

Final Executive Summary

NERA Economic Consulting (NERA) has been engaged by the Ministerial Council on Energy's Smart Meter Working Group (SMWG) to estimate the net benefits associated with a mandatory rollout of smart metering, and a non-smart meter direct load control alternative. This note summarises the results of Phase 2 of the national cost benefit analysis and includes the estimates of the costs and benefits of smart metering and direct load control for each jurisdiction. Since the release of the Phase 2 reports for public consultation we have received submissions from distributors, retailers, metering manufacturers and consumer groups, amongst others. The comments raised in submissions have led to us revising the cost benefit results, which are discussed further in this note. This note also provides NERA's final recommendation as to the national minimum functionality for smart meters.

What are smart meters?

Smart meters are electricity meters that are capable of measuring and recording energy consumption in short intervals. They are also capable of two-way communication, which enables energy providers to read and control features of the meter remotely.¹

Smart meters provide energy providers with capabilities that can deliver benefits, including:

- § lowering the cost of distribution network service providers' and retail businesses' services;
- § avoiding network augmentation and reducing unserved energy by facilitating the introduction of innovative tariff products and enabling direct load control capabilities that change the time of use of, and total demand for, electricity; and
- § enhancing service performance.

These benefits need to be weighed against the costs of a large scale rollout. These costs include the cost of purchasing and installing the meters, communications costs, and the cost of upgrading distributors' and retailers' billing and management systems to process and store more detailed usage data and the upgrade of the National Electricity Market Management Company (NEMMCO) and the Western Australia Independent Market Operator (WA IMO) data management systems. The costs and benefits of a smart meter rollout must also be weighed against the costs and benefits associated with other demand management alternatives.

At its meeting in April 2007 the Council of Australian Governments (COAG) endorsed a staged approach for the national mandated rollout of electricity smart meters to areas where benefits outweigh costs, as indicated by the results of a cost benefit analysis.

¹ Meters that are capable of measuring and recording energy in short intervals but do not have two-way communication abilities ('interval meters') are distinguished from 'smart meters' which do have a two-way communication ability.

A national cost benefit analysis of smart metering

In July 2007, the SMWG appointed a team of consultants to undertake the cost benefit analysis required by COAG.² The cost benefit analysis is intended to provide the basis for future Ministerial Council on Energy (MCE) decisions with regard to smart meters.

The Terms of Reference for the cost benefit analysis divided the project into two work phases.

Phase 1 involved an incremental assessment of a list of smart metering functionalities for the purpose of recommending those functions to be included in a minimum national functionality. At its meeting on 13 December 2007 the MCE agreed to establish a minimum functionality for smart meters in the National Electricity Rules in line with the recommendations made as part of Phase 1 of our study and following the consideration of submissions on Phase 1. Our final recommendations on the national minimum functionality as presented in this Overview Report are consistent with the MCE's decision. We note that the MCE is considering further specific requirements for the home area network to support in-home displays and direct load control of appliances. Our conclusions in relation to the associated functionality that would facilitate the home area network are outlined in this report.

Phase 2 addressed the further question of whether the costs of rolling out smart meters (or of undertaking an alternative direct load control scenario) exceed the benefits, given the particular circumstances of each jurisdiction and regional differences within those jurisdictions (ie, urban, rural and remote areas). This assessment is intended to assist the MCE in determining any specific areas where replacement and rollout may be exempted or delayed on the basis of local factors that are demonstrated to reduce net benefits for consumers.

The Phase 2 Overview Report constituted the second output of the cost benefit analysis, and was released for public consultation. The report has been prepared by NERA and is not endorsed by the SMWG, the Standing Committee of Officials (SCO) or the MCE. Following the release of the consultancy reports for public consultation, 28 submissions have been received. The issues raised in submissions have been taken into consideration in the finalisation of results for the cost benefit analysis, as outlined in this note.

The cost benefit analysis was undertaken by four consulting teams

The national cost benefit analysis has been undertaken in six interlinked workstreams by separate consulting teams. Each workstream has been conducted in parallel and this Overview Report brings together the different streams of analysis to calculate the net benefits of alternative approaches to a smart metering rollout and a direct load control rollout.

The consulting teams involved in this review and their respective workstreams are:

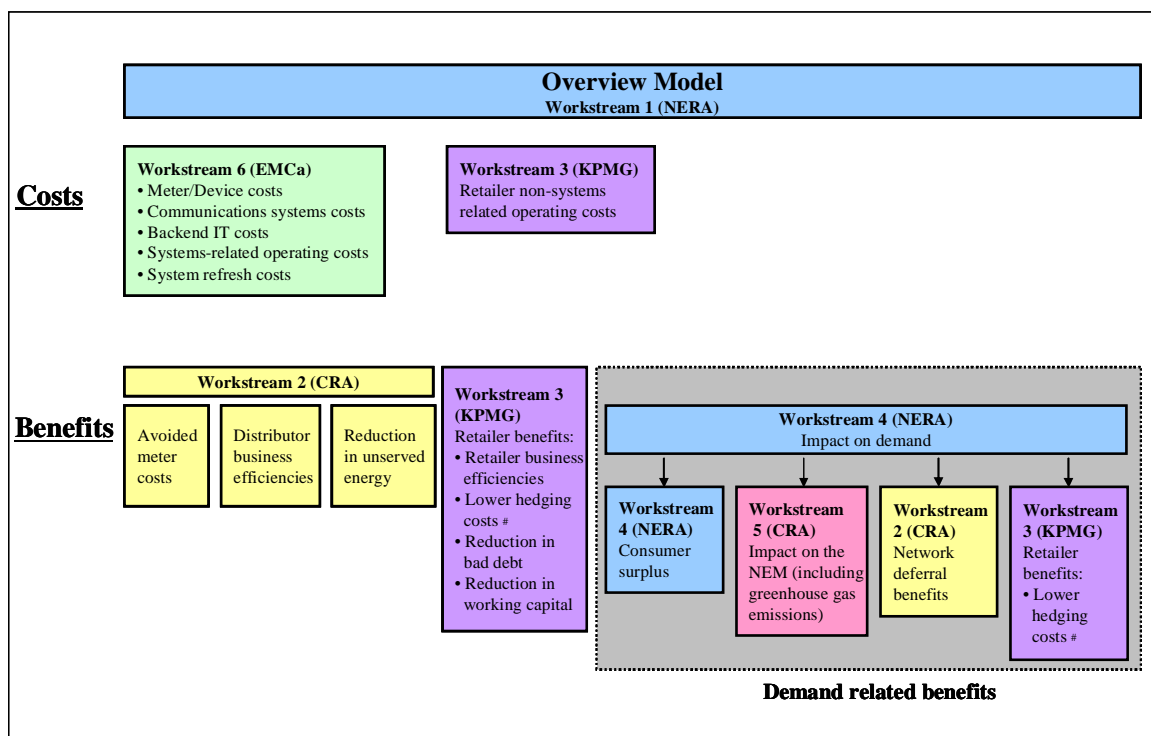
- § NERA Economic Consulting (NERA): Workstream 1 - Coordination (including responsibility for this Phase 2 Overview Report and resulting recommendations);
Workstream 4 - Consumer Impacts;

² The team of consultants that has been involved in this assignment are discussed in the following section.

- § CRA International (CRA): Workstream 2 - Network Impacts; Workstream 5 - Economic Impacts (market and greenhouse modelling);
- § KPMG: Workstream 3 - Retailer Impacts; and
- § Energy Market Consulting associates (EMCa): Workstream 6 - Transitional Implementation Costs and their allocation.

