# Interval Meter Technology Trials and Pricing Experiments

## *Issues for Small Consumers*

*Prepared by*

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*For*

**Consumer Utilities Advocacy Centre**

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Discussion Paper

*For Consumer Utilities Advocacy Centre*

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## Disclaimer

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# EXECUTIVE SUMMARY

## Introduction

In July 2004, the Essential Services Commission (ESC) decided to mandate the rollout of interval meters for all electricity customers in Victoria (Essential Services Commission 2004). The Victorian Government has since undertaken investigations into the costs and benefits of an accelerated rollout of advanced meters equipped with communication capability. It has deferred the rollout of interval meters while these investigations are ongoing. As part of the investigations, the Victorian Government has agreed to fund interval meter technology trials and pricing experiments. These trials are due to commence in the final quarter of 2006, will run for six to nine months and will involve 1,000 households. The intention is that advanced interval meters will be rolled out from 2008.

This Discussion Paper considers consumer issues raised by the proposed metering and pricing trials. Its objectives are to:

- Review and document issues arising for small consumers from proposed interval metering trials and pricing experiments in Victoria
- Provide consumer advocates with a credible resource on these issues for use in advocacy work
- Draw attention to the social and equity-related issues that need to be considered in a comprehensive analysis of costs and benefits associated with interval meter rollouts
- Discuss approaches to trial design and other social policy responses that will help to address identified consumer issues.

## Social Justice in Electricity Markets

Electricity is an essential service and governments have a responsibility to ensure universal, affordable access to electricity. Further, from a social justice perspective, the burden of providing universal electricity supply should be shared fairly across society. In a privatised electricity market, this means that governments may need to use their regulatory powers to protect the public interest.

The most obvious way in which access to electricity may be threatened is when a household is experiencing financial hardship and has trouble paying their bill. This situation is more likely to occur in low-income households or households experiencing some other kind of disadvantage. Interval meter trials and pricing experiments, and any subsequent rollout of interval meters, have the potential to increase financial hardship for these customer groups. It is essential that the trials collect all necessary information on the social impacts of interval meters and alternative tariffs for all customer groups.

From a social justice perspective, it is also important to note that households differ in their ability to respond to the price signals provided by interval meters and dynamic tariffs. Typically, households that are experiencing disadvantage have the least discretionary demand and are least able to respond to price signals. Disparities in the ability to respond to price signals are of concern because they raise the possibility of increases in relative hardship – the gap between the rich and the poor – even though absolute hardship is unchanged. There is a risk that the price signals made possible through interval metering will make the rich richer and the poor poorer. These issues are considered in more detail throughout the Discussion Paper.

### Interval Metering Technology

Interval meters are meters that can record electricity usage over a short interval of time, typically half an hour, allowing construction of a customer load profile. Interval meters can be equipped with two-way communications, allowing utilities to read meters remotely, confirm a particular demand response by a customer, remotely manage load, send electronic bills, offer dynamic pricing structures and remotely connect or disconnect supply. Interval meters can also be linked to in-house displays that provide customers with price signals, consumption data and other information.

In most cases, the interval meter and the technology used to communicate with the utility will be essentially invisible to consumers, just as current accumulation meters are invisible or ignored. However, the quality of the visible component of the technology – the customer interface – will be very important to consumers. If customers are expected to respond to dynamic price signals, it is critical that these signals are clearly communicated. Complicated tariff structures that are not supported by in-house displays will make it difficult for consumers to respond to price signals. There is strong evidence that greater demand reductions can be achieved when in-house displays are provided. However, the benefits of providing in-house displays need to be weighed against the costs to consumers. Trials should aim to provide data to support cost-benefit analysis of in-house displays.

Remote load control, in which utilities briefly switch off appliances such as air conditioners, raises some specific issues for consumers. Some consumers see the technology as an invasion of privacy or are concerned that use of the technology will interfere with their comfort and lifestyle. For this reason, it is important that any trials of this technology are voluntary and that the technology is implemented in a way that avoids significant impacts on comfort or lifestyle.

### Dynamic Pricing

Interval meters support the implementation of dynamic pricing structures in which the price of electricity varies with time. Types of dynamic pricing include:

- Time-of-use pricing, in which the day is divided into time bands and different prices are charged during each time band
- Seasonal time-of-use pricing, in which a different time-of-use pricing structure applies at different times of year to reflect differing costs of supply
- Critical peak pricing, in which customers pay significantly higher prices during a small number of critical peak periods that are only known up to a day in advance

- Real time pricing, in which electricity prices change constantly to reflect the underlying cost of electricity supply

- Interruptible tariffs, in which customers receive a discount for allowing utilities to remotely control elements of their load

- Curtailable tariffs, in which customers are offered a discount if they are able to reduce their demand below an agreed threshold.

For those consumers that are currently cross-subsidising consumers with high peak demand, dynamic pricing should result in lower bills. Some consumers that currently have high peak demand will also be able to manage their energy demand so that they receive savings on their annual energy bills. However, other customers will have little scope to reduce demand in peak periods. Dynamic tariffs penalise those households that have little or no discretionary energy consumption, leading to unavoidable bill increases for those households. Low-income and disadvantaged consumers tend to have the least discretionary electricity demand and are the least able to respond effectively to dynamic price signals.

Dynamic tariffs need to remain voluntary so that customer groups that are likely to be negatively impacted can retain the option of a flat, regulated tariff under a deemed or standing contract. This approach will deliver peak reductions from those customers that are most able, without imposing hardship on particular customer groups, particularly those experiencing disadvantage.

## Previous Trials

The Discussion Paper reviews trials of interval metering and dynamic pricing by Country Energy, Integral Energy, Energy Australia and ETSA Utilities. The general impression from this review of metering and pricing trials in Australia is that utilities are very aware of possible negative impacts on consumers and have adopted appropriate measures to limit any impacts. First, the trials are voluntary and there are no penalties for opting out of the trial. Second, participants often receive incentive payments that offset any increases in bills. Third, some trials have excluded customers with payment difficulties so that there is no risk that these customers will experience an increase in hardship. Fourth, meters and associated equipment (including in-house displays) are provided at no cost to the customer. Finally, tariffs seem to have been set so that most customers will experience only small increases in bills even if they do not change their behaviour. These measures are appropriate for trials and should be adopted in the Victorian trials.

## Trial Design: Addressing Consumer Issues

Findings and recommendations relevant to trial design are briefly summarised below.

**Tariff and technology options**

- There would be value in trialling all dynamic tariff types other than real time pricing, however curtailable and interruptible tariffs and critical peak pricing (with an in-house display) seem most likely to deliver customer benefits

- As there is still some uncertainty about the value of in-house displays, it would be appropriate to design the trials to provide additional data on this issue

- Whatever the combinations of technology and tariff chosen, there should be a clear commitment that interval meter trials and pricing experiments should not increase financial hardship and new tariff structures should not be implemented in a way that increases financial hardship

- Simplicity in the design of tariffs is also critical – asking consumers to respond to complex seasonal TOU tariffs with multiple parts and seasonal changes may be asking too much

- Dynamic tariffs should not be used as an opportunity to further increase fixed charges at the expense of variable usage charges.

**Participant recruitment**

- Participation in smart meter and dynamic pricing trials must remain voluntary to minimise the risk of negative consumer impacts, however this means that the benefits will be overestimated (as participants that would not benefit will not participate)

- Self-selection cannot be avoided in a voluntary study, however, by randomly contacting potential participants and recruiting participants to match a representative demographic profile, self-selection can be minimised

- Potential participants must be fully informed of any potential harm they might experience as a result of participation in the trial, including the potential for higher bills

- Rules for opting out or having bills recalculated based on a regulated tariff need to be established prior to the trial and fully explained to participants.

**Participation rules**

- Participation should be voluntary

- Participants should have the right to opt out of the trial at any time without penalty, at which time they can revert to their previous contract, a standing contract or negotiate a new market contract with a retailer of their choice

- The Victorian Government should consider a rule under which participants that receive a high bill and decide to opt out of the trial would have the option of having their bill recalculated based on their previous tariff

**Incentive payments**

- Incentive payments mute the price signal delivered through dynamic pricing by insulating customers from higher bills and may reduce the observed demand response

- While it may be appropriate to use incentive payments in the Victorian trials, the Victorian Government could also consider non-financial incentives, such as free energy audits and energy efficiency retrofits

- If bill credits are to be provided as an incentive for participation, they should be delivered as a credit on each bill during the trial period

- For maximum consumer benefit, the trials could provide higher bill credits for summer and winter bills (relative to spring and autumn bills) as these are the times of year when bills are likely to be higher.

**Communication with participants**

- Ethical research practice requires that participants are fully informed of any potential harm to them from participation in the research, which means that all customers, but particularly those experiencing disadvantage, need to be fully informed of any potential increases to their bills as a result of the trials

- Ideally, there should be a dedicated telephone number that participants can call to ask questions or provide feedback at any time

- Brochures used to communicate trial details need to be easy to understand

- For TOU tariff trials without an in-house display, a fridge magnet showing the tariff structure would be very useful.

- For CPP trials, it is critical that customers receive notification of critical peak events via multiple forms of communication, including telephone calls, SMS, email and notification on an in-house display.

**Issues for disadvantaged customers**

- Low-income and disadvantaged customers are the most likely to experience negative impacts from smart meter and dynamic tariff trials, as well as the wider rollout

- However, some of these customers may benefit from dynamic tariffs

- Rather than exclude these customers from trials, the Victorian Government should specifically examine the impacts on these customers and look at ways that dynamic tariffs can assist them

- Disadvantaged customers participating in tariff trials will likely need extra protections to ensure that they do not experience increased hardship, which could potentially be managed by setting up a separate customer sample designed to provide representation of the different categories of disadvantage and operating under different rules.

- The Victorian Government might also consider trialling some socially sensitive, non-dynamic tariffs for disadvantaged customers.

**Social research**

- To fully understand the social impact of smart metering and dynamic tariffs, trials need to assess how benefits and costs vary across different customer groups and, where disadvantaged customers are included in a trial, explore in detail the issues that arise for these customers

- There is a need for qualitative social research with participants, through surveys, interviews or focus groups, to document participant experiences during the trial and investigate how their satisfaction with the trial would change under the differing conditions of a full rollout.

