Review of policy adjustments

A REPORT PREPARED FOR CITIPOWER

July 2010

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Introduction

In preparation for the forthcoming regulatory control period, CitiPower engaged the National Institute of Economic and Industry Research (NIEIR) to forecast energy consumption and customer numbers from 2010 to 2019. NIEIR included a series of adjustments to its forecasts to allow for the impact on energy consumption of various Government climate change and energy efficiency policies.

CitiPower engaged Frontier Economics (Frontier) to express an opinion of the policy adjustments made to the forecasts of energy consumption for the period 2010 to 2015. Frontier Economics was asked to consider the following:

- The impacts of policies implemented by Government to address climate change and energy efficiency that will have a material impact on energy consumption. In particular:
  - whether it is reasonable to consider the policy for the purposes of making post-model adjustments to the forecasts of energy consumption;
  - an indication of the range of estimates that Frontier considers would be reasonable.
- The impacts of any other matters that can be considered a policy response to climate change and energy efficiency;
- Any other matters considered necessary or desirable to address.

We have reviewed the NIEIR energy forecasts and policy adjustments set out in the report titled *Electricity sales and customer number projections for the CitiPower region to 2019* (NIEIR, 2009). Although the NIEIR report does not account for the most recent policy developments, we have used this as a starting point to derive NIEIR's implied energy forecasts prior to the effects of any policy adjustments.

The list of policies assessed, and the application to customer type, are summarised in Table 1. Frontier has reviewed all of NIEIR's policy adjustment estimates except for the impact of 6 Star Building requirements and the impact of electric cars. It is Frontier's view that both of these policies are (i) highly uncertain and (ii) are likely to have an immaterial impact on total customer demand. We note that these policies contribute only marginally to NIEIR's analysis.

Frontier has only estimated the impact of Standby Power on Residential customers due to a lack of transparent data regarding appliance usage in the Commercial sector. Residential Standby Power savings represents 80-90% of NIEIR's total estimated Standby Power savings. In each of these cases, although it is reasonable to include an adjustment for energy consumed, the effects are not material enough to warrant a review of the NIEIR estimates.

Table 1: Comparison of policy impact assessments (by customer type)

Policy	NIEIR	Frontier
CPRS	Residential and commercial (included in the base modelling)	Residential and commercial (considered separately)
6 Star building standards	Residential only	Not estimated
Advanced Meters (AMI)	Residential + Commercial	Residential + Commercial
Electric cars	Residential only	Not estimated
Hot water	Residential + Commercial	Residential only
Insulation	Residential only	Residential only
MEPS – Air conditioning	Residential + Commercial	Residential + Commercial*
MEPs – Lighting	Residential + Commercial	Residential + Commercial
Photovoltaics	Residential only	Residential only
Standby power	Residential + Commercial	Residential only
VEET	Residential only	Residential only

* *Frontier estimated the combined Residential and Commercial effect only (not be customer type)*

Summary of results

In our opinion:

- it is reasonable to consider each of the policies listed in Table 1 to make adjustments to the forecasts of energy consumption. We provide a summary of estimated adjustments that we consider reasonable in the following tables.
- we do not consider the impacts of other policy adjustments to be material enough to warrant adjustments to the forecasts.
- other matters that should be addressed are changes to policies which were announced after the NIEIR report was published. These include:
  - a delay in the introduction of the CPRS;
  - an indefinite moratorium on the introduction of Time of Use (TOU) tariffs. These are associated with Advanced Metering Infrastructure and reflect more cost reflective pricing of energy (higher tariffs during peak hours and lower tariffs during off-peak hours);
  - the early cancellation of the Federal Home Insulation Program (HIP).

A comparison of NIEIR and Frontier estimates is provided in Table 2 to Table 4. In most cases we consider that NIEIR's approach and estimates are reasonable. The main areas of difference are:

- **the impact of Advanced Metering Infrastructure (AMI)** – Irrespective of the moratorium on TOU tariffs, Frontier adopt more conservative estimates of potential energy savings from AMI than NIEIR. NIEIR assume that AMI will lead to energy savings of 7-8% (residential). Frontier has adopted a more conservative estimate of 2.5% (residential) and 0.5% (commercial) based on different sources that we consider more appropriate. We considered the impact of the recently announced moratorium on TOU tariffs associated with AMI, but do not consider that this would materially affect the results. Firstly, we believe that even if the moratorium is maintained for compulsory TOU tariffs, optional TOU tariffs are likely to be allowed as these are required to capture many of the purported benefits of AMI. As discussed in this report, optional TOU tariffs should deliver the bulk of potential energy savings. Secondly, some studies indicate that in-home displays (IHD) which provide consumers with real-time information on energy use can deliver energy savings even in the absence of TOU tariffs. While IHD are not mandatory as part of the AMI roll-out, the meters will have the functionality to support IHD and consumers most responsive to the information will be most likely install an IHD.
- **the impact of lighting Minimum Energy Performance Standard (MEPS)** – Frontier project larger potential savings in the residential sector, though this is partly offset by lower projected savings in the commercial sector. Frontier has based its estimates on detailed data on residential energy by end-use (DEWHA, 2008). The net effect is that, while NIEIR project that lighting MEPS savings will be realised more quickly, Frontier project marginally greater savings by 2015.
- **the timing of savings from Victorian Energy Efficiency Target (VEET)** – Frontier projects larger overall savings which will be achieved more rapidly. The source of the discrepancy is due to differences in the treatment of double-counting / overlap with other policies, in particular lighting energy savings under lighting MEPS. NIEIR have assumed that 10% of the VEET savings are additional to other policy measures (though this is partly consistent with NIEIR's projected savings in residential lighting, which rise more quickly than in Frontier's estimates). Frontier has reviewed the source of VEET activities to date and compared the projected VEET savings against the savings from lighting under the MEPS. The results suggest that VEET will drive similar overall levels of lighting energy savings by 2015, but will deliver a larger portion of lighting savings more quickly than under the lighting MEPS alone. The division of savings between lighting MEPS and VEET is internally consistent with the assumptions adopted – under an

alternate estimate used, the savings from VEET would be lower initially but the savings from lighting would be higher.

- **the impact of insulation** – NIEIR's estimates were published prior to the cancellation of the Federal HIP. Frontier's projections account for the cancellation of the scheme, which explains our lower estimates. Despite this, it is still reasonable to account for savings associated with the policy, since around 30% of uninsulated homes have already received insulation prior to the cancellation of the scheme.

The cumulative effect of these differences is dominated by our lower estimate of the reduction in energy consumption to account for AMI. Frontier's total estimated reduction in energy as a result of these policies is lower than NIEIR's. Comparisons between Frontier's and NIEIR's estimates are provided in Figure 1 and Figure 2.

Since these estimated adjustments take account of double counting (policy overlap), they are generally interdependent rather than standalone. For example, we estimate that lighting MEPS savings will be realised more slowly than NIEIR, but a consequence of this is that our estimated energy savings under VEET are higher than NIEIR (since the policy overlap is less). Both our estimates and NIEIR's are internally consistent, but it would not be consistent to adopt adjustments from one but not the other.

We have not included estimates of the CPRS effects in these summary tables and figures because NIEIR incorporates the CPRS within their energy forecast modelling (as opposed to an explicit post-model adjustment). In our opinion the approach and assumptions described by NIEIR are reasonable, and we use these to derive an estimate of the CPRS effect based on NIEIR's approach in Section 3. We also use this to estimate the effect of a delay in the CPRS, though for consistency we recommend that this adjustment is made through the NIEIR energy modelling.

