# 10 Technologies to achieve demand management

|  |
| --- |
| Key points |
| * Efficient implementation of demand management technologies will be fundamental to steer electricity consumption towards a lower cost future. However, because the benefits from demand management are split across a number of parties, free rider problems can hinder uptake of technologies to support demand management. * The costs and benefits of such technologies are uncertain and change over time. However, smart metering infrastructure (including the smart meter itself, IT equipment, back-end software, and two-way communication equipment) underpins most forms of demand management (including time-based pricing and most load management solutions). * With this core technology in place, it is not necessary to prescribe the uptake of other technologies, including the ever-broadening range of ‘add-on’ technologies (to inform customers about electricity usage, prices and to automate demand response). * Nevertheless, given uncertainty over the net benefits from smart meters, it is prudent to assess the potential of alternative technologies to achieve demand management (that do not necessarily require a smart meter), including direct load control technologies and demand limiting switches. * Governments around the world have generally responded to incentive problems stalling investment in smart meters by mandating roll-outs or using similar regulatory tools. Most businesses have smart meters, but outside Victoria only a small share of residential consumers currently have such meters. Even still, the Victorian roll-out has caused concerns due to a moratorium on their effective use and higher than anticipated costs. * A rapid roll-out of smart meters may not be immediately practical or efficient. Within any constrained network region, a sufficient penetration of smart meters is needed to realise network savings. Universal adoption within a network area would support these savings, while also reaping economies of purchasing and minimising other costs. * A planned roll-out is most likely to deliver net-benefits, whereas a market-based approach would involve significant risks. Distributors should be responsible for staged roll-outs on a region-by-region basis, subject to a cost-benefit test (and the relevant jurisdiction lifting retail price regulation — chapter 12). The AER should encourage distributors to minimise costs by benchmarking adherence to a commercial standard. * Costs should be borne by end-users, with low-income households to receive appropriate assistance. Time-based network tariffs are an essential prerequisite to the rollout of smart meters, which should be accompanied by community consultation. |
|  |

Electricity demand management relies on technology solutions to achieve time-based pricing and to support load management. Advanced metering infrastructure — so called ‘smart meters’[[1]](#footnote-1) — are used to implement nearly all forms of demand management, including efficient pricing, some load control programs and distributed generation options. (Options to implement demand management in the absence of smart meters are more limited and are generally more difficult and costly to implement than if smart meters were available.) Underinvestment in smart meters and consequent failure to implement efficient demand management could lead to costly overinvestment in network infrastructure to meet peak loads.

As discussed in chapter 9, there are important question marks over the potential costs and benefits of specific demand management technologies, including how these might change over time. There is also considerable uncertainty around how consumers’ behaviour patterns might change with a greater focus on demand management, and what role technologies will play in supporting such behavioural change. Further, future changes to the patterns of electricity use, such as from the uptake of electric vehicles, could potentially exacerbate peak demand or, if carefully managed, might provide an opportunity to smooth out consumption patterns. To that end, efficient implementation of demand management technologies and price signals will be fundamental to steer electricity consumption towards a lower cost future.

To ensure the potential for benefits from demand management are realised, and that investments in enabling technologies are of value to consumers, it is important that consumers be consulted about the imperatives for change. Failure to do this adequately could lead to a consumer reaction that undermines the case for investment in technologies and stalls the gradual progression towards pricing changes that will benefit consumers over the longer term. The Victorian experience of poor engagement with consumers confirms the risks from not persuading consumers in a carefully coordinated manner and at an early stage.

This chapter primarily looks at whether smart meter technology should be more widely implemented in Australia. However, because available technologies and their costs and benefits are uncertain and likely to change over time, the net present value of all feasible options should be evaluated. In addition, given the unexpectedly high cost experience of the Victorian roll-out (box 10.1) it is prudent to consider alternative technologies. Other possibilities to achieve demand management options that do not rely on a smart meter might include[[2]](#footnote-2):

* direct load control[[3]](#footnote-3) — where, with the prior agreement of the customer, the power supply to household appliances can be remotely controlled (by retailers or distributors) to reduce the draw on network capacity at peak times. For an air-conditioner, this involves cycling the compressor on and off at regular intervals (but with the fan still running)
* demand limiting switches to keep demand within an agreed threshold at peak times.

Section 10.1 provides some background to demand management technologies and recent experiences with their implementation. Section 10.2 looks at the challenges to implementing smart meters, including why coordinated action is appropriate and why a regulated approach is considered more feasible than a market-based solution. The section then discusses why a distributor is best placed to undertake the roll-out and ways that a distributer-led roll-out could be implemented. That includes whether approval of funds should occur within the existing incentive regulation framework or as a separate item of expenditure given the peculiarities of the investment (including that, at this stage, distribution businesses may not have fully aligned incentives to roll-out smart meters and apply more cost-reflective network charges). Issues surrounding how other technologies to reduce peak load inefficiencies could be implemented (including without relying on smart meters) are examined in section 10.3.

## 10.1 About demand management technologies

Demand management technologies are about using the supply-side infrastructure more efficiently and intelligently — via smart meter infrastructure, or (in the absence of smart meters) through direct load control (figure 10.1). Under either approach, the goal is to achieve a ‘demand response’ — reduction in peak demand — which allows less expenditure on peak capacity across the network and helps to ease upward pressure on electricity bills.

Figure 10.1 Technology pathways to achieve demand management

|  |
| --- |
| Technology pathways to achieve demand management. This figure shows the approaches that can be used to manage demand either with or without smart meters. In the case of with smart meters, an approach involves the use of time-based pricing. In the absence of smart meters, an option would be to use direct load control of consumer appliances. |

### Understanding smart meters

Smart meters measure and record (at 30 minute intervals) how much electricity a household or business is using. Such meter readings are communicated directly to a central data collection point, removing the need for physical meter reading. It is possible to invest in additional technology and software so that households and businesses can access detailed information from the smart meter about their electricity use. Current options include through in-home displays, web portals or via a home ‘gateway’ — a connection between the smart meter and a home computer and the internet (figure 10.1).

Smart meters facilitate a move to an environment where consumers can observe the direct impact of time-based pricing (prices that reflect the full cost of supplying electricity at particular times). As such, the phasing in of time-based prices usually accompanies smart meter roll-outs.

The majority of Australian households outside Victoria do not have smart meters and, as such, do not face time-based pricing.[[4]](#footnote-4) Further, a significant proportion of those households who do have smart meters (mainly in Victoria) also do not currently face time-based pricing. Victoria is in the paradoxical position that it has widespread availability of smart meters, but a moratorium on time-based tariffs for residential users until the middle of 2013, at which point it will be voluntary for customers to switch to a simple time-based tariff (O’Brien 2012). (Meanwhile, customers are paying for the cost of the roll-out, adding around $25 a quarter to household’s electricity bills.) In contrast, a much higher share of business users have smart meters and, to varying degrees, already face time-dependent prices (albeit that this mostly reflects variation in wholesale power prices rather than time-based network charges).

In a number of countries (such as in France, much of the US, Canada and China), household and business customers face time varying tariffs (albeit that the price signals they face are often only partly cost-reflective) (CRA 2005).

#### Smart meters can promote better demand management and operational efficiencies

Smart meters require a relatively large outlay, but they can provide versatile demand management options. The newer generation smart meters allow two-way flows of information, which in addition to time-based pricing, can allow:

* control of customer equipment, such as direct load control of air-conditioners and pool pumps, subject to their agreement
* interactions with consumer ‘add-on’ technologies, to inform a customer’s energy use decisions and enable automated ‘set and forget’ controls.

These demand management solutions can help reduce the transaction costs for consumers in responding to price signals and, hence, can activate a higher level of demand response than might otherwise be the case. For example, they can assist end users who might feel inconvenienced by managing their electricity use in the absence of ‘no-fuss’ automated solutions.