**Knowledge sharing**

- The decision by the Victorian Government to coordinate Victorian trials presents a strong opportunity to ensure that the design of the trials is transparent and that knowledge generated is publicly available, which is an appropriate role for government in a competitive electricity market.

## Conclusions

Smart metering technology and dynamic electricity pricing have the potential to enhance the economic and environmental sustainability of electricity supply. The intention of this Discussion Paper is not to create barriers to the introduction of smart metering and dynamic electricity pricing. Rather, it seeks to ensure that the social dimension of sustainability is given due consideration alongside economic and environmental considerations. Metering and pricing trials need to be implemented in a socially sensitive way, taking into account the diverse circumstances of Victorian domestic consumers. Further, these trials need to collect sufficient information to give confidence that the wider rollout of meters and dynamic tariffs can be managed to avoid increases in financial hardship.

From our review of previous and current trials in Australia, it appears that utilities are very sensitive to the possible social impacts of the trials and have taken appropriate steps to limit these impacts. The Victorian Government has the opportunity to draw on this previous experience when coordinating trials in Victoria. Ensuring that the trials provide the necessary information to draw conclusions about wider social impacts (and ways to address them) is more difficult. In a wider rollout, there will inevitably be winners and losers if cross-subsidies are to be removed and the utility is to maintain its revenue. Identifying who will lose from these tariffs is difficult using the distorted sample from a voluntary trial.

Separate trials for disadvantaged customers will help to ensure that the specific impacts experienced by these vulnerable consumers are given adequate attention. Expansion of the scope of social research associated with the trials will also increase the value of the trials as an input to social impact assessment of the wider rollout.

One way to limit the wider social impacts of dynamic tariffs is to ensure that these tariffs remain voluntary. However, a better approach might be to give disadvantaged households the support they need to take advantage of dynamic pricing, through concessions, customer safety net provisions, targeted retrofits and other measures. If retail competition is to bring benefits to all consumers, then ways to safely bring disadvantaged customers into the market need to be identified.

Finally, it is important to be cautious about what can actually be achieved through use of price signals. Electricity is an essential service and demand for electricity is inelastic. It is likely that equivalent or better reductions in demand can be achieved using non-price measures, such as regulation to improve energy efficiency, targeted retrofits for disadvantaged households and subsidies for energy efficient equipment and distributed energy. These measures would have fewer negative impacts for consumers and would be more likely to deliver greenhouse gas reductions alongside reductions in peak demand.

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# ABBREVIATIONS

| | |
|---|---|
| AIMRO | Advanced Interval Meter Roll-Out |
| CPP | Critical peak pricing |
| CUAC | Consumer Utilities Advocacy Centre |
| DLC | Distribution Line Carrier |
| ESC | Essential Services Commission (Victoria) |
| ESCOSA | Essential Services Commission of South Australia |
| LCU | Load Control Unit |
| IMRO | Interval Meter Roll Out |
| ISF | Institute for Sustainable Futures |
| PLC | Power Line Carrier |
| RTP | Real time pricing |
| TOU | Time-of-use |
| UTS | University of Technology, Sydney |

# 1 INTRODUCTION

This Discussion Paper, prepared by the Institute for Sustainable Futures (ISF) at the University of Technology, Sydney (UTS), explores consumer issues associated with interval meter technology trials and pricing experiments currently planned for Victoria's electricity sector. Section 1.1 provides background on the decisions and processes that have led to the planned trials. Section 1.2 discusses the objectives of the Discussion Paper. Section 1.3 briefly outlines the approach used to develop the Discussion paper. Section 1.4 summarises the structure of the Discussion Paper.

## *1.1 Background*

In July 2004, the Essential Services Commission (ESC) decided to mandate the rollout of interval meters for all electricity customers in Victoria (Essential Services Commission 2004). An **interval meter** is a particular type of electricity meter that records electricity consumption in real time (e.g. every half hour). When real time information on electricity consumption is available, electricity retailers and network businesses can charge different rates for electricity delivered at different times of day or year. If higher prices are charged at peak times, consumers may respond by shifting their consumption away from these periods. This is an attractive prospect for policy makers, regulators and utility businesses because it reduces the investment in electricity network infrastructure required to cope with peak demand.

In its Final Decision, the ESC noted that interval meters would deliver better price signals to consumers and support cost-reflective pricing of electricity. It concluded that 'a rollout of interval meters would improve the competitiveness and efficiency of the electricity market in Victoria and thereby contribute future net economic benefits to electricity customers and to the economy generally' (Essential Services Commission 2004, pp., p.1). The rollout of interval meters to residential customers was to occur progressively, on the following basis:

- Interval meters to be installed by 2011 for all large residential customers (those consuming less than 160 MWh per year but more than 20 MWh per year) with off-peak metering or three-phase metering, with new and replacement installation commencing in 2006
- Interval meters to be installed by 2013 for all residential customers (those consuming less than 20 MWh per year) with off-peak metering or three-phase metering, with new and replacement installation commencing in 2006
- Interval meters to be installed on a new and replacement basis for all residential customers with single-phase, non-off-peak metering, with installation commencing in 2008.

The ESC based its decision on an assessment that the benefits of an Interval Meter Roll-Out (IMRO) would exceed the costs.

The ESC's decision did not require any communications equipment to be installed as part of the interval meter rollout. If there is no way to communicate real time consumption data, many of the potential benefits of interval metering will be lost. Therefore, the Victorian Government commissioned a specific study to investigate the costs and benefits of including communications technology as part of the IMRO (CRA International 2005). The study also investigated the costs and benefits of accelerating the IMRO.

The study found that an accelerated IMRO, using any one of three communications technologies, would have net benefits over the IMRO proposed by the ESC (CRA International 2005). It recommended deferral of the commencement of the ESC's IMRO to allow further development of a proposal for an Advanced Interval Meter Roll-Out (AIMRO). It also recommended that the Victorian Government coordinate technology trials and pricing experiments. The role of the technology trials is to confirm that particular technologies meet requirements for advanced metering in urban and rural areas and to improve understanding of any performance or operational issues. The role of the pricing experiments is to estimate the potential magnitude of electricity demand reduction associated with different tariff structures.

The Victorian Government has since agreed to fund interval meter technology trials and pricing experiments. It has established a Strategy Group to oversee the trials with membership from the ESC, Department of Infrastructure, industry and the Consumer Utilities Advocacy Centre (CUAC). Trials are due to commence in the final quarter of 2006, will run for six to nine months and will involve 1,000 households. The intention is that advanced interval meters will be rolled out from 2008.

Interval meter technology trials and pricing experiments raise numerous questions for Victorian utility consumers. How will trial participants be selected? Will they have the opportunity to opt out of a trial? Will there be financial incentives for participation? Will participants receive higher overall bills if they are unable to shift consumption away from peak periods? What types of metering interface best meet the needs of small consumers? Do participants fully understand the trial tariff structures? Will the trials collect all of the information required to fully assess all costs and benefits to small consumers?

This Discussion Paper considers these and other consumer issues raised by the proposed metering and pricing trials. It will assist the consumer advocacy organisations that are engaging with this issue to understand the possible consumer issues and social impacts raised by the trials, and to devise social policy responses. In addition, it offers advice on how to design and implement the trials so that consumer interests are taken into account.

While this Discussion Paper is focused on the Victorian situation, the issues considered here have broader relevance, given the decision by the Council of Australian Governments in February 2006 to pursue rollout of interval meters across Australia. The caveat on this decision is that the benefits must outweigh the costs for residential customers. This Discussion Paper will consider the social costs and benefits of interval metering for residential customers, providing valuable input into the debate on interval metering in other jurisdictions.

## 1.2 Objectives

The objectives of this Discussion Paper are to:

- Review and document issues arising for small consumers from proposed interval metering trials and pricing experiments in Victoria
- Provide consumer advocates with a credible resource on these issues for use in advocacy work
- Draw attention to the social and equity-related issues that need to be considered in a comprehensive analysis of costs and benefits associated with interval meter rollouts
- Discuss approaches to trial design and other social policy responses that will help to address identified consumer issues.

## 1.3 Approach

To develop this Discussion Paper, the ISF drew on relevant reports and other literature related to interval meter trials, tariff design and social justice in electricity markets. A full bibliography is provided in Section 8.

In addition, ISF conducted a small number of interviews. We spoke to consumer advocates as well as utility representatives that had experience with interval meter trials and pricing experiments in Australia. Interview participants are listed under the Acknowledgements in the front of the Discussion Paper.

## 1.4 Structure of the Discussion Paper

The Discussion Paper is structured as follows:

- Section 2 explores the idea of social justice in electricity markets to provide a foundation for identifying consumer issues associated with interval meter trials and pricing experiments
- Section 3 provides more detail on interval metering technology, associated communication technologies and customer interfaces
- Section 4 reviews the various forms of dynamic pricing that become available once interval meters are installed and identifies consumer issues associated with each
- Section 5 discusses some of the previous and current interval meter trials in Australia and consumer issues that have emerged from these trials
- Section 6 provides advice on how to design interval meter and dynamic tariff trials to address the consumer issues raised in the Discussion Paper
- Section 7 presents final conclusions.

# 2 SOCIAL JUSTICE IN ELECTRICITY MARKETS

It is widely recognised that energy is an essential service. Energy provides space heating and cooling to keep our homes at a liveable temperature; it provides hot water, refrigeration and cooking facilities to help people maintain basic hygiene and health; and it provides lighting to increase safety. In addition, access to energy meets important social needs; it supports economic and social exchange and helps individuals to participate in broader society. The Bracks Government sees access to energy as 'a prerequisite to social participation and adequate standards of living' (Department of Infrastructure 2006, pp., p.1).

While electricity is not the only available source of energy, it is essential for powering refrigeration, lighting, appliances and equipment, and is the only readily available energy source for homes that do not have access to natural gas. Access to electricity is essential in a modern society.

Because electricity is an essential service, governments have a responsibility to ensure universal, affordable access to electricity. Further, from a social justice perspective, the burden of providing universal electricity supply should be shared fairly across society. In a privatised electricity market, this means that governments may need to use their regulatory powers to protect the public interest.