Table 2: Energy reduction from policies: Residential and Commercial, CitiPower (GWh)

Policy		2010	2011	2012	2013	2014	2015
6 Star buildings	NIEIR	0.0	0.0	0.2	0.5	0.8	1.1
	Frontier	-	-	-	-	-	-
AMI	NIEIR	0.0	18.5	65.3	117.0	144.1	147.8
	Frontier	0.0	7.1	25.0	44.5	54.3	54.9
Electric cars	NIEIR	-1.2	-2.0	-2.8	-3.5	-4.3	-5.1
	Frontier	-	-	-	-	-	-
Hot water	NIEIR	2.6	5.3	8.0	10.6	13.1	15.5
	Frontier	2.6	5.2	9.3	13.5	17.7	21.6
Insulation	NIEIR	7.7	12.9	15.4	15.4	15.4	15.4
	Frontier	3.2	3.2	3.2	3.2	3.2	3.2
MEPS – Air-con	NIEIR	0.5	1.3	2.4	3.5	4.5	5.4
	Frontier	1.0	1.5	2.1	2.6	3.2	3.8
MEPs – Lighting	NIEIR	48.5	72.7	96.9	111.5	116.3	121.1
	Frontier	28.8	49.9	69.3	87.8	104.5	121.9
Photovoltaics	NIEIR	2.0	2.5	3.0	3.4	3.7	4.0
	Frontier	1.9	2.3	2.7	3.0	3.4	3.6
Standby power	NIEIR	0.0	3.5	10.5	17.6	22.5	25.2
	Frontier	0.0	3.9	8.4	12.9	17.5	22.0
VEET	NIEIR	3.6	5.7	7.8	9.9	12.5	14.0
	Frontier	45.1	46.1	38.8	24.2	1.1	0.0

Table 3: Energy reduction from policies: Commercial, CitiPower (GWh)

Policy		2010	2011	2012	2013	2014	2015
AMI	NIEIR	0.0	7.0	24.9	44.6	54.9	56.3
	Frontier	0.0	2.9	10.1	17.9	21.5	21.8
Electric cars	NIEIR	-1.2	-2.0	-2.8	-3.5	-4.3	-5.1
	Frontier	-	-	-	-	-	-
Hot water	NIEIR	2.6	4.3	6.0	7.7	9.4	11.1
	Frontier*	2.6	4.3	6.0	7.7	9.4	11.1
MEPS – Air-con	NIEIR	0.2	0.7	1.2	1.7	2.2	2.6
	Frontier**	-	-	-	-	-	-
MEPs – Lighting	NIEIR	22.9	34.3	45.8	52.6	54.9	57.2
	Frontier	25.6	34.8	41.5	47.5	50.5	51.8
Standby power	NIEIR	0.0	0.6	1.9	3.2	4.5	5.8
	Frontier*	0.0	0.6	1.9	3.2	4.5	5.8

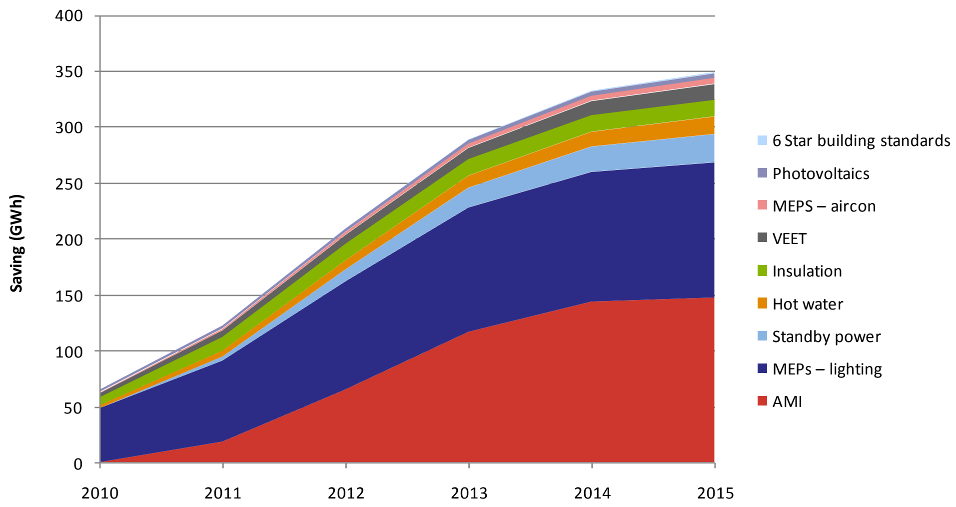
** Adopted NIEIR assumptions for commercial ** Estimated combined Residential and Commercial only*

Table 4: Energy reduction from policies: Residential, CitiPower (GWh)

Year		2010	2011	2012	2013	2014	2015
6 Star buildings	NIEIR	0.0	0.0	0.2	0.5	0.8	1.1
	Frontier	-	-	-	-	-	-
AMI	NIEIR	0.0	11.4	40.4	72.4	89.2	91.5
	Frontier	0.0	4.2	14.9	26.6	32.8	33.2
Hot water	NIEIR	0.0	1.0	2.1	2.9	3.7	4.4
	Frontier	0.0	1.0	3.3	5.8	8.3	10.5
Insulation	NIEIR	7.7	12.9	15.4	15.4	15.4	15.4
	Frontier	3.2	3.2	3.2	3.2	3.2	3.2
MEPS – Air-con	NIEIR	0.2	0.7	1.2	1.8	2.3	2.8
	Frontier**	-	-	-	-	-	-
MEPs – Lighting	NIEIR	25.6	38.4	51.2	58.8	61.4	64.0
	Frontier	3.2	15.1	27.8	40.3	54.0	70.1
Photovoltaics	NIEIR	2.0	2.5	3.0	3.4	3.7	4.0
	Frontier	1.9	2.3	2.7	3.0	3.4	3.6
Standby power	NIEIR	0.0	2.9	8.6	14.4	18.0	19.4
	Frontier	0.0	3.2	6.5	9.7	13.0	16.2
VEET	NIEIR	3.6	5.7	7.8	9.9	12.5	14.0
	Frontier	45.1	46.1	38.8	24.2	1.1	0.0

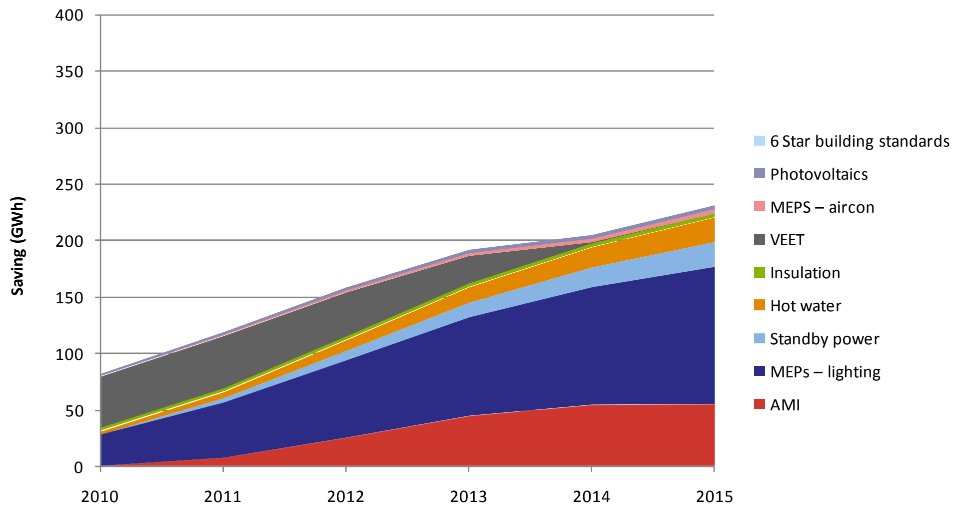
*** Estimated combined Residential and Commercial only*

Figure 1: Policy impacts and energy savings: NIEIR adjustments



Source: NIEIR (2009)

