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Benefits and Costs of the Victorian AMI Program

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1. Executive summary

1.1. AMI Program overview

The objective of the Victorian Government's Advanced Metering Infrastructure (AMI) Program[1] is to transform the operation of the electricity industry to a smarter and more efficient digital environment by:

- Rolling out new electricity smart meters and associated communications infrastructure to all residential and small business premises across Victoria by the end of 2013 (AMI Rollout); and
- Delivering new AMI enabled services to these customers (AMI Program).

This transformation will lead to significant efficiency gains across the industry, as well as the avoidance of future costs. In addition, AMI will enable customers to make more informed decisions about their energy use and make it easier for them access new electricity pricing and services.

Increased competitive pressure in the retail market, combined with continued regulatory oversight will ensure that the benefits of the AMI Program are passed through to customers.

These benefits of the AMI Program will be progressively realised as the AMI is rolled out and new services are enabled.

The AMI Program consists of the following:

- Rollout of advanced metering infrastructure to all Victorian households and small businesses (those that consume less than 160MWh per annum);
- A consumer education program that explains the AMI Program;
- New cross-industry processes and systems that enable:
  - accurate and timely collection and delivery of half-hourly metering data on electricity consumption (and generation, if any) at the household or business facility;
  - remote and prompt delivery of customer services, such as reconnections and disconnections;
  - demand management responses by consumers facilitated by the availability of new pricing arrangements (e.g., time-of-use prices) and load management tools that will empower consumers to make more informed energy consumption decisions;
  - new products from retailers and others that support the realisation of the benefits made available by AMI;
  - new network management tools, such as accurate knowledge of local network performance and remote implementation of demand constraints; and
- New systems, communications and data sharing infrastructure that create benefits for customers and the broader economy by facilitating further developments such as smart grids.

1 As stated in the Terms of Reference of the AMI Policy Committee, which comprises representatives of electricity distribution companies, electricity retailers, consumer groups, regulators, and the market operator and is chaired by the Victorian Government.

The evolution of the AMI Program dates back to 2002. It has adapted to improvements in AMI technology and practice, and reductions in AMI costs. The Government's role in the AMI Program[2] is to develop and implement an efficient legislative and policy framework, provide strong leadership, secure public and investor confidence in the initiative, manage emerging risks, and ensure effective coordination and alignment of the AMI Program activities across government, industry, regulators, market operators and other stakeholders in order to assist in delivering successful outcomes.

Consistent with this role, in 2006 the Victorian Government initiated the 'AMI Program' to deliver core infrastructure and, subsequently, realise a raft of benefits from that infrastructure. In 2008, through Orders in Council, the Victorian Government established obligations on the electricity distribution companies to install smart meters, together with the supporting communications infrastructure, IT systems and processes (AMI Rollout). This initial phase of the AMI Program, viz. the AMI Rollout, apart from involving the installation of specific AMI functionality[3], also obliges electricity distribution companies to provide a set of defined services[4] that benefit the community.

1.2. Costs and benefits of the AMI Program

As part of its role in the AMI Program, the Victorian Government, through the Department of Primary Industries, recently commissioned three assessments to update previous studies into the costs and benefits of the AMI Program. These were as follows:

- A review of the lifecycle costs of the AMI Rollout based on the information that the electricity distribution companies had submitted to the AER in 2009 as part of their cost-recovery proposals. This study, referred to in this report as the 2010 Cost Report[5], uses the costs of the AMI Rollout that were subsequently approved by the AER for recovery in the electricity distribution tariffs for 2010 that will be charged to retailers and which are generally passed on to customers[6]. It also addresses other costs that would be incurred through to 2028 as estimated by the consultant.
- A review of the lifecycle benefits available from the AMI Program based on the most up to date information available. That report is referred to here as the 2009 Benefits Report[7]. Where a benefit requires additional investment in order to be realised, this cost was also quantified in the 2009 Benefits Report. These benefits and costs constitute the current scope of the AMI Program. This report also provided a "low case" and "high case" for the benefits of the AMI Program, and a low and high estimate of the additional costs (beyond those specified in the 2010 Cost Report) that would be required to realise the full range of benefits that had been identified.

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2 As stated in the Terms of Reference for the AMI Policy Committee.

3 The rollout was mandated through an Amendment to the *Electricity Industry Act 2000 (Vic)*. The minimum functionality to be implemented in the rollout is defined in the *Minimum AMI Functionality Specification (Victoria)*, September 2008.

4 The services to be initially delivered by electricity distribution companies are defined in the *Minimum AMI Service Levels Specification (Victoria)*, September 2008.

5 Energy Market Consulting associates (EMCa) and Strata Energy Consulting, *Updated Assessment of AMI Costs for Victoria*, for Department of Primary Industries (Vic), June 2010.

6 While retailers generally pass on the costs they are charged by the distribution company, the structure of those costs may not be.

7 Futura Consulting, *Advanced Metering Infrastructure Program - Benefits Realisation Roadmap*, for Department of Primary Industries (Vic), December 2009.

- A review of the benefits detailed in the 2009 Benefits Report. This review, which is referred to here as the 2010 Benefits Review[8], reassessed the information provided in the 2009 Benefits Report to present a revised estimate of the level of benefits that could be conservatively expected to occur under low case assumptions concerning the deployment and utilisation of AMI. This is referred to in the remainder of this report as the low benefits case (where any low case value from the 2009 Benefits Report is mentioned it is specifically labelled as such).

This summary report consolidates and presents the results of those assessments of the costs and benefits of the AMI Rollout and the overall AMI Program[9]. While acknowledging that traditional cost/benefit analyses typically present low and high ranges for costs and benefits, this report uses the following data sourcing approach:

- AMI Rollout Cost: A single, estimated cost from the 2010 Cost Report
- 'Additional costs' required for the broader AMI Program to be delivered (i.e., beyond the AMI Rollout): low and high values from the 2009 Benefits Report. Where a single value is required for presentational purposes, the mid-point of the range has been used; and
- Benefit values: the low and high values used in this report have been sourced from the 2010 Benefits Review. The low and high benefit values of the 2009 Benefits Report have not been used in this cost/benefit analysis, except where specifically referenced for the purpose of comparison[10].

1.2.1. Costs

The present value of the total cost of the AMI Rollout (as defined by the Government), which will install smart meters together with supporting communications infrastructure, IT systems and processes, is estimated to be $1.621 billion[11] (plus or minus $200 million[12]) over the 2008 - 2028 timeframe[13]. The total cost of the AMI Program, which incorporates functionalities and costs identified in the 2009 Benefits Report to enhance the range of services available to customers, is estimated to be $1.813 billion (plus or minus $249 million)[14].

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8 Oakley Greenwood, *Review of AMI Benefits*, for Department of Primary Industries (Vic), July 2010.

9 Each of the reports presents the assumptions they use in regard to specific cost components and benefits. In addition, general assumptions are also presented, as follows:

- 2010 Cost Report: Appendix A: PV calculations (page A-40),
- 2009 Benefit Report:, section 4.4 (page 30),
- 2010 Benefit Review, section 4.2 (page 24).

10 It is important to note that the 2010 Benefits Review used some different input values and general economic assumptions from those used in the 2009 Benefits Report. In the 2010 Benefits Review, these were corrected at the individual benefit level for the low benefit case and for the benefits whose values changed in the high case.

11 All dollar figures cited in this report are in present value 2008 dollars unless noted otherwise.

12 2010 Cost Report.

13 This timeframe was chosen because the smart meters that are specified for use in the AMI Program are assumed to have a 15 year life. Because the rollout will be completed in 2013, the study timeframe ends in 2028. Costs began being incurred in 2008 at the commencement of the rollout, so that constitutes the starting point for the study timeframe.

14 The plus or minus figure of $249 million for the costs of the AMI Program is comprised of the $200 million uncertainty allowance cited in the 2010 Cost Report for the AMI Rollout and the midpoint of the low case and high case costs of the additional functionality associated with the AMI Program that were presented in the 2009 Benefits Report.

Almost all of the costs of the AMI Rollout will be incurred by the five electricity distribution companies that operate in Victoria. The five electricity distribution companies will also incur a portion of the identified additional costs associated with the AMI Program.

It is also worth noting that, while the cost of the AMI Rollout of $1.621 billion is a large sum, electricity distribution businesses spend large sums on metering-related activities in the normal course of their business. An estimate of the 'business as usual' cost has been constructed using the low case value of those benefits from the 2010 Benefit Review, which are benefits that result from costs being avoided (see section 3.6 for details). This indicates that the costs that are directly attributable to metering and manual meter reading and connection activities that would be incurred had there not been an AMI Program are, conservatively estimated at about $1.459 billion[15].

On this basis, one could conclude that the AMI Rollout is a concentrated investment of $1.621 billion in metering and manual meter reading and connection activities that, over 20 years (the AMI Program's lifecycle), would cost about 11% more than the 20-year cost that the electricity distribution companies would be likely to spend on those activities under business as usual conditions. The AMI Program, however, will deliver substantial additional benefits.

1.2.2. Benefits

The benefits of the AMI Program have been estimated to be in the range $2.577 billion to $5.004 billion[16], again over the 2008 – 2028 timeframe. Most of these benefits result from savings that will be experienced initially by the Victorian electricity distribution companies as improved operational efficiencies are realised through utilisation of the AMI infrastructure itself. They do not depend on new legislation or regulations, discretionary actions on the part of retailers or consumers, or the provision of new services. These benefits[17] are estimated to be $2.036 billion[18].

The benefits of the AMI Rollout (as distinct from the AMI Program) over that same timeframe have been estimated to range from $1.874 billion[19] to $3.513 billion[20].

1.3. Summary and conclusions

The AMI Program is cost-effective no matter which mix of costs and benefits is used. In the extreme, if the low case benefits and highest costs are used, for either the AMI Rollout or AMI Program, a clear net benefit results. Table 1 on the following page presents the main findings of the 2010 Benefits Review, 2009 Benefits Report and the 2010 Cost Report regarding the benefits and costs of the AMI Rollout and AMI Program. Further details and analyses are provided after the table.

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15 The sum of the low case value of benefits 1, 2, 5, 6, 7, and 9.

16 2010 Benefits Review.

17 Some of these benefits are essentially 'hard-wired'. The others are benefits that are readily available through the technology as long as appropriate processes and procedures are adopted by the distribution companies.

18 2010 Benefits Review.

19 2010 Benefits Review.

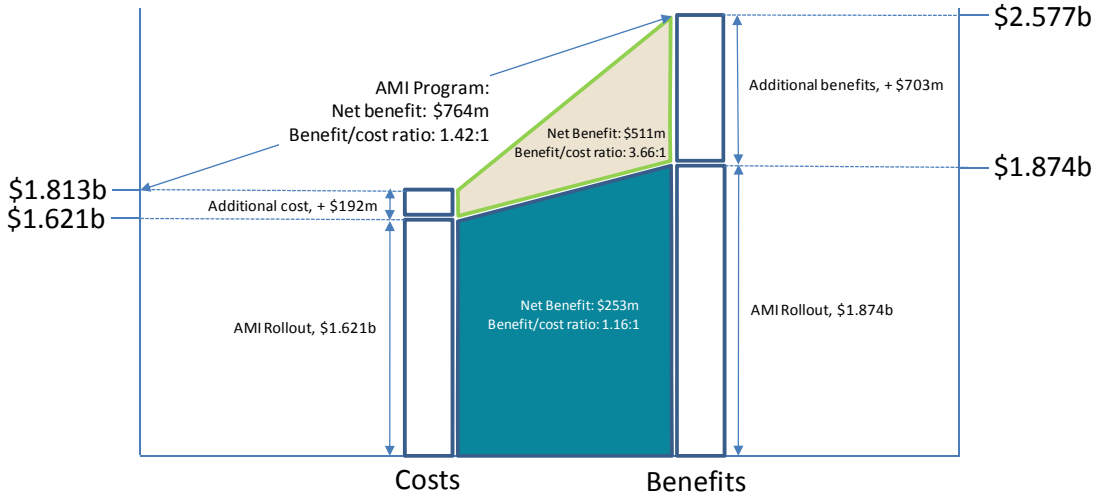
20 Based on removing the benefit value of Benefits 4, 10, 11, 14 through 16, 18 through 28, 33 through 35, and 38 (as numbered in the 2009 Benefits Report) from the total value of the low and high cases. In terms of the low case this equates to $2.577 billion minus $703 million; in the high case it equates to $5.004 billion minus $1.491 million.

Table 1: Overview of AMI Rollout and Program costs and benefits

Policy Component	Value (PV 2008 $)
AMI Rollout (i.e. government mandate)	
Cost	$1,621 billion
Low case benefits	$1.874 billion
AMI Program (i.e. AMI Rollout plus discretionary activities)	
Cost	$1.813 billion
Low case benefits	$2.577 billion
Business as Usual (i.e. no AMI Program)	
Cost	$1.459 billion
Benefit/cost ratios	
AMI Rollout vs. Business as Usual ($1.874b / $1.459b)	1.28 to 1.00
AMI Program vs. Business as Usual ($2.577b / $1.459b)	1.77 to 1.00
AMI Program incremental benefit vs. incremental cost {($2.577b - $1.459b) / ($1.813b - $1.459b)}	3.16 to 1.00

- ***There is a sound economic case for both the AMI Rollout and the AMI Program*** – As shown in Figure 1 below, both the AMI Rollout and the AMI Program are cost effective when the low case benefits and expected costs are considered.