Network businesses can also operate their grid more intelligently with smart meters, including by remotely connecting and disconnecting customers, remotely reading meters and gaining real time information about outages and other reliability outcomes. These benefits of smart meters are often referred to as operational efficiencies.

|  |
| --- |
| Box 10.1 Lessons from the Victorian smart meter roll-out |
| In 2006, the Victorian Government directed distributors to install 2.4 million smart meters in Victorian homes from 2009–2013, with consumers directly paying for the cost. The roll-out was expected to deliver large net-benefits, including cheaper energy use, improved supply efficiency and increased retail competition. However, subsequent revisions to the cost-benefit analyses that informed this decision[[5]](#footnote-5) suggest that the roll-out is now likely to involve a net cost over its lifetime.   * In 2008, the MCE (2008) estimated the prospective cost of a smart meter roll-out in Victoria as $673‑1089 million, while the Victorian DPI (DPI 2008) estimated it at $1160‑1560 million. * In under two years, revised estimates indicated that the expected total cost of the roll-out would be roughly double that anticipated by various parties in 2008.   Different categorisation of costs makes it difficult to identify which costs were higher than predicted, but IT and installation costs in particular were more costly than expected (EMCa 2008; Deloitte 2011).  On the benefits side of the ledger, Deloitte (2011) found $400 million fewer benefits from ‘efficiencies in network operations’ than had been previously estimated in reports by Futura (2009) and Oakley Greenwood (2010a). Consumer benefits from time-based pricing have been delayed by the Moratorium.  In 2009, the Victorian Auditor-General’s Office audited the performance of the smart meter roll-out. It found various problems with the project, including:   * a lack of detailed economic analysis and flaws in the supporting cost-benefit study, and insufficient evaluation of the consumer impacts, project (and technology) risks * a need for stronger project governance by the responsible state department, especially given the scale and cost of the market intervention * inadequate community engagement, given the significant effect on consumers.   Overall, it appears that the Victorian decision to roll-out smart meters was premature and/or poorly planned with inadequate knowledge about smart meter technologies, their costs and associated risks. Further, there was inadequate consumer education about the potential changes and benefits post the roll-out. More consumer testing may have helped to avoid this outcome. In addition, the pace and mandatory nature of the roll-out may have inflated costs. The meter specification and performance requirements may also have been overly restrictive and, if interpreted strictly by network businesses, inconsistent with accepted commercial standards. Moreover, the failure to enact pricing reform since the roll-out has compromised a major source of potential benefits to consumers. Not surprisingly, consumer dissatisfaction with the process has been high, which may further frustrate subsequent attempts to implement pricing changes. |
| *Sources*: Victorian Auditor-General 2009; Deloitte 2011; Futura 2009; Oakley Greenwood 2010a. |

#### Mixed results from roll-outs and uncertainties about costs and benefits

Smart meters are a relatively new, but not revolutionary, technology. The associated hardware, IT and communications technologies are continuing to mature, which is consistent with declining costs (or stable costs with increasing functionality) over time. For example, the price of smart meters in the European market is forecast to decrease by over 30 per cent between 2010 and 2017 (Frost and Sullivan 2011). This is driven mainly by mass-market cost reductions, with 2 providers serving 90 per cent of the European market.

Evidence about the impact of smart meters is increasing with the completion of a number of large-scale roll-outs.[[6]](#footnote-6) Smart meter roll-outs have occurred or are occurring in many European countries, including France, Italy, Spain, Sweden, The Netherlands and, more recently, in the UK.[[7]](#footnote-7) Smart meters are also common in many areas of the US and Canada. The most prominent Australian example of a broad scale roll-out is in Victoria.

Both international and Australian experience demonstrates that a carefully managed implementation is crucial to realise the potential net-benefits from smart meters. For example, the roll-out in Victoria faced multiple setbacks, including implementation costs that far exceeded original estimates. The benefits from the Victorian roll-out are also likely to be lower than planned, given the initial moratorium on time-based tariffs. That and inadequate community engagement led to a significant number of customers refusing to have a meter installed.

The costs of smart meters are routinely evaluated prior to any roll-out, but there are a number of uncertainties which makes it difficult to estimate costs. In Victoria, the total costs over the lifetime of the meter are likely to be around $800 per meter. While accurate comparisons are difficult, it appears some international roll-outs have occurred more cheaply than the costs experienced in Victoria (although the functionality of meters is usually more limited and the associated communication systems slower and less versatile). Nevertheless, if evaluating international projects on a cost per meter basis, estimates vary widely, ranging between $114 and $740 in 2007 values (Rousseau 2007).

The Commission’s attempt to quantify the costs (and benefits) of smart meters revealed a wide range of potential estimates (chapter 9). Roll-out and implementation costs are sensitive to small changes in a range of assumptions, including:

* the density of a roll-out and the topography, which affects:
* the feasibility of different communications technologies (given the technical performance and associated cost of options)
* installation costs, with an uncoordinated roll-out significantly raising the per unit cost of installing a new meter compared to a street-by-street approach
* the pace of technology changes, particularly those affecting communications options and, so-called, back-end IT software, and the resulting impact on costs
* the speed of a roll-out, including whether any market power is conferred on installers or other suppliers
* the functionality of meters, and expectations about the extent to which meter costs might decline over time and with large purchases.

The benefits of smart meters are also uncertain. They depend crucially on the application of efficient network tariffs and, in turn, consumers’ acceptance of these changes and related assumptions about their responsiveness to prices. As discussed in chapter 9, the benefits will also vary according to the length of the transition to efficient network pricing structures, and the extent that retailers pass these through to end-users.

### Alternative options are more limited

Noting the apparent high costs and uncertain net-benefits of smart meters, any evaluation of the stream of benefits and costs from smart meters should consider possible alternatives. It is possible that lower cost technologies to implement demand management could yield higher net benefits.

#### It is important to evaluate the future stream of costs and benefits of alternatives

Alternatives to smart meters are less ‘future proof’, providing limited opportunity to make use of new technologies to enhance demand management and adapt to changing consumer needs. While a sunk investment in lower cost technologies would not preclude the later uptake of smart meters, because some early benefits from reduced peak consumption would already be achieved, the *incremental* net-benefit of smart meters would be more limited.

Therefore, a static analysis of alternatives is not appropriate, since it could support an initially lower cost option that locked in a lower stream of net benefits in the longer term. To avoid this, it is important to value the net *present value* of smart meters and any feasible alternative technologies to achieve demand management.

#### Direct load control could be a candidate

In the absence of smart meters, direct load control technologies probably offer the most practical option to implement peak demand management.[[8]](#footnote-8) The use of direct load control technology as an alternative to smart meters is most relevant for households, as most businesses already have smart meters (reflecting the lower relative cost of a smart meter installation for larger users).

Direct load control can operate either in the presence or in the absence of price signals, and therefore, with or without smart meters. In either case, it can allow a network provider to secure a predictable peak demand response from consumers. As shown in figure 10.2, its use for a relatively short period of time can significantly ‘clip’ the peak of households’ demand compared to when it is not used.

However, in the absence of cost-reflective pricing, such schemes require the use of incentive payments to encourage participation (figure 10.1) to ensure households can realise the cost savings from reducing their peak consumption.[[9]](#footnote-9)

Most direct load trials have focussed on managing the peak power use of air-conditioners and pool pumps. Direct load control of pool pumps can operate all year round, similar to the off-peak programming of electric hot water services. For air-conditioners, the direct load control would typically only be used on the handful of hottest days each summer. Because cooling is highly valued during critical peaks on extremely hot days, the fan in the unit continues to operate, but its compressor is controlled to avoid the potential for network congestion over a period of up to 4 hours. Usually, the compressor of the air-conditioner is remotely cycled on and off (using either, or a combination of, radio or internet communication) such that the unit does not operate for 7.5 to 15 minutes out of every half hour window.

Figure 10.2 ‘Clipping the peak’ — the impact of direct load control

KW consumed by hour on four daysa

|  |
| --- |
| Clipping the peak – the impact of direct load control. This figure shows how direct load control impacted 68 homes in Glenelg between a 24 hour period in homes where there was no curtailment at 35 degrees C, no curtailment at 40 degrees C, no curtailment average and curtailment using direct load control at 36 degrees C for 15 minutes off in 30 minutes.  ***Direct load control*** |

a Based on data from 68 homes in Glenelg South Australia.

*Data source*: ETSA Utilities 2008

Trials find that the managed use of the compressor and power supply to an air-conditioner has little impact on customer comfort levels if the compressor is set to operate between half and two thirds of the time (Futura 2011). Comfort levels can be increased further by extending the direct load control function to cool the house prior to and following a period of direct load control.