The most obvious way in which access to electricity may be threatened is when a household is experiencing financial hardship and has trouble paying their bill. This situation is more likely to occur in low-income households or households experiencing some other kind of disadvantage, where:

> Persons [are] seen as disadvantaged when their life circumstances [prevent] them from participating fully in community life. These people may include those with a disability, mental illness or substance dependency, in poverty, the unemployed, the homeless, Indigenous [people], older persons and those with carer responsibilities (ACT Government 2003, pp., p.3).

Just as disadvantage prevents people from participating fully in community life, so it can prevent them from participating fully in electricity markets.

In March 2005, the Victorian Government established a Committee of Inquiry into Financial Hardship of Energy Consumers. The Inquiry Report (Committee of Inquiry into the Financial Hardship of Energy Consumers 2005) and a subsequent Bracks Government Policy Statement (Department of Infrastructure 2006) establish a process for addressing consumer hardship and preventing disconnection from supply. It is not the purpose of this Discussion Paper to assess the adequacy of this process. Instead, this Discussion Paper will consider the specific question of whether interval meter trials and pricing experiments have the potential to increase financial hardship for some customer groups.

Of course, it is not only the trials that may have the potential to increase hardship; the subsequent roll-out may also create hardship. From a social justice perspective, it is essential that the trials collect all necessary information on the social impacts of interval meters and alternative tariffs to support comprehensive social impact assessment (Dufty 2005). Otherwise, it will not be possible to ensure that the costs and benefits of an AIMRO are shared fairly across all consumers. This means that technology trials and pricing experiments need to include a representative sample of Victorians. If the sample does not include representatives from particular groups experiencing disadvantage, the findings may exclude important negative impacts experienced by those groups. However, the inclusion of disadvantaged groups in trials, potentially exposing them to higher electricity bills, raises ethical issues. These issues are considered in more detail in Section 6.

The rationale for interval metering and dynamic tariffs is that they offer a way to introduce customers to price signals that better reflect the real cost of electricity supply. However, customers differ in their need, desire and ability to respond to price signals. One of the key differences relates to the customer's discretionary demand. Discretionary demand is non-essential demand that can be easily curtailed or shifted to another time. Some households have a lot of discretionary demand because they have a lot of appliances, use electricity for leisure and lifestyle pursuits or have flexibility in the times when they use electricity. Other households have little discretionary use because they can only afford to use electricity for essential purposes and are constrained in the times when they use electricity.

Given this background, it is possible to identify customer groups that will have very different responses to price signals. For example:

- Households with high income and high levels of consumption will generally have high levels of discretionary demand. These households are most able to respond to price signals but have the least need to do so, as they can easily afford to pay higher bills.

- Large families, tenants, households with low income, households with members that are not participating in the workforce or work irregular hours, and other households experiencing disadvantage will generally have low levels of discretionary demand. These households are the least able to respond to price signals because, for example, they lack the capital to upgrade housing stock or appliances, are subject to time constraints that force them to consume in peak times or have cultural reasons for consuming electricity at particular times. However, these households have the most pressing need to reduce their electricity bills.

- Middle-income households are the most likely to respond to price signals as they have an appropriate balance of ability to respond and financial incentive to respond.

Disparities in the ability to respond to price signals are of concern because they raise the possibility of increases in relative hardship – the gap between the rich and the poor – even though absolute hardship is unchanged. There is a risk that the price signals made possible through interval metering will make the rich richer and the poor poorer.

Given this context, there is a clear need to consider ethics and social justice in trial design. At the very least, the trials should seek to avoid increases in absolute or relative hardship for participants. This means paying close attention to tariff design, participant recruitment methods, rules and incentives for participation and communication. These issues are considered in more detail in Section 6, following reviews of the available technologies and tariffs and a summary of lessons from previous or ongoing trials in Australia.

# 3 INTERVAL METERING TECHNOLOGY

As noted in Section 1.1, interval meters are electricity meters that record consumption over short periods of time (typically every 30 minutes), allowing construction of a customer load profile. When combined with communication technologies, interval meters are often referred to as **smart meters**. According to the Bayard Group, the global growth in smart metering is linked to four factors:

- Increasingly common supply and network constraints in electricity systems
- The development of new, cost-competitive, digital technologies
- The introduction of liberalised, competitive energy markets
- Growing concern about environmental protection (Bayard Group 2006).

It is interesting that the Bayard Group does not list consumer need as one of the drivers for the growth in smart metering. While some consumers may be interested in having more detailed information about their electricity consumption, many give electricity consumption little thought and simply pay the bill when it arrives. As consumers are not directly driving the introduction of advanced metering technologies, it is particularly important to identify possible impacts of the technology on consumers.

The economic theory underlying the introduction of smart metering technology is that consumers will respond to improved price signals. Smart meters offer a way to deliver a price signal that changes over time, providing an improved reflection of the real cost of delivering electricity to a particular customer at a particular time. The specific technology employed influences the effectiveness of the price signal delivered to the consumer. The sections below consider each of the elements in the interval meter technology chain in more detail.

## *3.1 The meter*

Traditional electricity meters are accumulation meters, based on 100-year old technology. They accumulate electricity usage data by recording the number of times a metal disk spins inside the meter box (Bayard Group 2006). They are read manually by visual inspection. Consumption is calculated as the difference between the new meter reading and the previous reading. These meters give no information about how electricity demand varies during the day. The customer only receives feedback on their total consumption when they receive their bill, which can be months after the consumption actually occurred.

Modern interval meters are solid-state digital meters that record and store energy usage, demand and other parameters over short intervals of time – typically half an hour. Thus, interval meters can be used to determine how electricity demand varies during the day. The graph of electricity demand over time for a particular customer is known as their load profile. Using the load profile, it is possible for utilities to implement dynamic pricing structures in which different prices are charged for usage at different times of day. In addition, consumption information can be fed back to the customer almost instantaneously, along with a price signal, so that they have an opportunity to modify their consumption.

## 3.2 Communications

Interval meters can be manually read by a technician who downloads the stored interval data from the meter. A rollout of manually read interval meters would satisfy the requirements of the ESC's IMRO decision. When an interval meter is manually read, it is possible (at least in theory) to charge customers a tariff that varies in a known way over time, either during the day or seasonally. The customer does not need instantaneous feedback on consumption and price to respond to this type of tariff structure. However, some metering systems still aggregate the interval data so that it cannot be used in this way.

Additional benefits are possible when the meter is combined with communication technologies. Mesh radio, power line carrier (PLC), distribution line carrier (DLC) and wireless (GPRS or CDMA) communication technologies can all be used to establish communication between the meter and the utility. Meters equipped to send data to the utility can be read remotely, which results in significant cost savings over manual reading. Remote reading also avoids one of the major problems of manual reading, which is obtaining access to the meter. In some systems, the data is sent to a meter reader as they walk or drive by the building. In others, it is sent via a fixed network to a local substation, a data concentrator or a central facility.

Meters can also be equipped with two-way communications via fixed networks, so that information can pass from the utility to the customer, as well as from the customer to the utility. This technology allows utilities not only to read meters remotely but also to confirm a particular demand response by a customer, to remotely manage load, to send electronic bills, to offer dynamic pricing structures and to remotely connect or disconnect supply (Bayard Group 2006; CRA International 2005). According to the Demand Response and Advanced Metering Coalition (DRAM 2004), advanced meters should be able to transmit data to the utility on at least a daily basis.

## 3.3 Customer interface

Although not identified as core functionality under AIMRO, some utilities are trialling the use of in-house displays to provide customers with price signals, consumption data and other information (see Section 5). The in-house display shows information such as the current electricity consumption and cost, accumulated consumption and cost and the tariff that currently applies. Some in-house displays are equipped with tariff indicator lights, to show peak, off-peak, shoulder and critical peak periods. They may also be able to display messages from the utility. In-house displays can be integrated into the interval meter or can be separate units.

Although not essential for most types of dynamic pricing, in-house displays are often used to support the implementation of critical peak pricing (see Section 4.3). In-house displays give customers the best opportunity to manage their demand by providing constant access to direct feedback on price and usage. A recent review of the literature on energy feedback found that the provision of direct feedback through in-house displays or the meter itself consistently delivers greater demand reductions than indirect feedback through bills or other methods; the former delivered savings of 5 to 15%, the latter savings of 0 to 10% (Darby 2006).

Another type of customer interface is available through the Internet. Password-protected interval data can be posted on the web so that customers can access information on their usage patterns, test the impact of their attempts to save energy and check the size of their bill. An example is the WebGraphs service provided by Testing and Certification Australia (see http://www.tcaust.com/tcaweb/tcapublishing.nsf/Content/WebGraphs).

## 3.4 Remote load control

Interval meters equipped with two-way communication can also be used to directly control appliances in the home. The meter can be connected to an appliance, such as an air conditioner or pool pump, giving the utility control over that appliance. In periods when demand is approaching the capacity of the network, the utility can send a signal to the appliance that switches it off for a short period, thereby reducing demand. Remote control of air conditioning load is common practice in the United States.

## 3.5 Discussion

In considering the potential consumer issues associated with interval metering technology, it is important to recognise a distinction between the visible and invisible components of the technology. In most cases, the interval meter and the technology used to communicate with the utility will be essentially invisible to consumers, just as current accumulation meters are invisible or ignored. Consumers will have little interest in the details of this technology, beyond its ability to empower them by providing them with more detail about their electricity use.

However, the quality of the visible component of the technology – the customer interface – will be very important to consumers. If customers are expected to respond to dynamic price signals, it is critical that these signals are clearly communicated. Complicated tariff structures that are not supported by in-house displays will make it difficult for consumers to respond to price signals. As noted earlier, there is strong evidence that stronger demand reductions can be achieved when in-house displays are provided.

The current generation of in-house displays, such as the Ampy Email EcoMeter, have prominent tariff indicator lights, graphical displays and real-time messaging to ensure that the consumer receives all necessary or desired information on a timely basis and in an easy to understand format. While these capabilities are desirable, it is important to seek a balance between the capability of the in-house display and the cost to consumers.