Figure 1: Costs and benefits of the AMI Rollout and AMI Program – Low case benefits and expected costs case



Under the low case benefits and expected costs case the net benefits of the AMI Rollout and AMI Program are $253 million and $764 million respectively. The respective ratios[21] of the benefits to costs are 1.16 to 1.00 and 1.42 to 1.00.

In addition, the benefits that can be expected to flow as a result of the basic operations of the AMI technology that is to be installed under the AMI Program total $2.036 billion, which exceeds the $1.813 billion estimated cost of the AMI Program. These basic operations include but are not limited to the automation of manual processes in meter reading, and disconnection and re-connection of electricity supply. These benefits do not require any changes to legislation, regulations or market rules; new pricing approaches on the part of electricity retailers; or behavioural changes on the part of customers. They are readily available through the technology as long as appropriate processes and procedures are adopted by the distribution companies.

- *The economics of the AMI Program are even stronger from an incremental perspective* – As stated above, the expected lifecycle cost of the AMI Program is estimated at $1.813 billion, and an estimate of the 'business as usual' costs that are attributable to metering and manual meter reading and connection activities has been calculated to be $1.459 billion[22].

  Consequently, $354 million can be taken as the incremental cost of the AMI Program (or 24% more than the 'business as usual' case). The corresponding incremental benefit of the AMI Program is estimated to be $1.118 billion. This equals the total AMI Program benefit of $2.577 billion less the $1.459 billion of benefits that are comprised of the avoided costs of metering and manual meter reading and connection activities had accumulation meters been retained as the default.

  Using these values, the incremental net benefit of the AMI Program is $764 million (that is, $1.118 billion less $354 million), and the ratio of incremental benefits to incremental costs is 3.16 to 1.00[23].

- *There is significant upside potential for additional benefits* – The 2009 Benefits Report estimated that the high case benefits of the AMI Rollout and the AMI Program would be about 2.6 times as great as those of the low case. The 2010 Benefits Review consciously used a more conservative approach in assessing the level of benefits that could be expected to result from the AMI Rollout and the AMI Program in both the low and high cases. In particular, it significantly reduced the magnitude of benefits estimated in the 2009 Benefits Report that assume that new pricing options will be offered by electricity retailers and taken up and responded to (in the form of energy-conserving behaviours) by customers. As a result, the 2010 Benefits Review estimated that the high case benefits would be only about 2.0 times those of the low case, as shown in Figure 2 on the following page. However, even at this level, there is significant upside potential for additional benefits from both the AMI Rollout and the AMI Program.

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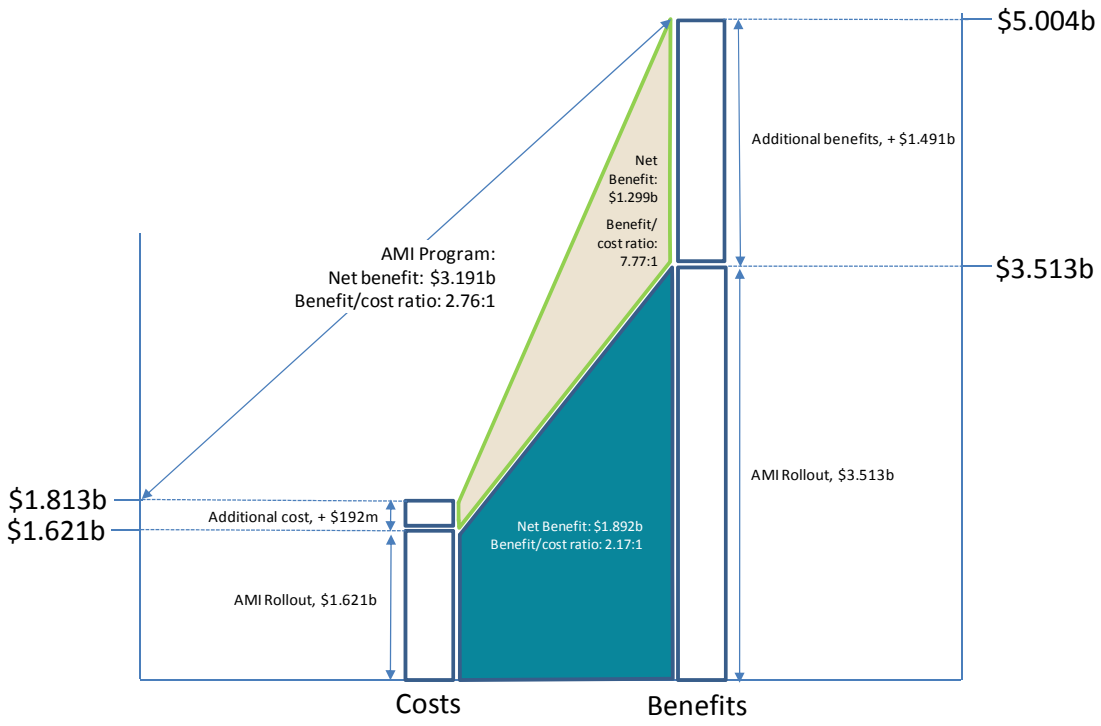
21 A benefit/cost ratio is the benefit amount divided by the cost amount. A benefit/cost ratio greater than 1.00 indicates that benefits exceed costs.

22 Benefits 1, 2, 5, 6, 7 and 9

23 Even if the worst case is modelled using the low case benefits estimated by Futura Consulting and the high case costs estimated by Energy Market Consulting associates (EMCa) and Futura Consulting, the incremental benefit/cost is 1.46 to 1.00. Under this analysis, the estimated cost of metering related activities is $1.150 billion. Using this cost, the incremental benefit/cost is calculated as follows: the incremental benefit of $1.331 billion ($2.481 billion less $1.150 billion) is divided by the incremental cost of $912 million ($1.621 billion plus $200 million plus 241 million less $1.150 billion).

Figure 2: Costs and benefits of the AMI Rollout and AMI Program – High benefits and expected cost case

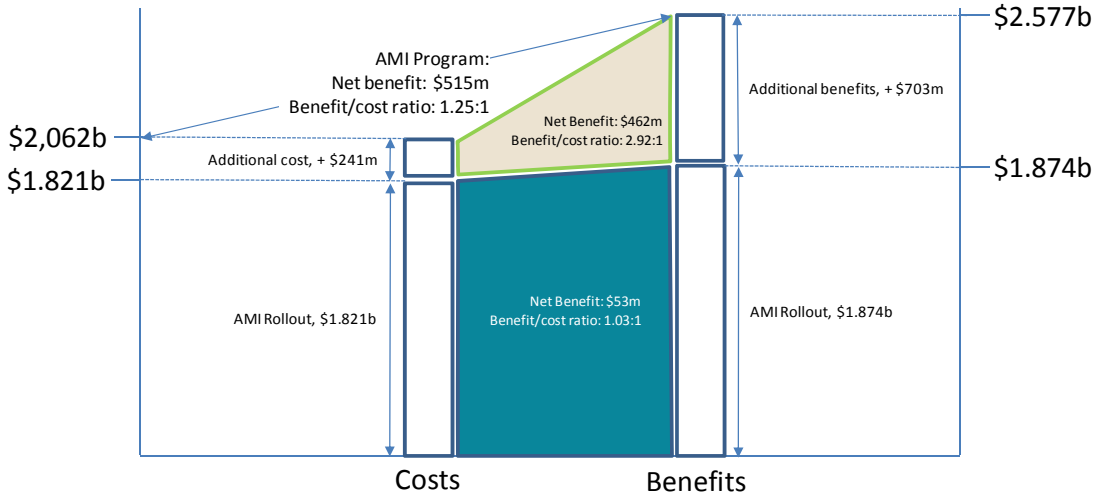


The potential upside could be even greater, given the fact that the authors of the 2010 Benefits Review felt that one of the largest benefits in the 2009 Benefits Report[24] could not be quantified with sufficient reliability to be included in the "conservative estimate of the level of benefits that would most likely result from the AMI Program", though they noted that its benefit was certainly non-zero.

- ***The case for the AMI Program remains sound, even if costs rise to the high end of the estimated range*** – Even if AMI Rollout costs were to increase by the $200 million uncertainty allowance detailed in the 2010 Cost Report, and the AMI Program costs were to increase to the high case estimate in the 2009 Benefits Report (an additional $49 million), both the AMI Rollout and the AMI Program would remain cost effective, based on the low case benefits, as shown in Figure 3 on the following page.

24 Benefit 11 (Ability to set emergency demand limits to share limited supply at times of network stress or supply shortage) in the 2009 Benefits Report,

Figure 3: Costs and benefits of the AMI Rollout and AMI Program – Low case benefits and high cost case



It is worth noting that the AMI Program remains cost-effective against the high cost case even if only the benefits of $2.036 billion that are readily available through the technology as long as appropriate processes and procedures are adopted by the distribution companies are considered.

- ***Progressing from the AMI Rollout to implementation of the full AMI Program improves cost-effectiveness*** – The net benefits and benefit/cost ratio of the AMI Program are greater than those of the AMI Rollout in the low case. In addition, as noted above, the $2.036 billion of benefits exceed the costs of the AMI Program, whereas this is not the case for the AMI Rollout. This indicates that pressing forward to implementation of the AMI Program beyond just the AMI Rollout will (a) improve the cost-effectiveness of the investment in AMI technology, and (b) make the realisation of that level of cost-effectiveness more certain.

- ***It is reasonable to expect that the vast majority of the benefits that are forecast to result from the rollout and use of AMI will ultimately flow to customers. This will ultimately depend, however, on effective regulatory price-setting processes.***

  It is important to recognise that the vast majority of the benefits estimated as flowing from the AMI Program are expected to result in the future cost of electricity being less than it would have been in the absence of the AMI Program. That is, they will tend to moderate increases due to other cost pressures (e.g., carbon pricing) rather than bring about absolute cost reductions. This will not be directly visible to customers on their bills, as these sorts of savings are not itemised on bills. However, changing consumption behaviour is a very good way for customers to achieve savings on their bills, particularly if they have taken up a time-varying price from their retailer[25], with customers who reduce their consumption during higher price periods likely to achieve larger benefits.

25 This is a generalisation and may not always hold true. Some customers, due to their existing pattern of consumption, may experience bill savings with little or indeed no change in their consumption pattern, while others may find it very difficult to change their consumption pattern enough to produce savings from a time-varying price offered by their retailer.

It is also the case that, while AMI makes possible time-varying prices at either or both the distribution and retail levels, there is no reason for customers to be required to be directly exposed to them. Retailers are likely to continue to provide prices that respond to what customers' want, which may include time-varying as well as flat prices. It is also likely that the electricity distribution companies, retailers, or third parties will offer products and services (including technology-based solutions) to help customers respond to and benefit from time-varying prices.

Effective regulatory price-setting processes will be responsible for delivering a significant proportion of the benefits of the AMI Rollout and AMI Program to customers. The most important of these processes, in terms of ensuring that the benefits of AMI accrue to customers, is the Australian Energy Regulator's (AER) review of the costs that are likely to be incurred by the electricity distribution businesses in delivering electricity to customers, and therefore their determination of the amount that the distributors can charge for these services. In this process, which seeks to act as a proxy for the workings of a competitive market and the details of which are available to the public, the AER seeks to ensure that the costs incurred by the electricity distribution companies are prudent and deliver value to customers.

It is important to note, however, that the electricity distributors' prices are reviewed in detail only every five years, so it is likely that a lag will exist between the time relevant benefits first occur and when they are explicitly taken account of in the setting of network prices (and therefore become available to customers). The AER has established the Efficiency Benefits Sharing Scheme (EBSS) to provide an incentive for electricity distributors to pursue efficiency improvements – through either investments in new technology or improvements in their operating procedures – that will reduce charges to customers[26].

26 Under the EBSS the electricity distributor will retain the benefit of any reduction in operating costs during the regulatory pricing period in which they first occur (i.e., for up to a maximum of five years). The benefit will then be shared on a 30% / 70% basis between the electricity distributor and its customers for a subsequent period (generally five years), after which the customers will receive the full benefit of the cost reduction. Full details of the EBSS are available on the AER website, www.aer.gov.au. See *Electricity distribution network service providers - Efficiency Benefits Sharing Scheme*, June 2008.

2. Background and purpose of this report

2.1. Background of Victoria's AMI Program

Smart meters record the customer's use of electricity on a half-hourly basis. They can also record various types of information related to the quality of electricity supplied to the customer. With the addition of two-way communications between the meter and the electricity supply system, all this information is available to electricity distribution companies in real time, and can be made available to retailers in accordance with service level obligations or other agreements. This provides significantly more and better information than has ever before been possible on the rate of electricity consumed over time, and the reliability and quality of electricity supply. The combination of the smart meter and two-way communications and supporting IT systems – and the additional capabilities this provides for electricity distributors, retailers and customers to respond to information on electricity demand levels, price or quality – is what constitutes advanced metering infrastructure (AMI). As such, AMI can provide a much better base of information to help the customer understand and control their use of electricity and, therefore, how much they spend on electricity and the impact of that consumption on greenhouse gas emissions.