Figure E.1 sets out the interactions between each of these workstreams in relation to the estimation of costs and benefits that inform this Overview Report.

Figure E.1 Interaction Between Workstreams



Stakeholders have been closely involved in the analysis

The estimation of costs and benefits has benefited from information provided by distributors, retailers, metering providers, market operators and consumer representative organisations. Detailed information requests were sent to electricity businesses and metering providers, and in addition a series of structured workshops were held with relevant stakeholders. In addition, the final Phase 2 results include changes to the estimated costs and benefits, resulting from changes to the approach used to estimate avoided cost benefits, arising from comments raised during the Phase 2 consultation process.

The information received during this study has formed the basis of the cost and benefit estimates developed particularly by EMCa, CRA International and KPMG.

Submissions on the Phase 2 reports

The MCE received 28 submissions from stakeholders resulting from the raising a number of concerns with the results presented in the Phase 2 reports. The main issues included:

- § the approach used to estimate avoided meter costs;
- § installation cost assumptions;
- § various concerns with cost assumptions for communication technology and information technology, and the treatment of local factors impacting on costs; and
- § concern about the uncertainty of the estimates.

Most of the information provided in submissions was of insufficient detail to allow a detailed reconsideration of the assumptions that had been made. However, in response to specific concerns, we focused on those assumption changes that we believed would have a material impact on the final results. As outlined below, the main changes related to the approach to the estimation of the avoided meter cost benefits. A detailed description of our response to specific issues raised in submissions has been prepared.

The assessment considered four scenarios

To assess the costs and benefits of a smart metering rollout and a non-smart meter direct load control alternative the SMWG developed three smart metering rollout scenarios and one non-smart meter rollout scenario for assessment. These scenarios are:

- § Scenario 1: Distributor-led rollout – where each distribution network service provider is given the responsibility for owning and installing meters and associated metering data services within its area of operations as a monopoly service provider;³
- § Scenario 2: Retailer-led rollout – where retailers have responsibility for procuring the installation of meters and data management services within a competitive market for these services;
- § Scenario 3: Non-smart meter direct load control (DLC) device rollout – which does not involve the installation of smart meters, and distributors have responsibility for retrofitting direct load control devices on high energy using appliances such as air-conditioners and pool pumps; and
- § Scenario 4: Centralised communications as part of a retailer-led rollout – where the entire Australian smart meter communications system is provided by either a new centralised agency or an existing market operator.

The scenarios are intended to estimate the range of costs and benefits that vary according to the rollout approach adopted. These are not intended to be conclusive of the options

³ Note that while in this scenario the *responsibility* for providing meters is a monopoly this implies only that metering assets are included in the distributor's regulatory asset base and the distributor controls purchasing. Meter purchasing and related installation and maintenance services are still competitively purchased from the market, as in current practice, and regulatory incentives would maintain pressure on these costs.

available to the MCE but rather to provide an understanding of how the costs and benefits may change under alternative approaches to rolling out smart metering and how these compare to a non smart metering alternative.

The scenarios have the potential to affect the costs of a smart meter rollout through differences in:

- § the infrastructure necessary for implementation;
- § the potential for the achievement of economies of scale; and
- § the scope for competitive provision of meters and meter data management services.⁴

Similarly, the benefits among scenarios may differ. This may be due to differences in the incentives retailers and distributors have for product innovation including the development of time of use tariffs (TOU) and critical peak pricing (CPP). There may also be benefits that distributors could achieve where they have the responsibility for the detailed design of the rollout that may not be realisable to the same extent under a retailer-led or a centralised communications rollout and vice versa.

The different scenarios also affect the allocation of the costs and benefits between retailers and distributors, particularly those costs and benefits associated with the role of the meter provider. Differences in the allocation of costs and benefits may change the incentives that either distributors or retailers have to invest in systems required to achieve some benefits, absent their inclusion in a mandated rollout.

Recommended national minimum functionality

The analysis of costs and benefits for the smart meter scenarios are based on the recommended national minimum functionality.⁵

After consideration of the submissions received on the Phase 1 reports, and further assessment of functions that we were unable to conclusively make a recommendation on in Phase 1, the functions in Table E.1 are recommended for inclusion in the minimum national functionality specification.

A description of each functionality is provided in section 3.2 of this report.

We note that a recommendation that emerges from this Overview Report is that an interface with a Home Area Network (HAN)⁶ should also be incorporated within the national minimum functionality for a smart meter rollout. This is discussed further below.

⁴ The competitive provision of meters and meter data management services is a substitute for the monopoly provision and subsequent regulation of those services and may result in a different distribution of costs and benefits between consumers and the providers of those services depending on the relative efficiency of competition versus regulation in uncovering the true price of services.

⁵ The costs and benefits associated with the inclusion of an interface to a Home Area Network in the minimum national functionality are shown separately in the main body of the report, as discussed in the following section.

⁶ Functionality 16.

Following the identification of the functionalities that should be included in the minimum national functionality specification it will be necessary to clearly specify the performance requirement for each functionality and to undertake related technical work (such as in relation to managing the risks associated with a lack of interoperability, where this is found to be material). These are tasks that should be worked through by technical experts in consultation with stakeholders.

Table E.1
Final functionalities recommended for inclusion in a
minimum national meter specification

No.	Functionality
Core functions	
1	Half-hourly consumption measurement and recording
2	Remote reading
3	Local reading – hand-held device
4	Local reading – visual display on meter
5	Communication and data security
6	Tamper detection
7	Remote time clock synchronisation
8 & 14	Load management at meters through a dedicated controlled circuit
Energy measurement	
9	Daily remote reading
10	Power factor measurement (three phase meters only)
11	Import/export metering
Switching and load management	
12	Remote connect/disconnect
13	Supply capacity control
Facilitation of Customer Interaction	
16	Interface with a Home Area Network
Supply and service monitoring	
19	Quality of supply and other event recording
20	Meter loss of supply and detection
Upgradeability and configurability	
25	Remote configuration
26	Remote software upgrades
29	Plug and play device commissioning

An interface with a home area network should be included in the national minimum functionality and would facilitate provision of an in home display by retailers

The analysis undertaken as part of Phase 1 was not able to conclusively resolve whether some of the functions identified for consideration by the SMWG, should be included in a national minimum functional specification for a smart meter. These functions included the interface to a HAN (functionality 16). In Phase 2 of the analysis we have considered this functionality in more detail.

The benefits that may be expected to result from the inclusion of this functionality relate to both:

- § the ability to facilitate direct load control of appliances via the smart metering infrastructure; and
- § the potential to enhance customer demand response to TOU tariffs and CPP and to achieve greater demand conservation overall, via the future provision of an in home display (IHD).

Our analysis suggests that the inclusion of functionality 16 would have positive net benefits, even in the lower bound, where it involved a DLC capability underpinned by smart thermostats (ie, functionality 16C) and where it did not also involve provision of an IHD. In the upper bound, functionality 16 is expected to have a positive net benefit both where it involves DLC capability and where it involves the provision of an IHD.