Figure 2: Policy impacts and energy savings: Frontier adjustments



Source: Frontier

Glossary

Term	Definition
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
AMI	Advanced Metering Infrastructure: electricity meters which allow for increased functionality, such as measuring electricity by time of use
BAU	Business as Usual (projection in the absence of a policy change)
CPP	Critical Peak Pricing (higher electricity tariffs during peak periods)
CPRS	Carbon Pollution Reduction Scheme
CPRS 5	Refers to 5% reduction in 2000 level emissions by 2020.
CPRS 15	Refers to 15% reduction in 2000 level emissions by 2020.
DECC	Department of Energy and Climate Change (UK)
DEWHA	Department of Environment, Water, Heritage and the Arts
EEHP	Energy Efficient Homes Package
EES	Energy Efficient Strategies
EITEI	Emissions Intensive Trade Exposed Industries: as defined by the CPRS
HAN	Home area network (used with AMI)
IHD	In-home display (used with AMI). A device which allows real-time monitoring of energy use and/or energy costs
HIP	Home Insulation Program
MCE	Ministerial Council on Energy
MEPS	Minimum Energy Performance Standard
NIEIR	National Institute of Economic and Industry Research
PV	Solar Photovoltaic (panels)
REC	Renewable Energy Certificate: tradeable certificates under the RET
RET	Renewable Energy Target
RIS	Regulatory Impact Statement

Term	Definition
SHCP	Solar Homes and Communities Plan
TOU	Time of use: electricity tariffs which vary by time of electricity use, such as peak and off-peak.
VEEC	Victorian Energy Efficiency Certificate: tradeable certificates under the VEET
VEET	Victorian Energy Efficiency Target

1 Introduction

1.1 Background

CitiPower's current regulatory control period is due to expire on 31 December 2010 and the next regulatory control period will commence on 1 January 2011. In preparation for the forthcoming regulatory control period, CitiPower engaged NIEIR to forecast electricity consumption for the period 2010 to 2019. NIEIR's electricity consumption forecasts are set out in the following report:

- NIEIR (November 2009), *Electricity sales and customer number projections for the CitiPower region to 2019*.

Frontier Economics (Frontier) was engaged by CitiPower to prepare a report assessing the impact of policy adjustments on the consumption forecasts. A copy of the Letter of Engagement is attached at Annexure 2. This report presents Frontier's assessment.

Authorship

I, Matt Harris, am the author of this report. I joined Frontier Economics in 2004, am a member of Frontier's Energy Practice, and lead Frontier's Climate Change work in Australia. I have advised clients on topics that include emissions trading scheme (ETS) design and impacts, carbon cost pass-through, carbon permit allocations issues, the market effects of renewable energy policies and the economy-wide impacts of ETS policies.

I recently provided policy advice and modelling for the Federal Coalition and Senator Xenophon on alternatives to the proposed CPRS. I also appeared before Senate Inquiries into the CPRS (Economics; Senate Select Committee on Climate Policy) (2009).

I have been assisted in preparing this report by Liam Blanckenberg. Liam is also a member of Frontier's Energy and Climate Change practices. Liam joined Frontier Economics in 2008.

Both my and Liam's curriculum vitae are attached at Annexure 3.

1.2 Scope of the review

CitiPower engaged Frontier Economics (Frontier) to express an opinion of the policy adjustments made to the forecasts of energy consumption for the period 2010 to 2015. Frontier Economics was asked to consider the following:

- The impacts of policies implemented by Government to address climate change and energy efficiency that will have a material impact on energy consumption. In particular:

  - whether it is reasonable to consider the policy for the purposes of making post-model adjustments to the forecasts of energy consumption;
  - an indication of the range of estimates that Frontier considers would be reasonable.
- The impacts of any other matters that can be considered a policy response to climate change and energy efficiency;
- Any other matters considered necessary or desirable to address.

We have reviewed the NIEIR energy forecasts and policy adjustments set out in the report titled *Electricity sales and customer number projections for the CitiPower region to 2019* (NIEIR, 2009). Although this report will be modified to take account of the most recent policy developments, we have used this as a starting point to derive NIEIR's implied energy forecasts prior to the effects of policy adjustments.

1.3 Structure of the report

The remainder of this paper is structured as follows:

- Section 2 includes an overview of NIEIR's post-model adjustment estimates. NIEIR report final energy projections after accounting for the post-model adjustments in their report. We include a revised summary of the data to report the implied pre-adjustment projections.
- Section 3 provides detailed summaries of methodologies and assumptions used in considering post-model policy adjustments.
- Annexure 1 contains a list of resources used in this report.
- Annexure 2 includes the letter of instructions provided by CitiPower.
- Annexure 3 presents CVs.

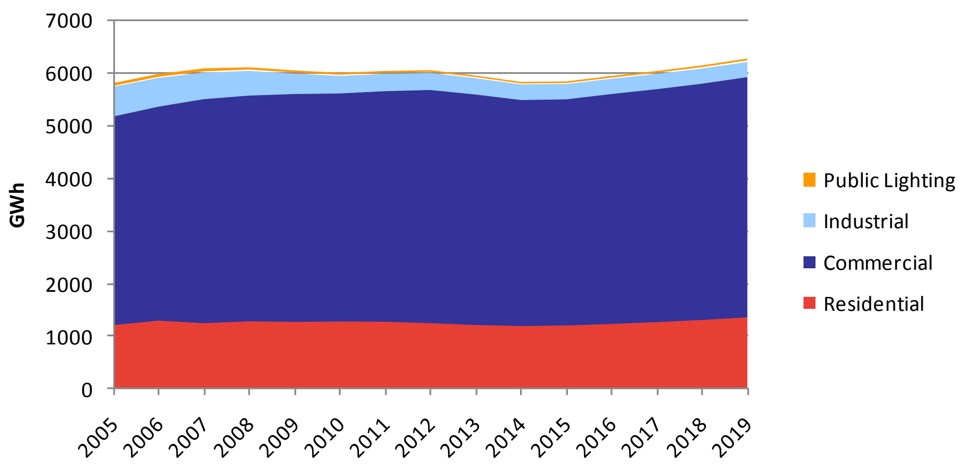
2 NIEIR's consumption forecast

In this section we review NIEIR's estimates to establish base case energy projections in the absence of policy adjustments. NIEIR report their energy projections after adjusting for specific policy adjustments; we add-back these adjustments to obtain NIEIR's projections prior to any policy adjustments. The purpose of this is to provide a starting point for considering policy adjustments, particularly to understand the relative mix of consumption by customer type (residential and commercial). We consider the policies and likely impacts in Section 3.

2.1 Energy forecasts by customer type

Figure 3 presents a chart of the CitiPower energy forecasts based on the data from Table 7.1 of the NIEIR report. We understand that this data already includes the policy adjustments that NIEIR summarise in Chapter 6 of their report.

Figure 3: NIEIR Energy forecasts after policy adjustments



Source: NIEIR (2009), Table7.1

2.2 Cumulative energy adjustments - Residential

We understand that NIEIR's residential adjustments (summarised in Table 6.2 of the NIEIR report) reflect the annual or incremental effect of each policy adjustment, and that the total change in energy consumed each year is based on the cumulative change (including all preceding years). We summarise this cumulative change in Residential energy in Table 5.

Table 5: Cumulative change in Residential energy due to policy adjustments, GWh

Year	2010	2011	2012	2013	2014	2015	% of 2015 total
CPRS	0.0	0.0	2.2	10.2	21.4	32.0	13%
MEPs – lighting	25.6	38.4	51.2	58.8	61.4	64.0	26%
Standby power	0.0	2.9	8.6	14.4	18.0	19.4	8%
Insulation	7.7	12.9	15.4	15.4	15.4	15.4	6%
Photovoltaics	2.0	2.5	3.0	3.4	3.7	4.0	2%
VEET	3.6	5.7	7.8	9.9	12.5	14.0	6%
Hot water	0.0	1.0	2.1	2.9	3.7	4.4	2%
MEPS – air conditioners	0.2	0.7	1.2	1.8	2.3	2.8	1%
6 Star building standards	0.0	0.0	0.2	0.5	0.8	1.1	0%
AMI	0.0	11.4	40.4	72.4	89.2	91.5	37%
Total	**39.2**	**75.5**	**132.0**	**189.7**	**228.3**	**248.5**	–

Source: Calculations based on NIEIR (2009), Table 6.2, Frontier estimates

The effect of the Carbon Pollution Reduction Scheme (CPRS) is not reported separately in the NIEIR report, however we derive estimates of this in Section 3.1 and include them here for completeness. Based on NIEIR's estimates, the most important policy measures are AMI (advanced meters), lighting MEPS, Standby Power, hot water and the CPRS.