The introduction of electronic, interval meters for residential and small non-residential customers was first considered by governments[27] to support mechanisms for reducing the growth in daily and seasonal peak demand. When demand increases, additional electricity generation, transmission and distribution infrastructure must be built, which increases the cost customers pay for their electricity.

A series of studies was undertaken in Victoria that determined that the implementation of electronic, interval meters would be cost beneficial, and in 2004 the Essential Services Commission (ESC) mandated the five Victorian electricity distribution companies to replace existing accumulation meters with electronic, interval meters for all customers that use less than 160MWh/year (referred to as 'small' customers). The replacement was to be made on an accelerated basis for customers with controlled load and otherwise as existing meters reached the end of their useful life, or when new connections were made. The interval meters to be installed were to be capable of supporting remote communication, but the use of that capability was not mandated.

Concerns were expressed by consumer groups and members of the electricity industry that the ESC's approach failed to consider the additional benefits that common protocol, two-way communications could provide. These aspects were then studied further[28] and in 2006 the Victorian Government replaced the ESC mandate with a commitment to roll out AMI to all small customers on an accelerated basis (over a period of about four years). This commitment was executed through an Amendment to the *Electricity Industry Act 2000 (Vic)*.

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27 In October 2001, the Victorian Infrastructure Planning Council (IPC) released its interim report which recommended that the Government "encourage demand management and the efficient use of energy, including requiring all households to be fitted with smart meters …". Similar matters were considered by the Commonwealth Government, as detailed in 2002 by The Hon. Warwick Parer in the final report of the Council of Australian Government's Independent Review of Energy Market Directions which proposed "an accelerated roll-out of interval meters over the next 5-10 years" and the "meters should meet minimum standards … and the cost should be included in the regulated distribution use of system (DUOS) cost base".

28 CRA International and Impaq Consulting, *Advanced Interval Meter Communications Study* (December 2005) for the Department of Infrastructure - Energy and Security Division.

In 2009, shortly after the AMI Rollout had begun, the Auditor-General questioned the incremental approach and the economic grounds on which the Government's decision had been made, and cited the existence of significant differences in the estimates of costs and benefits of AMI that had been made, respectively, by the electricity supply industry, a national study of the costs and benefits of AMI[29], and those contained in the studies that had been conducted for the Victorian Government.

In late 2009 and continuing into 2010, the Victorian Government undertook further due diligence work to address the concerns that had been raised in the Auditor-General's report. These efforts included the commissioning of three independent reports:

- A review of the lifecycle costs of the AMI Rollout based on the information that the electricity distribution companies submitted to the AER in 2009 for cost-recovery. This study, referred to in this report as the 2010 Cost Report[30], uses the costs of the AMI Rollout that were subsequently approved by the AER for recovery in the metering charges that will be charged to retailers and which are generally passed on to customers[31]. It also addresses other costs that would be incurred through to 2028 as estimated by the consultant.
- A review of the lifecycle benefits available from the AMI Program which are based on the most up to date information available. That report is referred to here as the 2009 Benefits Report[32]. Where a benefit requires additional investment in order to be realised, this cost was also quantified. The benefits and costs constitute the current scope of the AMI Program. This report also provided a “low case” and “high case” for the benefits of the AMI Program, and a low and high estimate of the additional costs (beyond those specified in the 2010 Cost Report) that would be required to realise the full range of the benefits identified.
- A 2010 Benefits Review[33] of the benefits detailed in the 2009 Benefits Report. This review reassessed the information provided in the 2009 Benefits Report to present a revised estimate of the level of benefits that could be expected to occur under low case assumptions concerning the deployment and utilisation of AMI. This is referred to in the remainder of this report as the low benefits case (where any low case value from the 2009 Benefits Report is mentioned it is specifically labelled as such).

2.2. Purpose of this report

This report summarises and combines the results of the three reports that were commissioned by the DPI in order to provide a consolidated assessment of the coats and benefits of the AMI Rollout and the AMI Program based on the most up to date information available. The report also discusses how those benefits are likely to be experienced by the community.

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29 The national study, entitled *Cost Benefit Analysis of Smart Metering and Direct Load Control, Final Overview Report,* was prepared by a team of consultants headed by NERA Economic Consulting for the Ministerial Council on Energy Smart Meter Working Group, and was published in February 2008.

30 Energy Market Consulting associates (EMCa) and Strata Energy Consulting, *Updated Assessment of AMI Costs for Victoria*, for Department of Primary Industries (Vic), June 2010.

31 While retailers generally pass on the costs they are charged by the distribution company, the structure of those costs may not be.

32 Futura Consulting, *Advanced Metering Infrastructure Program - Benefits Realisation Roadmap*, for Department of Primary Industries (Vic), December 2009.

33 Oakley Greenwood, *Review of AMI Benefits*, for Department of Primary Industries (Vic), July 2010.

3. Summary of benefits and costs

3.1. Overview

The most up to date assessments of the benefits and costs of the Victorian AMI Rollout and AMI Program show that benefits will exceed costs. This is true no matter which mix of costs and benefits is used. As shown in Table 2 below, the benefit/cost ratio of the low case (expected costs and low case benefits) is 1.16 to 1.00 for the AMI Rollout and 1.42 to 1.00 for the AMI Program, indicating that the benefits of these initiatives materially exceed their costs. The margin is significantly higher in the high case (expected costs and high benefits), and remains positive even in the worst case (high costs and low benefits). In the worst case the AMI Rollout is only marginally cost-effective at a benefit/cost ratio of 1.03 to 1.00, but the AMI Program remains materially cost-effective with a benefit/cost ratio of 1.25 to 1.00.

Table 2: Benefits and costs of the Victorian AMI Rollout and Program ($m)[34]

Benefit/cost case and item	AMI Rollout	AMI Program
Low case (low benefits and expected costs)		
Benefits	1,874	2,577
Costs	1,621	1,813
Net benefits	253	764
Benefit/cost ratio	1.16 to 1.00	1.42 to 1.00
Worst case (low benefits and high costs)		
Benefits	1,874	2,577
Costs	1,821	2,062
Net benefits	53	515
Benefit/cost ratio	1.03 to 1.00	1.25 to 1.00
High case (high benefits and expected costs)		
Benefits	3,513	5,004
Costs	1,621	1,813
Net benefits	1,892	3,191
Benefit/cost ratio	2.17 to 1.00	2.76 to 1.00

Source: OGW analysis of the 2010 Cost Report and 2010 Benefits Review.

34 All dollar figures cited in this report are in present value 2008 dollars unless noted otherwise.

3.2. Comparison with results of the national study of benefits and costs of smart meter infrastructure

The results for the AMI Program in the low case are higher than those reported earlier in the national study of the benefits and costs of smart meter infrastructure that was conducted for the Ministerial Council on Energy[35]. In that study, the deployment and use of AMI in Victoria was estimated to result in net benefits ranging from $12 million in the minimum benefits case to $841 million in the maximum benefits case[36]. These values corresponded to benefit/cost ratios of 1.01 and 2.25 respectively.

The main reason that the net benefits have increased in the more recent studies conducted for the Victorian Government is that the 2009 Benefits Report included a number of AMI benefits that had either not been foreseen at the time the national study was conducted or had been foreseen but not quantified in that study. In total, where the national study identified and quantified 17 benefits, the 2009 Benefits Report identified and quantified 38. Table 3 below lists the 17 benefits identified in the national study and the 21 additional benefits that were included and quantified in the 2009 Benefits Report, using the number that was assigned to each benefit in the 2009 Benefits Report.

Table 3: Benefits identified in the National AMI Benefit/Cost Study and 2009 Benefits Report

Benefit No	National Study AMI benefits	Benefit No	Additional benefits identified and quantified in the 2009 Benefits Report
1	Avoided costs of installing import / export metering	3	Reduced testing of meters
2	Avoided costs of meter replacement programs	4	Reduced cost of network loading studies for network planning
5	Avoided cost of routine reading (including reductions in PDEs and route management)	8	Avoided additional cost of energy from time clock errors
6	Avoided cost of special reads	10	Avoided cost of setting demand limits for customers to promote fair sharing and defer augmentation capex
7	Avoided cost of time switch replacement and O&M	11	Ability to set emergency demand limits to share limited supply at times of network stress or supply shortage

35 NERA Economic Consulting, *Cost Benefit Analysis of Smart Metering and Direct Load Control, Overview Report for Consultation, Report for the Ministerial Council on Energy Smart Meter Working Group*, 29 February 2008.

36 This counterfactual (referred to in the national study as the alternative counterfactual), assumed that electronic manually read interval meters would be installed (but read as accumulation meters) in accordance with Victoria's then-prevailing new and replacement metering policy. This was considered by the study's authors to be more representative of what would take place in Victoria in the absence of the AMI Rollout. The national study also used another counterfactual in which continued use of accumulation meters was assumed to be what would happen in the absence of a firm decision to roll out AMI. This was deemed to be the primary counterfactual as none of the Australian states and territories (other than Victoria) had committed at that time to a rollout of manually read interval meters. Under this primary counterfactual the net benefit of AMI was determined to range from negative $101 million in the minimum benefits case to positive $694 million in the maximum business case, corresponding to benefit/cost ratios of 0.91 and 2.03 respectively.

Benefit No	National Study AMI benefits	Benefit No	Additional benefits identified and quantified in the 2009 Benefits Report
8	Avoided cost of manual disconnections and reconnections (and avoided revenue loss)	14	Avoided cost of investigation of customer complaints about voltage Quality of Supply (QoS), including equipment cost and cost of reporting to regulator
9	Avoided cost of supply capacity circuit breaker	18	Avoided cost of end of line monitoring systems
12	Avoided cost of replacing service fuses that fail from overload	20	Avoided cost of communications to ACRs, sectionalisers and line switches[37]
13	Avoided cost of investigation of customer complaints about voltage QoS, including equipment cost and cost of reporting to regulator	21	Avoided cost of proportion of HV/LV transformer fuse operations on overload
15	Reduced cost for post storm supply restoration – avoid delays in detecting and correcting nested outages	22	Avoided cost of proportion of transformer failures on overload
16	Reduction in calls to faults and emergencies lines	26	Customer benefit of being able to switch retailer more quickly and more certainly. (Note: this is not the bill saving)
17	Avoided cost of investigation of customer complaints of loss of supply which turn out not to be a loss of supply	25	Reduction in admin cost for customer churn with daily interval data – customers can change retailer within a day instead of waiting up to three months till next manual read – e.g. reduction in call centre activity from customers checking on progress of switching, reduction in written communication to customers
19	Reduction in unserved energy (with quicker detection of outages and quicker restoration times)	27	Reduction in Metering Data Agent (MDA) costs – using the AMI infrastructure to provide MDA services to large industrial and commercial customers
23	Reduction in calls related to estimated bills and high bill enquiries	28	Ability for customers to move to monthly billing on the basis of electronic bill presentment, reducing admin costs, collection costs, etc.
24	Reduction in energy trading costs through improved wholesale forecasting accuracy	29	Avoided network and generation augmentation from peak demand reduction from three-rate TOU network tariff introduction and resultant three-rate retail tariff
26	Reduction in the administration cost of bad debt incurred on non-payment on move outs	31	Energy conservation from three-rate Time of Use (TOU) tariff
33	Avoided network augmentation from peak demand reduction from TOU retail tariff introduction and from CPP tariff implementation	30	Energy conservation from Critical Peak Pricing (CPP) tariff implementation

37 Automatic circuit reclosers (ACRs) are circuit breakers designed to re-connect power following the detection and interruption of a fault. Sectionalisers are self-contained, circuit-opening devices that are used in conjunction with reclosers or circuit breakers, to automatically isolate sections of electrical distribution systems that have undergone a fault.

Benefit No	National Study AMI benefits	Benefit No	Additional benefits identified and quantified in the 2009 Benefits Report
		32	Additional demand response from In Home Displays (IHDs) on CPP
		36	Peak demand reduction through deferral of refrigerator auto defrost cycle out of peak period
		37	Avoided cost of other communications to manage customers' loads for renewable generation tracking, electric vehicle charging and local generation management
		38	Revenue from reading smart water meters for water utilities

3.3. 2009 Benefits Report

The 2009 Benefits Report identified 38 specific benefits that result from the deployment and use of AMI. It is these 38 benefits that constitute the AMI Program.

The 2009 Benefits Report estimated the value of each of the 38 identified benefits in what it described as a low case and a high case. The total benefits across these two cases varied significantly – from $2.481 billion in the low case to $6.504 billion in the high case.

The low case and high case considered in the 2009 Benefits Report were intended to represent the low end and the high end of the likely range of AMI benefits. The development of a set of inputs which includes low end and high end values can be expected to produce valuations at two extremes. This was, in fact, the purpose of the 2009 Benefits Report - to define the range within which the benefits of AMI could be confidently predicted to fall.

As a result of this approach, where there was a high level of confidence in the inputs regarding the valuation of a specific benefit, the range between its low and high case values was narrow. For example, in the case of the avoided cost of routine meter reading due to the use of AMI (Benefit 5), the cost per read for the existing meters is well known as it has been detailed in the regulatory price determinations of each of the electricity distribution companies. Where there was less certainty in the inputs, the range of the benefit value between the low and high cases was larger. For example, the magnitude of the benefit that AMI can provide in reducing the duration of outages experienced by customers[38] (Benefit 19) had a large range in the 2009 Benefits Report. This was due to uncertainty regarding the specific impact that would be achieved by the outage restoration processes that would likely be implemented in association with the deployment of AMI.