We note that the decision as to whether to include functionality 16 in the national minimum specification relates only to whether the meters that are rolled out include an interface with a HAN. How that interface is ultimately used will be determined by the commercial considerations of both retailers and distributors. That is, whether the interface is used to provide DLC capability and, if so, whether that is provided via a smart thermostat or via an open-system in-home communications device (eg, Zigbee). This is not determined as part of the minimum national functionality but will be a subsequent business decision. Similarly, whether consumers are provided with IHDs will depend on businesses' consideration of whether they expect to achieve an enhanced demand response or could realise other benefits from an IHD. Importantly, the Phase 1 recommendation that IHDs not be included in the minimum national functionality ***does not preclude retailers from choosing to supply customers with IHDs***, provided the interface with the HAN is included in the national minimum functionality.

Given that the inclusion of functionality 16 has a positive net benefit nationally in the lower bound estimate where it facilitates DLC, and that there is the potential upside from realising additional benefits, we recommend that functionality 16 should be included within the minimum national functionality.

We note that, whilst considered positive, there is a significant degree of uncertainty in relation to the magnitude of the net benefits associated with the inclusion of an interface to a HAN, particularly in relation to the potential to enhance customer demand response via an

IHD. As a result we present the additional net benefit that may result from the inclusion of this functionality separately in this report.

Smart metering is estimated to deliver net benefits of between -\$299 million and \$3.3 billion nationally⁷

Table E.2 summarises the overall net benefit resulting from the analysis, considered nationally across all of the jurisdictions in Australia, for each of the alternative rollout scenarios. The maximum net benefits of smart metering (excluding the costs and benefits that may accrue from the interface with a HAN) are estimated to arise from a distributor-led rollout of smart metering (Scenario 1), with a range of between -\$299 million and \$3.3 billion in net present value (NPV) terms over a twenty year period. The net benefits increase to -\$260 million and \$3.7 billion when the costs and benefits associated with an interface with a HAN are included.⁸ For the alternative rollout scenarios 2 and 4, the net benefit of smart metering is negative in the lower bound, reflecting both the higher costs associated with those scenarios and the lower level of expected benefits.

These revised results reflect revisions to the costs and benefits following consultation on the Phase 2 results. The revisions include:

- § adjustments to the assumptions about the quantity of meters expected to be replaced, affecting the avoided cost benefits. The change was to better align the profile of meter lives with actual replacement meter numbers provided by distributors.
- § minor changes to the costs of meters, in response to further information being provided by distributors;
- § for ActewAGL, changing the second counterfactual to reflect their new and replacement meter policy of replacing meters with interval meters;
- § for Queensland, the replacement cost of ripple control has been reduced on the assumption that only secondary systems would need to be replaced over the assessment period; and
- § resolving minor calculation errors in the cost and benefit estimates discovered since the Phase 2 results were published, which increases the costs particularly for New South Wales.

The effect of these revisions has been to lower the net benefits, as the avoided cost benefits have been reduced. Avoided meter cost benefits have fallen by between 15 and 24 per cent compared with the earlier estimates. This leads to the lower net benefit bound for Scenario 1 becoming negative.

The net benefits reported in Table E.2 reflect a counterfactual of accumulation meters for each jurisdiction. We have also examined a counterfactual reflecting a continuation of the

⁷ Excluding the net benefits that may accrue from the interface with a HAN. The potential additional net benefits that may arise as the result of the inclusion of this interface are discussed below.

⁸ The upper estimate reflects a 15 per cent take-up rate for DLC (functionality 16C) plus an additional 7% conservation effect associated with providing customers with an IHD.

current metering policy in each jurisdiction. Under this counterfactual, the overall national net benefit increases.⁹

Table E.2
Net Present Value of Benefits and Costs (\$m) – National
(Excluding HAN, Accumulation Meter Counterfactual)

National	SMI costs	Avoided meter costs	Business efficiencies and other benefits	Demand response	Net position
Scenario 1					
Distributor-led					
Minimum Net Benefit	(4,432)	1,388	2,496	250	(299)
Maximum Net Benefit	(2,715)	1,978	3,272	738	3,272
Scenario 2					
Retailer-led					
Minimum Net Benefit	(6,084)	1,388	2,111	250	(2,336)
Maximum Net Benefit	(3,586)	1,978	2,662	738	1,792
Scenario 3					
Non-smart meter DLC					
Minimum Net Benefit	(369)	n/a	n/a	403	34
Maximum Net Benefit	(128)	n/a	n/a	746	618
Scenario 4					
Centralised communications					
Minimum Net Benefit	(5,732)	1,388	2,111	250	(1,984)
Maximum Net Benefit	(3,330)	1,978	2,662	738	2,047

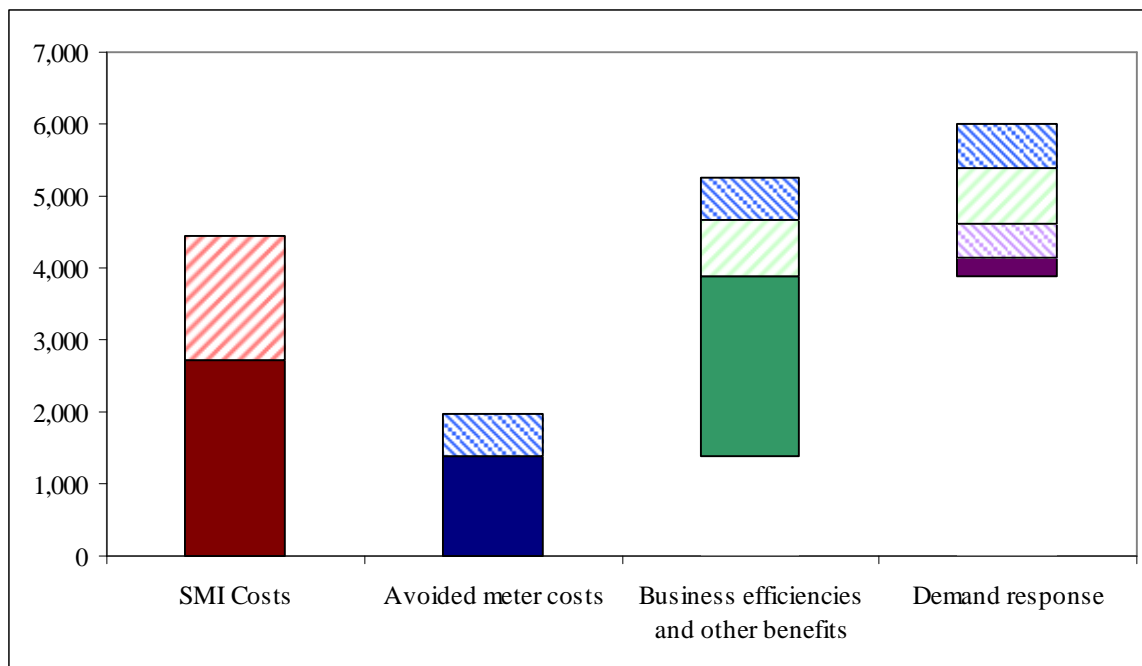
Figure E2 is a waterfall diagram and should be interpreted as follows. The solid component of each of the bars represents the lowest end of the range estimated for the Smart Metering Infrastructure (SMI)¹⁰ costs, avoided meter costs, business efficiencies or demand response. The potential additional cost or benefit for each of the categories (as reflected by the upper end of the estimation range in each case) is indicated by the hatched areas. The colour of the hatched area corresponds to the colour of the solid area for each of the categories. The bars representing the benefits are shown so that the total of the low range for the benefits can be read directly from the graph. The total magnitude of the additional benefits (ie, the top end of the ranges) is then indicated by the height of the uppermost hatched areas in the demand

⁹ Jurisdictional results under this second counterfactual are discussed further below.