The cost of these various technologies is perhaps the major potential issue for consumers. While the technology is often provided free of charge during trials, utilities will need to recover any additional costs during full-scale rollouts. Under the IMRO, utilities were to roll out 217,000 new interval meters and 777,000 replacement interval meters to all customers over 2006-10 at a cost of $445 million (ESC 2006). The provision of metering services to small customers is a prescribed service that is separately regulated by the ESC and distributors recover the costs through regulated metering charges. At present, the charges for manually read interval meters are the same as the charges for accumulation meters, which means that the costs of the IMRO would be spread across all customers. Nevertheless, the IMRO does have additional costs, which are borne by customers. These additional costs can be significant for customers that are already experiencing financial hardship.

It is not yet clear how customers would be charged for the cost of an AIMRO but a similar approach may be adopted. A report by CRA International (2005) found that an AIMRO would have net benefits under appropriate technology configurations. While the addition of communication technology raises the cost of metering, there are operational savings for the utility in addition to potential savings resulting from demand response. If these findings are accurate, it should be possible to deliver an AIMRO without any additional cost to the consumer and perhaps even at a lower cost than an IMRO. However, much depends on the actual approach to cost recovery and consumer advocates will need to monitor any future decisions on this issue.

It is important to note that the CRA International report did not consider the cost of providing in-house displays. As noted above, there is evidence that in-house displays provide access to additional benefits for consumers and utilities. However, these benefits need to be weighed against the additional cost. It would be appropriate for metering trials in Victoria to compare the demand response achieved with and without in-house displays to better understand the benefits they provide to consumers and utilities. This would then support additional cost-benefit analysis to determine whether it is appropriate, from a consumer perspective, to provide in-house displays as part of an AIMRO.

Remote load control also raises issues for consumers. Some consumers see the technology as an invasion of privacy or are concerned that use of the technology will interfere with their comfort and lifestyle. For this reason, it is important that any trials of this technology are voluntary and that the technology is implemented in a way that avoids significant impacts on comfort or lifestyle.

# 4 DYNAMIC PRICING

As long as technology costs are kept down, the interval metering technology discussed in Section 3 does not, in itself, result in any significant changes for the domestic consumer. However, interval metering supports the implementation of dynamic pricing, where the price charged for electricity varies with time. According to Wellsmore (2006, pp., p.4), the arguments raised in favour of dynamic pricing fall into three categories:

- Sending a 'price signal' to consumers to undertake demand management
- The desirability of ending cross-subsidies between consumers with different levels of use or who create different costs for their providers; and
- Improving cost-recovery by trying to match the costs of consumption with the bills being sent to customers.

Each of these arguments has merit. However, it is important to consider the impacts on consumers associated with various types of dynamic pricing. This section reviews the major types of dynamic pricing that are possible in conjunction with interval metering and outlines their advantages and disadvantages for consumers.

## *4.1 Time-of-use tariffs*

A time-of-use (TOU), or time-of-day, tariff is a type of dynamic pricing in which the day is divided into time bands and different prices are charged during each time band. In a basic TOU tariff, the day is divided into peak and off-peak periods, with a higher price charged during peak periods. This encourages consumers to shift their consumption out of the peak period and into the off-peak period, thereby reducing demand on electricity infrastructure at these times.

More complicated forms of TOU tariff may identify shoulder periods between the peak and off-peak periods, with prices intermediate between the peak and off-peak prices. The identified periods may also differ on weekdays and weekends. However, to make it easy for consumers to remember and respond to the tariff structure, there are usually no more than four separate time periods defined during the day. Energetics (2003) found no evidence that small customers would be willing to accept pricing structures with more than two or three different parts.

A TOU tariff can be implemented using a manually read interval meter with no communication or in-house displays. The only requirement is that consumption during each of the defined tariff periods can be identified in the data read from the meter. In this case, the customer can be informed of the tariff structure using brochures and/or web pages. At the other extreme, a TOU tariff could be implemented using remotely-read meters, two-way communication and an in-house display to inform customers of the applicable tariff.

For many domestic consumers, TOU tariffs will already be familiar from off-peak billing for hot water or from telephone bills. The tariff structures are relatively easy for customers to remember and their constancy allows customers to establish new routines to reduce consumption in peak times.

TOU tariffs reduce the extent to which customers with lower demand during peak periods, such as those without air conditioners, are subsidising customers who have high demand during peak periods. From this perspective, TOU tariffs more appropriately reflect the real cost of supply to a particular household. However, customers that are unable to shift their consumption out of the peak periods, for whatever reason, may experience higher bills. This may be appropriate if the customer is willing and able to pay for an air-conditioned home, but can be problematic if the customer is a large family with little scope to shift consumption.

Another concern with TOU tariffs, particularly when they are implemented without an in-house display to remind customers of the different tariffs at different times of day, is that customers can receive a large initial bill if they fail to respond or understand the price signals. With quarterly billing, there is a delay of up to three months between electricity usage and the price signal provided in the bill. This means that customers can accumulate a large bill without realising they are doing so. For customers with cash flow problems, this can create financial hardship. This problem can be managed to some extent by providing an in-house display as a reminder of daily tariff changes or by billing more frequently (e.g. monthly).

## 4.2 Seasonal time-of-use

As the timing, duration and magnitude of peak periods differs from summer to winter, some utilities have implemented seasonal TOU tariffs to better reflect the differing seasonal costs of electricity supply. Usually, this means that a different TOU tariff applies at different times of year. The seasons may be defined in various ways, depending on the network objectives. Typically, there are higher prices for summer and winter peak periods and lower prices for spring and autumn.

A seasonal TOU tariff has much the same advantages and disadvantages as described in Section 4.1. However, the tariff structure is more complex, making it more difficult for customers to understand, remember and respond to it. Further, the seasonal changes may make it more difficult for customers to establish routines that avoid consumption during peak periods. In addition, bills in particular seasons are likely to be higher than they are at present. For customers experiencing cash flow problems, these higher bills may be difficult to manage, even if bills are lower at other times of the year.

## 4.3 Critical peak pricing

In critical peak pricing (CPP), or dynamic peak pricing, customers pay significantly higher prices during a small number of ‘critical peaks’. The price for these periods is defined in advance but the timing of the critical peaks is not known until shortly before the event. The utility informs the customer of an impending critical peak using various communications media, including automated telephone calls, email, SMS and messages on in-house displays. The warning may be received as much as 24 hours before the event or as little as two hours before the event. The customer then has the opportunity to avoid the high prices by curtailing consumption during the critical peak. There is evidence that CPP provides greater overall consumer benefits than TOU pricing (Faruqui & George 2002).

Critical peaks usually have a short duration (up to four hours) and the utility usually commits to a maximum number of events per year, month and day. From a network perspective, CPP reflects the fact that there are only a small number of events each year in which demand approaches network capacity, usually prompted by very high or low temperature or market events (such as removal of generation capacity). The cost of supply during these times is very high, due to high costs in the wholesale electricity market and/or high network congestion costs. CPP sends a price signal to consumers to reflect this. For utilities, critical peak pricing can deliver 95% of the value of real time pricing (see Section 4.4) while containing back office costs (Amos 2006).

While CPP could theoretically be implemented using an interval meter with no communication capability, in practice it is usually implemented using an interval meter with two-way communications and an in-house display. The in-house display provides a way to deliver the message to the customer that a critical peak is impending. It gives the customer the best opportunity to recognise the higher price and shift their consumption.

Outside critical peak periods, the customer pays an underlying flat tariff or TOU tariff that is less than the comparable tariff. This compensates the customer for the high prices during the critical peak. When the underlying tariff is a TOU tariff, the utility usually sets the timing of critical peaks to coincide with the daily peak period.

CPP raises several issues for domestic consumers. If the customer misses the announcement of the critical peak or the notice of the event is short, they may not be able to shift their consumption and may experience significant costs. For example, if a customer set their air conditioner to come on at a certain time each day and missed the announcement of a critical peak event, they would incur a large cost. Trials to date seem to indicate that this is not a major problem when participation is voluntary and customers are able to choose their preferred communication type (see Section 5). However, voluntary participation creates a separate set of problems; self-selection of participants and exclusion of those participants that are likely to experience negative impacts means that trials will underestimate the negative impacts of a wider roll-out. Further, it is important that the decision to volunteer for a trial is based on complete and accurate information about the potential impacts. These issues are considered in more detail in Section 6.

Mandatory rollout of this kind of tariff would be problematic, as some customers may have limited access to communication media (e.g. the Internet and mobile phones), insufficient understanding of the tariff (e.g. due to language problems) or little discretionary energy use. These customers would be penalised for their inability to respond. These problems are also considered in more detail in Section 6.

## 4.4 Real time pricing

In a real time pricing (RTP) situation, electricity prices change constantly to reflect the underlying cost of electricity supply. For example, prices might be changed every hour to reflect those in the wholesale electricity market, plus an underlying charge for infrastructure (Amos 2006). RTP requires the customer to be constantly vigilant to identify periods when prices are high and reduce their demand in these periods accordingly. As such, it is best suited to large commercial or industrial customers with large amounts of discretionary demand, rather than small domestic customers. ISF is not aware of any current proposals to trial RTP with domestic customers, so this type of dynamic pricing is not considered further here.

## 4.5 Interruptible and curtailable tariffs

Interruptible tariffs are used in conjunction with the remote load control technology discussed in Section 3.4. As compensation to customers that agree to have their appliance load interrupted in some way by the utility, they receive a tariff that is discounted in some way compared to the standard tariff. The discount might take the form of an incentive payment, a rebate based on the number of times load control is used or a reduced tariff.

Interruptible tariffs are only problematic for domestic customers if they begin to impact on lifestyle and comfort to a greater degree than the customer had expected. As long as these tariffs remain voluntary and the customer can opt out without penalty, they seem to raise few direct issues for consumers and ask very little of consumers. For utilities, one of the benefits of using interruptible tariffs is that the amount of load reduction available is known and does not rely on unpredictable customer behaviour.