### Technology may be a friend

Technological change will aid the management of electricity demand. While adopting new technologies can be costly, the real cost can fall dramatically over time as scale economies result from mainstream take-up. Already, technologies offer solutions to simplify managing the timing of energy consumption. The horizon of potential automated demand management solutions is large (for example, mobile phone apps can remotely control appliances). Peak load pricing and the diffusion of smart meters would accelerate such innovation.

Further, there may be grounds to accelerate the development and uptake of technologies to enable demand management. For example, some participants have suggested mandating a demand response capability in the future manufacturing standards of key appliances, such as air conditioners, pool pumps and, in the future, electric vehicle batteries (Wilkenfeld 2011b). If consumers are informed about the benefits of having additional functionality in their appliances and it is of value to them, they will simply demand it, hence avoiding any need for intervention. However, many appliances are long lived and the benefits from choosing one appliance over another are uncertain when considered over a long period. Of course, until smart meters are more widely available to implement time-based pricing, consumers lack incentives to choose appliances with more advanced energy management features.

## 10.2 Some challenges implementing smart meters

### Demand management and ‘split benefits’ across market participants

The benefits or costs from adopting demand management (and wider use of price signals to encourage more efficient electricity consumption patterns) often fall to more than one agent — generators, network businesses and retailers and, ultimately, consumers. However, each party may have an incentive to either resist the change if they believe they will experience a cost, or where there are likely benefits, to free ride on investments in demand management made by others — the so-called ‘split-incentive’ problem. As such, each party could decide not to invest.

A supplier that was vertically integrated along the entire supply chain could internalise the sum of possible demand management gains (and, in the case of generator, potential losses) and evaluate them against the likely costs of implementing demand management solutions. However, as noted in chapter 2, the reforms that led to structural separation of the competitive segments of the electricity sector in the 1990s — while reaping significant economic benefits — have frustrated such coordinated decision-making. Ausgrid claimed that hot water load control in NSW — introduced in the 1950s by the vertically integrated electricity supplier at the time — would not proceed now, despite the huge savings it realised (Maltabarow 2012, p. 5).[[10]](#footnote-10)

### Underinvestment in smart meters is a likely symptom of the split-benefits problem

It is widely recognised that, of all demand management related costs, smart meter investments suffer most acutely from the split-benefits problem:

A key economic obstacle to a market-driven roll-out is the fragmentation of benefits among multiple stakeholders, which disperses investment incentives. (Schächtele et al. 2011, p. 1)

… fragmentation across the value chain has reduced the incentive for any single player to invest in smart meter[s]. (McKinsey 2010, p. 49)

As summarised by the AEMC:

… evidence to date suggests that no single party has sufficient incentive to invest the upfront costs in installing smart meters, the benefits in terms of cost savings are likely to accrue across all parties, but should ultimately flow to the consumer. However, consumers do not have sufficient information to assess the costs and benefits, retailers do not have any certainty that they will retain a consumer long enough to recoup the costs of the meter, and distribution network service providers do not have the certainty that they would recover their investment through the price determination process. (2012t, p. 3)

The issue of smart meter investments has been widely debated, both in Australia and overseas. The split incentives problem and the significant upfront cost of smart meters have attracted governments’ attention, but solutions have frequently been hindered by the potential consumer resistance to their introduction and time variant pricing. Nevertheless, a range of regulatory approaches to encourage the adoption of smart meters have been put on the table. Some governments around the world have mandated universal roll-outs or instituted regulations for staged roll-outs, such as by setting targets for the penetration of smart meters. For example, according to an EU single market directive and German Federal Government regulation, 80 per cent of households in Germany will have a smart meter by 2020. A high penetration of smart meters has also been achieved through regulation and utility-driven roll-outs in Sweden (now with 100 per cent smart meters), Italy (now with 90 per cent smart meters) and Finland (Frost and Sullivan 2011).

A key question is whether a regulated approach is necessary to encourage adoption of smart meters or whether more market-driven approaches could work better?

#### A lead business player?

One option to facilitate investment in smart meters would require a lead business player. The leader would coordinate the costs and benefits of demand management along the supply chain, and each party would contribute to a common funding pool in proportion to the benefits they acquire. The Australian Energy Market Commission (AEMC 2012e) suggested a form of contractual agreement that apportioned the costs and benefits of smart meters across parties.

This approach shares similarities with Littlechild’s public contest model for interconnectors (chapter 20) and seeks to address the hold-out problem among multiple beneficiaries that cannot individually appropriate the full benefit of their investments in demand management. While theoretically possible, coordinating the disparate commercial interests of potential beneficiaries from demand management raises issues of implementation costs and is likely to be a slow process.

#### Household action?

Arguably, consumers should individually choose whether to install smart meters and directly bear the costs since they should ultimately capture most benefits from more cost-reflective pricing and other demand management solutions that lower overall electricity costs. Having the discretion to choose whether to invest in a smart meter and face time-based pricing resonates with most consumers. It is also a position advocated by the Victorian Government and, in NSW, by the independent regulator:

The roll-out of time-of-use meters should be at the discretion of the customer or its retailer, rather than being mandated by governments or distributors (IPART 2012d, p. 8)

In IPART’s view, such an approach would mean that customers with the greatest willingness or ability to shift their demand would accept time-based pricing and may potentially pay for the installation of a meter. Regardless, under any option to deploy smart meters and time-based pricing, IPART cautions that to improve productivity, a necessary criterion is that the benefits must exceed the costs.

However, there are several difficulties with uncoordinated action through individual choice:

* The incentives to purchase smart meters depend on consumers’ profile of consumption and the relative prices of peak versus off-peak use. Consumers that use a significant level of power at peak times (‘peaky’ customers) will have the least incentive to buy smart meters that reveal their consumption profile and are likely to stay on an average ‘flat’ tariff.
* However, an average tariff can only support efficient consumption (and be truly cost reflective) if the load profile of its customer base is flat or completely unresponsive to prices (box 10.2).
* Because of this, the retention of a group of customers on an average tariff would continue to result in over consumption at peak times and inefficient investment to meet that consumption.
* Such consumption would continue to be subsidised by less peaky consumers and lower their incentives to purchase a smart meter (unless the ‘flat’ tariff was instead set very high, which is unlikely to be an acceptable option since, to ensure an efficient peak consumption, it would have to be set at the peak price).
* Without smart meters, consumers do not know their own consumption profile well and the implication of that profile for cost-reflective prices.
* Schächtele et al. (2011) summarised recent smart meter cost-benefit studies[[11]](#footnote-11) and found that consumers expressed a high degree of uncertainty about the benefits of smart meters, reflecting highly variable consumption profiles and uncertainty about how they could adapt to time varying tariffs.
* Wissner and Growitsch (2010; as cited in Schächtele et al. (2011)) identified informational deficiencies faced by consumers and the likelihood that if they underestimate the savings from using a smart meter (and discount for the uncertainties), they would have a low willingness to pay.
* Currently, most consumers are generally apathetic towards their energy use. While they may express concern about the rising cost of their energy, it is a significant step to choose a time-based tariff voluntarily and bear the upfront cost of a smart meter.

|  |
| --- |
| Box 10.2 Flat tariffs cannot achieve efficient consumption. |
| The only circumstance in which a flat tariff can be efficient is if:   * the flat price is set at the cost of peak consumption, or * consumers have a completely flat load profile, which is generally only observed in some industrial settings (which also means that peak demand would not exist), or * demand is completely unresponsive to price signals, which is not evidenced in practice.   Other than in the circumstances above, peak consumption and resulting investments in network capacity will always be inefficient under a flat tariff, hence resulting in a sub-optimally high level of excess network capacity to meet peak consumption. The reason for this is that the efficiency savings from smart meters ultimately rely on behavioural change (a consumption response). If peaky consumers do not face a higher price for their peak consumption, other less peaky consumers would continue to subsidise their consumption choices. Even if the higher costs of peak time consumption were fully recovered through a higher than average flat price that would simply reduce the transfer of income from non-peaky to peaky consumers. While that would improve fairness, it would not avoid inefficient over investment in the network to meet the over-consumption at peak times. |
|  |
|  |

The above considerations suggest that the voluntary uptake of smart meters by individual consumers would likely be low and slow.[[12]](#footnote-12) This could significantly limit the potential for network savings and result in sub-optimal net-benefits.