¹⁰ SMI refers to all the communication and data management support requirements of smart meters in addition to the meters themselves.

response bars.¹¹ The waterfall diagram allows for both upper and lower ranges of total benefits to be compared directly with upper and lower ranges of the costs.

Figure E.2
NPV of Benefits and Costs (\$m) - National Scenario 1
(Excluding HAN, Accumulation Meter Counterfactual)

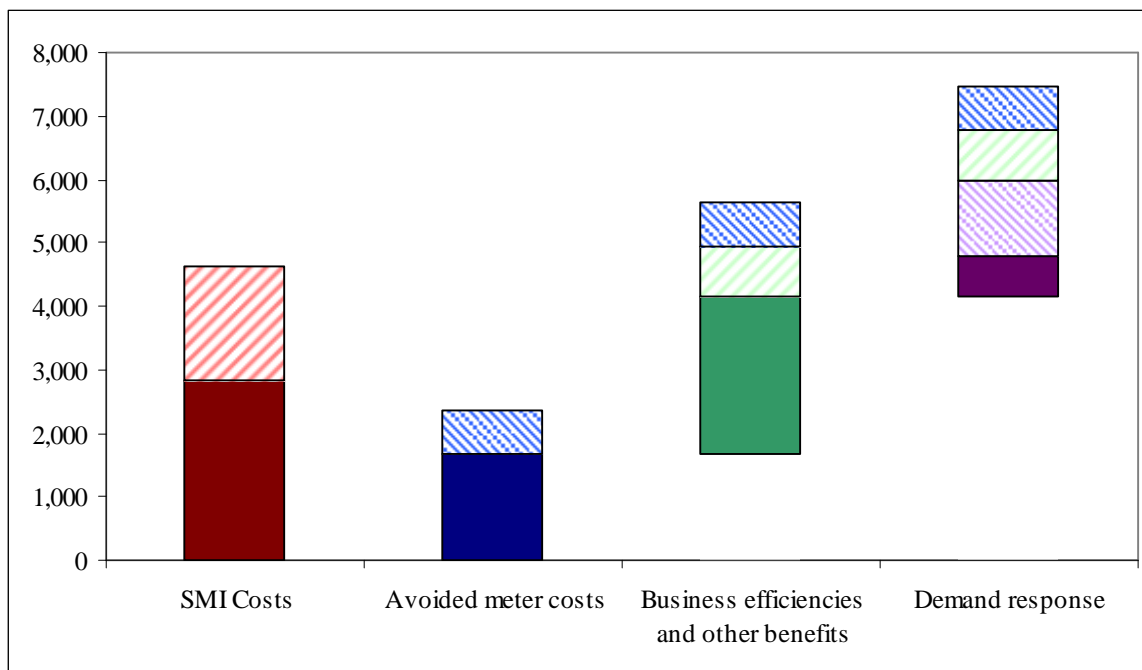


Inclusion of an interface with a HAN in the smart metering functionality increases the demand response benefit estimated for the three smart meter rollout scenarios compared with the estimates presented above, as well as increasing the rollout costs. The additional net benefit that may be realisable from the inclusion of the HAN ranges from \$39 million (in NPV terms over the twenty year period) to \$392 million.¹² The net benefits including the HAN for a distributor-led rollout, under the counterfactual of the current metering policy and adjusted to reflect the NSW summer peak are illustrated in Figure E.3, and are estimated to range between \$146 million and \$4.6 billion. These net benefits are based on costs ranging between \$2.8 billion and \$4.6 billion, and benefits of between \$4.8 billion and \$7.5 billion.

¹¹ Note that there are three hatched areas in the demand response bar, indicating the additional benefit (upper end of the range) for the avoided meter costs (shaded blue), business efficiencies (shaded green) and demand response (shaded purple).

¹² The lower bound estimate reported above reflects the incremental net benefit from utilising the HAN capability to facilitate DLC using smart thermostats (functionality 16C), assuming the lower bound uptake for DLC of 7.5 percent and no IHD. The upper estimate reflects a 15 percent take-up rate for DLC (functionality 16C) plus an additional 7% conservation effect associated with providing customers with an IHD. This additional conservation effect is highly uncertain and has been estimated to be zero in the lower bound of our analysis (in which circumstance the provision of an IHD would result in a *negative* net benefit). See discussion in section 16.2.

Figure E.3
NPV of Benefits and Costs (\$m) - National Scenario 1
(Including HAN, Current Metering Policy Counterfactual, NSW Summer Peak¹³)



The cost of smart metering is estimated to be between \$2.7 billion and \$4.4 billion (in NPV terms)

The total cost of a national smart metering rollout has been estimated as ranging from \$2.7 billion to \$4.4 billion in NPV terms over a 20 year period, for a distributor-led rollout. The costs rise to over \$6.1 billion for a retailer led rollout (upper bound). These estimates are based on the transitional cost estimates made by EMCa,¹⁴ along with estimates of operational costs and IT and modem refresh costs (as applicable) made by CRA and KPMG.¹⁵ These estimates have been developed through an extensive cost build up exercise, which includes estimating the costs of:

- § smart meters and their installation in each jurisdiction;
- § communications infrastructure;
- § meter data and communications management systems;

¹³ The results presented in our analysis have been based on load profiles for 2006/07, in which NSW was winter peaking. NEMMCO SOO projections show that NSW is moving to summer peaking, and to examine the implications of this we have estimated demand response benefits for NSW assuming a summer peak in addition to the winter peak based on the 2006/07 data. Using the summer peak for NSW increases the estimated demand response benefits because of the higher summer elasticity assumptions.

¹⁴ EMCa Workstream 6 Transitional Costs Consultation Report (February 2008), section 12.2, Table 12-2. Note that the costs in EMCa's report have been present valued as part of the overall cost benefit modelling undertaken by NERA.

¹⁵ CRA Workstream 2 Network Impact Consultation Report (February 2008), section 16. KPMG, Retail Impact Consultation Workstream Report (February 2008), Section 7.

- § market operator systems to manage changes to market settlement information and new metering-related business to business transactions;
- § retailer systems to support the retailer activities expected to be undertaken as a result of the rollout of smart meters in each scenario; and
- § distributor systems to support the distributor activities expected to be undertaken as a result of the rollout of smart meters in each scenario.

In addition, an allowance has been made for program management costs relating to the smart metering infrastructure rollout.

The costs differed between each scenario due to:

- § differences in the assumed communications infrastructure considered by EMCa to be appropriate to support each scenario;
- § differences in the non-communications infrastructure, eg, the number of meter data management systems required; and
- § differences in meter costs between scenarios.

The benefits of smart metering are estimated to be between \$4.1 billion and \$6.0 billion (in NPV terms)

The benefits associated with a national rollout of smart metering have been estimated by CRA, KPMG and NERA to be between \$4.1 billion and \$6.0 billion in NPV terms over the twenty year period of analysis, under the distributor-led rollout scenario. The value of the benefits falls under the alternative rollout scenarios, to \$3.7 billion in the lower bound for both the retailer-led rollout and the centralised communications scenario

The majority of the benefits result from avoided meter costs associated with not having to replace the existing meter stock and business efficiency benefits for distributors (totalling approximately 33 to 37 per cent¹⁶ and 46 to 59 per cent of total benefits, respectively). In contrast, demand response benefits represent between 6 and 14 per cent of total estimated benefits (excluding the potential demand response benefits associated with including an interface to the HAN).