A curtailable tariff adopts a slightly different approach. Under this type of tariff, the utility offers incentive payments to customers that are able to reduce their energy use by an agreed amount on specified peak days. Curtailable tariffs were used in California following the electricity crisis in 2001. Under the 20:20 Program, customers were offered 20% discounts on their electricity bills for reducing their energy use by more than 20% (DRAM 2002). Under a curtailable tariff, it is up to the customer how they achieve the specified load reduction. This empowers customers to manage their load in the way that is most appropriate at the time. If, for some reason, they can't achieve the specified reduction, they are not penalised. This type of scheme seems particularly positive for consumers.

## 4.6 Discussion

It is clear that interval metering technology makes new types of dynamic pricing possible that better reflect the time variation of the costs of electricity supply. For utilities, this type of pricing is attractive because it has the potential to trigger a demand response at times when the network is most likely to be constrained. This demand reduction may be sufficient to delay network augmentation in particular areas, resulting in significant cost savings.

The benefits for consumers are more variable. For those consumers that are currently cross-subsidising consumers with high peak demand, dynamic pricing should result in lower bills. Some consumers that currently have high peak demand will also be able to manage their energy demand so that they receive savings on their annual energy bills. However, other customers will have little scope to reduce demand in peak periods. As pointed out by Langmore and Dufty (2004, pp., p.4), dynamic tariffs penalise those households that have little or no discretionary energy consumption, leading to unavoidable bill increases for those households.

Previous work has shown that low-income and disadvantaged consumers have the least discretionary electricity demand and are the least likely to be able to respond effectively to dynamic price signals (ISF 2004). At the same time, low-income households can have high peak demand for reasons that are out of their control (Wellsmore 2006). Often, these customers live in housing stock (often rented) with poor thermal performance, equipped with inefficient appliances. They lack the capital to improve their energy efficiency and have little non-essential demand. Consequently, these customers are the most likely to experience negative impacts from new dynamic tariff structures. This is a concern from a social justice perspective.

The variation in available benefits for domestic consumers is of less concern during pricing trials, as participation tends to be voluntary, most trials include incentive payments to offset any bill increases and there are usually no penalties for opting out. However, following rollout of interval meters, utilities will have an incentive to move more customers onto dynamic tariffs. Dynamic tariffs need to remain voluntary so that customer groups that are likely to be negatively impacted can retain the option of a flat, regulated tariff under a deemed or standing contract. This approach will deliver peak reductions from those customers that are most able, without imposing hardship on particular customer groups, particularly those experiencing disadvantage.

A voluntary approach still has some problems. Is seems unfair that high-income households with large amounts of discretionary demand should have a greater opportunity to save on their bills than low-income households with little discretionary demand. This points to the importance of separate, non-price policy approaches to address social justice concerns.

It is important to note that the potential magnitude of consumer impacts varies with the type of tariff structure. Interruptible and curtailable tariffs will not result in bill increases. For other types of dynamic pricing, the likelihood of a bill increase depends very much on the specific details of the tariff structure. Obviously, tariffs with very high prices at particular times, such as CPP and RTP, can potentially create large bills in a short period of time. However, although the peak prices in a TOU tariff will be significantly lower than those applying during critical peaks, they apply over longer periods; this means that TOU tariffs may have a greater total potential to create high bills. Clearly, regulators need to closely examine the details of particular tariff offerings to identify those that may be of concern.

The complexity of some dynamic tariff offerings is also a concern. Regulators will need to closely scrutinise dynamic tariff offerings and the way that these are marketed to ensure that vulnerable customers are not locked into tariffs that they do not fully understand.

# 5 PREVIOUS TRIALS

This section reviews interval meter trials and pricing experiments undertaken (or underway) in Australia to identify any consumer issues that arise and how these have been addressed.

## 5.1 The Country Energy Home Energy Efficiency Trial

Country Energy commenced an 18-month Home Energy Efficiency Trial in December 2004. The purpose of the trial was to 'better understand [their] residential customers' propensity to change their electricity consumption patterns, if provided with more information about their consumption and its relative cost at different times of the day and year' (Hamilton 2006). The trial involved 150 residential customers in the Queanbeyan and Jerrabomberra region, all with single-phase electricity supply. This area was chosen because it is broadly representative of the regional areas that Country Energy serves. It has a varied demographic profile, with a mix of low, medium and high incomes, different family sizes and different life stages. It also has a good mix of housing types, from the older homes in Queanbeyan to larger, newer homes in Jerrabomberra (Hamilton, 2006, pers.comm., 13 July).

To select participants, Country Energy started with a survey to collect data on demographics, appliance ownership and energy usage. From more than 600 customers expressing an interest in participating, Country Energy randomly selected participants to match particular demographic profiles that covered a range of users (Hamilton & Zoi 2005). The use of a demographic profile was a deliberate attempt to avoid self-selection of customers who were already environmentally aware, such as Green Power customers. There was no specific attempt to include disadvantaged households in the sample. However, disadvantaged households would have been represented to the extent that they appear in the broader population of the area (Hamilton, 2006, pers.comm., 13 July).

Participation in the trial was voluntary. Participants received an incentive payment of $40 per quarter in an attempt to ensure that they were not penalised for their participation (Hamilton, 2006, pers.comm., 13 July). Participants also had the ability to opt out at any stage without penalty and either return to their previous pricing structure or seek a contestable contract with Country Energy or another retailer (Hamilton & Zoi 2005). Only five customers opted out during the trial. Four of these dropped out because they moved out of the trial area; one dropped out due to personal concerns about the trial (Hamilton, 2006, pers.comm., 13 July).

The technology used in the trial was provided to participants at no cost. It included:

- An Ampy EM1212 meter with net metering capability, load profile recording and load control capability
- A Powerline Interface Module with a GSM phone modem (allowing two way communications to the utility) and a narrowband power line carrier modem (allowing operation of the Home Energy Monitor from any power point in the home)

- A Home Energy Monitor, with LED 'traffic lights' showing the level of tariff and an LCD screen to show real time cost and consumption information (on an hourly, daily, weekly and monthly basis)

- A dedicated back-office software system to manage the data.

The meters were remotely interrogated on a regular basis to gather half hour load profile information. Billing was quarterly and bills provided extra information on comparative usage and consumption during the trial (Hamilton & Zoi 2005).

The pricing structure used for trial participants is summarised in Table 1. It combined seasonal TOU pricing with critical peak pricing. Red, amber and green lights on the Home Energy Monitor identified the critical peak, peak and off-peak/shoulder periods respectively. During the trial, critical peaks were activated a maximum of 12 times per year in response to temperature or market events. Customers were notified by email, SMS and a message to the Home Energy Monitor at least two hours before the event. The critical peaks only occurred during the existing peak periods and are shown with a red light and audible signal on the Home Energy Monitor.

| Period | Definition | Price |
|---|---|---|
| Critical peak (red) | Maximum of 12 times per year with at least 2 hours notice | 37.74 c/kWh |
| Peak (amber) | Summer (Nov to Feb): 2pm to 8pm, Monday to Sunday<br>Winter: (Mar to Oct): 7am to 9am and 5pm to 8pm, Monday to Sunday | 18.87 c/kWh |
| Shoulder (green) | Summer (Nov to Feb): 7am to 2pm and 8pm to 10pm, Monday to Friday<br>Winter: (Mar to Oct): 9am to 5pm and 8pm to 10pm, Monday to Friday | 12.7 c/kWh |
| Off peak (green) | All other times | 7.03 c/kWh |
| Service Availability Charge | | 39.78 cents per day |

**Table 1: Home Energy Efficiency Trial pricing structure.**

On average, trial participants reduced their energy use by 5% overall and by 30% in peak periods (Searle 2006). As a result of the incentive payments, no customers had a net negative impact on their bill (Hamilton, 2006, pers.comm., 13 July). However, not all participants would have saved on their bills in the absence of the incentive payment; savings depended on participant circumstances (Hamilton 2006). Country Energy reviewed the demographic characteristics of the customers that would not have achieved savings and did not find any evidence that particular groups were being disadvantaged (Hamilton, 2006, pers.comm., 13 July).

Over the course of the trial, Country Energy conducted three surveys and a focus group with participants to obtain customer feedback. Brochures, in a question and answer format, were used to provide basic information to trial participants. There was also a dedicated number that participants could call that went through to a specific call centre where the staff had all been trained in details of the trial. Customer feedback was largely positive, with almost all participants being keen to continue to use the trial equipment and more than 80% welcoming or tolerating the critical peak alerts (Hamilton 2006). Interestingly, customers who claimed little knowledge about energy efficiency at the start claimed a high or very high understanding by the end (Hamilton, 2006, pers.comm., 13 July). The 'traffic lights' on the Home Energy Monitor appeared to work very well to inform customers of the different tariff periods (Hamilton, 2006, pers.comm., 13 July).

Hamilton (2006) draws together lessons from the trial with relevance to consumers:

- Proposed tariffs need to be simple, given that the typical residential customer is currently on a simple tariff and has little understanding of time of use pricing and interval metering
- Provide simple information and set up a dedicated contact point for participants
- Respond to customer feedback on an ongoing basis.

Country Energy is extending the trial for six months based on customer feedback. However, Hamilton notes that Country Energy does not 'believe that the cost of mandating interval meters will be outweighed by benefits in every case' (Hamilton 2006). That is, there will be winners and losers from introduction of this technology unless additional policy initiatives and customer protection measures are implemented simultaneously.

## *5.2 Integral Energy trials*

Integral Energy is running three trials at the moment:

- An advanced metering trial, focused purely on the technology
- A Seasonal Energy trial, testing the response to a seasonal TOU tariff
- A Dynamic Peak Pricing trial, testing the response to dynamic peak pricing.

The advanced metering trial, which is currently at the bench test stage, will trial an Echelon metering system that uses PLC technology to communicate interval data to a data concentrator and GPRS to communicate data from the concentrator to head office. Integral Energy sees this as a low-cost technology in situations where there is a high density of interval meters; it would therefore be appropriate for a full roll-out (Telford, 2006. pers.comm., 13 July).

Integral Energy is currently recruiting participants for its two pricing trials in western Sydney. The trials are due to commence on 1 August 2006 and run for two years. The purpose of the trials is 'test whether customers…are interested in reducing their electricity usage during the peak times when prices and the cost of supplying electricity are significantly higher' (Integral Energy 2006). The trials only involve participants in Western Sydney and are intended to gauge customer response across a range of temperatures (Telford, 2006. pers.comm., 13 July).