All benefit estimates in the 2009 Benefits Report were stated in present value 2008 dollars, and were calculated as the value of the benefits provided by AMI before costs were considered (that is, on a gross benefit basis). The present value of the lifecycle costs of the AMI Rollout and AMI Program were estimated separately, as discussed later in this report.

38 The duration of outages experienced by the average customer in the course of a year is reflected in a measure called SAIDI, which stands for 'system average interruption duration index'. SAIDI is calculated as the total number of minutes in which any customer is without electricity during the year due to either planned or unplanned outages divided by the number of customers served by the distribution company.

The 2009 Benefits Report categorised the benefits as originating from three different sources, as shown in Table 4 below.

Table 4: Sources of AMI Program benefits identified in the 2009 Benefits Report ($m)

Benefit source	Description	Low case	High case
Distribution company operations	Benefits that result from improvements in the operational efficiency of the distribution network and of metering operations due to the deployment of AMI. Examples include the reduction in operating costs provided by the ability to read meters remotely, the benefit provided to customers by the ability to identify and rectify faults more quickly.	1,879	3,255
Retailer operations	Benefits that result from reductions in the business operations of electricity retailers due to the deployment of AMI. In most cases, these benefits result from the availability of interval meter data on a daily basis. As an example, this data can help the retailer better forecast the amount of electricity it needs to purchase, and thereby reduce its contracting costs. The prompt availability of billing data will also reduce the number of estimated bills the retailer sends out, and therefore the number of questions it needs to respond to from customers that receive estimated bills.	47	139
Customer demand response and HAN operation	Benefits that result from changes in the customer's energy consumption pattern in reaction to the more detailed consumption information and cost-reflective price signals that AMI allows. For example, retailers may offer and customers may respond to time-of-use or critical peak prices by reducing their electricity consumption during peak periods and other times. Customers may also install Home Area Networks so that they can better understand and manage their consumption of electricity either through the use of automated controls that respond to information from the meter, or through their own behaviour.	556	3,110
Total		2,481	6,504

Source: 2009 Benefits Report (note: totals reflect the sum of unrounded values).

It is interesting to note that:

- Benefits that accrue in network and metering operational efficiency comprise the major component of total AMI Program benefits: 75.7% in the low case and 50.0% in the high case. These benefits also exhibit the narrowest range between the low case and the high case, indicating that the authors of the 2009 Benefits Report had more confidence in the inputs used in calculating these benefits than those in the other two categories. They vary by a factor of 1.7 between the low and high cases, as compared to factors of 3.0 and 5.6 for the retailer operational benefits and those that result from customer demand response and HAN operations respectively.
- Benefits that originate in the operations of electricity retailers represent only a small proportion of the total AMI benefits – ranging from 1.9% to 2.1% in the low and high cases.
- Benefits that result from demand response and the use of HANs vary significantly – from 22.4% in the low case to 47.8% in the high case. This is not surprising given the fact that these benefits depend on discretionary actions being taken by retailers (by offering time-varying prices) and customers (by taking up and responding to those prices).

It should be noted, however, that the 2009 Benefits Report included benefits that require investment beyond that needed for the *Minimum AMI Functionality Specification (Victoria)*. These benefits and their associated costs were assessed in the 2009 Benefits Report as ranging from $143 million to $241 million, with an average of $192 million. These benefits and costs are included in the figures reported for the AMI Program in Table 2, but are removed from the figures reported for the AMI Rollout in that table.

A summary of the results of the 2009 Benefits Report is presented in Appendix A, which also identifies those benefits that require additional investment and have therefore been included in the assessment of the cost-effectiveness of the AMI Program, but not the AMI Rollout.

3.4. 2010 Benefits Review

The purpose of the 2010 Benefits Review was to critically review the magnitude of the benefits presented in the 2009 Benefits Report, and their likelihood of being realised. Accordingly, the 2010 Benefits Review reviewed the benefits from a somewhat different perspective to that taken in the 2009 Benefits Report, as follows:

- Because the primary purpose of the Benefits Review was to inform this assessment of the benefits and costs of AMI, it focussed on quantifying a conservative estimate of the level of benefits that would most likely result from the AMI Program. This entailed a different focus from that taken in the 2009 Benefits Report. Where the 2009 Benefits Report provided the range over which each benefit might vary, the 2010 Benefits Review sought to identify the point within (or outside) that range that is most likely to occur. The 2010 Benefits Review was specifically not concerned with how big the benefit might be under more favourable conditions or assumptions; hence it did not review the high case.
- A review of the 2009 Benefits Report revealed that the largest 11 benefits accounted for over 82% of total low case AMI benefits, and the largest 20 of the 38 benefits accounted for over 95%. For efficiency, the 2010 Benefits Review concentrated on the top 20 benefits, since it is those benefits that will have the greatest impact on whether the aggregate benefits of the AMI Program exceed its aggregate costs[39].
- The 2010 Benefits Review categorised the benefits differently from the 2009 Benefits Report. Again, because the primary purpose of the 2010 Benefits Review was to inform this assessment of the benefits and costs of the AMI Program, it was concerned with the certainty of the benefits being realised. As such, it categorised the benefits of the AMI Program in terms of whether they (a) accrue primarily as a result of the operation of the AMI technology itself, (b) require further legislative, governmental or regulatory action and/or (c) require further discretionary actions on the part of electricity retailers or customers.

Using the approach discussed above, the 2010 Benefits Review categorised the benefits of the AMI Program as shown in Table 5 on the following page.

39 The valuations of the other 18 benefits were accepted as presented in the 2009 Benefits Report.

Table 5: Present value of benefits, by likelihood of realisation ($m)

Category No	Benefit category of likelihood	No of benefits	Aggregate benefit value	% of total benefit value
1	Benefits resulting from operation of AMI technology (as specified for the Victorian AMI Rollout)[40]	11	1,531	59.4%
2	Benefits resulting from operation of additional AMI technology (as identified in the 2009 Benefits Report)	15	505	19.6%
3	Benefits requiring legislative, regulatory or market rules changes	4	66	2.6%
4	Benefits requiring discretionary retailer or customer action	9	475	18.4%
Total		39[41]	2,577	100.0%

Source: 2010 Benefits Review

As can be seen, the benefits that can be expected to result from the operation of the AMI technology itself (comprised of the technology required to meet the minimum, mandated functionality for the Victorian AMI Rollout and the additional AMI technology identified in the 2009 Benefits Report) total $2.036 billion. The value of these two categories of benefits exceeds the $1.813 billion estimated cost of the AMI Program, and do not require that (a) changes be made to existing legislation, regulation or market rules, (b) any new services are offered, or (c) any discretionary actions are taken on the part of electricity retailers or customers.

It is also interesting to note that the $2.577 billion that the 2010 Benefits Review estimated to be the total benefits of the AMI Program is only slightly higher than the low case estimate of the 2009 Benefits Report. This difference resulted from:

- adjustments that needed to be made to ensure consistency of the general economic and market assumptions used across the three consultant reports; these adjustments affected all but three of the 38 benefits identified in the 2009 Benefits Report, though in all but one case were quite minor in magnitude;
- changes to the approach and data input values used in estimating the value of 11 of the benefits as assessed in the 2009 Benefits Report; and
- the addition of one benefit that had not been identified in the 2009 Benefits Report.

40 This category includes the benefits from the AMI technology as detailed in *Minimum AMI Functionality Specification (Victoria)*, September 2008, for the Victorian AMI Rollout and from the additional functionality identified in the 2009 Benefits Report. As in the case of other benefits, the benefits of the additional functionality are calculated without accounting for the associated costs. Those costs are assessed in the 2010 Cost Report and the 2009 Benefits Report.

41 The 2010 Benefits Review identified one additional benefit that could be obtained from the AMI Program functionality, namely Benefit 35a, Energy conservation from general information programs.

While these adjustments resulted in material changes in the value of individual benefits as compared to the values estimated in the low case of the 2009 Benefits Report, the aggregate benefit estimated in the 2010 Benefits Review was only marginally higher than the low case of the 2009 Benefits Report[42].

It is also worth noting that the 2010 Benefits Review omitted one of the benefits that was ascribed one of the highest values ($422 million, low case) in the 2009 Benefits Report. This was the ability to use AMI to reduce the amount of electricity delivered to all customers during an emergency in the electricity system so that all customers can still have some electricity supply, rather than some customers having to be blacked out entirely. While the authors of the 2010 Benefits Review agreed that this functionality constitutes a real benefit, they also felt that the inputs to the valuation of the benefit were very uncertain. The 2010 Benefits Review summed up this view as follows:

> *Based on the uncertainties discussed above, we do not feel that a refined recalculation of this benefit is possible at this point. While we are certain that it is a real benefit with a non-zero value, we think the functionality of being able to apportion supply restrictions across the entire customer base, rather than having rolling outages, is more reasonably viewed as an insurance benefit that comes at a very modest incremental capital cost to that of the AMI rollout*[43].

A summary of the results of the low case benefits of the 2010 Benefits Review is provided in Appendix B. Appendix C combines the results of the 2009 Benefits Report with those of the 2010 Benefits Review and provides a comprehensive summary and comparison of the specific benefit values that resulted in the 2009 Benefits Report and 2010 Benefits Review low cases.

The 2010 Benefits Review also undertook a limited review of the high case benefit values contained in the 2009 Benefits Report. This review assessed the high case benefits of the AMI Program at $5.004 billion, a 23.1% reduction as compared to the $6.507 billion estimated in the 2009 Benefits Report. This review was limited to those benefits whose 'benefit specific inputs' were changed in the review of the 2009 Benefits Report low case. The limited scope of this review was felt to be sufficient and consistent with the overall objective of the 2010 Benefits Review, which was to establish whether the policy decision to mandate the AMI Rollout as part of the overall AMI Program was cost-justified. It also ensured that the low and high case benefits it presented would be consistent and comparable with each other.

42 17 benefits (Benefit numbers 1, 2, 5, 6, 7, 9, 14, 17, 19, 22, 26, 27, 30, 34, 35, 35a and 37) shared a total increase in value of $706 million, while 5 benefits (Benefit numbers 8, 11, 29, 31 and 38) shared a reduction in their value of $608 million, resulting in a net increase in total benefits of $96 million. The changes in the values of these benefits and a brief description of the reasons for the changes that were made are presented in Appendix B

43 2010 Benefits Review, p.31.

3.5. 2010 Cost Report

The 2010 Cost Report estimated the lifecycle costs of the AMI Rollout consistent with the scope that was approved by the AER[44], as shown in Table 6 below.

Table 6: Economic lifecycle cost estimate of AMI Rollout functionality ($m)

Cost category	Description	Present value of lifecycle cost
Transitional capex	Purchase and installation costs of the AMI meters, communications equipment and associated IT systems, as well as the costs of managing the AMI Rollout itself	1,124
Transitional opex	The incremental operating costs incurred during the initial AMI deployment	147
Growth capex	Cost of AMI meters that are required for new premises that are constructed over the course of the AMI lifecycle (through 2028), including associated installation and communications costs	75
Abolishments	Cost of AMI meters that need to be replaced because of housing renovations, demolitions or reconstructions	30
Failure replacements	Cost of the estimated number of AMI meters that will fail and therefore need replacement during the course of the AMI lifecycle, and associated installation and communications costs	28
Ongoing opex	Ongoing costs of communications system operations, communications backhaul, and AMI-related IT operating costs	137
IT, comms and meter refresh	Costs that will be required to replace a proportion of the IT and communications infrastructure, based on their assumed 7 year life, and to replace AMI meters as they reach the end of their assumed 15 year life.	79
Total		***1,621***

Source: 2010 Cost Report

44 Victorian Government guidelines for cost benefit analyses recommend that costs to be incurred by Government be identified. The DPI has estimated these to be in the range of $15 to $21 million for the period 2005 to 2015. . The budget includes the costs of government (and regulator) employees and consultants involved in policy formulation and advice; governance and facilitation activities; community advocacy and relations (including consumer education and awareness campaigns); and facilitation for benefits to be realised. While related to the AMI Program, they have not been included in the total estimated cost of the AMI Program as: (1) a key objective of this study is to facilitate comparisons with previous studies of the costs and benefits of relevant programs. As none of these include governmental costs, they have been excluded to preserve consistency; (2) they are immaterial costs of the AMI Program; and (3) the costs presented have been provided by Government.

The 2010 Cost Report noted that AMI metering costs (including the cost of meters and communications infrastructure, and their installation), AMI IT costs, and AMI program management costs have now been resolved to a greater extent than was previously possible, but that there are a number of other areas in which significant uncertainty still exists[45]. As a result, the authors of the 2010 Cost Report suggest that the lifecycle cost of the AMI Rollout could be $200 million greater or less than the $1,621 figure provided in Table 6 above.

As noted in Table 2 and section 3.3 above, realisation of some of the benefits estimated above will require investment beyond that required to comply with the *Minimum AMI Functionality Specification*. The cost of this additional functionality was estimated in the 2009 Benefits Report and must be added to the lifecycle costs in order to establish the total costs associated with the total benefits that have been estimated for the AMI Program.

Doing so results in a total cost estimate for the AMI Program of $1.813 billion in present value 2008 dollars over the period 2006 to 2028.

Extracts from the 2010 Cost Report are presented in Appendix D.