CRA estimate that the potential benefit arising from avoiding the need to replace the existing meter stock ranges from \$1.4 billion to \$2.0 billion. This estimate is based on a number of factors, including assumptions regarding the amount of installation time, and thereby costs incurred to replace existing meters in each jurisdiction and the existing mix of meters in each jurisdiction.¹⁷

These avoided cost benefits have decreased compared to those estimated for the initial Phase 2 results, reflecting revisions to the numbers of replacement assets following the provision of additional information by distributors. Despite these revisions, avoided meter cost benefits

¹⁶ This percentage reflects the counterfactual of accumulation meters in each jurisdiction, and is higher under the alternative counterfactual of a continuation of each jurisdiction's current metering policies.

¹⁷ CRA Workstream 2 Network Impact Consultation Report (February 2008), section 6.

remain a significant proportion of the total benefits associated with the smart metering scenarios.

CRA also identify a number of distributor business efficiency benefits resulting from smart metering, which total between \$2.1 billion and \$2.9 billion in NPV terms over the twenty year period of the analysis. These benefits include:

- § the avoided cost of routine manual meter reading;
- § the avoided cost of special meter reads (ie, when customers move into or out of a premise);
- § the avoided costs of manual disconnections and reconnections;
- § reductions in calls to faults and emergency lines; and
- § avoided costs of customer complaints about voltage quality of supply.

KPMG identify a number of retailer benefits resulting from smart metering, which total between \$98 million and \$196 million in NPV terms over the twenty year period of the analysis (or between 4 to 6 per cent of the total estimate of business efficiencies). These benefits include:

- § a reduction in call centre costs as a result of fewer high bill enquiries;
- § a reduction in bad-debt and working capital requirements;
- § a reduction in hedging costs, due to interval data leading to improved forecasting; and
- § other cost reductions, including costs for data validation and settlement and management time.

KPMG estimate that call centre costs rise initially as customers query new tariff products that are introduced following a smart metering rollout, however, these costs subsequently are expected to decrease.

The final benefit category results from changes in the time of use and level of electricity demand by consumers which leads to:

- § the deferral of peak network augmentation;
- § reductions in retailers' hedging costs as a result of reductions in peak wholesale prices;
- § the deferral of peak generating capacity;¹⁸ and
- § reductions in the level of unserved energy, generation operating costs and carbon emissions resulting from changes in the pattern of electricity market dispatch.

¹⁸ We note that CRA has concluded that the relatively small size of the overall system demand reductions that have been estimated to follow a rollout of smart meters or a DLC alternative would not be sufficient to defer generation investment in practice. However, CRA have estimated benefits in relation to a reduction in unserved energy, resulting from the demand reduction. CRA Workstream 5 Market Impact Consultation Report (February 2008), section 4.2.

The demand response benefits are calculated based on assumptions in relation to the TOU tariffs and CPP products that may be offered following a smart meter rollout and the likely take-up rate of those tariffs (developed by KPMG as part of the retail workstream¹⁹) and estimates of the demand response resulting from the introduction of these tariffs, which have been developed by NERA.²⁰ CRA have taken these estimates of demand response and estimated both the potential value of the network deferral benefits that may occur and the impact on the electricity market (including the reduction in greenhouse gas emissions). Nationally the demand response benefits range between \$250 million and \$738 million in NPV terms over the twenty year period of the analysis (excluding the demand response benefits that may arise from including an interface to a HAN). This represents between 6 and 14 per cent of total benefits resulting from the introduction of smart metering. Including an interface to a HAN may increase the total demand response benefits by between a *further* \$250 million to \$709 million.²¹

Part of the demand response benefits resulting from the introduction of smart metering is the potential for reductions in carbon emissions due to changes in the pattern and level of customer demand leading to changes in the pattern of generation dispatch. The impact of a smart meter rollout on greenhouse gases depends critically on:

- § the extent to which the introduction of TOU and CPP tariffs *shifts* demand from peak to off-peak periods versus reducing overall consumption;
- § whether smart meters also result in an energy conservation impact; and
- § whether smart meters also enable DLC.

Overall CRA has estimated that greenhouse gas emissions will fall as a result of a smart meter rollout.²² Over the twenty year period of the cost benefit analysis the total reduction in greenhouse gases is estimated to be between 597,000 tonnes and 12.3 million tonnes. This excludes any additional demand impacts associated with the HAN. The effect of including the HAN, combined with any conservation effect that might result from the provision of IHDs, is that the total reduction in greenhouse gases might be as great as 31.0 million tonnes. The extent of the reduction in emissions is greater where smart meters also enable DLC and where it is assumed that the provision of IHDs engenders an additional energy conservation impact.

¹⁹ KPMG, Workstream 3 Retail Impacts Consultation Report (February 2008), Appendix A.

²⁰ NERA, Workstream 4 Consumer Impacts Consultation Report (February 2008), section 5.

²¹ The bottom end of this range reflects the use of the HAN to provide DLC capability only whilst the upper end of the range reflects the provision of an IHD leading to an additional 7% energy conservation response. As discussed in section 16.2.3 of this report, there is considerable uncertainty in relation to the potential energy conservation response. It should also be noted that the additional benefits reported above have associated additional costs. The scope for additional *net* benefits from inclusion of the HAN have been discussed earlier.

²² CRA Workstream 5 Market Impact Consultation Report (February 2008), section 4.3.2, scaled back to only include avoided greenhouse gases during the assessment period.

The net benefits of smart metering are not unequivocally positive for all jurisdictions

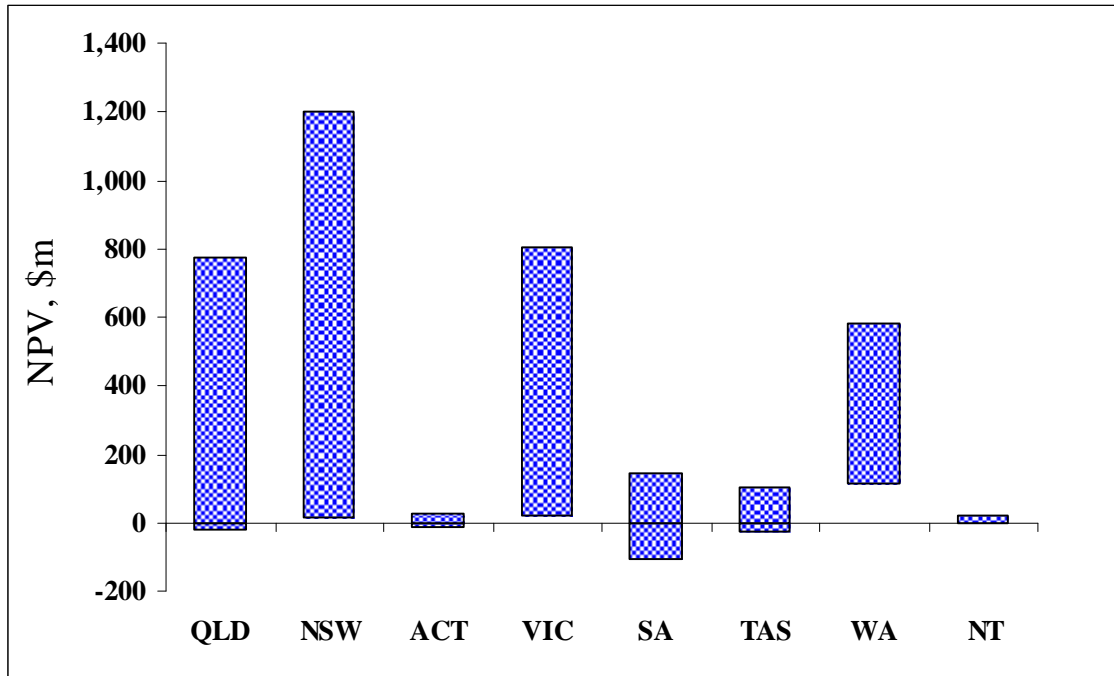
The national aggregated results mask differences in the underlying net benefits by jurisdiction, as both the costs and benefits vary according to the circumstances present in each jurisdiction. Table E.3 and Figures E.4 and E.5 below summarise the results for scenario 1 for each jurisdiction, and indicate the upper and lower ranges for the net benefit (in NPV terms) estimated in each case. The results are shown for both the counterfactual of a continuation of each jurisdiction's current metering policy and the counterfactual of accumulation metering. The accumulation metering counterfactual provides a useful baseline for the assessment and puts all jurisdictions on an equal footing. However, in considering decisions for specific jurisdictions, their current meter replacement policies and activities may be the more appropriate baseline.