A sufficient penetration of the technology would be required to:

* stem growth in peak consumption and so defer investment in peak capacity in any given region. This means that a critical mass of participants would be needed for the cost of smart meters to yield value. In addition, the more consumers with smart meters, the more valuable is access to the technology for retailers, including for them to alter their billing systems, marketing approach, hedging strategy, and offer more innovative tariffs and demand management services. Similarly, a universal roll-out would most efficiently reduce existing network costs. For example, the retention of traditional accumulation meters for a proportion of customers would raise the cost of physically reading meters (smart meters allow remote reading, connection and disconnection) and would continue cross subsidies between customers.
* reach economies of scale and minimise the costs of meter procurement, installation, communications infrastructure and supporting IT and data management systems. In particular:
* Cost advantages accrue with installation density, making universal installation within a given area generally lower cost. (Any countervailing risks of market power that allow suppliers to inflate prices during a large-scale roll-out can be limited by sensible phasing, contracting with a variety of suppliers and avoiding excessively tight mandatory completion dates).
* Studies find reduced roll-out costs from state-mandated comprehensive roll-outs and that these better achieve targets for uptake of time dependent pricing (Schächtele et al. 2011).
* Within any region, the cost of smart meters is likely to be most efficiently incurred and coordinated by a single party, subject to competitive tenders.[[13]](#footnote-13)

Accordingly, the value of a smart meter to any given consumer depends on the actions of other consumers, suggesting the need for their mandated adoption. In theory, there could be exemptions for low-usage or low-income customer groups. However, in the former case, it is not clear that low total consumption equates with low use at critical peak times. The best evidence available (figure 10.3) is sourced from interval meter data, but unfortunately adopts an extremely broad interpretation of peak use (defined as a 15 hour period during each weekday). This limits the use of the results to isolate the contribution of average low-usage customers to the short periods where peak (and network) costs are highest.

Targeted relief for the costs of installation for disadvantaged consumers is likely to be more efficient than failing to install meters (as discussed later). This reflects:

* the relatively high cost of installing and procuring smart meters on a case-by-case basis when, for example, an exempted household moves residence or the customer opts to transfer to time-based charges
* the likely increase in fixed costs for the low proportion of households continuing to require physical meter readings. The annual cost of quarterly meters reads could be in the order of $80-$200 per meter, which would significantly contribute towards the cost of a new smart meter.

Figure 10.3 Relation between peak and off-peak consumptiona

Percentage of households, by kWh consumption in peak and off peak periods

|  |
| --- |
|  |
| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | |  | *High* | 3 | 18 | 44 |  |  | | **Peak** | *Medium* | 7 | 10 | 1 |  |  | |  | *Low* | 16 | 1 | 0.1 |  |  | |  |  | *Low* | *Medium* | *High* |  |  | |  |  |  | **Off-peak** |  |  |  | |

a Based on Interval data from 1000 households. High usage is defined as 10+ kWh per day, Medium as 5-9 kWh per day and Low as 0-4 kWh per day. The peak period is defined very broadly as between 7am to 10pm on weekdays. To illustrate how to read the diagram, three per cent of households have high peak use and low off-peak use.

*Data source*: Simshauser 2012, p. 11 Presentation at Power of Choice Forum, 19 April Sydney.

However, many consumers are likely to resist a mandated roll-out of a technology for which they would be obliged to pay that had uncertain benefits. Mandated roll-outs leave no real decision-making power to consumers and have been found to perform relatively worse at encouraging consumers to adapt their behaviour to price signals (Schächtele et al. 2011). This emphasises the importance of retailer involvement and broad education and marketing, including:

* informing consumers about the real costs imposed by just a few hours of peak demand. People are sometimes voluntarily willing to change their behaviour if they are aware of the broader public (and private) benefits of curtailing peak demands
* raising awareness and showing examples of how to make savings by shifting peak-time consumption. Pricing pilots could be helpful to inform retailers about the likely strategies employed by consumers to shift their consumption, and ways to communicate messages effectively to different consumers
* providing options to reduce price risks, such as through participation in controlled load programs, or offering a range of ‘smoothed’ tariffs
* using targeted hardship programs and, in the future, electricity storage technologies to address the fears of vulnerable users who have no discretion in their power use, such as when power use is required for medical needs.

Many mass marketing and informational costs are fixed for a sufficient number of consumers, and could be more effective if pitched on a broader scale or, at least, on a community-by-community basis (akin to the transition to digital television).

### A collective funding principle to pay for smart meters

Ideally, within a geographic region, a roll-out would be financed through a mandatory fixed charge included in network tariffs. Given meters have an asset life of around 15 years (and the communication module within the meter a life of around 7 years), the annual charge would only be a share of the total meter purchase price. Consumers could be given choices about how smart meter costs were reflected in their retail bills. In particular, while it is likely that retailers would broadly reflect the structure of the smart meter related network charges in their tariff offerings to consumers, they would be likely to also offer a number of other tariff structures and contracts (as per mobile phone plans). In addition, it is expected that retailers would offer different levels of price smoothing (in exchange for an appropriate risk management premium).

Regardless of how smart meter costs are reflected in consumers’ bills, there may be equity concerns for disadvantaged groups who are unable to offset the higher fixed costs through savings in their power use. There is already assistance to disadvantaged households with low incomes or struggling with their utility bills. For instance, lower-income households spend a much greater share of their income on electricity and face large problems in budgeting for quarterly billing (chapter 2). (Of course, with the roll out of smart meters that provide the ability to measure consumption remotely, much more regular billing could become practical.)

Given this, state and territory governments could develop criteria for any assistance to low income households for the cost of smart meter fixed charges that are similar to those already used to target financial concessions generally. It would be desirable that such criteria be consistent, at least, across the NEM and possibly also consistent across utility services more broadly (draft recommendation 11.6). Any assistance should be transparent and financed in the most efficient way, such as through efficient general taxes or, if need be, as a small levy on the fixed charge applied to all electricity consumers.

The incidence of fixed smart meter costs can be distinguished from the equity and efficiency impacts of time-based pricing. As such, if low-income consumers are shielded from the fixed costs of a smart meter through targeted assistance, the potential for poor outcomes from time-based network tariffs for these consumers is significantly reduced. Trials find that low-income households tend to benefit from time-dependent charges if the cost of a smart meter is not included. For example, some studies suggests 80 per cent of low income households (which tend to have flatter load profiles) would be better off under time-based pricing without even altering their consumption patterns, and if responding to price signals, 92 per cent of low income households would be better off (Faruqui 2010).

Therefore, subject to passing a cost benefit analysis and appropriate consumer education beforehand, once a smart meter has been installed and retail price caps are removed (draft recommendation 12.3), there should be mandatory application of time-based network charges by distribution networks (draft recommendation 11.3). (Chapter 11 discusses the structure of these tariffs, transitional measures to ease the progression to cost-reflective time-based network tariffs, and specific assistance to vulnerable households.)

### A region-by-region roll-out when the net-benefits are maximised

There are compelling grounds for a coordinated roll-out of smart meters by a single party on behalf of consumers. And, as discussed above, the costs should be paid for by consumers (with some exceptions). However, the concept of a universal roll-out need not be national or for a whole city. Rather, smart meters and the associated infrastructure could be installed on a universal basis within a discrete geographic region, subject to a cost benefit analysis to determine when it is most likely that the net present value of doing so is maximised. Likewise, coordination and overall management by a single party should not be taken to imply single suppliers of either the meters themselves or the contract installation of them. Competitive tendering for the capital equipment and installation services would be appropriate to minimise costs, irrespective of the party that ultimately bears any financial risk and responsibility for a roll-out.

It is unlikely that a cost-benefit analysis would justify the roll-out of smart meters in areas of the network where there is currently significant excess capacity. Conversely, a smart meter roll-out in a particular region would be more likely to pass a cost-benefit test where the current network is approaching capacity, since that would maximise the potential for demand management to avoid costly network upgrades. Similarly, if existing meters are approaching the end of their asset lives, the additional cost of adopting smart meters would be lower compared to replacement of meters still well within their asset lives. In rural and regional areas of the network, there may be higher returns from smart meters associated with operational efficiencies for network businesses, including detection of supply failures, and remote connection, disconnection and meter reading.