3.6. 'Business as usual' costs

An estimate of the costs that the distribution businesses would incur under 'business as usual' conditions (that is, if there was no AMI Rollout) has also been made. It was done by assuming that the costs that can be avoided by the deployment of AMI[46] can be thought of as being costs that would be incurred in the business as usual case. These costs occur in the areas of meter deployment, meter reading and disconnections and reconnections of supply at customers' premises. It is important to recognise, however, that the avoided costs are not the total costs of these business as usual undertakings; it is likely that the full business as usual cost related to these activities would be marginally higher. The specific avoided costs that have been included in the estimate of 'business as usual' costs were the following:

- Benefit 1 – Avoided costs of installing import/export metering – $35 million

  The cost of special metering for premises with local generation (such as PV systems), which requires separate measurement of import and export electricity flows, is avoided under the AMI Program as smart meters have this capability.

- Benefit 2 – Avoided costs of meter replacement – $492 million

  New premises require meters to be installed. Existing premises that change their electricity supply needs in certain ways also require new meters to be installed. In addition, a certain percentage of meters fail each year and need to be replaced. Because the AMI Program involves an accelerated rollout of smart meters it avoids the cost of the meters that would be required for these purposes[47]. In addition, because the smart meters

45 Examples of these areas of uncertainty include exchange rate variations, unforeseen deployment or operational risks, changes in equipment and service specifications for future supplies that are not yet contractually committed, the extent to which the world AMI vendor market evolves over the period of the Victorian AMI rollout, deployment decisions by other states including national alignment of specifications, and the effectiveness of regulatory arrangements over the remainder of the deployment and operational lifecycle.

46 The magnitude of these avoided costs was originally estimated in the 2009 Benefits Report. Some of the estimates were subsequently revised in the 2010 Benefits Review.

47 The number smart meters that will be needed for new premises, alterations in existing premises and to replace failed smart meters were estimated in the 2010 Cost Report and their costs included in the estimated cost of the AMI Rollout provided in that report.

to be installed can cope with many of the changes that occur in customers' electricity supply needs, it also avoids the costs associated with installing metering to support those changes, over the useful life of the smart meters.

- Benefit 5 – Avoided cost of routine meter reading (including reductions in the costs of hardware used in meter reading (PDEs) and the costs of route management) – $298 million

  Manual reading of meters involves meter readers visiting every premise either every month (in the case of most non-residential premises) or every quarter (in the case of most residential premises). Technology, called portable data entry devices (PDEs), is needed to record the meter data and sophisticated software is needed to schedule the order in which meters are read. With AMI, the reading of meters is performed remotely, so these costs are avoided.

- Benefit 6 – Avoided cost of special reads – $171 million

  Special – or 'off-cycle' – meter readings are most commonly required when a customer moves out of a premise. These meter readings must be undertaken on an ad hoc basis, and this very often requires the reader driving to the premise, which significantly increases the costs of these meter readings as compared to routine meter reads. AMI allows these meter readings to be undertaken as and when they are needed, thereby avoiding these inefficient reading costs and associated transportation costs.

- Benefit 7 – Avoided cost of time switch replacement and O&M – $99 million

  Like the meter, the time switches used to control off-peak load, such as water heaters and slab heating systems, lose their accuracy and require routine maintenance. With AMI, the time is regularly reset remotely, so accuracy is no longer an issue. Also, electronic smart meters have time switch functionality incorporated within them, so the cost of separately conducted maintenance of the time switch is avoided.

- Benefit 9 – Avoided cost of manual disconnections and reconnections (and avoided revenue loss) – $364 million

  Smart meters have a built-in supply contactor. AMI allows this to be remotely switched, meaning that attendance at a premise to perform a disconnection or reconnection (e.g., by removing a fuse) is generally no longer required[48]. Further, remote disconnection and reconnection better supports the competitive retail sector and allows these services to be performed more cheaply and in a more timely manner. This should mean that premises that do not have a customer that can be billed by the retailer will be routinely disconnected, thereby avoiding retailers incurring costs for delivered energy that cannot be recovered from a customer.

The sum of these avoided cost benefits is $1.459 billion. Therefore, if there was no AMI Program, these benefits would not be realised, and these costs would be incurred. These costs have therefore been used as a conservative estimate of the cost of the business as usual case.

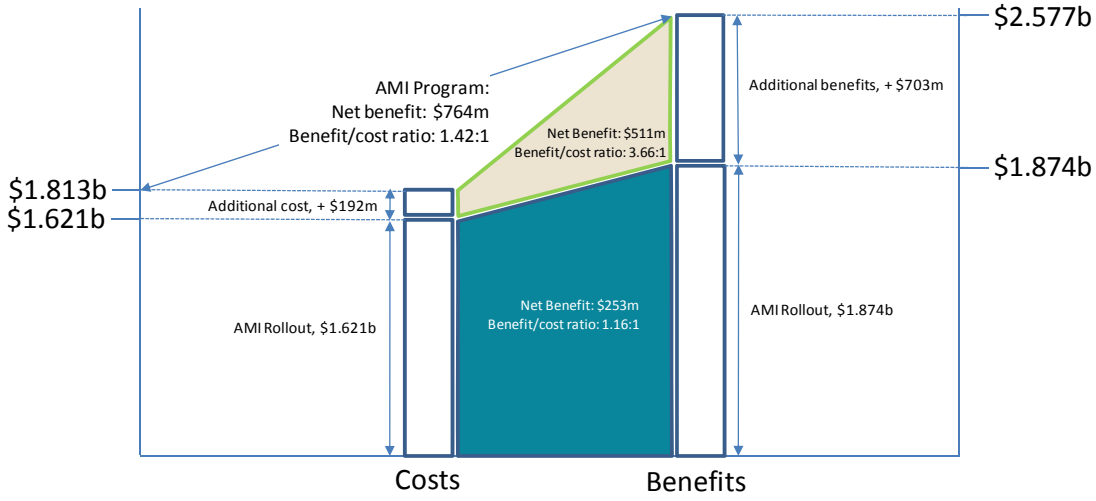
3.7. Summary and conclusions

The AMI Program is cost-effective no matter which mix of costs and benefits is used. In the extreme, if the low case benefits and highest costs are used, for either the AMI Rollout or AMI Program, a net benefit results. Further details and analyses are provided below.

48 The exception is when a physical disconnection of supply and not just a meter disconnection is needed, which can be the case when certain electricity supply works need to be conducted.

- ***There is a sound case for both the AMI Rollout and the AMI Program*** – As shown in Figure 4 below, both the AMI Rollout and the AMI Program are cost effective when the low case benefits and expected costs are considered.

Figure 4: Costs and benefits of the AMI Rollout and AMI Program – Low case benefits and expected costs case



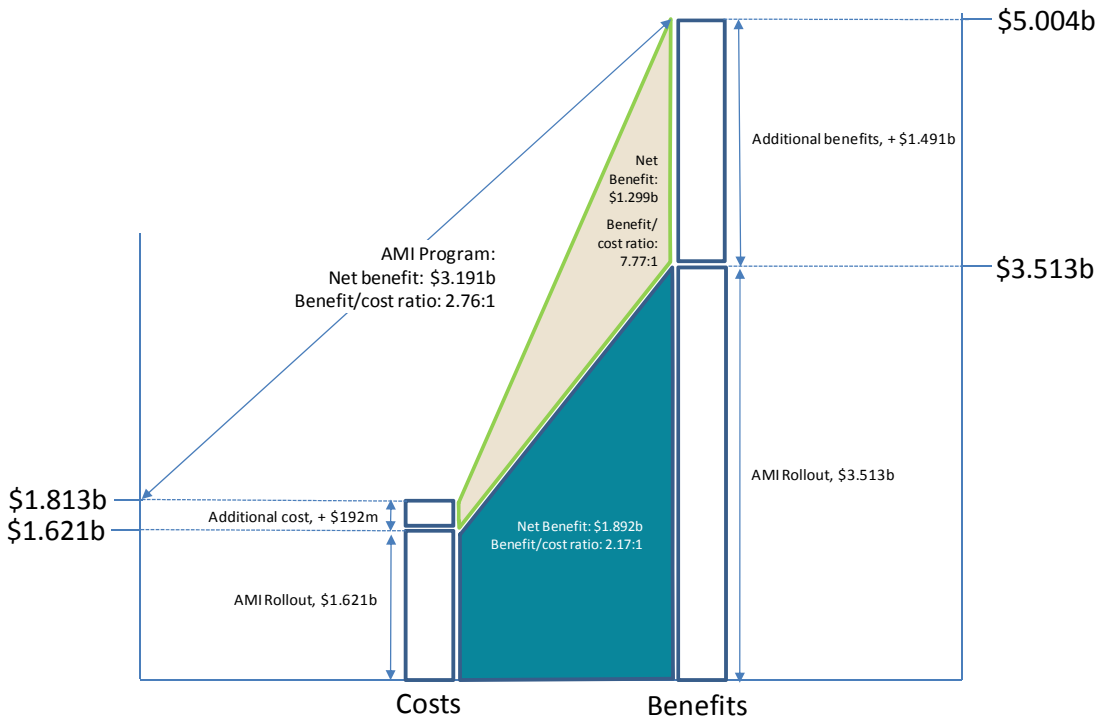
Under the low benefits and expected costs case the net benefit of the AMI Rollout and AMI Program are $253 million and $764 million respectively. The respective ratios of the benefits to costs are 1.16 to 1.00 and 1.42 to 1.00.

Further, the benefits that can be expected to flow as a result of the basic operations of the AMI technology that is to be installed under the AMI Program total $2.036 billion, which exceeds the $1.813 billion estimated cost of the AMI Program. These basic operations include but are not limited to the automation of manual processes in meter reading, and disconnection and re-connection of electricity supply. These benefits do not require any changes to legislation, regulations or market rules; new pricing approaches on the part of electricity retailers; or behavioural changes on the part of customers[49].

- ***There is significant upside potential for additional benefits*** - The 2009 Benefits Report estimated that the high case benefits of the AMI Rollout and the AMI Program would be about 2.6 times as great as those of the low case. The 2010 Benefits Review consciously used a more conservative approach in assessing the level of benefits that could be expected to result from the AMI Rollout and the AMI Program in both the low and high cases. In particular, it significantly reduced the magnitude of benefits estimated in the 2009 Benefits Report that assume that new pricing options will be offered by electricity retailers and taken up and responded to (in the form of energy-conserving behaviours) by customers. As a result, the 2010 Benefits Review estimated that the high case benefits would be only about 2.0 times those of the low case, as shown in Figure 5 on the following page. However, even at this level, there is significant upside potential for additional benefits from both the AMI Rollout and the AMI Program.

49 Some of these benefits are essentially 'hard-wired'. The others are benefits that are readily available through the technology as long as appropriate processes and procedures are adopted by the distribution companies.

Figure 5: Costs and benefits of the AMI Rollout and AMI Program – High benefits and expected cost case

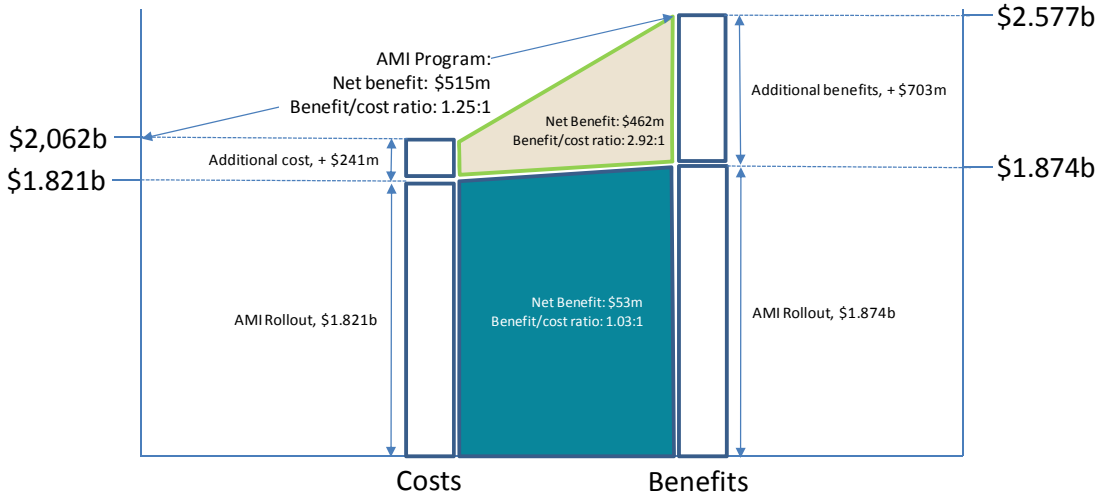


The potential upside could be even greater, given the fact that the authors of the 2010 Benefits Review felt that one of the largest benefits in the 2009 Benefits Report[50] could not be quantified with sufficient reliability to be included in the "conservative estimate of the level of benefits that would most likely result from the AMI Program", though they noted that its benefit was certainly non-zero.

- ***The case for the AMI Program remains sound, even if costs rise to the high end of the estimated range*** – Even if AMI Rollout costs were to increase by the $200 million uncertainty allowance detailed in the 2010 Cost Report, and the AMI Program costs were to increase to the high case estimate in the 2009 Benefits Report (an additional $49 million), both the AMI Rollout and the AMI Program would remain cost effective, based on the low case benefits, as shown in Figure 6 on the following page.