The adoption of the counterfactual of current metering policy increases the net benefit in Queensland, NSW and Tasmania (compared to the counterfactual of accumulation metering), but does not alter the overall outcomes of the cost benefit analysis for these jurisdictions. For Victoria, the adoption of the current policy counterfactual of new and replacement metering being interval meters results in the net benefit calculated for Victoria of a distributor-led smart meter rollout being positive in both the lower and upper bound.²³

These jurisdictional results reflect revisions to the avoided meter cost benefits resulting from comments made in submissions.

²³ If the accumulation metering counterfactual is adopted, the net benefit calculated for Victoria falls, such that it becomes negative in the lower bound.

Figure E.4
Summary of Results by Jurisdiction – Net Benefit (NPV, \$m), Scenario 1
(Excluding HAN, Current Metering Policy Counterfactual)²⁴



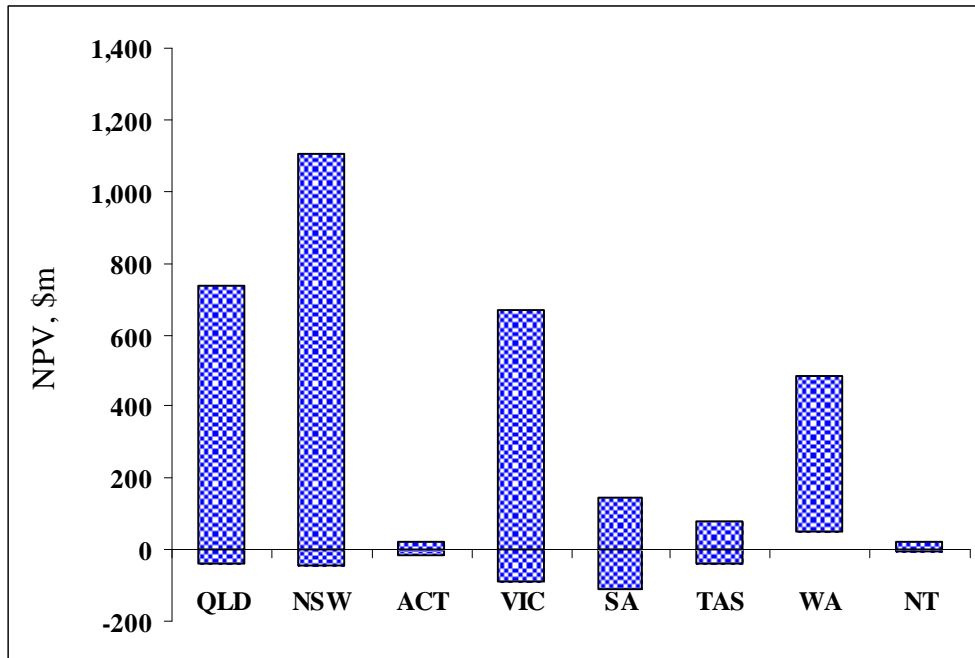
²⁴ The New South Wales results presented here are based on the load profile for 2006/07 in which the load peak was in winter. If a summer peaking load profile assumption was made, the benefits would be likely to increase.

Table E.3
Net Present Value of Benefits and Costs (\$m) – National
(Excluding HAN, Current Metering Policy Counterfactual)²⁵

	QLD	NSW	ACT	VIC	SA	TAS	WA	NT	Nationwide
Scenario 1									
Distributor-led									
Minimum Net Benefit	-17	16	-13	21	-108	-27	113	-4	-19
Maximum Net Benefit	777	1,201	29	806	146	102	580	22	3,664
Scenario 2									
Retailer-led									
Minimum Net Benefit	-520	-628	-33	-418	-251	-65	-126	-14	-2,056
Maximum Net Benefit	343	839	18	491	45	62	372	14	2,183
Scenario 3									
Non-smart meter DLC									
Minimum Net Benefit	28	-1	n/a	5	-0	n/a	6	-3	34
Maximum Net Benefit	201	164	n/a	116	66	n/a	72	-1	618
Scenario 4									
Centralised communications									
Minimum Net Benefit	-458	-511	-26	-307	-220	-76	-95	-11	-1,704
Maximum Net Benefit	455	749	21	611	84	74	429	16	2,439

²⁵ The New South Wales results are based on the 2006/07 winter peaking load profile assumption.

Figure E.5
Summary of Results by Jurisdiction – Net Benefit (NPV, \$m), Scenario 1
(Excluding HAN, Accumulation Counterfactual)²⁶



A range of sensitivities have been performed on the jurisdictional results, the outcomes of which are reported in the body of the report.

The results indicate that a distributor-led rollout of smart metering in New South Wales and Western Australia would deliver positive net benefits on the basis of the estimated avoided meter costs and business efficiencies alone, when compared with current metering policies. The positive net benefits in these jurisdictions are now also contingent on obtaining demand response benefits, particularly if costs are likely to be closer to the upper bound estimates. The inclusion of an interface with a home area network in these jurisdictions would likely further increase the net benefits (through further enhancing the demand response), particularly if direct load control was targeted to maximise both participation and the resultant network deferral benefits.

The Queensland results have changed since the Phase 2 results were first released, with the lower bound now being negative under both counterfactuals. Given the high upper bound estimate, this suggests that there may be considerable benefits from smart metering in Queensland, however it would be necessary to ensure that costs were towards the lower bound, and benefits towards the upper bound. This also suggests that demand response benefits will be important for a positive net benefit outcome in Queensland.

In Victoria, smart metering delivers positive net benefits in both the upper and lower bound, when considered against the current metering policy counterfactual. In this case, the rollout would be justified solely on the basis of avoided meter costs and business efficiency benefits alone. If the accumulation counterfactual is assumed then in order to achieve a positive net

²⁶ The New South Wales results reflect the 2006/07 winter peaking load profile.

benefit, the cost of the rollout needs to be towards the lower bound of the estimated range, and business efficiency benefits towards the upper end of the range. Demand response benefits should be more aggressively pursued (through the introduction of TOU tariffs and/or CPP, or direct load control programs) in order to make up any shortfall between benefits and costs on business efficiency and avoided meter costs. The inclusion of an interface with a home area network would likely further increase the net benefits (by enhancing the demand response), particularly if direct load control was targeted to maximise both participation and the resultant network deferral benefits. However, on the basis of our analysis, the incremental impact of including the HAN would not of itself be sufficient to ensure that there was a positive net benefit in rolling out smart meters under the accumulation counterfactual²⁷ without also achieving costs towards the lower end of the range or business efficiency benefits towards the upper end of the range.