2.3 Cumulative energy adjustments - Commercial

We understand that the Commercial adjustments summarised in Table 6.5 of the NIEIR report reflect the cumulative effect of each policy and that the total change in energy consumed each year is based on the cumulative change.

We summarise this cumulative change in commercial energy in Table 6. The most important policy measures for commercial energy are the CPRS, AMI (advanced meters), lighting MEPS and hot water. The CPRS has a much larger impact on the Commercial sector because elasticity of demand is higher than the Residential sector, and the relative increase in prices is higher (since the base is a lower electricity price).

Table 6: Cumulative change in Commercial energy due to policy adjustments, GWh

Year	2010	2011	2012	2013	2014	2015	%
CPRS	0.0	0.0	19.3	89.4	187.0	279.7	69%
MEPs – lighting	22.87	34.31	45.75	52.61	54.9	57.18	14%
Standby power	0	0.64	1.93	3.22	4.5	5.79	1%
Hot water (off-peak)	2.56	4.27	5.98	7.69	9.4	11.11	3%
MEPS – air conditioners	0.22	0.65	1.15	1.71	2.2	2.64	1%
AMI	0	7.04	24.88	44.59	54.92	56.32	14%
Electric cars (off-peak)	-1.18	-1.96	-2.75	-3.53	-4.32	-5.11	-1%
Total	**24.5**	**45.0**	**96.2**	**195.7**	**308.6**	**407.6**	–

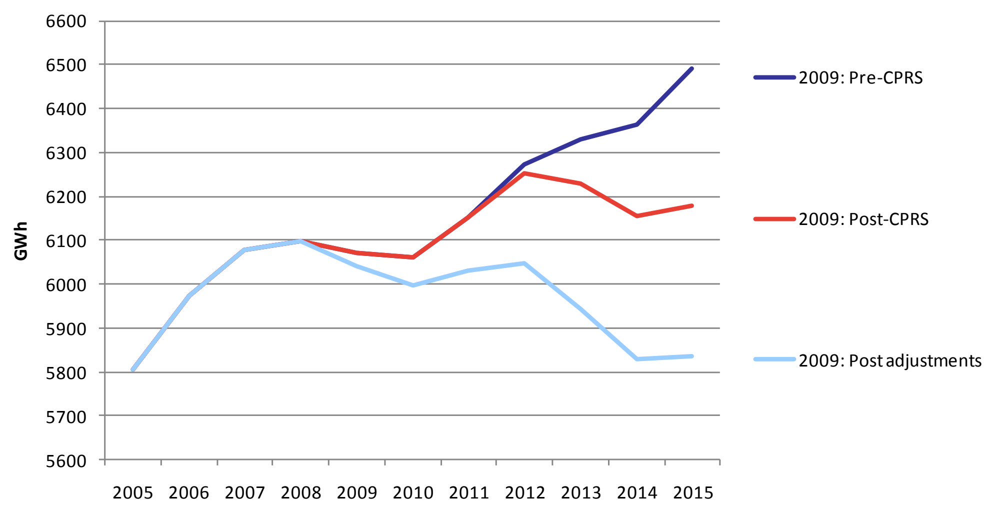
Source: Calculations based on NIEIR (2009), Table 6.5

2.4 Relative impact of the NIEIR policy adjustments

The data in Table 7.1 of the NIEIR report is the energy consumed *after* accounting for the post-model adjustments. By adding back the cumulative reductions in residential and commercial energy in Table 5 and Table 6 to the estimates in Table 7.1 of the NIEIR report, we can estimate the energy projections *prior* to the post-model adjustments.

We have charted the energy projection in Figure 7 to gauge how future energy projections compare with recent historic projections, before and after policy adjustments. NIEIR only reports their policy adjusted projections which are represented by the light blue line in Figure 7. We have added back the policy adjustments described by NIEIR (red line) and then added back the estimated effects of the CPRS (dark blue) to derive a "reference case" projection more comparable with historic projections. These estimates include Residential, Commercial, Industrial and Public Lighting. As expected, the pre-CPRS estimates (dark blue) reflect similar growth to recent history.

Figure 4: Total energy projections, CitiPower



Source: NIEIR (2009), Frontier calculations

2.5 Customer numbers and average energy use

NIEIR report projected customer numbers in Table 7.2 of their report. This data can be used to derive average energy use by customer type. This is useful for later comparisons against other public estimates of policy impacts, which are often presented on a state or national level.

Table 7: Average energy (2008), CitiPower

	Residential	Commercial	Industrial	Public lighting
Customers	249,942	45,472	2,623	3,643
Energy (GWh)	1,295	4,290	473	42
Average (kWh)	5,181	94,332	180,425	11,469

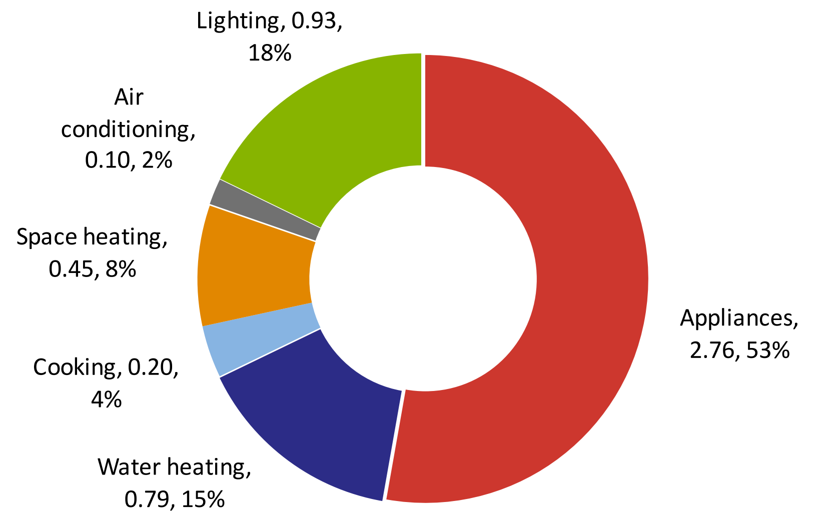
Source: Calculations based on NIEIR (2009) Table 7.1, 6.2, 6.5

2.6 Average energy by end-use

The Department of the Environment, Water, Heritage and the Arts (DEWHA) published a detailed report on residential energy use, titled *Energy use in the Australian residential sector 1986-2020* (DEWHA, 2008). The report uses bottom-up modelling to derive estimates of residential energy by end-use by state (Figure 5).

This provides a useful context for estimated policy savings in subsequent sections.

Figure 5: Residential energy by end-use, Victoria (MWh per household*)



Source: DEWHA (2008), Frontier calculations.

*Notes *Total use is reported as 5.3MWh per household.*

3 Policy adjustments

This Section includes:

- a summary of the policy changes identified by NIEIR which have been used to adjust their energy projections;
- commentary on the reasonableness of making post-model adjustments for each policy change;
- estimates of reasonable adjustments in each instance, including assumptions and methodology for developing these estimates. In most instances we consider the approach adopted by NIEIR and find that the NIEIR approach and estimates are reasonable, subject to changes to policies announced after the NIEIR report was produced.

The policy adjustments considered by NIEIR and Frontier are summarised in Table 8.

Table 8: Comparison of policy impact assessments (by customer type)

Policy	NIEIR	Frontier
CPRS	Residential and commercial (included in the base modelling)	Residential and commercial (considered separately)
6 Star building standards	Residential only	Not estimated
Advanced Meters (AMI)	Residential + Commercial	Residential + Commercial
Electric cars	Residential only	Not estimated
Hot water	Residential + Commercial	Residential only
Insulation	Residential only	Residential only
MEPS – Air conditioning	Residential + Commercial	Residential + Commercial (not divided)
MEPs – Lighting	Residential + Commercial	Residential + Commercial
Photovoltaics	Residential only	Residential only
Standby power	Residential + Commercial	Residential only
VEET	Residential only	Residential only

Frontier has not reviewed the following policy adjustments made by NIEIR:

- 6 Star Building standards
- Electric cars.