50 Benefit 11 (Ability to set emergency demand limits to share limited supply at times of network stress or supply shortage) in the 2009 Benefits Report,

Figure 6: Costs and benefits of the AMI Rollout and AMI Program – Low benefits and high cost case



It is worth noting that the AMI Program remains cost-effective against the high cost case even if only the benefits of $2.036 billion that are readily available through the technology as long as appropriate processes and procedures are adopted by the distribution companies are considered.

- ***Progressing from the AMI Rollout to implementation of the full AMI Program improves cost-effectiveness*** – The net benefits and benefit/cost ratio of the AMI Program are greater than those of the AMI Rollout in the low case. In addition, as noted above, the $2.036 billion of benefits exceed the costs of the AMI Program, whereas this is not the case for the AMI Rollout. This indicates that pressing forward to implementation of the AMI Program beyond just the AMI Rollout will (a) improve the cost-effectiveness of the investment in AMI technology, and (b) make the realisation of that level of cost-effectiveness more certain.

4. How the community will experience AMI benefits

As noted in section 3.3 above, the 2009 Benefits Report categorised benefits according to where the benefit would originate – either in electricity distribution operations, retail operations or through changes in customers' consumption behaviour. In is likely, however, that the vast majority of the benefits will flow on to customers as explained below.

- ***Electricity distribution operations***: Some of these benefits (for example, any reduction in the duration of outages), will flow directly to customers. However, not all of these benefits will be experienced as bill savings, and many other factors can affect customers' bills in any case (such as the wholesale cost of electricity). Reductions in outages is a good example; again, this benefit will not necessarily save money for customers (particularly residential customers), but it will certainly provide benefits in terms of avoided inconvenience and possibly some avoided costs (such as the need to replace food that might go bad during an outage). Other benefits that occur in network operations will flow to the distribution company in the first instance, but can be expected to subsequently flow on to customers as a result of the regulatory price-setting process.

  The most important part of this process is the Australian Energy Regulator's (AER) review of the costs that are likely to be incurred by the electricity distribution businesses in delivering electricity to customers, and therefore their determination of the amount that the distributors can charge for these services. In this process, which seeks to act as a proxy for the workings of a competitive market and the details of which are available to the public, the AER seeks to ensure that the costs incurred by the electricity distribution companies are prudent and deliver value to customers.

  It is important to note, however, that the electricity distributors' prices are reviewed in detail only every five years, so it is likely that a lag will exist between the time relevant benefits first occur and when they are explicitly taken account of in the setting of network prices (and therefore become available to customers). The AER has established the Efficiency Benefits Sharing Scheme (EBSS) to provide an incentive for electricity distributors to pursue efficiency improvements – through either investments in new technology or improvements in their operating procedures – that will reduce charges to customers[51].

- ***Retail operations***: Although only a small proportion of the identified benefits of AMI are expected to occur within the domain of retailers' operations, it is expected that competition in the retail electricity market will result in a high proportion of those benefits flowing through to customers. An example is the ability of retailers to use the information provided by smart meters to better understand and forecast customer demand. This is expected to allow retailers to optimise their purchases of financial hedges. Retailers that do so will be in a better position to compete for customers by offering slightly lower prices, and by tailoring prices to the profile of the customer.

51 Under the EBSS the electricity distributor will retain the benefit of any reduction in operating costs during the regulatory pricing period in which they first occur (i.e., for up to a maximum of five years). The benefits will then be shared on a 30% / 70% basis between the electricity distributor and its customers for a subsequent period (generally five years), after which the customers will receive the full benefit of the cost reduction. Full details of the EBSS are available on the AER website, www.aer.gov.au. See *Electricity distribution network service providers - Efficiency Benefits Sharing Scheme*, June 2008.

- *Benefits from changes in customers' consumption behaviour (demand response and the use of HANs and IHDs*: Benefits of reduced consumption of electricity in peak and other periods will flow directly to the customer on his or her bill[52]. The extent of these benefits to any individual customer will depend on the nature and level of the tariff that the customer is on, and the amount by which the customer changes his or her consumption behaviour. To the extent that changes in customers' consumption patterns in aggregate reduce or defer the need for additional electricity generation, transmission and/or distribution infrastructure, the future cost of electricity will be lower than it otherwise would have been. Although this impact may not be visible to customers as a reduction on the bill, it will constitute a monetary benefit to all customers.

As discussed in section 3.4 above, the 2010 Benefits Review categorised each of the benefits of AMI by the likelihood of it being realised. This was done by assessing whether the benefit was a direct product of the operation of the AMI technology alone, or required (a) changes or amendments to existing legislation, regulations, codes or licensing requirements, and/or (b) discretionary actions on the part of electricity retailers (such as offering time-varying prices) or customers (such as taking up and responding to such prices).

Most of the benefits identified as flowing directly from the operation of the AMI technology alone are those that the 2009 Benefits Report identified as occurring in network operations, though a number of the benefits that occur in retailer operations also result directly from the operation of the technology. Similarly, most of the benefits identified in the 2009 Benefits Report as arising from changes in customer consumption behaviour were categorised in the 2010 Benefits Review as those that require discretionary actions on the part of retailers and/or customers.

In conclusion:

- *It is reasonable to expect that the vast majority of the benefits that are forecast to result from the rollout and use of AMI will ultimately flow to customers. This will ultimately depend, however, on effective regulatory price-setting processes.*

  It is important to recognise that the vast majority of the benefits estimated as flowing from the AMI Program are expected to result in the future cost of electricity being less than it would have been in the absence of the AMI Program. That is, they will tend to moderate increases due to other cost pressures (e.g., carbon pricing) rather than bring about absolute cost reductions. This will not be directly visible to customers on their bills, as these sorts of savings are not itemised on bills. However, changing consumption behaviour is a very good way for customers to achieve savings on their bills, particularly if they have taken up a time-varying price from their retailer[53], with customers who reduce their consumption during higher price periods likely to achieve larger benefits.

52 It is worth noting that the bill savings of individual customers who take up and respond to the price signals enabled by AMI have not been included in the quantification of AMI benefits. It is only where the aggregate impact of customers' behavioural changes reduces the costs incurred by one or more parts of the electricity supply chain that a benefit is assessed. Where this occurs, it is that cost reduction (rather than bill savings) that constitutes the benefit that has been included in the 2009 Benefits Report and the 2010 Benefits Review.

53 This is a generalisation and may not always hold true. Some customers, due to their existing pattern of consumption, may experience bill savings with little or indeed no change in their consumption pattern, while others may find it very difficult to change their consumption pattern enough to produce savings from a time-varying price offered by their retailer.

It is also the case that, while AMI makes possible time-varying prices at either or both the distribution and retail levels, there is no reason for customers to be required to be directly exposed to them. Retailers are likely to continue to provide prices that respond to what customers' want, which may include time-varying as well as flat prices. It is also likely that the electricity distribution companies, retailers, or third parties will offer products and services (including technology-based solutions) to help customers respond to and benefit from time-varying prices.

Appendix A: Results of the 2009 Benefits Report (extracts)

EXECUTIVE SUMMARY

BACKGROUND AND SCOPE

The implementation of the Victorian AMI program has recently begun, with AMI meters being rolled out from September 2009. Since the AMI cost-benefit analyses were undertaken by the Victorian Government in 2005 and by MCE in 2007/8, the Victorian Government and industry have developed a greater understanding of the functionalities and benefits of AMI. In addition, further information on the benefits of AMI is also now available from other Australian and international sources.

This report takes the opportunity to update the previous cost-benefit analyses based on information that has more recently become available, and identifies how to realise the anticipated benefits that may be derived from the implementation of AMI.

This report provides:

- Further analysis of the potential benefits of the AMI program beyond the immediate functioning of the new metering system; and
- A roadmap or suggested pathway that the Victorian Government may use to achieve these benefits over the next 20 years.

METHODOLOGY

Given the short timeframe to undertake this study, it was not possible to go through a formal request for information process to stakeholders. Data has instead been drawn from previous studies and publicly available sources.

Our approach to the assessment of benefits has been to:

- Identify the potential benefit areas, and the individual quantifiable benefits in each area;
- Identify metrics to allow the quantification of each of those individual benefits;
- Source input data for each of the metrics;
- Consider the lower and upper cases of the input data for each of the metrics; and
- Model the likely low case and high case of each benefit, calculating the nominal annual value and then calculating the present value over the 20 year horizon of this study.

GENERAL ASSUMPTIONS

The following are the general assumptions used in this analysis:

- Discount rate = 8%. This is the same as what was used in the MCE smart metering cost-benefit analysis of 2007/8, and hence provides comparability to the earlier work;
- The total number of customers consuming less than 160 MWh pa is assumed to be the same as the MCE study – 2,433,827;
- Small customer retail tariff of 16c/kWh. This assumption is used in the valuation of energy consumption savings benefits;
- Energy component of retail tariff – low case 40%, high case 50%. This assumption is also used in the valuation of energy consumption savings benefits;
- Assessment timeframe – 20 years, which is consistent with the MCE analysis;
- Rollout duration – 5 years. This reflects the AMI rollout program, starting in 2009 and finishing in 2013;
- IT systems opex is 15% of capex, which is consistent with the MCE analysis;
- IT systems refresh is assumed half way through the timeframe and at a cost of 40% of the original capex. This assumption was also used in the MCE analysis;
- Where IT capital expenditure for DBs is calculated, it is assumed that there will be three sets of IT systems, not five – one for Jemena and UED, one for CitiPower and Powercor, and one for SP AusNet;
- Growth of number of customers (from DBs' submissions to MCE) – low case 1.49% pa, high case 1.78% pa;
- Energy use growth[1] – low case 0.7%, high case 2.0%, and
- Demand growth[2] – low case 1.9%pa, high case 2.9% pa.

1 Taken from AEMO Electricity Statement of Opportunities (SOO) 2009

2 Ibid

BENEFITS

The total benefits of the AMI program have been estimated at PV $2.5 billion for the low case and PV $6.5 billion for the high case. Network benefits account for 76% of the low case and 50% of the high case benefits. Demand response and Home Area Network (HAN) benefits account for 22% of the low and 48% of the high case benefits, while retailer benefits account for 2% of low and high case benefits.

Table 1 provides a detailed summary of the benefit values that have now been calculated. The first five columns are self explanatory.

The column “Enabling technology in the DBs’ AER submissions” indicates whether the benefits are directly enabled by the functionality of the initial Victorian AMI rollout. These benefits are not dependent on additional functionality that is pending determination in the National Smart Metering Program (NSMP).

Some of the benefits listed require additional systems or equipment to enable their implementation. The column “Additional cost required to realise benefits” is the assessment of the present value of the additional cost. Most of the values detailed here have been drawn from the MCE smart metering cost-benefit analysis.

Some of the benefits also require additional actions to initiate the realisation of the benefit. The column “Action or issue resolution required to realise benefit” indicates whether such actions are needed and also summarises the action required or the issues to be resolved.

The last three columns indicate the timeframe for the start of the realisation of each benefit. A tick in the “Short (Rollout)” column indicates that the benefit can be progressively realised during the AMI rollout period. A tick in the “Medium (3 to 10 years)” column indicates that the realisation of the benefit will not occur until after the AMI rollout has been completed. A tick in the “Long (10 to 15 years)” column indicates that the realisation of the benefit will not start to occur until about 10 years from the start of the rollout.