In all cases, a key determinant of the potential benefits would be a requirement for tariffs to better reflect the real time-variant underlying costs of network services, since price difference between peak and off-peak use is a major driver of changes in consumer behaviour.

### Who should implement a smart meter roll-out?

The obvious contenders for coordinating a universal, region-by-region roll-out would be distributors or retailers. The choice of one party over another would not necessarily preclude scope for competition in metering services, or dictate the ownership of meters and access to data and other sources of benefits. In particular, a party responsible for coordinating a roll-out would be expected to competitively tender for smart meter services.

The Commission considers that the division of responsibility and control between parties is finely balanced, reflecting compromises between alternatives.

#### Should retailers lead a smart meter roll-out?

As meeting customer needs is their core business, retailers may be in the best position to influence customer behaviour.

The availability of smart meters offers benefits to retailers, including the scope to add value to their traditional services by:

* more frequently billing their customers, and reducing the risk of default and the associated use of hardship provisions
* using detailed consumption data to offer tariffs and service plans that better meet customer needs and patterns of use
* offering load management programs and energy consulting services, such as automated solutions or direct load control of air-conditioners and other peak-heavy appliances
* educating customers about how to get the best deal with the options that time variant pricing offers.

As stated by the chief economist of retailer AGL:

A smart grid, and what it can do for power system load factor, is a genuinely good story for our industry, and for our customers. (2012, p. 7)

To the extent that smart meters enable retailers to add value to their traditional service range, they may only need to partially transfer the costs of smart meters to their customers. However, the benefits retailers obtain from subsiding smart meters may be eroded if the consumer switches to another retailer, thus reducing the incentives for installing such meters. As summarised by Schächtele et al. (2011):

This business strategy suffers from a typical holdup problem as an investment risk results from the fact that consumers can easily switch retailers. Thus, retailers are hindered in covering part of the investment costs of consumers, which creates a major hurdle for market entry. (p. 11-12)

Imposing a sufficient lock-in period to ensure payback of benefits could potentially solve the pay-back problem, but faces some practical obstacles. Participants claim that the cost of acquiring customers, such as marketing and inducements, can already take years to recover. An incumbent retailer may have a greater capacity to pass costs on with less risk of losing market share (but any market power they hold could also reduce the likelihood of minimising the costs of a roll-out).

Another issue to be considered is that under current network and energy charging regimes, retailers take a margin on the total amount they invoice to final consumers, and thus generally gain more income the more power that consumers use. Ensuring that the structure of time variant network charges aligns the incentives of retailers with the objective of influencing consumers to move their consumption away from peak times will be an important part of a successful transition. Another argument that would not favour retailers leading a roll-out of smart meters is that a retailer may have a dispersed customer base that is not well aligned with the appropriate geographic region that is targeted to deliver the highest net benefit from a roll-out.

Even if retailers do not lead a smart meter roll-out, they would still need to be responsible for other investments and would be a crucial player in informing consumers. That would include the provision of consumer interface or add-on technologies and educational material about time-based pricing to assist customers in adjusting their consumption patterns to help manage their energy use and costs. Indeed, it is in this line of technologies where the market role of retailers and scope for innovation and personalisation of services is likely to be most warranted. As stated by the Energy Retailers Association of Australia, because meeting and shaping consumer needs is a retailer’s core business, they have the primary relationship with consumers and:

… are best placed to educate and inform consumers about the benefits of new technology and how these benefits align with consumer needs, such as energy cost management. (2012b, p. 7)

#### Distributors are the preferred candidate

A clear benefit from a distributor-led roll-out is their knowledge about the potential for network cost savings within given regions of their network. As network augmentation projects are generally lumpy and forward-looking, some localised network areas will have considerable spare capacity, perhaps for several decades. Accordingly, the returns from a smart meter investment to facilitate demand management in such areas would usually be low.

Other reasons supporting a distributor led roll-out include:

* network businesses benefit from operational efficiencies enabled through smart meters. However, to defray their existing costs of, for example, disconnections, connections and meter reading, a smart meter roll-out would have to be universal within a given region of their network
* many of the communication infrastructure options used to support a smart meter roll-out interact closely with the grid, which distributors control. Further, consistency of communication infrastructure and standards across the network should reduce costs. There are significantly fewer distribution companies to apply consistent standards across than there would be retailers
* the widespread adoption of time-dependent charging by retailers hinges on whether or not they face a time-dependent distribution network tariff for their customers’ consumption. For this reason, tariff structures imposed by distributors would be a key trigger for a change to the business model of retailers
* this has been the model used to date in Victoria and in trials elsewhere.

On balance, and consistent with many others who have considered the options, the Commission supports a distributor-led arrangement for the roll-out of smart meters. Distributors would install meters and would own the technology and network management system within their area of operation (figure 10.4).

The Commission’s assessment is consistent with other studies that quantify the potential net benefits from smart meter technologies. In particular, a distributor-led arrangement was also the assessment of the (then) Ministerial Council on Energy in their 2008 evaluation of four possible scenarios.[[14]](#footnote-14) A distributor-led arrangement similarly accords with the Victorian approach to their government-mandated roll-out. However, rather than offering a blueprint for successful implementation, the Victorian experience provides some important learning — principally:

* to estimate and manage costs extremely carefully
* to avoid a negative consumer reaction and educate consumers in advance about the reasons for the roll-out and the potential benefits of time variant pricing and demand management that smart meters enable
* with the close involvement of retailers, to ensure that time-based network tariffs are introduced following the roll-out (and that the range of retail tariff options and other potential advantages to customers are phased in).

### Who should control the information hub?

Apart from allowing efficient pricing, smart meters provide a wealth of information and options to use that information for a range of uses by multiple market participants. For example, smart meters can be used to collect valuable information about each household’s consumption patterns and, with add-on technologies to enable retailers to communicate prices to end-users, the price responsiveness of consumers can also be gauged. The use of this information would be subject to appropriate privacy considerations. In addition, with the agreement of end-users, smart meters allow the centralised implementation of sophisticated load management programs and can broaden the range of options to support emergency management of system reliability.

This raises the question of which party or parties should operate a central command and control hub of the smart meter platform (or whether any such universal coordination or central control is needed at all). This includes responsibility to implement and operate a single meter data management system (MDMS), which validates data and coordinates the communication of commands and information to and from meters (figure 10.4). Under a distributor-led roll-out, the communications infrastructure would be controlled and maintained by distributors, since it closely interacts with their network functions. As such, distribution businesses would also operate the network management systems (NMS) — the IT platform that links to the communications system and interfaces with the MDMS.[[15]](#footnote-15)

Some participants suggested that AEMO could operate a central MDMS as it is independent from distributors and already has some responsibilities for smart meters. (AEMO currently facilitates the communication of metering information between distributors and retailers.) The efficiencies and risks from having a single MDMS would have to be thoroughly analysed, but the option appears to have some merit. In particular, a central MDMS operated by AEMO:

* could deliver scale economies because it would spread the costs of fixed IT expenditures
* would allow prioritisation of communication flows and commands to smart meters from a variety of parties, including:
* AEMO itself (to protect overall system security)
* retailers (to manage both network and wholesale market events, billing to their customers, and deliver demand management services, such as direct load control, on behalf of their customers)
* transmission and distribution businesses (to manage peak network events and implement load management according to contracted arrangements)
* other approved third parties (such as demand aggregators)
* gives confidence that a distributor-led roll-out would not disadvantage other market players who might have legitimate reasons to access smart meter information and, with the agreement of customers, make use of the control and communication functions offered by this technology.

Currently, the transactions settlement and business-to-business system operated by AEMO is not a real time system. It would require an overhaul to be used as the seed of a central MDMS.[[16]](#footnote-16) Equally, however, an alternative where distributors each developed their own MDMS (as occurred in Victoria) would require sizeable investment. Appropriate empirical analysis would have to inform the relative costs and merits of either approach.