Frontier is of the view that these policies are highly uncertain and are likely to contribute only marginally to overall energy consumption. As such, these policies are not material enough to warrant review of NIEIR's methodology.

3.1 Carbon Pollution Reduction Scheme (CPRS)

3.1.1 Overview

The CPRS is the Australian Government's proposed emissions trading scheme, which was originally planned to commence operation from 2010. The Government's modelling estimates conclude that this will raise electricity prices and result in slower growth in energy consumption over time.

In May 2009, the CPRS was delayed until mid-2011 and the carbon price was to be capped at a fixed price of $10 until 2012.[1] The CPRS legislation failed to pass the Senate in August 2009, and again in December 2009.

On 27 April 2010, the Government announced that it would delay the implementation of the CPRS until after the end of the current commitment period of the Kyoto Protocol and until there is greater clarity on the action of other major economies including the US, China and India. In practice, this is assumed to imply a one year delay in introduction; the original carbon price forecasts after that date will be largely determined by international trade, and as such the original projections are reasonable. This latest announcement occurred after the NIEIR report was released. In summary:

- the CPRS will result in a material increase in electricity prices – even allowing for a one year delay in introduction this warrants an adjustment to energy forecasts;
- the NIEIR approach and estimates were reasonable based on information available at the time;
- the recently announced delay will postpone any demand response forecast in 2011/12, though the adjustments after that date remain reasonable given available information.

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1 http://www.climatechange.gov.au/minister/wong/2009/media-releases/May/mr20090504.aspx

3.1.2 NIEIR's approach

NIEIR discuss their methodology for accounting for the CPRS in section 5.2 of their report. NIEIR assume a carbon price based on the Commonwealth Treasury modelling presented in *Australia's Low Pollution Future* (ALPF 2008). They then assume a rate of cost pass-through to estimate the effect of carbon costs on electricity prices. The term 'pass-through' reflects the proportion of carbon costs that are passed on to energy consumers in the form of higher electricity prices. NIEIR then account for the responsiveness of demand to price increases (own-price demand elasticity). Each of these assumptions is considered below.

Carbon price

NIEIR report that their assumed carbon prices are taken from the Treasury CPRS5 scenario until 2015 after which prices transition to the CPRS15 scenario out to 2025.[2] The unlabelled table on page 38 of NIEIR's report suggests that the carbon prices applied accurately reflects this. The recently announced delay in the CPRS introduction will mean that it is unlikely that there will be a carbon price in 2012. Carbon prices after that date will be determined by international trade, and the Treasury forecasts adopted by NIEIR for future periods are still reasonable despite the delay.

Pass-through – effect on electricity prices[3]

NIEIR's methodology for estimating the effect on electricity prices is less clear. The report states that electricity prices are based on those in the CPRS White Paper (ALPF, 2008). The data in the unlabelled table in section 5.2 includes assumed pass-through and electricity prices, which suggests that NIEIR adopted their own assumptions based on ALPF (2008) results. NIEIR's reported assumptions regarding carbon prices and pass-through are outlined in Table 9. This suggests that the rate of pass-through during the period 2013-2015 is close to 80% in each year.

2 Treasury modelled several scenarios based on different emissions reduction targets. CPRS5 refers to a 5% reduction in 2000 level emissions by 2020, while CPRS15 refers to a 15% reduction in 2000 level emissions by 2020. The target adopted is contingent on other country commitments to reduce emissions, though the Government has currently only committed to CPRS5. The difference between the two scenarios is that CPRS15 includes a higher carbon price than CPRS5. In all instances in the modelling, Australia is assumed to be a price-taker in the global carbon markets; CPRS15 assumes larger global emissions reduction targets, which drives a higher global carbon price.

3 Pass-through reflects the proportion of carbon costs that are passed-through to consumers via higher electricity prices.

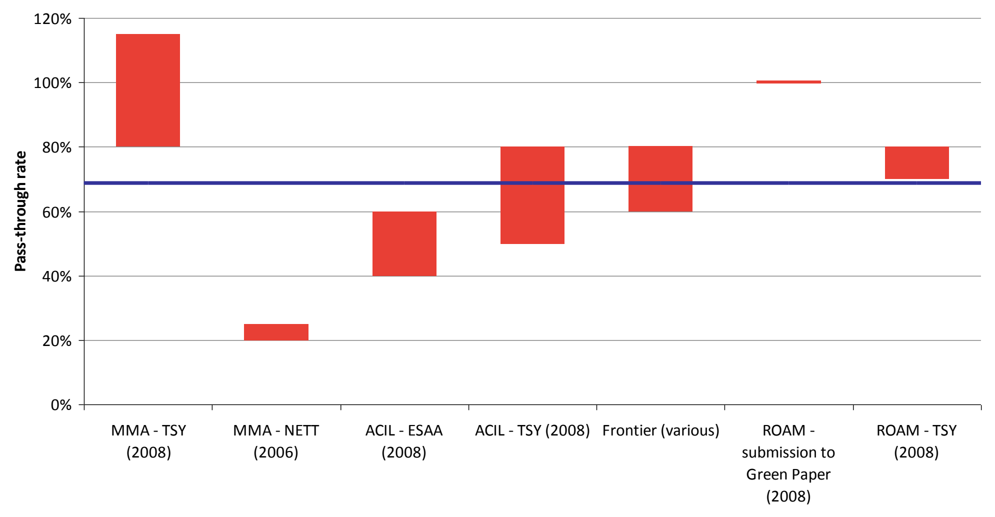
Table 9: Permit price, electricity price and cost pass-through

Financial Year end	2012	2013	2020	2030
$/tCO2	10	25	45	55
Pass-through	70%	80%	90%	100%
$/MWh increase	7.5	17.5	40	50

Source: NIEIR (2009).

Frontier discusses the factors affecting carbon prices and cost pass-through in detail in a report for the AEMC (Frontier, 2009). The report includes a summary of various public estimates of cost pass-through (page 11) – this analysis is reproduced below in Figure 6. There is considerable variance in these estimates, which reflects the degree of uncertainty regarding how the market will behave. The report also considers observations from the EU ETS, which generally reflects pass-through rates of 60-100%.

Figure 6: Public estimates of carbon cost pass-through in electricity prices



Source: Frontier (2009).

The pass-through rates and estimated electricity price increases adopted by NIEIR are broadly consistent with these estimates, and reasonable given the large degree of uncertainty. If anything, we expect that the rate of pass-through in Victoria should be at the higher range of these estimates due to the higher emissions intensity of Victorian generators (though this may be constrained by potential for energy imports from other regions). We also expect that pass-through would tend to be higher in the initial years of the CPRS as the ability to switch to cleaner forms of generation is limited by existing investments. As the carbon price increases over time, less carbon intensive plant becomes viable and so the correlation between carbon price and electricity price is more likely to fall. In both of these respects NIEIR have adopted reasonable and conservative assumptions regarding the rate of pass-through in the early years of the scheme.

Elasticity – effect on demand

NIEIR do not separately report the effect of higher electricity prices (due to the CPRS) on demand. However, this can be estimated based on NIEIR's carbon price assumptions, reported electricity prices and elasticity assumptions[4].

Firstly, we obtained NIEIR's estimates of elasticity for each category. NIEIR adopt a conservative 'smoothing' assumption, whereby savings in energy are achieved over a period of 5 years in response to a given price increase. NIEIR's elasticity and smoothing assumptions are presented in Table 10.