Table 1: Summary of benefits and realisation requirements

			Benefit value (PV $m)		Enabling technology in DBs' AER submissions	Additional cost required to realise benefit			Action or issue resolution required to realise benefit		Timeframe for start of realisation of benefit		
Benefits category	**No**	**Benefits**	**Low**	**High**		**Low (PV $m)**	**High (PV $m)**	**Description**	**Y/N**	**Description / comment**	**Short (rollout)**	**Medium (3 to 10 years)**	**Long (10 to 15 years)**
Interval metering	1	Avoided costs of installing import / export metering	33	147	✓				Y	DPI may need to work with DBs to ensure that customers can have an AMI meter ahead of rollout in their area. This also relies on the continuation of the net feed-in tariff.	✓		
	2	Avoided costs of meter replacement programs	455	655	✓				N		✓		
	3	Reduced testing of meters	7	33	✓				N		✓		
	4	Reduced cost of network loading studies for network planning	5	12	✗	0.6	1.2	For DBs: systems integration of MDM with network loading and planning systems	N	DBs should initiate this feature without any action required by DPI		✓	

			Benefit value (PV $m)		Enabling technology in DBs' AER submissions	Additional cost required to realise benefit			Action or issue resolution required to realise benefit		Timeframe for start of realisation of benefit		
Benefits category	**No**	**Benefits**	**Low**	**High**		**Low (PV $m)**	**High (PV $m)**	**Description**	**Y/N**	**Description / comment**	**Short (rollout)**	**Medium (3 to 10 years)**	**Long (10 to 15 years)**
Remote meter reading	5	Avoided cost of routine reading (including reductions in costs of PDEs and route management)	290	308	✓				N		✓		
	6	Avoided cost of special reads	139	211	✓				N		✓		
Load management	7	Avoided cost of time switch replacement and O&M	93	170	✓				N		✓		
	8	Avoided additional cost of energy from time switch clock errors	48	97	✓				N		✓		
Remote connect / disconnect	9	Avoided cost of manual disconnections and reconnections (and avoided revenue loss)	140	385	✓				N		✓		

			Benefit value (PV $m)		Enabling technology in DBs' AER submissions	Additional cost required to realise benefit			Action or issue resolution required to realise benefit		Timeframe for start of realisation of benefit		
Benefits category	**No**	**Benefits**	**Low**	**High**		**Low (PV $m)**	**High (PV $m)**	**Description**	**Y/N**	**Description / comment**	**Short (rollout)**	**Medium (3 to 10 years)**	**Long (10 to 15 years)**
Supply capacity control	10	Avoided cost of setting demand limits for customers to promote fair sharing and defer augmentation capex	5	13	✗			For DBs: addition of supply capacity management system; also required for item 11 below, where cost is covered	Y			✓	
	11	Ability to set emergency demand limits to share limited supply at times of network stress or supply shortage	422	628	✗	7.6	11	For DBs: addition of supply capacity management system	Y	DPI to initiate establishment of governance and procedures		✓	
	12	Avoided cost of supply capacity circuit breaker	4	7	✓				N	Requires DB to set supply capacity limit in meter at rollout	✓		
	13	Avoided cost of replacing service fuses that fail from overload	5	14	✓				N	Requires DB to set supply capacity limit in meter at rollout	✓		

			Benefit value (PV $m)		Enabling technology in DBs' AER submissions	Additional cost required to realise benefit			Action or issue resolution required to realise benefit		Timeframe for start of realisation of benefit		
Benefits category	**No**	**Benefits**	**Low**	**High**		**Low (PV $m)**	**High (PV $m)**	**Description**	**Y/N**	**Description / comment**	**Short (rollout)**	**Medium (3 to 10 years)**	**Long (10 to 15 years)**
Quality of Supply (QoS) and other event recording	14	Avoided cost of investigation of customer complaints about voltage QoS, including equipment cost and cost of reporting to regulator	38	38	✗	9.7	16	For DBs: addition of QoS recording system	Y	DPI should initiate this as it is not in DBs interest to record QoS from meters		✓	
Outage detection	15	Reduced cost for post storm supply restoration – avoid delays in detecting and correcting nested outages	9	71	✗	2.4	3.6	For DBs: systems integration of AMI to Outage Management Systems	Y	Clarification is needed as to whether DBs have included the linking of AMI to OMS in the budgets submitted to AER		✓	
	16	Reduction in calls to faults and emergencies lines	14	14	✗			Costs included in item 15 above	Y	Clarification is needed as to whether DBs have included the linking of AMI to OMS in the budgets submitted to AER		✓	

			Benefit value (PV $m)		Enabling technology in DBs' AER submissions	Additional cost required to realise benefit			Action or issue resolution required to realise benefit		Timeframe for start of realisation of benefit		
Benefits category	**No**	**Benefits**	**Low**	**High**		**Low (PV $m)**	**High (PV $m)**	**Description**	**Y/N**	**Description / comment**	**Short (rollout)**	**Medium (3 to 10 years)**	**Long (10 to 15 years)**
	17	Avoided cost of investigation of customer complaints of loss of supply which turn out to be not a loss of supply	14	14	✓				Y	Clarification is needed as to whether DBs have included the linking of AMI to OMS in the budgets submitted to AER		✓	
	18	Avoided cost of end of line monitoring systems	4	4	×			Costs included in item 15 above	N			✓	
	19	Reduction in unserved energy (with quicker detection of outages and quicker restoration times)	126	345	×			Costs included in item 15 above	Y	Clarification is needed as to whether DBs have included the linking of AMI to OMS in the budgets submitted to AER		✓	
Smart grid	20	Avoided cost of communications to ACRs, sectionalisers and line switches	3	3	✓	0.5	1	For DBs: replacement of comms equipment	N			✓	

			Benefit value (PV $m)		Enabling technology in DBs' AER submissions	Additional cost required to realise benefit			Action or issue resolution required to realise benefit		Timeframe for start of realisation of benefit		
Benefits category	**No**	**Benefits**	**Low**	**High**		**Low (PV $m)**	**High (PV $m)**	**Description**	**Y/N**	**Description / comment**	**Short (rollout)**	**Medium (3 to 10 years)**	**Long (10 to 15 years)**
	21	Avoided cost of proportion of HV/LV transformer fuse operations on overload	5	14	×	6.1	12	For DBs: new IT application to aggregate interval data for customers served by larger distribution transformers	Y	DPI to provide lead with smart grid policy setting to ensure consistency of customer experience across all DBs		✓	
	22	Avoided cost of proportion of transformer failures on overload	20	73	×			Costs included in item 21 above	Y	DPI to provide lead with smart grid policy setting to ensure consistency of customer experience across all DBs		✓	
		Total Network Benefits	**1,879**	**3,255**		**27**	**45**						
Retailer benefits	23	Reduction in calls related to estimated bills and high bill enquiries	4.6	5.0	✓			Costs included in total below	Y	DPI may need to initiate changes to billing requirements to have historic interval and daily/weekly consumption added		✓	

			Benefit value (PV $m)		Enabling technology in DBs' AER submissions	Additional cost required to realise benefit			Action or issue resolution required to realise benefit		Timeframe for start of realisation of benefit		
Benefits category	**No**	**Benefits**	**Low**	**High**		**Low (PV $m)**	**High (PV $m)**	**Description**	**Y/N**	**Description / comment**	**Short (rollout)**	**Medium (3 to 10 years)**	**Long (10 to 15 years)**
	24	Reduction in energy trading costs through improved wholesale forecasting accuracy	8	82	✓			Costs included in total below	N	It is assumed that the benefits quantum will cause retailers to initiate this themselves		✓	
	25	Reduction in the administration cost of bad debt incurred on non-payment on move outs	1.8	1.83	✓			Costs included in total below	N			✓	
	26	Customer benefit of being able to switch retailer more quickly and more certainly. Note: this is not the bill saving	7	15	✓			Costs included in total below	N			✓	

			Benefit value (PV $m)		Enabling technology in DBs' AER submissions	Additional cost required to realise benefit			Action or issue resolution required to realise benefit		Timeframe for start of realisation of benefit		
Benefits category	**No**	**Benefits**	**Low**	**High**		**Low (PV $m)**	**High (PV $m)**	**Description**	**Y/N**	**Description / comment**	**Short (rollout)**	**Medium (3 to 10 years)**	**Long (10 to 15 years)**
	27	Reduction in MDA costs – putting I&C customers on DB AMI networks	25	36	✓			Costs included in total below	Y	DPI/DBs work to achieve the framework necessary for AMI for customers >160 MWh per annum to be read using <160 MWh processes and systems	✓		
	28	Ability for customers to move to monthly billing on the basis of electronic bills, reducing, admin costs, collection costs etc	-	-	✓			Costs included in total below	N		✓		
		Total Retailer Benefits	**47**	**139**		**64**	**94**	**Total Retailer IT costs to support all benefits[3]**					

3 This covers all retailer IT costs to support all benefits; not just the retailer benefits.

			Benefit value (PV $m)		Enabling technology in DBs' AER submissions	Additional cost required to realise benefit			Action or issue resolution required to realise benefit		Timeframe for start of realisation of benefit		
Benefits category	**No**	**Benefits**	**Low**	**High**		**Low (PV $m)**	**High (PV $m)**	**Description**	**Y/N**	**Description / comment**	**Short (rollout)**	**Medium (3 to 10 years)**	**Long (10 to 15 years)**
Demand response	29	Avoided network and generation augmentation from peak demand reduction from three-rate TOU network tariff introduction and resultant three-rate retail tariff	89	521	✓				Y	DPI needs to ensure network three-rate TOU tariffs implemented	✓		
	30	Avoided network and generation augmentation from peak demand reduction from CPP tariff implementation	73	465	✓				Y	DPI will need to give a policy direction lead to industry to achieve the introduction of CPP tariffs		✓	
	31	Energy conservation from three-rate TOU tariff	123	796	✓				N	No further activity required once TOU tariffs implemented from item 29	✓		
	32	Energy conservation from CPP tariff implementation	10	84	✓				N	As per item 30		✓	

			Benefit value (PV $m)		Enabling technology in DBs' AER submissions	Additional cost required to realise benefit			Action or issue resolution required to realise benefit		Timeframe for start of realisation of benefit		
Benefits category	**No**	**Benefits**	**Low**	**High**		**Low (PV $m)**	**High (PV $m)**	**Description**	**Y/N**	**Description / comment**	**Short (rollout)**	**Medium (3 to 10 years)**	**Long (10 to 15 years)**
Home Area Network (HAN)	33	Additional demand response from IHDs on CPP	4	18	✗	31	52	Note: the cost for this benefit is required for benefit 35 as well. For DBs, cost for means for binding HAN devices to ESP required for all HAN benefits low case PV $3m, high case PV $6m. For customers: cost of IHDs, low case PV $28m, high case PV $46m.	Y	DPI will need to give direction to the industry to ensure implementation of HAN binding arrangements (e.g. through B2B or Web portal)		✓	

			Benefit value (PV $m)		Enabling technology in DBs' AER submissions	Additional cost required to realise benefit			Action or issue resolution required to realise benefit		Timeframe for start of realisation of benefit		
Benefits category	**No**	**Benefits**	**Low**	**High**		**Low (PV $m)**	**High (PV $m)**	**Description**	**Y/N**	**Description / comment**	**Short (rollout)**	**Medium (3 to 10 years)**	**Long (10 to 15 years)**
	34	Additional demand response from direct load control of air conditioners	85	581	×	18	44	Cost to DBs to receive load management commands from retailers -Low case PV $3m, high case PV $6m. Cost to consumers of PCTs and IR controllers - low case PV $15m high case PV $38m	Y	DPI may need to provide policy direction to initiate this		✓	
	35	Energy conservation from IHDs	49	74	×			Costs included in item 33 above	Y	DPI may need to take a facilitation role, or through policy create incentives to encourage uptake of IHDs to realise this benefit		✓	
	36	Peak demand reduction through deferral of refrigerator auto defrost cycle out of peak period	28	196	×				Y	DPI should have discussions with appliance manufacturers and Federal Government to initiate this			✓

			Benefit value (PV $m)		Enabling technology in DBs' AER submissions	Additional cost required to realise benefit			Action or issue resolution required to realise benefit		Timeframe for start of realisation of benefit		
Benefits category	**No**	**Benefits**	**Low**	**High**		**Low (PV $m)**	**High (PV $m)**	**Description**	**Y/N**	**Description / comment**	**Short (rollout)**	**Medium (3 to 10 years)**	**Long (10 to 15 years)**
	37	Avoided cost of other communications to manage customers' loads for renewable generation tracking, electric vehicle charging and local generation management	34	257	×				Y	DPI may need to take policy lead to ensure AMI will provide communications for demand tracking to match renewable generation and appropriate management of electric vehicle charging.		✓	
	38	Revenue from reading smart water meters for water utilities	60	119	×	3	6	Interfacing to water utilities' systems, and store and forward system at DBs	Y	DPI may need to play a facilitation role		✓	
		Total Demand response and HAN Benefits	**556**	**3,110**	**Additional cost - Demand response & HAN**	**52**	**102**						
		Benefits Grand Total	**2,481**	**6,504**	**Additional cost - Grand Total**	**143**	**241**						

Appendix B: Results of the 2010 Benefits Review of benefits (extracts)

Table 1: Comparison of low benefit values from the 2009 Benefits Report and the 2010 Benefits Review

Benefit No	Benefit	Value (2008$ M[1]) in		Amount (2008$ M[1]) due to change in		Most significant benefit-specific changes[2]
		2009 Benefits Report (low)	OGW Review[3] (low)	General economic and market assumptions[4]	Benefit-specific inputs[5]	
1	Avoided costs of installing import / export metering	33	35	2	0	
2	Avoided costs of meter replacement	455	492	37	0	
3	Reduced testing of meters	7	7	0	0	
4	Reduced cost of network loading studies for network planning	5	5	0	0	
5	Avoided cost of routine reading (including reductions in costs of PDEs and route management)	290	298	8	0	
6	Avoided cost of special reads	139	171	8	25	Cost per read revised upwards
7	Avoided cost of time switch replacement and O&M	93	99	5	0	

1 Rounded to nearest million dollars.

2 The methodology and benefit-specific inputs used in the 2009 Benefits Report have been accepted unless otherwise noted.

3 Shaded cells indicate those benefits whose methodologies and/or benefit-specific inputs have been revised in the OGW review.