Any system would need to ensure consumer privacy and have appropriate security safeguards. In particular, the NER (and National Energy Customer Framework) should provide clear guidance about which parties are approved to access data. Currently, the NER assumes an arrangement where a consumer’s agent, such as their retailer, can receive, relay and store data on behalf of their consumers. A central MDMS would assist retailers to have timely access to data (collected from multiple distribution businesses) allowing them to efficiently perform their exclusive role in interacting with and providing data to end-users.

The use of customer data by retailers would be an important aspect of their business, assisting with:

* the design and packaging of tariffs
* hedging strategies — managing price volatility — and efficiently charging for risk management services in accordance with different customers’ load profiles
* targeting demand management services, such as direct load control.

Figure 10.4 The smart meter platform

|  |
| --- |
| The smart meter platform. This figure shows how smart meters communicate to and from a residence, with data and information flowing through communication infrastructure, a distributor’s NMS and being stored in a central MDMS that both distributors and retailers can communicate with and access information from. |

### How would approval of smart meters fit into the current regulatory framework?

Smart meters are unlike many of the conventional expenditure components of building block proposals (wires, trenches, poles and substations):

1. their success requires complementary policies, such as the phased introduction of peak pricing. By implementing smart meters, businesses, in effect, would be committing to introduce time-based prices and, in time, would face revenue implications from not pricing efficiently. In the fullness of time, this represents a significant shift in the existing paradigm of distribution businesses, and while some businesses may embrace such a change, others may be more reluctant
2. the effective use of smart meters may require the adoption of appliance standards and would certainly rely on retailers having aligned incentives to pass-through (or manage) more cost-reflective network charges. Each of these factors lie outside the control of the network business and would rely on decisions by governments. Further, governments themselves may seek to interfere in the benefits from smart meters, including by limiting the introduction of efficient pricing, hence creating risks for distributors
3. the current regulatory regime may undermine distribution businesses’ incentives for their implementation. While smart meters can support more efficient network capital spending, the current regime may not provide efficient incentives to reduce capital expenditure (chapter 5). For example, the use of a revenue cap would act as an obstacle where smart meters are used to implement time-based network charges.
4. current retail price regulations may see retailers less than enthusiastic about time-based network charges, given the possibility of threats to their revenues, and the perception of general consumer resistance. The potential benefits from time-based network charges could be undermined by restrictions on retail pricing flexibility
5. it is desirable to plan and receive approval for their implementation over a longer timeframe than the current five year regulatory period — it is not clear that the regulatory regime (and the AER’s application of it) would value savings beyond the current regulatory period
6. many benefits accrue to parties other than the distribution businesses (‘spillover’ effects). The current regulatory regime for distribution does not take into account these broader market benefits (although it is proposed that a Regulatory Investment Test for Distribution (RIT-D) would do so)
7. they are not (yet) customary investments for distribution businesses, and so may not be selected as a ‘non-network’ option
8. there is significant uncertainty about the costs of roll-outs and about demand responsiveness (though trials have provided some information)
9. the cost-benefit analysis underpinning a decision to proceed requires information from non-distribution businesses (such as transmission businesses)
10. their introduction requires a level of customer acceptance, especially to ensure a smooth transition to their use for time-based network charges — a risk that distributors may be hesitant to take.

These factors indicate that:

* distribution businesses do not have fully aligned incentives to roll-out smart meters, and implement time-based pricing
* it is unlikely that the current propose-respond building-block model would function well in this regard.

A workable approach would need to take account of the peculiarities of smart meter investments shown in (a) to (j) above and sequence the roll-out to address the coordination problems affecting their deployment.

#### An important starting point is to address policy risks

State and territory policies lie outside the control of distribution businesses and pose considerable risks for investment in smart meters. The risks would be moderated by:

1. giving the AER a legal capacity to mandate roll-outs in given regions (subject to safeguards) throughout the NEM
2. removing existing state-based obstacles to time-based prices, such as the current moratorium in Victoria, retail price regulation in other jurisdictions, and the capacity of jurisdictional governments to exert influence through the licence conditions of network businesses
3. a commitment not to change the policy environment in a way that devalues smart meter assets (such as by re-imposing retail price regulations after a period of price flexibility).

#### Decision-making requires information

The AER would require detailed network planning information to approve smart meter roll-outs as would distribution businesses. A starting point to gather such information would be from the proposed distribution annual planning report, as already proposed in the current rule change proposal with the AEMC — *Draft National Electricity Amendment (Distribution Network Planning Expansion Framework) Rule 2012*. The rule change proposes that distribution businesses publish an annual planning review covering an appropriate forward planning period of no less than five years, which should include forecasts of maximum demand for sub-transmission lines, zone substations and primary distribution feeders. Businesses would also be required to identify limitations within their network from forecast load exceeding capacity (and design fault levels) or relating to voltage regulation.

While some planning information is better than none, a longer-term plan (say of ten years) may be required:

* since the roll-out of smart meters has a long lead time, it would need to occur well in advance, if it were to make viable the option of deferring network augmentation
* to establish that the demand response from smart meters is sufficient to defer a network augmentation.

Given the central role of time variant network tariffs in efficiently moderating the use of peak network capacity by end-users, the AER and network businesses would also require detailed information on the responsiveness of consumers to higher peak charges. Chapter 12 recommends an increase in the innovation allowance of distribution businesses, which would help to facilitate the acquisition of such knowledge. Nevertheless, existing evidence from trials and experiments could help to guide early decisions until a larger pool of information accrues.

Similarly, evidence-based decisions would need to consider trends in smart meter costs, their technological capabilities and the likely network savings. Which party does this would depend on the choice of roll-out model (figures 10.5 and 10.6). There are also compelling grounds to reduce investment uncertainty (through early disclosure of roll-out costs by distributors for AER approval) and to increase the likelihood that the AER approves only prudent investments by benchmarking the efficient costs of smart meter roll-outs. Benchmarking should be based on domestic and, where possible, comparable international commercial experiences, and would be overseen by the AER — consistent with its capacity for such benchmarking under the Rules (chapter 8).

#### Can a commercially motivated approach work?

Allowing a commercially motivated decision by a distribution business about when and where to roll out smart meters has attractions. The distribution business has much information which should help it analyse when and where best to roll-out smart meters. The process for investment approval would follow a model similar to the current revenue determination process (figure 10.5).

However, complementary incentive regulations are a key prerequisite for a commercially motivated approach and, as indicated earlier, for a raft of reasons it is not apparent that the incentives of distribution businesses to implement smart meters align with them assessing the net-benefits in an impartial and rigorous manner.

* There are major challenges in designing a regulatory regime that overcomes the current flaws (chapter 5), which are magnified when there are gains in future regulatory periods and spillovers to other parties. Any regime that achieved that goal would be complex (more so than the current arrangements), and may not have the predicted outcomes.
* Indeed, even were a distribution business to propose a smart meter roll-out and demand management as part of a normal revenue determination proposal, it could subsequently decide not to proceed with the roll-out if it found alternative ways of meeting demand, or if demand forecasts proved incorrect. While this is generally a desirable outcome of incentive regulation, it may not be appropriate where the benefits of the investment extend beyond the investor.
* The introduction of a RIT-D could enhance the current regulatory regime’s procedural attention to assessing the market-wide benefits from investments such as smart meters. However, the Commission notes that any such arrangement would have to overcome problems similar to those associated with the application of the parallel regulatory instrument for transmission — the RIT‑T. In particular:
* given the interested status of the party responsible for assessing the net-benefits, and that such an assessment necessarily relies on assumptions and informed judgements, ensuring estimates of the net-benefits are impartial and genuine is inherently a vexed issue (chapter 19).
* as discussed in chapter 15, rigorous and independent cost-benefit analysis is necessary to provide assurance to governments and consumers that there is value in investments.

Figure 10.5 A commercially motivated approach appears attractive

|  |
| --- |
| A commercially motivated approach appears attractive. This figure shows the possible process for implementing smart meters using the commercial incentives of distributors and the standard incentive regulation framework. |

Accordingly, there are reasons why (at least in any initial period of moving towards smart meter roll-outs and more efficient network pricing) it would not be appropriate to rely on distributors to bring-forward completely unbiased cost-benefit proposals for regulatory approval. Over the longer term, workable solutions to support the approval of efficient smart meter investments proposed by distributors could develop, especially when the effect of the package of reforms proposed by this report ‘washes through’. However, at this stage, there is a high risk that the incentives of distributors would not be appropriately aligned to support efficient investment proposals, suggesting that an alternative independent party would be best placed to assess the net-benefits of roll-out opportunities in constrained network areas.