Table 10: NIEIR elasticity assumptions (smoothed over time)

Elasticity	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Split	15%	35%	25%	17%	8%	100%
Residential	-0.0375	-0.0875	-0.0625	-0.0425	-0.02	-0.25
Commercial	-0.0525	-0.1225	-0.0875	-0.0595	-0.028	-0.35
Industrial	-0.057	-0.133	-0.095	-0.0646	-0.0304	-0.38

Source: CitiPower, Frontier calculations

Secondly, we estimate the incremental increase in electricity prices due to the CPRS in each year. NIEIR report the post-CPRS retail electricity prices in Table 5.5 of their report. Since demand elasticity depends on the relative *change* in prices, we need to estimate pre-CPRS prices[5]. We do this by subtracting the implied increase in electricity prices (the bottom row of Table 9 above) from NIEIR's reported retail electricity prices (Table 5.5 of NIEIR's report). The annual increase in prices due to the CPRS is largest in 2012 (when the CPRS was originally to be introduced at a capped carbon price) and in 2013 (when the fixed price on carbon is removed). Due to the assumed 'smoothing' effect, however,

4 NIEIR's elasticity assumptions are not reported in their report. These assumptions were obtained from CitiPower.

5 We could simply look at the increase in NIEIR's reported Post-CPRS prices each year, though this would assume that all changes in electricity prices are only due to the CPRS; if electricity prices are rising over time due to causes other than the CPRS, this would incorrectly reflect these other factors. For example, the Pre-CPRS retail prices in Table 11 are rising over time (for reasons other than the CPRS).

the impact on energy is more gradual – the effect of the price increase from 2012 is not fully reflected in energy until 2016, and the effect of the 2013 price increase is not fully reflected until 2017.

As a result of these assumptions, the CPRS accounts for a reduction of 2.2% in residential energy and 5.6% in commercial and industrial energy by 2015. This reflects an elasticity of -0.18 for residential customers and -0.22 for commercial customers by 2015 because, while the price effects are immediate, NIEIR assume that the demand response takes place over the following 5 years (hence the remainder of the demand response takes place after 2015).

Table 11: CPRS effect on prices and energy, CitiPower

Financial Year end	2012	2013	2014	2015
$/tCO2	10	25	26	27
Pass-through	70%	80%	81%	83%
Estimated carbon uplift ($/MWh)	7.5	17.5	20.7	23.9
Annual change $/MWh	*7.5*	*10.0*	*3.2*	*3.2*
Retail prices: Pre-CPRS (estimated[2])				
Residential c/KWh	18.0	18.5	18.9	19.6
Commercial c/KWh	10.0	9.8	9.6	9.5
Retail prices: Post-CPRS (reported[1])				
Residential c/KWh	18.7	20.2	21	22
Commercial c/KWh	10.7	11.5	11.7	11.9
Annual change price due to CPRS (%)				
Residential	4%	5.2%	1.6%	1.5%
Commercial	8%	9.5%	2.8%	2.8%
Total change in retail price due to CPRS (%)				
Residential	4%	9%	11%	12%
Commercial	8%	18%	22%	25%
Change in energy (%)				
Residential	-0.2%	-0.7%	-1.5%	-2.2%
Commercial	-0.4%	-1.8%	-3.8%	-5.6%

Source: NIEIR (2009), Frontier calculations. 1 Reported in NIEIR Table 5.5. 2. Pre-CPRS retail prices are calculated as the Post-CPRS prices (reported by NIEIR) minus the carbon uplift in each year.

Based on the above assumptions, we have quantified the impact of the CPRS on residential, commercial, industrial and public lighting energy in Table 12.

Table 12: Estimated reduction in energy due to CPRS, CitiPower (GWh)

Year	Residential	Commercial	Industrial	Public Lighting	Total
2012	2	18	1	0	22
2013	10	83	6	0	100
2014	21	174	13	0	209
2015	32	261	19	1	312

Source: NIEIR (2009), Frontier estimates

Effect of CPRS delay

The recently announced delay in the CPRS means that the carbon price in 2012 is more likely to be $0/tCO2. We assume that the price after 2012 will revert to the same level as previously assumed, since this will be dictated by international trade. This means that although there is no increase in electricity price due to carbon in 2012, this is offset by a higher increase in carbon (and electricity) prices from 2012 to 2013. Given the 'smoothing' of a demand response adopted by NIEIR (which we support), the lower electricity prices in 2012 results in a reduced demand response in each subsequent year, though the difference becomes less over time as demand responds to the higher increase from 2012-2013. The net effects are represented in Table 13.

Table 13: Estimated reduction in energy due to delayed CPRS, CitiPower (GWh)

Year	Residential	Commercial	Industrial	Public Lighting	Total
2012	0	0	0	0	0
2013	5	43	3	0	51
2014	18	150	11	0	179
2015	30	250	18	1	299

Source: NIEIR (2009), Frontier estimates

3.1.3 Other studies

In this sub-section we consider other public estimates of the effect of carbon prices on electricity prices, and the resulting effects on energy consumption.

MMA (for Treasury, Australia's Low Pollution Future, 2008)

MMA conducted electricity sector modelling of the CPRS for the Commonwealth Treasury in 2008 (MMA, 2008). This was an input into the Commonwealth Treasury report *(*ALPF 2008*)*.

MMA do not report an elasticity of demand and in many instances report results aggregated over time or across multiple regions. Nevertheless, approximate cost pass-through and elasticity of demand can be inferred from the results that are reported. Australia's energy output is reported in Table 3.2 of the MMA report[6] and electricity prices are reported in Tables 4.1 (Wholesale prices, by State), Table 4.2 (Retail prices, by State) and Table 2 (Wholesale and Retail, Australian average). The carbon prices for each scenario are presented in Figure 2.9 of MMA's report– the underlying data for this chart is available from Treasury.

From 2010 and 2020 the rate of carbon cost pass-through in Victoria can be estimated at 82-98% in the CPRS5 scenario. This results in electricity price increases in Victoria of 75% (wholesale) and 33% (retail) by 2020. Prices to 2015 are not reported. Average electricity prices across Australia increase by 56% (wholesale) and 27% (retail) by 2020. The Victorian increases are higher than the Australia average, which is expected given the higher emissions intensity of generation in Victoria.

Demand is not reported by state, but demand across Australia falls by 11% in the CPRS5 scenario by 2020. This implies an elasticity of demand of 42% (based on retail prices). This is higher than the total elasticity assumed by NIEIR (25-38%), and considerably higher than the average actually observed by NIEIR prior to 2015 (18-22%), which takes into account NIEIR's assumed lag in demand response.

ACIL Tasman (for ESAA, 2008)

ACIL Tasman conducted modelling of an ETS for the ESAA in 2008 (ACIL Tasman, 2008) This was conducted prior to the proposed CPRS, so ACIL estimated their own carbon price based on assumed emissions reductions scenarios of 10% (ETS10) and 20% (ETS20) by 2020. Demand and prices were reported for 2020, so pass-through and demand elasticity can be inferred from the results.

ACIL reported slower growth in Australian electricity consumed of 12 % by 2020 in the ETS10 scenario.[7] This corresponded with an increase in average retail prices in 2020 of 24%, from 14.3c/kWh to 17.8c/kWh[8]. The changes in energy

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6 MMA (2008), p37.

7 ACIL (2008), p28. Note that household demand decreased by 19% in the ACIL study.

8 ACIL (2008), p7.

and prices are compared with a Business as Usual scenario without an ETS. This implies a retail elasticity of demand of 49% (by 2020). This is materially larger than the elasticity assumed by NIEIR (25-38%).

3.1.4 Summary

Despite the recently announced delay to the introduction of the proposed CPRS, in our view it is reasonable to adjust for the effects of the scheme, once the effects of the delay are accounted for.

We consider NIEIR's estimates of the impact of the CPRS on energy demand to be reasonable on the basis that:

- NIEIR adopt Commonwealth Treasury carbon price assumptions.
- NIEIR's assumed rate of cost pass-through is within the range of public estimates.
- NIEIR adopt sensible elasticity assumptions, particularly with regard to the lagged demand response. This is evident in comparison with other public estimates.

The delay in the CPRS will mean that the reduction in energy demand will be delayed, though by 2015 the difference is small. Although we have provided estimates of these effects to account for the delay, since it is not an explicit post-model adjustment made to the NIEIR estimates we recommend that this is accounted for in the NIEIR modelling to ensure consistency.

3.2 Advanced Metering Infrastructure (AMI)

3.2.1 Overview

In 2004, the Essential Services Commission (ESC) decided to mandate interval meters for 2.6 million Victorian electricity customers. The rollout commenced in mid 2009 and is forecast to be completed by the end of 2013.