For the pricing trials, the intention is to recruit a representative cross-section of Integral Energy customers. Consequently, Integral Energy has invited a random sample of customers to participate (Telford, 2006. pers.comm., 13 July). To ensure that the final sample is broadly representative, Integral Energy has developed participant profiles using demographic and consumption characteristics. These will be used to guide participant recruitment. For example, Integral Energy will recruit to ensure that large and small customers, low-income households and households with air conditioners are represented (Wellsmore, 2006, pers.comm., 13 June).

Importantly, customers that have payment difficulties have been excluded from the trial. This is because bills are likely to be more variable under the new tariffs, with higher bills in summer and winter and lower bills in autumn and spring. Exclusion of customers with payment difficulties protects these customers from possible cash flow problems.

The Seasonal Energy trial tests a seasonal TOU tariff with peak and off-peak prices and periods that vary according to the season (Wellsmore, 2006, pers.comm., 13 June). The proposed tariff structure for 2006-07 is summarised in Table 2. Customers on Off-Peak 1 and Off-Peak 2 rates for particular appliances (usually electric water heaters) continue to pay these rates for these appliances. With this tariff structure, it is likely that participants will receive lower bills in autumn and spring quarters and higher bills in winter and summer quarters.

To enable charging of a seasonal tariff, Integral Energy will provide participants with interval meters that communicate with the utility via mobile phone technology. However, participants in the Seasonal Energy trial will not receive an in-house display.

| Period | Period definition | Tariff |
|---|---|---|
| Extended Summer Peak | 1pm to 8pm (working days) between 1 November and 31 March inclusive | 30.3996 c/kWh |
| Winter Peak | 5pm to 7pm (working days) between 1 June and 31 August inclusive | 30.3996 c/kWh |
| Off-Peak | All other times of the year | 9.7449 c/kWh |
| Access charge | | 38.87664 cents per day |

**Table 2: Integral Energy proposed seasonal time of use tariff structure.**

The second pricing trial tests dynamic peak pricing, with an underlying TOU tariff. The tariff structure is summarised in Table 3. Dynamic peak pricing events will occur at fixed times (1pm to 8pm) on 12 working days each year during the trial period. Under this tariff, customers pay less for their electricity for 99% of the time, but significantly more during dynamic peaks.

| Period | Definition | Tariff |
|---|---|---|
| Dynamic peak | 1pm to 8pm, working days; 12 days per year | 167.0306 c/kWh |
| Shoulder period | 1pm to 8pm, all other working days | 10.7646 c/kWh |
| Off-peak | All other times | 8.3204 c/kWh |
| Access charge | | 38.87664 cents per day |

**Table 3: Integral Energy proposed dynamic peak pricing structure.**

Dynamic peak events will normally occur during times of high electricity demand, such as very hot days in summer and very cold days in winter. Integral Energy will give at least two hours notice of a dynamic peak event using either a phone call with a recorded voice message, an SMS or an email. Customers may nominate which form of communication they would prefer, and can nominate all three.

To implement dynamic peak pricing, Integral Energy will install an interval meter with two-way communications and an in-home display unit called an Energy Monitor, similar to that used in the Country Energy trial (see Section 5.1).

Participants in both trials will be eligible for two incentive payments. The first is an up-front joining bonus of $100 for customers who decide to participate, paid as a credit on their bill. The second is a $200 completion bonus credited to participants that complete the full two-year trial. Participants can withdraw from the trial at any time and revert to the standard default tariff; they would then be ineligible for the $200 payment (Wellsmore, 2006, pers.comm., 13 June).

Integral Energy has examined a sample of customers to see what impact the trial tariffs would have on their bills if they ignored the price signals and continued to consume in the same way as before the trial. After inclusion of the incentive payments, they believe that most, but not all, customers would receive a lower annual bill even if they did not respond to the price signals (Wellsmore, 2006, pers.comm., 13 June).

Integral Energy has provided potential participants with brochures providing details of the trial and tariffs. There is also a dedicated telephone number that participants can call if they have questions or wish to opt out of the trial. The methods used to collect customer feedback during the trial are yet to be determined.

## 5.3 EnergyAustralia initiatives

EnergyAustralia is currently rolling out smart meters to residential customers across its network on a new and replacement basis, as well as to all customers that consume more than 15 MWh per year. It estimates that it is installing about 50,000 interval meters each year. The meters are being used to support a TOU tariff structure called PowerSmart. The tariff structure is summarised in Table 4. For customers that choose this tariff, a new interval meter is installed free of charge if one is not in place. There is no in-house display and the tariff can be implemented without advanced communications capabilities.

| Period | Definition | Tariff |
|---|---|---|
| Peak | 2pm to 8pm weekdays | 24.75 cents/kWh |
| Shoulder period | 7am to 2pm and 8pm to 10pm weekdays<br>7am to 10pm weekends and public holidays | 9.0085 cents/kWh |
| Off-peak | 10pm to 7am every day | 5.3485 cents/kWh |
| Service availability charge | | 36.3 cents per day |

**Table 4: EnergyAustralia's PowerSmart tariff structure.**

EnergyAustralia surveyed the bills of 3,000 residential PowerSmart customers and found that 94% have received bills that were the same or cheaper as what they would have paid under standard flat tariffs. Customers saved an average of 10% on their bills and some customers saved more than 30%. Of customers that received higher bills, the increase was usually less than 5% (Energy Australia 2006).

Building on this experience, EnergyAustralia is conducting a two-and-a-half year Strategic Pricing Study involving more than 750 residential customers. The study will test customer response to seasonal TOU tariffs and dynamic peak pricing to determine capital deferral potential. Table 5 summarises the dynamic peak pricing tariffs.

| Period | Definition | Tariff | |
|---|---|---|---|
| | | PowerAlert (Medium) | PowerAlert (High) |
| Peak | Up to 12 Dynamic Peak Pricing Periods per year lasting from half an hour to four hours, only between 7am and 10pm | 100 c/kWh | 200 c/kWh |
| Shoulder period | 7am to 10pm every day | 9.5 c/kWh | 8.5 c/kWh |
| Off-peak | 10pm to 7am every day | 7.5 c/kWh | 6.5 c/kWh |
| Service availability charge | | 32 cents per day | |

**Table 5: EnergyAustralia's PowerAlert tariff structures.**

Dynamic peak pricing periods will occur up to 12 times per calendar year, no more than four times per month and no more than once per day. Participants will be notified at least two hours before the event via a choice of SMS, email, telephone or the web, as well as through an in-house display. The timing of the dynamic peak pricing periods will reflect times of actual peak demand, due to very high or low temperatures or events such as the shutdown of a power station. Tariffs outside these periods are lower than the regulated flat tariffs.

EnergyAustralia is recruiting participants at random for the Strategic Pricing Study. Participation is voluntary and participants may opt out at any time with no penalty. Participants receive incentive payments as part of the contract they sign when entering the trial. EnergyAustralia is using initial surveys to keep track of self-selection within the random sample. Initial indications are that participants are more likely than average to be home owners with three-phase supply and above average consumption (EnergyAustralia, 2006, pers.comm., 17 July).

EnergyAustralia is also undertaking an Advanced Metering Infrastructure Trial in 10,000 homes to assess the operational savings associated with automated meter reading. The meters installed will have two-way communication capability and will enable real-time detection of power loss, more accurate meter reading and same-day remote connections and disconnections (EnergyAustralia 2006). This trial is purely focused on the technology and will involve installation of meters in low, medium and high-density applications (EnergyAustralia, 2006, pers.comm., 17 July).

EnergyAustralia is also running a trial with 300 pool owners to test the take up rates of voluntary TOU tariffs in this customer group and to collect data on the savings these customers can achieve (EnergyAustralia 2006).

## 5.4 AGL Retail trial in Victoria

AGL Retail is currently conducting a two year trial in Victoria using type 5 manually read interval metering technology to measure the demand response to critical peak prices that are five times the normal peak price. Preliminary results of this trial have not indicated any significant change in demand (Kelly 2005). ISF was unable to contact an appropriate AGL representative to seek additional information on this trial in the time available for this study.

## 5.5 ETSA trial of direct load control

In 2005, ETSA Utilities was commissioned by the Essential Services Commission of South Australia (ESCOSA) to undertake a demand management program in South Australia. As part of this program, ETSA Utilities is undertaking trials of direct load control technology. Direct load control enables the utility to switch off air-conditioners for periods of a few minutes each hour on very hot days.

ETSA Utilities is using Comverge Load Control Units (LCUs) and control software for direct load control. The LCUs are installed on the outside of the home, adjacent to the air-conditioner compressor. They are remotely controlled using ETSA's radio network. In the trials, the LCUs were only used to switch off air-conditioner compressors, not air-conditioner fans (ETSA Utilities 2006b).

A pilot trial of the technology was undertaken on five hot days (maximum temperature above 34°C) in March 2006. Twenty homes were chosen to give a representative cross-section of house type, age, lifestyle, geographic location and size and type of air conditioner (ETSA Utilities 2006b). In addition to the LCUs, interval meters were installed to collect data on load profiles for the participants. The primary aim of the pilot trial was to 'determine customer perception of change in comfort levels resulting from the remote management of domestic air conditioners' (ETSA Utilities 2006b, pp., p.2). None of the participants reported any noticeable change in temperature or comfort levels and all were happy to continue participating in the trial (ETSA Utilities 2006b; Searle 2006). Aggregate demand was reduced by about 17% (ETSA Utilities 2006b)

Following on from the pilot trial, ETSA Utilities is planning a larger trial for summer 2006 under the banner "Beat the Peak". The Glenelg area has been selected for the trial because it is an area served by two substations that are likely to require augmentation in the next few years unless peak demand is reduced. The area also has high air conditioner penetration. The trial will involve a larger number of homes in a concentrated location, served by the Glenelg and Morphetville substations. The objective is to assess the impact of direct load control on substation and transformer load (ETSA Utilities 2006a).