Charging a central independent body with the task of rigorously assessing the net benefits of smart meters would develop a hub of knowledge and experience that could outweigh the initial informational advantages associated with distributor-led proposals. Further, were the AER to undertake such a function, it would marry with their additional responsibilities to support efficient time-based pricing (as outlined in chapter 11).

While attempts to adapt the current incentive regime for such purposes should not be abandoned, in the meantime, there are grounds for a planned approach that ensures, where justified, a region-by-region roll-out of smart meters (figure 10.6).

#### The key ingredients of a planned approach

Any planned approach would be subject to stringent cost-benefit analysis (CBA) undertaken by the AER (drawing on information from proposals put forward by distribution businesses and proposals or submissions as requested by the AER).

The AER’s process for seeking proposals and supporting evidence from distribution businesses should be as streamlined as possible. The engagement of distribution businesses would be needed to support good outcomes, including smart meter roll-outs that target constrained network areas. As CBA involves assumptions and uncertainty, distribution businesses would have an important role in providing feedback on the AER’s CBAs, which should also be publicly available.

The Commission seeks feedback on any improvements to the process proposed for smart meter roll-outs, and how distribution businesses can contribute to the Australian Energy Regulator’s assessment of the costs and benefits.

The roll-out of smart meters should proceed when the AER assesses that the net present value of benefits are most likely to be maximised, or at least, after allowing for uncertainties, when the benefits would clearly exceed the costs. The evaluation of the net-benefits from smart meters should consider other feasible alternatives (technologies to implement demand management that do not rely on smart meters), including direct load control. The timing of approvals would not be constrained by existing regulatory determination periods.

Once meters were in place, it would also be mandatory that network businesses start to implement time-based charges. The framework of such charges, including assumptions about how they would initially be phased in and made more cost-reflective over time, would be implicit in the AER’s CBA. Such judgements should be informed by evidence from pricing trials and developed in consultation with distribution businesses (taking submissions if desired), and made transparent at the time of approving the commencement of a roll-out. Otherwise, the inadequacies in the overall incentive regime might lead to implementing smart meters, but not to their efficient use. Moreover, where the AER mandates smart meters, subsequent regulatory determinations (including approval of demand forecasts) should take account of their expected network savings.

Figure 10.6 A planned process for rolling out smart meters

|  |
| --- |
| A planned process for rolling out smart meters. This figure shows a planned process for implementing smart meters, including through the AER undertaking an initial cost benefit analysis. |

#### How would distributors recover prudent costs under a planned approach?

The AER could require businesses to roll-out smart meters, with either:

* an initial cost proposal by the business and ultimately an ex-ante determination by the AER of a revenue allowance that could recover their expected costs from customer charges. Businesses that were able to roll-out meters at lower than expected costs would retain the savings, creating incentives for cost minimisation, or;
* the AER ex-post approving a rate of return on prudent expenditure (effectively ‘rate of return’ regulation).

The former is preferred if the distribution business could be reasonably satisfied that the AER would not underestimate the required revenue to support smart meters, or that any such estimate is reasonably certain. However, even with the better provision of information (as discussed above), there is likely to be significant remaining uncertainty until many regional roll-outs have occurred. (The Victorian experience highlights the divergence between ex-ante and ex-post costs.)

Of the two options, the second appears to reduce business risk the most because it reduces the potential for the AER to set a revenue amount well short of the actual roll-out costs (and avoids the alternative risk of adding a sizeable risk premium to the estimated costs). Under this option, business should still provide the AER with a projected costing for provisional approval. That would reduce risks for business and avoid a situation where the AER subsequently determined that the business did not adhere to a commercial standard or chose an uncommercial technology. The use of competitive tendering would also encourage the efficient provision of smart meters, their installation and the provision of associated technologies such as enabling IT.

As an illustration of the uncertainties with the regulatory return of smart meter costs, the AER deemed that in Victoria, SP Ausnet’s roll-out was not prudent, a problem that would have been less likely had the AER given in-principle ex ante approval of the proposed approach. The AER considered that SP Ausnet’s adoption of WiMax (as the communications technology) involved a substantial departure from the commercial standard that a reasonable business would exercise under the circumstances. The AER adjusted the proposed advanced metering budget of SP Ausnet by around $70 million (ACT 2012, Appeal by SPI Electricity Pty Ltd [2012]). The decision went to the Australian Competition Tribunal for merits review, which remitted some matters back to the AER for consideration. In particular, the AER is now considering the costs and delays if SP AusNet were to change to a different communications technology.

## 10.3 Other technologies to reduce peak load inefficiencies

Appropriately cost-reflective network prices that reflect the timing of consumption are an efficient tool to provide consumers with the flexibility to:

* determine the amount of energy they consume at peak times
* substitute between alternative power uses at peak times
* shift their consumption through time to make use of much lower off-peak rates.

Once instituted, such price signals also provide incentives for end-users (or retailers acting on their behalf) to invest in technologies that assist in responding to price signals.

A particular technology that can reduce peak demand and act as either a potential substitute or complement to smart meters (and efficient pricing) is direct load control.

### How is direct load control achieved?

#### In the presence of smart meters

Many consumers facing cost-reflective prices will want to reduce peak load demand. They could do this by manually turning off electrical equipment, but that requires monitoring[[17]](#footnote-17) and simple oversights could expose consumers to large bills. In contrast, direct load control requires little ongoing effort for the consumer. If applied to air-conditioning, it provides a tool to balance price risks and in-home thermal comfort. In the presence of a smart meter and a compatible appliance, the costs of implementing direct load control are low — potentially costing around $10-20 with the addition of a small piece of equipment to link with a compatible appliance (Wilkenfeld 2012).

#### …and in the absence of smart meters

Network companies (with the prior agreement of consumers) could still implement direct load control without smart meters and secure the benefits from reductions in peak demand. However, without price signals, consumer participation in direct load control programs requires incentive payments. For example, Queensland distributor, Energex, is offering a $250 cash card for the installation of a load control device in new split system air-conditioners (which would allow Energex to defer more costly long-run network upgrades). However, such an approach is a blunt tool to secure the benefits of reductions in peak consumption, since standardised incentive payments bear no relation to different values consumers place on their peak consumption.

Ultimately, the most appropriate approach to implementing direct load control is an empirical question. At this stage, the technologies and their costs are rapidly evolving, which makes it hard to accurately assess the net benefits. Even if the cost of more rudimentary technologies were more cost-effective than smart meters over the short-run, it would be prudent to avoid locking-in technology solutions without evaluating the stream of net-benefits (and that of alternatives) over the longer term. In particular, to the extent that direct load control might appear to provide a more immediate cost-effective means of reducing peak loads, its adoption would be likely to preclude the efficient uptake of smart meters (including efficient pricing and their other sources of benefit) for some time into the future.

#### Should demand response capability be mandated in selected new appliances?

Direct load control has significantly lower costs where the relevant appliance already incorporates the capacity to respond to remote commands. For example, enabling direct load control by retrofitting of an air-conditioner requires electrical re-wiring and could cost around $1500 (Energy Australia and Transgrid 2009). However, with an appliance that was originally designed and manufactured to incorporate a demand response capability, direct load control could be achieved for only a small fraction of that cost.

The Australian Standard AS4755 *Framework for demand response capabilities and supporting technologies for electrical products* was published in 2007 to assist with this (box 10.3). Such a demand response capability could be applied to the manufacturing standard of numerous electrical devices, but is currently being investigated for air-conditioners, pool pumps and electric vehicles. An appliance that includes a demand response interface is frequently termed a ‘smart appliance’.

A small number of air-conditioners available on the market today are compatible with the AS4755 standard. These appliances can be activated for direct load control with the installation of a so-called Demand Response Enabling Device (DRED). The DRED can be:

1. a self-contained unit that receives remote signals to control load, processes them according to its settings, and sends instructions to the attached appliance
2. a ‘receiver’ attached to the appliance, with smart meters performing many of the other functions.