4 See Section **Error! Reference source not found.** for a discussion of these assumptions.

5 These are discussed on a benefit-by-benefit basis in Section **Error! Reference source not found.**.

Benefit No	Benefit	Value (2008$ M[1]) in		Amount (2008$ M[1]) due to change in		Most significant benefit-specific changes[2]
		2009 Benefits Report (low)	OGW Review[3] (low)	General economic and market assumptions[4]	Benefit-specific inputs[5]	
8	Avoided additional cost of energy from time switch clock errors	48	41	3	-11	Energy cost savings revised downwards Augmentation savings that had been overlooked were added
9	Avoided cost of manual disconnections and reconnections (and avoided revenue loss)	140	364	5	219	Cost per disconnect/reconnect revised downwards Average hours of unserved energy revised upwards Used a more representative VCR value Incidence of the service revised upwards for one DB
10	Avoided cost of setting demand limits for customers to promote fair sharing and defer augmentation capex	5	5	0	0	

Benefit No	Benefit	Value (2008$ M[1]) in		Amount (2008$ M[1]) due to change in		Most significant benefit-specific changes[2]
		2009 Benefits Report (low)	OGW Review[3] (low)	General economic and market assumptions[4]	Benefit-specific inputs[5]	
11	Ability to set emergency demand limits to share limited supply at times of network stress or supply shortage	422	0	6	-428	Input used for VCR has no empirical base Historical base used is highly variable Benefit of a highly probabilistic nature; more appropriately characterised as an insurance value
12	Avoided cost of supply capacity circuit breaker	4	4	0	0	
13	Avoided cost of replacing service fuses that fail from overload	5	5	0	0	
14	Avoided cost of investigation of customer complaints about voltage QoS, including equipment cost and cost of reporting to regulator	38	39	1	0	
15	Reduced cost for post storm supply restoration - avoid delays in detecting and correcting nested outages	9	9	0	0	Accepted the methodology and inputs in the 2009 Benefits Report but also note that the benefit value needs to be revised upwards materially due to the lack of data with which to accurately estimate the avoided unserved energy and the reduced need for DB fault restoration labour
16	Reduction in calls to faults and emergencies lines	14	14	0	0	

Benefit No	Benefit	Value (2008$ M[1]) in		Amount (2008$ M[1]) due to change in		Most significant benefit-specific changes[2]
		2009 Benefits Report (low)	OGW Review[3] (low)	General economic and market assumptions[4]	Benefit-specific inputs[5]	
17	Avoided cost of investigation of customer complaints of loss of supply which turn out to be not a loss of supply	14	15	1	0	
18	Avoided cost of end of line monitoring	4	4	0	0	
19	Reduction in unserved energy (with quicker detection of outages and quicker restoration times)	126	375	2	247	Base SAIDI figures were revised Impact on SAIDI revised upwards Benefit had been conceptualised as affecting only small-volume customers, but will actually affect all customers
20	Avoided cost of communications to feeder automation equipment	3	3	0	0	
21	Avoided cost of proportion of HV/LV transformer fuse operations on overload	5	5	0	0	
22	Avoided cost of a proportion of transformer failures on overload	20	28	0	7	Reduction in USE due to this benefit had not been accounted for
23	Reduction in calls related to estimated bills and high bill enquiries	5	5	0	0	
24	Reduction in energy trading costs through improved wholesale forecasting accuracy	8	8	0	0	

Benefit No	Benefit	Value (2008$ M[1]) in		Amount (2008$ M[1]) due to change in		Most significant benefit-specific changes[2]
		2009 Benefits Report (low)	OGW Review[3] (low)	General economic and market assumptions[4]	Benefit-specific inputs[5]	
25	Reduction in the administration cost of bad debt incurred on non-payment on move outs	2	2	0	0	
26	Customer benefit of being able to switch retailer more quickly and more certainly. Note: this is not the bill saving	7	8	0	0	
27	Reduction in MDA costs – putting I&C customers on DB AMI networks	25	26	0	0	
28	Ability for customers to move to monthly billing on the basis of electronic bills, reducing, admin costs, collection costs etc	0	0	0	0	
29	Avoided network and generation augmentation from peak demand reduction from three-rate TOU network tariff introduction and resultant three-rate retail tariff	89	44	0	-45	Take-up of the TOU tariff revised downwards Cost of avoided infrastructure revised upwards
30	Avoided network and generation augmentation from peak demand reduction from CPP tariff implementation	73	133	0	60	Cost of avoided generation and network infrastructure revised downwards Benefit will accrue as rollout proceeds, not just when rollout is complete
31	Energy conservation from three-rate TOU tariff	123	49	0	-74	Take-up of the TOU tariff revised downwards Cost of avoided energy had been understated
32	Energy conservation from CPP tariff implementation	10	10	0	0	
33	Additional demand response from IHDs on CPP	4	4	0	0	

Benefit No	Benefit	Value (2008$ M[1]) in		Amount (2008$ M[1]) due to change in		Most significant benefit-specific changes[2]
		2009 Benefits Report (low)	OGW Review[3] (low)	General economic and market assumptions[4]	Benefit-specific inputs[5]	
34	Additional demand response from direct load control of air conditioners	85	113	1	26	Cost of avoided generation and network infrastructure revised upwards Benefit will accrue as rollout proceeds, not just when rollout is complete
35	Energy conservation from IHDs	49	50	1	0	
36	Peak demand reduction through deferral of refrigerator auto defrost cycle out of peak period	28	28	1	0	
37	Avoided cost of other communications to manage customers' loads for renewable generation tracking, electric vehicle charging and local generation management	34	35	1	0	
38	Revenue from reading smart water meters for water utilities	60	0	1	-60	AMI enables this benefit, but it should be taken up in the cost-benefit case for water meters Payments from water companies to DBs is a transfer, not a benefit
35a	Energy conservation from general information programs		44	0	44	Benefit had not been addressed
Total		**2,481**	**2,577**	**84**	**12**	

Appendix C: Comprehensive list of AMI Benefits

Advanced Metering Infrastructure – Net Benefits

The following table presents the:

- Gross 'low case' benefit values from the 2009 Benefits Report, compared with the gross 'low case' benefit values from the 2010 Benefits Review (prior to accounting for additional costs);
- Gross 'high case' benefit values from the 2010 Benefits Review;
- Additional costs to realise benefits, as detailed in the 2009 Benefits Report; and
- Net benefit values for each benefit (or group of benefits that share costs), which is derived by deducting the 'additional costs' from the gross values.

Benefit Number	Benefit	Gross Value (2008$ M)				Additional Costs		Net Value (2008$ M)		
		Low Case 2009	Low Case 2010	Change	High Case 2010	Low Case 2009	High Case 2009	Low Case 2009	Low Case 2010	High Case 2010
1	Avoided costs of installing import/export metering	33	35	2	147	0	0	33	35	147
2	Avoided costs of meter replacement	455	492	37	655	0	0	455	492	655
3	Reduced testing of meters	7	7		33	0	0	7	7	33
4	Reduced cost of network loading studies for network planning	5	5		12	1	1	4	4	11
5	Avoided cost of routine reading (including reductions in costs of PDEs and route management)	290	298	8	308	0	0	290	298	308
6	Avoided cost of special reads	139	171	32	171	0	0	139	171	171
7	Avoided cost of time switch replacement and O&M	93	99	6	170	0	0	93	99	170
8	Avoided additional cost of energy from time switch clock errors	48	41	-7	82	0	0	48	41	82
9	Avoided cost of manual disconnections and reconnections (and avoided revenue loss)	140	364	224	646	0	0	140	364	646
10	Avoided cost of setting demand limits for customers to promote fair sharing and defer	5	5		13	8	11	419	-3	2

Benefit Number	Benefit	Gross Value (2008$ M)				Additional Costs		Net Value (2008$ M)		
		Low Case 2009	Low Case 2010	Change	High Case 2010	Low Case 2009	High Case 2009	Low Case 2009	Low Case 2010	High Case 2010
	augmentation capex									
11	Ability to set emergency demand limits to share limited supply at times of network stress or supply shortage	422	0	-422	0					
12	Avoided cost of supply capacity circuit breaker	4	4		7	0	0	4	4	7
13	Avoided cost of replacing service fuses that fail from overload	5	5		14	0	0	5	5	14
14	Avoided cost of investigation of customer complaints about voltage QoS, including equipment cost and cost of reporting to regulator	38	39	1	38	10	16	28	29	22
15	Reduced cost for post storm supply restoration - avoid delays in detecting and correcting nested outages	9	9		71	2	4	151	400	685
16	Reduction in calls to faults and emergencies lines	14	14		14					
17	Avoided cost of investigation of customer complaints of loss of supply which turn out to be not a loss of supply	14	15	1	14	0	0	14	15	14
18	Avoided cost of end of line monitoring	4	4		4	Included in 15		Included in 15		
19	Reduction in unserved energy (with quicker detection of outages and quicker restoration times)	126	375	249	600	Included in 15		Included in 15		
20	Avoided cost of communications to feeder automation equipment	3	3		3	1	1	3	3	2
21	Avoided cost of proportion of HV/LV transformer fuse operations on overload	5	5		14	6	12	-1	-1	2
22	Avoided cost of a proportion of transformer failures on overload	20	28	8	73	0	0	20	28	73

Benefit Number	Benefit	Gross Value (2008$ M)				Additional Costs		Net Value (2008$ M)		
		Low Case 2009	Low Case 2010	Change	High Case 2010	Low Case 2009	High Case 2009	Low Case 2009	Low Case 2010	High Case 2010
23	Reduction in calls related to estimated bills and high bill enquiries	5	5		5					
24	Reduction in energy trading costs through improved wholesale forecasting accuracy	8	8		82					
25	Reduction in the administration cost of bad debt incurred on non-payment on move outs	2	2		2					
26	Customer benefit of being able to switch retailer more quickly and more certainly. (Note this is not the bill saving.)	7	8	1	15	64	94	-17	-15	46
27	Reduction in MDA costs - putting I&C customers on DB AMI Networks	25	26	1	36					
28	Ability for customers to move to monthly billing on the basis of electronic bills, reducing admin costs, collection costs, etc	0	0		0					
29	Avoided network and generation augmentation from peak demand reduction from three-rate TOU network tariff introduction and resultant three-rate retail tariff	89	44	-45	148	0	0	89	44	148
30	Avoided network and generation augmentation from peak demand reduction from CPP tariff implementation	73	133	60	370	0	0	73	133	370
31	Energy conservation from three-rate TOU	123	49	-74	174	0	0	123	49	174
32	Energy conservation from CPP tariff implementation	10	10		84	0	0	10	10	84
33	Additional demand response from IHDs on CPP	4	4		18	31	52	22	23	40
34	Additional demand response from direct load control of air conditioners	85	113	28	417	18	44	67	95	373
35	Energy conservation from IHDs	49	50	1	74	Included in 33		Included in 33		
35a	Energy conservation from general information programs	0	44	44	38	0	0	0	44	38

Benefit Number	Benefit	Gross Value (2008$ M)				Additional Costs		Net Value (2008$ M)		
		Low Case 2009	Low Case 2010	Change	High Case 2010	Low Case 2009	High Case 2009	Low Case 2009	Low Case 2010	High Case 2010
36	Peak demand reduction through deferral of refrigerator auto defrost cycle out of peak period	28	28		196	0	0	28	28	196
37	Avoided cost of other communications to manage customers' loads for renewable generation tracking, electric vehicle charging and local generation management	34	35	1	257			34	35	257
38	Revenue from reading smart water meters for water utilities	60	0	-60	0	3	6	57	-3	-6
	Totals	**2,481**	**2,577**	**96**	**5,004**	**143**	**241**	**2,338**	**2,434**	**4,763**

Notes:

- Shaded 'Low Case 2010' values are "Additional Benefits" and have "Additional Costs"
- Some 'Additional Costs' apply to multiple benefits. Where relevant, results have been consolidated.
- Totals have been adjusted to account for rounding

Sources: 2009 Benefits Report and 2010 Benefits Review

Appendix D: Results of the 2010 Cost Report (extracts)

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2.1 Introduction

A forensic, desktop assessment has been undertaken of the Victorian DBs' budget applications and charges applications to the AER for 2010 and 2011, along with the AER's (and Energeia's) assessments of those applications in its Final Determination[10].

Costs were analysed within each of the following generic cost categories:

- Meters, communications and installation capital expenditure (CAPEX);
- Information technology (IT) CAPEX;
- Program management costs (which were variously submitted as CAPEX and operating expenditure (OPEX));
- Transitional OPEX;
- Ongoing OPEX (i.e. post the 2006-13 transitional period); and
- Other post-transitional period costs (i.e. for the period 2014-28).

[10] The final charges applications of the DBs represent the costs approved by the AER; therefore any reference in this report and its appendices to "as submitted" costs should be read as being also a reference to costs approved by the AER in its Final Determination

3.4 Present value of costs

Having estimated the total transitional costs and the ongoing costs, we have calculated the present value of the estimated AMI-related costs for the period being analysed: 2006-28.

The present value of AMI-related costs over the assumed complete lifecycle of the Victorian AMI program (i.e. from 2006-28), and including sunk costs over the period 2006-09, is assessed as $1,621 million ±$200 million.

The breakdown of the present value is contained in Table 2. A (real) discount rate of 8% has been used, and present values are to mid-2008, which aligns with the use of 2008 dollars by the AER and in related DPI studies.

Table 2: Economic cost estimate for AMI program - PV of total lifecycle costs (2006-2028) ($m)

	PV to mid 2008
PV (including 2006 - 2009 sunk costs)	
- Transitional CAPEX	1,124
- Transitional OPEX	147
- Growth CAPEX	75
- Abolishments	30
- Failure replacements	28
- Ongoing OPEX	137
- IT, comms and meter refresh	79
TOTAL PV (incl pre 2010)	**1,621**

Approximately 80% of the total present value consists of transitional costs, of which CAPEX comprises almost 90%.

If 2006-09 sunk costs are excluded from the present value analysis, then the estimated present value of the cost of the Victorian AMI program (i.e. of future economic costs only) is $1,324 million, or $297m less than the PV of the total (past and future) lifecycle cost.