Participation for both trials is voluntary and participants receive an incentive payment of $100. Otherwise, there is no change to tariff arrangements and no noticeable reduction in energy bills. Participants are given a named contact to call if they wish to provide feedback or report adverse impacts or problems (ETSA Utilities 2006b).

## 5.6 International experience

There is a great deal of international experience with smart metering and dynamic pricing. One example is worth noting. Puget Sound Energy in the United States undertook a TOU pilot study with 300,000 residential and small business customers in 2001. Peak load reductions and customer satisfaction were initially encouraging. However, after a change in the price differential between the TOU tariff and the equivalent flat tariff in 2002, it was found that 94% of customers were paying more in their bills than they would have under the non time-dependent rate. The pilot was terminated before it was due for completion (Energetics 2003). This example raises concerns that smart metering and dynamic pricing will be used as a way to increase utility revenue, rather than a way of delivering consumer benefit.

## 5.7 Discussion

The general impression from this review of metering and pricing trials in Australia is that utilities are very aware of possible negative impacts on consumers and have adopted appropriate measures to limit any impacts. First, the trials are voluntary and there are no penalties for opting out of the trial. Second, participants often receive incentive payments that offset any increases in bills. Third, some trials have excluded customers with payment difficulties so that there is no risk that these customers will experience an increase in hardship. Fourth, meters and associated equipment (including in-house displays) are provided at no cost to the customer. Finally, tariffs seem to have been set so that most customers will experience only small increases in bills even if they do not change their behaviour.

These measures are appropriate for trials and should be adopted in the Victorian trials. However, the existing trials also raise some issues. First, the results of voluntary trials should not be used to support mandatory implementation of a particular tariff structure. The type of customers that participate in a voluntary trial will not be representative of the broad range of customers in the wider population. In particular, the trials to date provide little information about how disadvantaged households might be impacted by different tariff structures.

Second, it is possible that the existing trials may underestimate customer demand response because price signals are muted by incentive payments. This is not to say that incentive payments should not be used, but that the results on demand response may be conservative where they are used.

Third, the method used to deliver incentive payments can raise issues for consumers. If incentive payments are paid only at the start and end of the trial, participants may experience cash flow problems during the trial that can increase hardship. Many domestic customers, particularly those experiencing disadvantage, will quickly spend an upfront incentive payment (or spend the extra money made available through an upfront bill credit) rather than saving the money until they receive their bill. A payment at the end of the trial may come too late to compensate for higher bills during the trial. The best approach for consumers is likely to be one in which any incentive payments are delivered as a credit on each bill during the trial period, so that cash flow problems are eased at the time of bill delivery.

# 6 TRIAL DESIGN: ADDRESSING CONSUMER ISSUES

Drawing on the previous sections, this section suggests ways in which consumer issues can be addressed through the design of smart meter and tariff trials. For the trials coordinated by the Victorian Government, there is an opportunity to learn from previous trials and to ensure that trials collect all information required to assess the costs and benefits of full-scale rollout.

## 6.1 Tariff and technology options

As noted in Section 3, the specific metering and communication technologies adopted in trials matter little to consumers. The main technological interface with the consumer is through the in-house display (when one is provided). The indications from trials to date are that customers respond well to critical peak pricing, supported by an in-house display that provides constant information on the applicable tariff. It is less clear whether customers respond well to TOU and seasonal TOU tariffs in the absence of an in-house display. The possibility that consumers could accumulate a larger than normal bill in the first quarter of TOU pricing, before they receive any real price signals, is of particular concern for low-income and disadvantaged customers.

Given these issues, it is possible to prioritise particular combinations of technology and tariff that are less likely to have negative impacts on consumers:

- A curtailable tariff, in which customers are asked to reduce their load at particular times in return for a discount on their bills, has the least potential to negatively impact on bills. Indeed, it could have a positive impact for many customers, without forcing them to respond when they are unable.

- A combination of remote load control and an interruptible tariff has no negative impact on bills but a small risk of negative impacts on comfort and lifestyle, depending on how the specific technology works. The ETSA Utilities trial found no negative impacts.

- Critical peak pricing, with an in-house display, gives customers a constant reminder of the tariffs that apply at particular times so that they have a real opportunity to respond to price signals by shifting or reducing demand. It can have a negative impact on bills when a customer is unable or unwilling to shift demand away from peak and critical peak periods. However, most of the potential impact on bills occurs during a limited number of critical peak periods that the customer can realistically avoid.

- TOU and seasonal TOU tariffs, with an in-house display, also give customers a constant reminder of changing tariffs so that they have a real opportunity to respond to price signals. Again, these tariffs can have a negative impact on bills when a customer is unable or unwilling to shift demand away from peak periods. Although the peak prices do not approach those in critical peak pricing, they apply for long periods throughout the year, which may increase the potential for a larger bill.

- TOU and seasonal TOU tariffs, without an in-house display, require customers to remember and understand how the tariff changes throughout the day without constant reminders. For some customers, this will not pose a problem. For others, there is potential to accumulate a large bill, particularly in the first quarter of TOU pricing, before an effective price signal is received in the bill. If this combination of tariff and technology is to be trialled, consideration should be given to increasing the frequency of billing (e.g. to monthly), to providing customers with some other form of feedback (e.g. information on the Internet) and to creative ways to remind customers of the tariff structure (e.g. fridge magnets).

While the Victorian Government should consider trialling all of the above combinations of technology and tariff, the first three options are the most likely to deliver direct consumer benefits.

As there is still some uncertainty about the value of in-house displays, it would be appropriate to design the trials to provide data on this issue. For a particular trial tariff, this would require the establishment of one trial group with in-house displays and one trial group without in-house displays to allow comparison of demand response and consumer experience. The data provided could be used to assess the costs and benefits of the provision of in-house displays from a consumer and utility perspective. It may be that the additional cost of in-house displays is offset by the greater demand response.

Whatever the combinations of technology and tariff chosen, there should be a clear commitment that:

- Interval meter trials and pricing experiments should not increase financial hardship

- After the trials, new tariff structures should not be implemented in a way that increases financial hardship.

In some of the trials conducted to date, the trial tariff was designed so that customers that made no attempt to respond to the price signals would experience roughly the same bills as they did before. This approach maximises the potential for consumers to receive benefits, while minimising the potential for negative impacts and may be appropriate for the Victorian trials.

Simplicity in the design of tariffs is also critical. While there is some evidence that small consumers are willing to accept more complicated tariffs, there is also evidence that most consumers think they consume less than the average and that the complicated tariffs will be visited on other households that consume more (Wellsmore 2006). Asking consumers to respond to complex seasonal TOU tariffs with multiple parts and seasonal changes may be asking too much.

Finally, it is important that dynamic tariffs are not used as an opportunity to further increase fixed charges at the expense of variable usage charges. This would have the effect of muting the price signals that the dynamic tariffs are trying to deliver and penalising customers with low consumption.

## 6.2 Participant recruitment

Participation in smart meter and dynamic pricing trials must remain voluntary to minimise the risk of negative consumer impacts. However, this raises the issue of self-selection. In any voluntary study, there will always be a degree of self-selection, as customers that are not willing to participate or feel that they will not benefit can simply opt out. This means that the sample will always be biased towards customers that are likely to benefit. Consequently, the results will tend to overestimate the benefits that would be achieved if the tariff were rolled out to the entire community.

Self-selection cannot be avoided in a voluntary study. However, by randomly contacting potential participants and recruiting participants to match a representative demographic profile, self-selection can be minimised. Random contacting of participants across the customer base will ensure that the potential pool of participants includes customers that are not already motivated to manage or reduce their consumption, limiting one source of self-selection. Recruiting participants to match a demographic profile will ensure that the final sample is representative of the range of demographic characteristics in the customer base. This approach to recruitment means that potential participants will need to complete a short survey to allow matching to the demographic profile.

For metering and tariff trials, the demographic profile should include not only the usual demographic details such as age, income, gender and educational attainment, but characteristics that specifically influence electricity use, such as household size, housing type, access to natural gas and the type of appliances installed.

Even in a voluntary trial, there are particular ethical issues that need to be considered during participant recruitment. Potential participants must be fully informed of any potential harm they might experience as a result of participation in the trial. This means that the potential for higher bills must be explained to participants before they sign up. Higher bills are not the only possible negative impacts that participants might experience. In seeking to avoid high bills during peak periods, there is a risk that customers may reduce their consumption to dangerous levels. For example, a customer might leave their air conditioner off on a very hot day and experience heat stress. Consequently, rules for opting out or having bills recalculated based on a regulated tariff need to be established prior to the trial and fully explained to participants. This will reduce the risk that customers will cause themselves harm in trying to avoid peak prices. Participation rules are considered in more detail in the next section.

## 6.3 Participation rules

From the trials conducted to date, it is possible to identify some rules of participation that could be adopted in the Victorian trials. First, as noted above, participation should be voluntary. Second, participants should have the right to opt out of the trial at any time without penalty, at which time they can revert to their previous contract, a standing contract or negotiate a new market contract with a retailer of their choice.

A third rule, not used in previous Australian trials, is worth considering. Under this rule, participants that receive a high bill and decide to opt out of the trial would have the option of having their bill recalculated based on their previous tariff. They would then be required to pay the lower of the two bills. This rule is an attempt to ensure that customers that misjudge the benefits available to them through the trial do not experience hardship when they receive a high bill. It should be strongly considered for trials of TOU tariffs in which there is no in-house display and quarterly billing.

If explained to participants at the start of the trial, this rule would undoubtedly mute the price signal delivered through the trial. However, it would help to address the ethical concerns raised in Section 6.2. A possible compromise that would allow for a stronger price signal while alleviating ethical concerns would be to monitor bills for all participants and compare the size of the bill to the bill that would be expected under a standard non-dynamic tariff. Where large bill increases are identified, participants could be informed of the option to have the bill recalculated. Alternatively, this rule could be used only for disadvantaged customers, as discussed in Section 6.6.

## 6.4 Incentive payments

Another way to address the issue discussed above is through incentive payments. Most of the trials reviewed used incentive payments, delivered as credits on the bill, to encourage participation in the trials and to ensure that customers were not worse off as a result of participation. The main problem with incentive payments is that they mute the price signal delivered through the dynamic tariff by insulating customers from higher bills. Consequently, they may reduce the observed demand response. In practice, most customers may be trying to save as much as possible, in which case the incentive payment may have no muting effect.