DREDs can be activated by a range of signals from the network provider or retailer, including those sent through power lines, phone lines, radio frequencies, and the internet. Passing signals through smart meters offers the potential for more sophisticated and personalised appliance responses and two-way communication with the network. It can also remove the need to roll-out a communication network exclusively for direct load control.[[18]](#footnote-18)

A standard avoids the development of multiple, potentially incompatible technologies and could encourage the more rapid diffusion of direct load control. However, Australia imports most appliances. It is often costly for overseas manufacturers to develop products geared to the standard of a small market, like Australia. Moreover, unique Australian standards could act as an import barrier. In that vein, there are dangers in mandating the AS4755 standard, though there have been calls to do so (Wilkenfeld 2010, p. 2). There may be stronger grounds for encouraging (or even mandating) labelling that indicates that an appliance is compatible with direct load control.

|  |
| --- |
| Box 10.3 The AS4755 standard for demand response capability |
| The Demand Response AS4755 standard applies to the interface between a demand response enabling device and a variety of electrical products including air-conditioners, pump controllers, water heaters and electric vehicle chargers. Different parts of the standard apply to particular appliances and each is in different stages of development. The air-conditioning part of the standard is most advanced, although it is expected that all parts should be published in 2012. Compliance with the Demand Response AS4755 standard would feature on the energy rating labels of appliances.  Activation of demand response capability, including direct load control, requires connection to the demand response enabling device, such as a smart meter with the appropriate functionality or, if available, a home area network. Participants inform the Commission that the cost of such a connection is not expected to be large (likely to be around $10-20 once compliance with the standard is more common) and may not require an electrician.  Voluntary compliance rates among appliance manufacturers are currently very low, which is not surprising given that the standard is new and evolving. By August 2011, only 2 out of roughly 78 potential brands of air-conditioning on sale in Australia had a demand response capability built in and ready to use, and a further 6 were compatible, subject to the addition of an extra part. |
| *Source*: Wilkenfeld (2011). |
|  |
|  |

Nevertheless, reflecting on the package of reforms proposed by this Inquiry, the Commission recommends that the Australian Government (including with the involvement of Standards Australia) should undertake a cost-benefit analysis of mandating a ‘demand response capability’ into the manufacturing standard of suitable appliances. Such an analysis should appropriately focus on the option of direct load control of air-conditioners, but also consider the suitability of other future options. Any such initiative should be subject to a *careful* analysis and show why alternatives would be worse. That would include evaluating the likelihood and timeframe over which market solutions, or other similar international standards would develop and, hence, whether an accelerated adoption would yield net benefits in preparation for smart meters and mandatory time-based tariffs. The analysis should consider the costs of departing from international standards as it could be unduly costly to prematurely mandate a standard in the absence of international momentum in that direction.

draft RECOMMENDATION 10.1

Distribution businesses should implement the roll-out of advanced metering infrastructure — so called smart meters — on a region-by-region basis within their network.

* Before any roll-out, the Australian Energy Regulator, drawing on the proposal and supporting evidence from the distribution business, should assess the net present value of costs and benefits, and be required to consider demand management options that do not rely on smart meters.
* When the Australian Energy Regulator determines the optimal start date of the roll-out, the relevant distributor must submit a costing to the Regulator for approval and agree to an appropriate timeline for implementation.
* Mandatory time-based network charges to retailers (draft recommendation 11.3) should be implemented once smart meters are installed, appropriate customer consultation and education has taken place, and retail price regulation is removed (draft recommendation 12.3).

1. The term ‘smart meters’ is used to describe the smart meter itself, and associated technologies, such as IT equipment, back end software, and two-way communication equipment. [↑](#footnote-ref-1)
2. Electricity storage and distributed generation technologies could also be alternatives, but these are addressed in chapter 13. [↑](#footnote-ref-2)
3. Direct load control (DLC) can be implemented both with and without a smart meter. If a smart meter is available, DLC can be implemented with greater flexibility and for a lower incremental cost. [↑](#footnote-ref-3)
4. Although many households face a separate off-peak tariff for their directly wired electric hot water service. [↑](#footnote-ref-4)
5. Two cost-benefit studies informed the Victorian Government’s decision — a 2004 study of installing manually read interval meters and a 2005 analysis of adding two-way communication technology. [↑](#footnote-ref-5)
6. The term roll-out refers to a coordinated program to install smart meters in a given geographic area. Although this may imply some degree of universality, it does not necessarily imply a government-mandated roll-out throughout a complete jurisdiction. [↑](#footnote-ref-6)
7. The UK is commencing a roll-out of 53 million smart meters to all residential properties and small and medium businesses over the period 2014-2020. The project is expected to deliver a net-benefit of £7.2bn (DECC UK Smart Metering Implementation Programme 2012). [↑](#footnote-ref-7)
8. Demand limiting switches are a similar technology approach, but are not remotely controlled by a utility provider and therefore require the end-user to pre-program decisions about which appliances to switch off during peak periods to stay within a nominated consumption limit. Such an approach tends to require greater customer effort than direct load control of household air-conditioners and pool pumps. An advantage of direct load control for network providers is that they can coordinate the use of power between households (having some households air-conditioner cycled on while others are cycles off) and can secure a more reliable demand response. [↑](#footnote-ref-8)
9. This requires individually contracting with end-users, but to avoid excessive administration costs, ‘participant’ households are typically offered a uniform flat incentive payment. Since end-users users value the use of power (or particular appliances) at peak times differently, compared to a price mechanism, incentive payments are a blunt and inefficient instrument to reduce peak use. Moreover, financing such payments through a higher average consumption price can distort pricing efficiency or lead to distributional concerns (chapter 11). [↑](#footnote-ref-9)
10. Ausgrid also claimed that it could not appropriate the benefits of demand management for transmission or wholesale generation costs, and that the benefits would be eight times greater than those recognised under the current regulatory framework (Maltabarow 2012, p. 4) [↑](#footnote-ref-10)
11. Including MacDonald (2007) for the British Government; Nabe et al. (2009) for the German Federal Network Agency; Kearney (2008); and Frontier Economics (2007). [↑](#footnote-ref-11)
12. In Germany and, in the UK, the penetration of smart meters initially relied on customers bearing a substantial portion of the upfront investment. As a result, penetration in both countries is low and has since resulted in stronger regulation to increase uptake. [↑](#footnote-ref-12)
13. While open communication standards could overcome this to some extent and promote the competitive supply of smart meters, it would not overcome the split incentives problem. [↑](#footnote-ref-13)
14. The other three scenarios examined were a retailer-led roll-out, a centralised communications roll-out and a direct load control roll-out without smart meters. The benefits from a distributor-led smart meter roll-out are largely due to a wider range of communications options and synergies with network management. [↑](#footnote-ref-14)
15. As directed from retailers or other third parties acting on behalf of consumers, distributors would provide metering data services (with the information stored within the MDMS) and relay communications to smart meters. Given the market power that could potentially bestow on distributors, regulation would be needed to outline a distributor’s obligation to provide these services at reasonable charge. [↑](#footnote-ref-15)
16. Currently smart meter data in Victoria is passed from distributors to retailers overnight. Unless they are designed to move data very quickly, the communications infrastructure, associated IT systems, and transfer of data between distributors and retailers, can create bottlenecks that generate delays. In the absence of real-time information flows in figure 10.4, customers could access their real time consumption by reading it from the meter directly, on a separate ‘in-home display’, or by using two-way ‘zigbee’ devices (a form of data communication using low power digital radio, similar to Bluetooth) or an home ‘gateway’ (connecting their smart meter to the the internet). In principle, gateway and zigbee devices could be used by a retailer to initiate load control of appliances, without having to send the request through distributors. [↑](#footnote-ref-16)
17. In addition, there are benefits from a central controller that rotates the use of power by appliances between households in a network area. [↑](#footnote-ref-17)
18. Although, even where smart meters are not present, an entirely new communication system may not be necessary as some distribution networks already have a system present for hot water control that could communicate with DREDs for little additional cost. For instance networks in Queensland and NSW may be able to use their existing ability to send signals down power lines to operate DREDs on air conditioners. [↑](#footnote-ref-18)