The results of the cost benefit analysis for South Australia show that for a rollout of smart metering to have a net positive benefit, it is necessary to have costs at the low end of the range estimated. Per customer business efficiency benefits are lower in South Australia than the national average, mainly due to much lower avoided costs for special reads (15% of the national average, driven by lower property churn, and much lower reading costs), lower avoided costs for routine meter reading and less reduction assumed in the cost of calls to faults and emergencies lines. Demand response benefits may assist in meeting any shortfall between costs and benefits in South Australia but would not result in a rollout becoming net positive if costs were at the high end of the range estimated, even taking into account the additional demand response that may be achievable with the inclusion of an interface to the HAN.

A decision whether or not to rollout smart meters in South Australia therefore appears to be dependent both on a view as to the reasonableness of the estimates presented in relation to the distribution efficiency benefits and the meter and installation costs, and also on the likelihood of the estimated demand response benefits. The consecutive peak days experienced in South Australia may increase the uncertainty associated with achieving a sustained demand response, particularly via TOU and CPP tariffs.

For the Australian Capital Territory, Tasmania and the Northern Territory our results indicate that the justification for a smart meter rollout is dependent on whether the bottom end of the range of cost estimates can be achieved together with the upper end of the avoided meter costs and business efficiency benefits. Additionally, in these jurisdictions we do not believe that there are likely to be significant demand response benefits. Therefore it is unlikely that there will be the same scope for potential 'upside' through demand response as there is in Victoria and South Australia.

The above results suggest that a national mandatory smart metering rollout may not be justified in all jurisdictions. We have therefore considered the implications for smart meters being rolled out in some, but not all, jurisdictions. This is particularly relevant for jurisdictions operating in the National Electricity Market (eg, Tasmania and the Australian Capital Territory). The main implications are:

²⁷ This is true even where a 7% conservation impact from the provision of IHDs is included, which we consider to be an aggressive assumption.

- § the requirement to settle the wholesale market on the basis of net system load profiles, rather than actual usage information would remain; and
- § retailers operating across jurisdictions may require different business processes for managing customer switching and services provided through smart metering, such as special reads. This is likely to increase the costs associated with managing a smart metering rollout.

EMCa indicates that there are unlikely to be particular economies of scale associated with a mass rollout of smart meters across each jurisdiction. For this reason there is unlikely to be rollout cost differences between a national rollout compared with individual jurisdictional rollouts.

We have also considered the difference in the expected net benefit of a smart meter rollout between urban, rural and remote areas. Both costs per national meter identification (NMI) and business efficiency benefits per NMI are greater for customers in rural and remote areas than for urban customers. In relative terms, the higher benefit per NMI in rural and remote areas exceeds the increase in costs per NMI for these customers on the basis of the estimates provided by EMCa and CRA. As a result, the net benefit per NMI of a smart meter rollout is greater for customers in rural and remote areas than it is for customers in urban areas. This implies that the benefits of a smart meter rollout will be greatest where customers in rural and remote areas are also included, rather than limiting a rollout to urban areas only.

We note that the analysis has assumed power line carrier (PLC) communications technology for rural and remote areas. A number of submissions raised concerns about the technical viability of PLC however, EMCa notes in its report that it considers that there are adequate answers to these concerns that it should be considered a viable technology for rural Australia, for the purposes of this analysis.²⁸ We have, however, also conducted sensitivity analysis based on alternatives to PLC. This analysis indicates that the relative outcomes of the cost benefit analysis in each jurisdiction would not be changed if PLC was found not to be viable. EMCa estimate that the lower bound of average lifecycle costs of smart metering and communications infrastructure would increase between \$3 and \$37 per NMI if PLC is not viable.²⁹

Non-smart meter direct load control may be a viable alternative in some jurisdictions

In addition to assessing three smart metering scenarios, a non-smart meter direct load control scenario was also considered. This approach is a substitute for providing a direct load control capability via the inclusion of an interface with a home area network in the smart meter specification (functionality 16). The results indicate that:

- § nationally, direct load control can deliver net benefits of between \$34 million and \$618 million;

²⁸ EMCa Workstream 6 Transitional Costs Consultation Report (February 2008), Section 5.6.2.

²⁹ Based on the difference between EMCa's scenario 1a and 1c for each jurisdiction, see EMCa Workstream 6 Transitional Costs Consultation Report (February 2008), Tables 5.4 to 5.6, pp 90-92.

- § in Queensland a non-smart meter DLC rollout is estimated to provide positive net benefits in both the upper and lower end of the ranges considered;
- § in New South Wales a non-smart meter DLC rollout has a positive net benefit in the upper bound and a marginal net cost in the lower bound. However, this reflects the winter peaking assumption in New South Wales, which results in DLC not leading to any network deferral. Under the summer peaking sensitivity a non-smart meter DLC rollout is estimated to provide positive net benefits in both the upper and lower bounds;
- § in Victoria, South Australia and Western Australia a non-smart meter DLC rollout is estimated to provide positive net benefits in the upper end of the ranges and to have either a zero or only minimal net benefit in the lower end of the range;
- § to the extent that a DLC rollout may be more effective in reducing peak demand (as a result of the avoidance of customer response fatigue on consecutive peak days), Scenario 3 may provide a more appropriate and cost effective strategy in South Australia as it provides a DLC capability without incurring the higher costs of a smart meter rollout; and
- § for the Northern Territory, the Australian Capital Territory and Tasmania a DLC rollout is not expected to result in a positive net benefit as result of the particular characteristics of load in those jurisdictions and the limited scope for network deferral.

Ultimately it is relevant to consider whether providing direct load control via smart metering infrastructure is more or less cost effective compared to via a direct communications device as examined as part of Scenario 3. Based on cost information provided by EMCa, NERA estimates that the incremental cost of providing direct load control capabilities via the smart metering rollout (ie, functionality 16AB or 16C) is lower than a stand-alone DLC rollout as in Scenario 3. In addition there is a potential for a larger demand response where DLC is implemented via smart meters to the extent that additional conservation may be achievable via provision of an IHD.³⁰

This suggests that for those jurisdictions where smart metering is otherwise justified direct load control capabilities should be implemented via the smart metering infrastructure. However, for those jurisdictions where smart metering is not justified on the basis of business efficiency or avoided meter cost benefits there may be benefits from implementing a non-smart meter direct load control program.

Uncertainties in relation to the analysis

The results presented in this report provide the best estimate of costs and benefits given information available over the course of this study. There is necessarily a degree of uncertainty in the estimation of both costs and benefits. Some of these uncertainties are captured within the ranges reported. The approach taken in this report is conservative, given that in the majority of cases we compare the high end of the cost estimates with the low end of the benefits. We also note that there are potential additional benefits in relation to distributor business efficiencies and customer service that have not been quantified and are therefore not reflected in the net benefit results presented in this report.

³⁰ NERA, Consumer Impact Consultation Report (February 2008), Section 7.1.