While it may be appropriate to use incentive payments in the Victorian trials, the Victorian Government could also consider some more innovative approaches. For example, the rule discussed in Section 6.3 could be used in place of an incentive payment. This would save money on incentive payments, while ensuring that no customers receive higher bills than they would have before.

Another possibility is to deliver non-financial incentives. For example, participants could be offered free energy audits and energy efficiency retrofits. This would have the added advantage of delivering electricity demand and usage reductions.

If bill credits are to be provided as an incentive for participation, they should be delivered as a credit on each bill during the trial period. Upfront incentive payments are not sufficient to compensate for later cash flow problems that consumers may experience during the trial. For maximum consumer benefit, the trials could provide higher bill credits for summer and winter bills (relative to spring and autumn bills) as these are the times of year when bills are likely to be higher.

## 6.5 Communication with participants

Communication with participants is an important part of trial design. Ethical research practice requires that participants are fully informed of any potential harm to them from participation in the research. In interval meter trials and pricing experiments, this means that all customers, but particularly those experiencing disadvantage, need to be fully informed of any potential increases to their bills as a result of the trials. To achieve this, clear communication needs to be established right from the start and maintained throughout the trial.

Ideally, there should be a dedicated telephone number that participants can call to ask questions or provide feedback at any time. Call centre staff that will deal with these enquiries need to be specifically trained in the details of the trial. Brochures used to communicate trial details need to be easy to understand. For TOU tariff trials without an in-house display, a fridge magnet showing the tariff structure would be very useful.

For CPP trials, it is critical that customers receive notification of critical peak events. This means providing multiple forms of communication, including telephone calls, SMS, email and notification on an in-house display. Some customers will not have Internet or mobile phone access. This makes the provision of an in-house display crucial.

## 6.6 Issues for disadvantaged customers

Low-income and disadvantaged customers are the most likely to experience negative impacts from smart meter and dynamic tariff trials, as well as the wider rollout. However, some of these customers may benefit from dynamic tariffs. Certainly, low-income households have strong incentives to save on their bills and often have very good knowledge of their consumption patterns. Concerns arise when households have little or no discretionary demand or lack the capacity to understand or respond to dynamic tariffs.

The Integral Energy trial excludes customers with payment difficulties. While this ensures no negative impact on these customers, it also excludes them from possible benefits (including incentive payments). In a full-scale rollout, even if dynamic tariffs remain voluntary, there will inevitably be disadvantaged customers that sign up for market contracts with dynamic tariffs. Rather than exclude these customers from trials, the Victorian Government should specifically examine the impacts on these customers and look at ways that dynamic tariffs can assist them.

Disadvantaged customers participating in tariff trials will likely need extra protections to ensure that they do not experience increased hardship. This could potentially be managed by setting up a separate customer sample designed to provide representation of the different categories of disadvantage. This trial could operate under slightly different rules. For example, free energy audits and retrofits could be provided for these participants to assist them to reduce or manage their demand. Incentive payments could be higher, or there could be additional rules for dealing with higher than expected bills (such as the recalculation option discussed in Section 6.3). The intent of this separate trial would be to explore particular issues that arise for disadvantaged customers and to identify ways that these customers might benefit from market participation. Alternatively, these issues could be explored through social research (e.g. focus groups) rather than trial participation.

The Victorian Government might also consider trialling some socially sensitive, non-dynamic tariffs for disadvantaged customers. For example, EnergyAustralia has previously proposed a Basic Tariff, in which there is no fixed charge, only usage charges (Wellsmore 2006). Customers would see a higher usage charge but would have greater scope to reduce their bill through reduced consumption. There would likely be benefits for households with low income and low consumption, as the access charge is a greater proportion of their total bill than it is for other households. The intent of this tariff, and other socially sensitive tariffs, is to recognise the essential nature of electricity and ensure that basis access to electricity is available to all households.

## 6.7 Social research

To fully understand the social impact of smart metering and dynamic tariffs, trials need to collect more than basic information on demand response and customer satisfaction. Trials need to assess how benefits and costs vary across different customer groups and, where disadvantaged customers are included in a trial, explore in detail the issues that arise for these customers. This indicates a need for qualitative social research with participants, through surveys, interviews or focus groups.

While the main focus of this research would be participant experiences during the trial, there would be value in broadening the scope to consider the impact of a wider rollout. A wider rollout will have different characteristics to a trial. For example, there may be no incentive payments, customers may have to pay for metering equipment and in-house displays and there may be penalties for opting out. Trial participants should be asked how their satisfaction with the trial would change in these cases. The intent is to collect sufficient information to allow an accurate assessment of consumer acceptance of the technology and tariffs in a real situation, outside the artificial construct of the trial.

## 6.8 Knowledge sharing

Utilities that have conducted trials to date are understandably protective of the intellectual property they have created through the trial process. However, lessons learnt through trials need to be shared to ensure that rollout of smart meters and dynamic tariffs occurs with the least pain to consumers. While mistakes will be made, it is important not to repeat them.

The decision by the Victorian Government to coordinate Victorian trials presents a strong opportunity to ensure that the design of the trials is transparent and that knowledge generated is publicly available. This is an appropriate role for government in a competitive electricity market.

# 7 CONCLUSIONS

Smart metering technology and dynamic electricity pricing have the potential to enhance the economic and environmental sustainability of electricity supply. If peak demand can be reduced, particularly on the handful of days when the network approaches capacity, then augmentation of the electricity network can be delayed, bringing significant cost savings for utilities (and ultimately for the consumers who pay the cost of providing the network). This frees up capital for other investments, such as investments to reduce the greenhouse intensity of electricity supply. Direct environmental benefits are also possible by delaying or avoiding provision of fossil fuel-fired peak generating capacity.

The intention of this Discussion Paper is not to create barriers to the introduction of smart metering and dynamic electricity pricing. Rather, it seeks to ensure that the social dimension of sustainability is given due consideration alongside economic and environmental considerations. Metering and pricing trials need to be implemented in a socially sensitive way, taking into account the diverse circumstances of Victorian domestic consumers. Further, these trials need to collect sufficient information to give confidence that the wider rollout of meters and dynamic tariffs can be managed to avoid increases in financial hardship.

From our review of previous and current trials in Australia, it appears that utilities are very sensitive to the possible social impacts of the trials and have taken appropriate steps to limit these impacts. The Victorian Government has the opportunity to draw on this previous experience when coordinating trials in Victoria. In general, consumer issues that arise during trials can be readily managed by following the suggestions in Section 6.

Ensuring that the trials provide the necessary information to draw conclusions about wider social impacts (and ways to address them) is more difficult. There is evidence that consumers are attracted to dynamic pricing because they believe they will be able to manage their demand in a way that will result in bill reductions. However, in practice, consumers often misjudge the benefits they will receive (Wellsmore 2006). In trials, a combination of incentive payments and self-selection of consumers that are most likely to benefit means that there is usually little pain for participants. In a wider rollout, there will inevitably be winners and losers if cross-subsidies are to be removed and the utility is to maintain its revenue. Identifying who will lose from these tariffs is difficult using the distorted sample from a voluntary trial.

Section 6.6 suggested undertaking separate trials for disadvantaged customers, to ensure that the specific impacts experienced by these vulnerable consumers are given adequate attention. Section 6.7 suggested expanding the scope of social research associated with the trials to ensure that questions relevant to a wider rollout are included. These suggestions will increase the value of the trials as an input to social impact assessment of the wider rollout.

One way to limit the wider social impacts of dynamic tariffs is to ensure that these tariffs remain voluntary. That is, even when interval meters are rolled out to all customers, domestic customers should retain the existing customer safety net provisions that allow them to remain on a deemed or standing contract with a regulated tariff. This will protect those consumers that, for whatever reason, are unable to respond to dynamic pricing in a way that will reduce or maintain the size of their bills.

This approach is not without its problems. Most notably, as pointed out by Wellsmore (2006, pp., p.18), this kind of approach has 'the potential to establish two classes of consumers'. Wealthy households with discretionary energy demand, access to efficient appliances and the ability to manage their demand will be able to access benefits through dynamic pricing. Large households, households with low incomes and tenants will be excluded from dynamic pricing and unable to access its potential benefits. Thus, the benefits go to those who least need them, increasing the gap between rich and poor. As Wellsmore (2006, pp., p.18) notes, this 'is a bitter price to pay for the economic purity of unwinding of cross-subsidies'.

A better approach would give disadvantaged households the support they need to take advantage of dynamic pricing, through concessions, customer safety net provisions, targeted retrofits and other measures. If retail competition is to bring benefits to all consumers, then ways to safely bring disadvantaged customers into the market need to be identified. The pricing trial for disadvantaged customers suggested in Section 6.6 could address some of these issues.

There is no doubt that, once smart meters are rolled out, utilities will have strong incentives to move customers onto dynamic tariffs to try and capture the network benefits of demand response. Regulators will need to continue to balance the economic and environmental gains of these tariffs against the potential for negative impacts for certain classes of consumer. In addition, regulators will need to closely scrutinise dynamic tariff offerings and the way that they are marketed to ensure that vulnerable customers are not locked into tariffs that they do not fully understand.

The Victorian Government's initiative in coordinating smart meter and pricing trials is commendable and provides an opportunity to collect the necessary information to assess the social impacts of widespread application of dynamic tariffs. Other jurisdictions should consider coordination of trials in the public interest; this is an appropriate role for government in competitive electricity markets.

Finally, it is important to be cautious about what can actually be achieved through use of price signals. Electricity is an essential service and demand for electricity is inelastic (Langmore & Dufty 2004; Wellsmore 2006). For Australian households, a 10% price rise is required to bring about a 2.5% reduction in electricity demand (Langmore & Dufty 2004). It is likely that equivalent or better reductions in demand can be achieved using non-price measures, such as regulation to improve energy efficiency, targeted retrofits for disadvantaged households and subsidies for energy efficient equipment and distributed energy. These measures would have fewer negative impacts for consumers and would be more likely to deliver greenhouse gas reductions alongside reductions in peak demand.

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