7.8.2? Please discuss why you agree or disagree.
Appendix B, Question 1	Do you agree with changing the metering installation definition in part A of the Rules? Please discuss why you agree or disagree. *(paragraphs 3, 4, 5, and 6)*
Appendix B, Question 2	Do you agree with not having any changes to rules 3 and 6 of part D of the Rules? Please discuss why you agree or disagree. *(paragraph 7)*
Appendix B, Question 3	Do you agree to changing rule 3.8 of code of practice D3 of part D of the Rules? Please discuss why you agree or disagree. *(paragraphs 8 and 9)*
Appendix B, Question 4	Do you agree that appropriate controls be placed within advanced metering installations and that it is reasonable to extend the inspection period beyond one year? Please discuss why you agree or disagree. *(paragraphs 11, 12, and 13)*
Appendix B, Question 5	Do you agree with not changing rule 3 of code of practice D4 of part D of the Rules? Please discuss why you agree or disagree. *(paragraphs 14 and 15)*

Appendix B, Question 6	Do you agree with the definitions in paragraph 18 being incorporated in the advanced metering guidelines? If not, what other suggestions do you have for improvement?
Appendix B, Question 7	Do you agree with the proposed changes to rule 5.1.7 of code of practice G1 of schedule G8 of the Rules? Please discuss why you agree or disagree. (paragraphs *18, 19, and 20)*
Appendix B, Question 8	Are there any other rules that you consider constrains the introduction of advanced metering infrastructure or technology that require changes? Please discuss any other rule changes you see as necessary.
Appendix E, Question 1	Do you agree with the minimum attributes listed in the advanced metering attributes table? Please discuss why you agree or disagree.
Appendix E, Question 2	Are there any other attributes that you consider should be included within any of the columns of the advanced metering attributes table? Please give reasons and discuss why you consider they should be included.