The most significant benefit of advanced meters is the ability to measure electricity consumption by time of day, which allows for more cost reflective pricing via Time of Use (TOU) tariffs[9]. This should encourage consumers to reduce consumption during times of peak demand. Peak demand is more costly

9 Time of Use (TOU) tariffs generally refer to tariffs varying by time of day, typically including peak, off peak and shoulder periods. An alternative (or extension) of this is Critical Peak Pricing (CPP), which reflect even higher tariffs during times of very high demand. This varies by time of year, typically includes no more than 12 events per year and usually involves notification to customers in advance of the event.

since capacity is required to serve demand for short periods of the year (hence a higher cost per MWh consumed).

Some trials of advanced meters report additional benefits from improved feedback where in-home displays (IHD) are implemented. IHD allow for real time display of energy use and costs, and some trials report that customers reduce consumption purely as a result of improved information regarding energy use and cost (as opposed to a response to higher prices). However, there is mixed evidence as to whether this drives greater conservation than TOU tariffs alone. IHDs are not required in Victoria, though all meters are required to have the functionality to support IHD.

On March 22, 2010, the Victorian Government announced that there will be a moratorium on the introduction of Time of Use (TOU) tariffs until the impact on consumers is fully assessed, though the roll out of meters will continue.[10] This announcement was made after the NIEIR report, hence it was not accounted for. We believe that it is unlikely that this will prevent the introduction of optional TOU tariffs in the near future, since this would reduce the potential benefits of installing advanced meters.

3.2.2 NIEIR approach

Methodology and assumptions

NIEIR discuss the potential energy impact of advanced meters in Section 6.9 of their report. NIEIR refer to a report from the Brattle Group[11] which includes a survey of the effect of dynamic pricing of electricity in 15 recent experiments. The report provides a useful summary of trial designs and results, however the focus of this report (summarised in Table 6.16 of the NIEIR report) is on the effect of time of use pricing (TOU) and critical peak pricing (CPP) on ***peak*** demand. This does not refer to the impact on ***average*** energy consumed across the year, so it is of limited use for supporting the energy assumptions that NIEIR adopt.

NIEIR also refer to a report by Energy Futures Australia (EFA) for the Total Environment Centre, TEC (2007)[12]. NIEIR actually report text from the TEC submission to the MCE[13], which summarises the EFA report. TEC conclude that various international studies point to average energy use reductions of 4-14%, including:

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10 http://www.premier.vic.gov.au/newsroom/9853.html

11 Brattle Group (2009a).

12 EFA (2007).

13 TEC submission to MCE (2008).

- Carbon Trust, UK 5 – 12%;
- Sustainability First (21 studies), UK 5 – 14%;
- HydroOne, Canada 7 – 10%;
- EnergyAustralia 6 – 8%; and
- Energy Futures Australia (EFA) 4 – 10%.

Based on these studies, NIEIR conclude that:

> "...NIEIR is taking the conservative view and using the results of the most relevant and local study (Energy Australia, New South Wales), NIEIR forecasts an 8 per cent reduction in energy demand for Victoria due to AMRO [AMI]."

In our view the TEC summary is not a sound basis on which to establish an estimate of average energy use reductions. In particular:

- The EnergyAustralia study[14] refers to a 5.5%-7.8% reduction in energy use **on days where a CPP event takes place**. However, there are only around 12 days of the year where this occurred, which means that the average energy reduction across the year is lower. This is correctly reported in the EFA report at page 36.
- The Sustainability First report[15] cited by EFA assumes average energy savings of 1-3% based on the studies considered. The 21 studies that are referred to in the Sustainability First report[16] are the subject of an older study (Darby, 2001) which refers to the effects of direct feedback and other technology.
- The Carbon Trust trial[17] involved SMEs only (not residential customers), reports on potential carbon savings (not energy), appears to involve a more detailed program of advice and assistance on carbon saving measures than just a smart meter installation, and the reported range refers to 5% savings implemented and 12% savings identified but not implemented.
- The HydroOne study[18] reports an average energy reduction of 4.9%, but speculates that 7-10% is feasible if customers were provided with conservation advice in addition to an in-home display (IHD).
- Finally, the EFA estimates[19] are not a study, but an estimate of potential if the overseas trial results are replicable in Australia.

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14 Sustainability First and Engage Consulting (2008).

15 Sustainability First (2006), p5.

16 Sustainability First (2006), p20 of Appendices.

17 Carbon Trust (2007).

18 HydroOne (2005), p8.

19 EFA (2007).

NIEIR Adjustments

NIEIR report that they apply a post-model adjustment to reduce energy by 8% to reflect the impact of AMI. Based on the figures reported by NIEIR, the reduction is approximately 7.5% if applied to energy *after* accounting for other post-model adjustments. Applying this figure after adjusting for other policy effects would avoid any double counting of savings. In the commercial category, NIEIR apply a reduction of 1.3% in energy by 2015, reflecting the lower responsiveness of commercial consumption to AMI.

Given our fundamental concerns about the TEC summary, in the next sub-section we examine a number of other studies that can inform the appropriate estimates for consumption reduction related to implementation of the AMI.

3.2.3 MCE review of interval meters

In 2007 the Ministerial Council on Energy (MCE) – on behalf of COAG – commissioned a cost-benefit analysis of a smart meter roll out in each jurisdiction. This work followed a number of Victorian studies on the costs and benefits of advanced meters[20]. The Victorian studies generally adopted assumptions which would result in larger average energy savings, though the impact on average energy was not separately reported. The MCE analysis was undertaken in six related work streams by separate consulting teams including:

- **NERA Economic Consulting (NERA)**: Workstream 1 - Coordination (including responsibility for the Phase 2 Overview Report and resulting recommendations); and Workstream 4 - Consumer Impacts.
- **CRA International (CRA)**: Workstream 2 - Network Impacts; and Workstream 5 - Economic Impacts (market and greenhouse modelling).
- **KPMG**: Workstream 3 - Retailer Impacts.
- **Energy Market Consulting Associates (EMCa)**: Workstream 6 – Transitional Implementation Costs and their Allocation.

Based on the outcome of these workstreams, the MCE report estimated the possible reduction in average energy consumption in Victoria ranges of -0.03% to -0.29% overall, or -0.15% to -1.43% for residential customers (Table 14). The result is driven by assumptions from each stream, including the elasticity of demand, TOU tariff settings, take-up rates for TOU tariffs, and the meter functionality. These are discussed below.

20 KPMG/CRA analysis (reported in the ESCV Position Paper, 2002), KPMG/CRA analysis (reported in the ESCV Final Decision, 2004), CRA/Impaq Consulting for ESCV, 2005.

Table 14: Victorian demand response (% change), 2016

	Base		High demand response		High demand, with IHD
	Residential	All	Residential	All	All
Maximum demand	1.38%	-0.61%	0.26%	-1.05%	-1.2% to -1.97%
Energy consumption	-0.15%	-0.03%	-1.43%	-0.29%	-0.56% to -0.66%

Source: NERA (2008), Tables E3, E4

Elasticity

Some studies on the energy saving benefits of advanced meters simply assume an overall energy saving based on various study/trial results. Other studies estimate the overall impact on energy consumption as a function of the change in tariffs and the responsiveness of demand to changes in price (elasticity). These differences in approach are generally because of inconsistencies in reporting of AMI trial results: few trials report detailed elasticity estimates, some report the reduction in average energy use, while other trials report only the average energy reduction during peak periods. The NERA study for the MCE adopts both approaches.

In the base case, NERA adopt elasticity and tariff assumptions to calculate an impact on average energy consumption. The energy elasticity assumptions adopted by NERA (2008) are based on the Californian Statewide Pricing Pilot Study.[21] In Victoria, own price elasticity of residential energy is assumed to be -0.041 to -0.044 in summer and -0.011 to -0.019 in winter. Elasticity of substitution is -0.076 to -0.069 in summer and -0.025 in winter. Commercial energy own price elasticity is -0.02. The estimated change in demand then depends on the assumed TOU tariffs, discussed below.