Based on information provided to EMCa by a number of the Victorian distributors, we are aware that the cost of smart metering infrastructure estimated by the Victorian distributors for the purpose of assessing the costs to pass through to customers by the Essential Services Commission (ESC) is above the upper bound of the costs estimated by EMCa. EMCa notes in its report that it has taken account of information provided by Victorian distributors to the extent possible given its limitations in scope and comparability.³¹ Nevertheless EMCa comments that it appears that the aggregate costs as assessed by the Victorian distributors are ‘somewhat higher’ than EMCa’s assessment.³²

EMCa comments that there is a difference between the balance of probability on which it has formed judgements for the purposes of the cost benefit analysis and the level of certainty that is reasonably sought by a commercial entity seeking regulatory cost recovery for a large investment. At this stage there are uncertainties, particularly in regard to communications technologies suitable for rural areas and these will be best resolved through implementation of some kind (whether by further trialling or through a prototype scale rollout). EMCa also notes the difference in scope of the estimates.³³ For example there is a difference between the cost of an IT business plan, which involves consideration of a range of benefits and other factors, and the incremental cost that is attributable to smart metering alone. EMCa has based its cost estimates for this analysis on the reasonable investment required to accommodate smart metering, using existing systems where this is considered to be generally feasible. As is appropriate for the national cost benefit analysis, this does not take account of any of the other factors which might drive different decisions for a particular business. EMCa is comfortable with the assumptions that it has taken for the purposes of this cost benefit analysis.³⁴

Given the above uncertainties, the results in this report are indicative of the likely benefits and costs of a smart metering rollout for each jurisdiction, and highlight where further, and more detailed business case assessments of the costs and benefits could be undertaken. These detailed business cases would naturally be part of any implementation process, in estimating costs and benefits specific to particular businesses, and would be supported by further trials as proposed by MCE in its December 2007 decision. This will allow the risks associated with the costs and benefits being different from those assumed as part of this study to be appropriately managed. Results from these assessments may influence the nature of a rollout in individual jurisdictions.

Consumers on average will be better off, but smart metering capabilities raise new consumer protection concerns

The implications for households of smart metering or direct load control programs will vary according to the specific household’s characteristics. The implications of smart metering for vulnerable consumers may therefore be of particular concern. The introduction of smart metering will potentially affect consumers by:

³¹ EMCa Workstream 6 Transitional Costs Consultation Report (February 2008), section 14.6

³² EMCa Workstream 6 Transitional Costs Consultation Report (February 2008), section 14.6.1

³³ EMCa Workstream 6 Transitional Costs Consultation Report (February 2008), section 14.6.5

³⁴ EMCa Workstream 6 Transitional Costs Consultation Report (February 2008), section 14.6.2

- § providing an opportunity to benefit from lower bills because of opportunities provided by new tariff product offerings;
- § initial increases in tariffs as the costs of the initial smart metering rollout are passed through to consumers; and
- § improvements in the service provided to customers.

Over time business cost savings resulting from the introduction of smart metering would be expected to be passed through to customers in the form of lower tariffs, either through the regulatory price setting framework (for distribution businesses and for retail businesses in those jurisdictions where there is no retail competition) or through competition. The allocation of benefits from smart metering presented in this report to distributors and retailers does not reflect the fact that many of the cost savings associated with smart metering will be ultimately passed through to customers in the form of lower prices than would have otherwise been the case in the absence of the smart metering rollout.

In general, our analysis indicates that households with a relatively low proportion of total consumption during peak periods (ie households where occupants work during the day) are likely to be better off after the introduction of TOU tariffs without necessarily needing to change current electricity usage behaviour. This highlights the fact that under flat tariff arrangements these households are currently cross-subsidising households who use a greater proportion of electricity during peak periods.

The NERA consumer impact analysis identifies a number of consumer issues that should be further considered as part of the policy framework for a national rollout of smart metering. These are:³⁵

- § the underlying regulatory framework for the introduction of smart metering should consider whether hardship policies and other consumer protections and assistance programs should be modified to ensure that existing protections are not eroded;³⁶
- § designing education programs about the introduction of smart metering and associated innovative tariff products to ensure that demand responses are maximised;
- § new mechanisms for ensuring that households facing financial stress are identified and provided with information on assistance available prior to utilising remote disconnection functionalities;
- § providing an opportunity for households to readily shift between tariff products if they discover that they are actually financially worse off from the new tariff product offering;
- § the need to consider the relationship between network businesses (offering TOU network tariffs and/or CPP) and the customer, given that most customers only receive a bill from a retailer and the retailer will not have an obligation to pass these new tariff structures onto

³⁵ NERA, Consumer Impact Consultation Report (February 2008), Page 113.

³⁶ We note that the relatively low benefits associated with demand response (compared to business efficiencies) from a smart meter rollout means that providing for vulnerable customers to be excluded from TOU and CPP tariffs (where they wish to be) would not materially impact the overall cost benefit results.

customers. Alternatively an incentive mechanism could be designed to ensure that TOU tariffs and/or CPP are transparently conveyed by retailers to customers; and

- § ensuring that there is sufficient notice of critical peak events to provide the opportunity for a household to respond appropriately to pricing signals.

A distributor-led smart metering rollout best satisfies the MCE's assessment objectives

Table E.3 presents NERA's assessment of the relative ranking of each of the rollout scenarios in relation to the objectives set out by the MCE. This assessment has been carried out on a national basis. The rankings for some objectives may differ for particular jurisdictions and we note these in the discussion in the report.

For each objective we have ranked how well each of the scenarios meets that objective compared to the alternative scenarios. A '1' indicates that that scenario meets the objective better than all other scenarios. A '2' indicates that the scenario is ranked second, and so on. Where a scenario does not have an impact on meeting a particular objective this is indicated in the table by a dash ('-').

For many of the objectives each of the smart meter rollout scenarios (ie, Scenarios 1, 2 and 4) are ranked equally. This is consistent with the findings of the analysis that the benefits are not expected to be materially different between the scenarios.

The table also indicates how well overall each of the objectives is achieved by each of the rollout scenarios. The dark shaded cells in the table indicate where the particular rollout scenario is expected to have a significant impact in relation to the corresponding objective. The lighter shaded cells indicate where the particular rollout scenario is expected to have only a moderate impact in relation to the corresponding objective. Finally, where cells are not shaded a scenario has either no impact or a negligible impact on meeting a particular objective.

Table E.4
Assessment of Rollout Scenarios Against MCE Required Objectives:
Relative Ranking of Scenarios

MCE Objectives	Scenario 1 Distributor-led smart meter rollout	Scenario 2 Retailer-led smart meter rollout	Scenario 3 Non smart meter DLC rollout	Scenario 4 Retailer-led smart meter rollout with centralised communications
Reducing peak demand ¹	2	2	1	2
Efficiency and innovation in electricity business operations	1	2	-	2
Promoting the long-term interests of electricity consumers	1	2	3	2
Promoting retail competition	1	1	-	1
Enabling consumers to better manage energy use and greenhouse gas emissions	1	1	-	1
Managing distributional price impacts for vulnerable customers	2	2	1	2
Promoting energy efficiency and greenhouse benefits	1	1	2	1
Providing a platform for other demand side response measures and avoiding discrimination against technologies	1	1	2	1

¹ Note that the smart meter scenarios would be ranked ahead of the non-smart meter DLC rollout if an interface with a HAN is included in the smart meter specification.