NERA recognise that the elasticity assumptions from California may be too conservative and so adopt a 'high demand response' scenario involving a larger reduction in average energy consumed. This is effectively a sensitivity involving a greater reduction in average energy consumed than that implied by the elasticity assumptions. NERA apply this assumed change to end-use demand, rather than try to calculate the implied elasticity required to achieve this change. This is presumably because no Australian trial of advanced meters reports detailed elasticity results. This is discussed below under 'conservation effect'.

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21 NERA (2008), pp iv, 39.

Conservation effect

NERA also develop a 'high demand response' scenario[22] which includes an assumed reduction in overall energy consumption, referred to as a 'conservation effect'. This has the same effect as increasing price elasticity, though the adjustment is made to the output (energy) rather than the input (elasticity). NERA include this scenario because the elasticity assumptions are based on the Californian SPP study (which found no overall saving in average energy consumed) while results from some Australian AMI trials show positive reductions in overall average energy consumption. NERA cite the example of Country Energy's Home Energy Efficiency Trial (HEET), which NERA report as finding a 'conservation effect' of 8%.[23] NERA's explanation is that the lower response in Californian may be attributable to the stricter building codes and higher conservation efforts prior to trials in California, which perhaps reduced the observable effects. This would suggest that the Californian elasticity assumptions are too low to apply in Australia.

The Country Energy HEET finding has been reported inconsistently across various sources (between 4-8% average energy reductions).[24] Country Energy actually report a *median* reduction in energy of 8%, and an *average* reduction of 4%[25]; the average is the correct figure to use when estimating potential energy savings from advanced meters.

NERA ultimately adopt a 3% conservation effect in this scenario. This is lower than both the Country Energy median and average energy savings, and this saving was further discounted due to the assumption regarding partial take-up of TOU tariffs (discussed below).

Feedback effect and In-Home Displays (IHD)

A number of advanced meter studies also consider a 'feedback effect' resulting from in-home displays (IHD). This refers to the benefits of providing consumers with real-time feedback of energy use and costs. This provides consumers with an improved understanding of their energy use and greater incentive to pursue energy efficiency measures. It is additional to a 'conservation effect', which is price related.

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22 NERA (2008), p46.

23 NERA (2008), p47.

24 DEWHA (2009), p112, report a 4% average energy reduction. Sustainability First and Engage Consulting (2008), p7, report 5%; Brattle Group (2009b), p20, report 8%.

25 Country Energy (2006), p17

In the Base Case, NERA consider the incremental effect of feedback and IHD (pp. 58-61) and assume that this will lead to 0% additional energy reductions, based on preliminary results from EnergyAustralia trials.

In the 'high demand response' scenario, NERA assume a 4% additional energy reduction due to a feedback effect. This is in addition to the 3% conservation effect in the High Demand Response scenario, and is based on the preliminary Integral trial results.

The minimum specifications of the Victorian AMI rollout requires that all AMI have an interface to a Home Area Network (HAN). This will facilitate IHDs, though the device is not mandatory.[26] It is reasonable to assume that some benefits of IHDs could potentially be realised.

Take-up rates

The impact on energy consumption depends on the extent of take-up of TOU tariffs (i.e. customers switching from flat tariffs), and whether it is assumed that take-up is uniform across customer types. The MCE study (specifically the KPMG report, Phase 2) assumes take-up of 35% (TOU) and 7.5% with TOU+CPP, while 57.5% remain on flat tariffs (Appendix A). Many of the Victorian studies on AMI assume 100% take-up of TOU tariffs. Energy savings also depend on assumptions regarding take-up by customer type; in other words, whether customers most likely to achieve energy savings are more likely to take-up TOU tariffs.

Studies in the US suggest take-up rates of around 20% if TOU are optional, or 80% if TOU are offered with an opt-out[27]. The Department of Energy and Climate Change (DECC) in the UK assume take-up rates of 20%, with sensitivities between 0% and 40%[28]. Hence, we consider less than 100% take-up is reasonable. However, the MCE study assumes that take-up is uniform across different customer types and discounts the energy savings accordingly. We would expect that relatively flat-load consumers, and peaky customers with the potential to shift demand so as to become less peaky than average, would be the most likely to initially take-up TOU tariffs. This is because these customers have the most to gain financially by moving to TOU tariffs. This is particularly the case with the moratorium on the use of TOU tariffs, where any voluntary take up will be by those customers with the most to gain.

As a greater proportion of relatively flat-load customers switch to TOU tariffs, the potential for cross-subsidisation of the remaining relatively peakier customers

26 Victoria DPI (2008).

27 Brattle Group (2010), p21.

28 DECC (2009a), p19.

is reduced. This would increase the required level of flat tariffs on the remaining non-switching customers to recover the costs of serving them. This would have the effect of imposing more cost reflective prices onto remaining customers even if they do not choose to adopt TOU tariffs themselves, in which case the average energy response may be larger than estimated if considering only reductions of customers on TOU tariffs.

Another way of viewing this is that the bulk of any reduction in consumption from the implementation of TOU tariffs will generally be driven by a minority of customers taking up those tariffs:

- Studies suggest that around 20-25% of participants contribute 75% of the measured response;[29]
- The Country Energy trial found that the median saving (8%) was much larger than the average saving (4%), which implies that a minority of customers will contribute the majority of the average saving;
- In developing the MCE take-up assumptions, KPMG noted that "for a significant minority of customers the savings would be reasonably material (eg above 5% of their annual electricity bill)".[30]

This means that even partial take-up of TOU tariffs should deliver most of the average energy savings, and savings should not be discounted linearly based on take-up rates. Even if take-up rates are low, the potential reduction in energy consumption can be proportionately higher. The MCE approach would likely understate the potential energy savings on this basis.

NERA also assume that the energy savings associated with both the conservation effect (3%) and the feedback effect (4%) are realised only if the consumer takes-up TOU or CPP tariffs. The 'feedback effect' should be independent from the take-up of TOU tariffs given that it reflects the impact of real-time feedback on energy use and costs rather than a response to tariffs. As such, the feedback effect should not be discounted based on take-up of TOU tariffs. The NERA assumption is inconsistent with the assumptions adopted in the UK (below), which adopted similar assumptions regarding TOU take-up but did not discount the feedback effect.

Conclusions

The input assumptions adopted in the MCE are generally reasonable based on available information, however we are of the view that the application of these different assumptions is not consistent, resulting in estimated energy savings that are too low:

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29 EPRI (2008), p21.

30 KPMG (2008), p62.

- The base case **elasticity** assumptions err on the low-side given that they are based on Californian trial results, which demonstrate lower energy savings than Australian trials. NERA account for this by including a 'high-demand response' scenario; they make this adjustment to average energy consumed rather than adjusting the elasticity assumptions. NERA also account for a 'feedback effect' in this scenario, whereby consumers respond to information provided by IHDs;
- The **tariff** assumptions are in line with standard practice, whereby energy savings from shifting demand are passed on to consumers;
- The **take-up rates** for TOU tariffs are broadly consistent with international studies or estimates. However, we consider that the application of these take-up rates in the MCE study results in average energy savings that are too low. Specifically:
  - The MCE studies assume that take-up of TOU tariffs is uniform across customer types. We would argue that it is likely that the customers most likely to take-up TOU tariffs are those that are most likely to deliver energy savings. The MCE approach would likely understate the potential energy savings on this basis.
  - The MCE studies discount the potential energy savings from the 'feedback effect' in proportion to take-up of TOU tariffs. However, given that the feedback effect results from improved information provided by an IHD, this should not depend on TOU tariffs. Again, the MCE approach would likely understate the potential energy savings on this basis.

3.2.4 Department of Energy and Climate Change UK

The Department of Energy and Climate Change (DECC) in the UK conducted a cost-benefit analysis of advanced maters in May 2009.[31] They assumed average annual reduction in energy (across the year) of 2.8%, mainly as a result of a feedback effect. DECC assumed potential overall energy reductions as low as 1.5% and as high as 4%.

DECC assume that 20% of customers would take-up TOU tariffs (with a range of 0% to 40%) though this does not reduce the DECC's overall reduction in average energy consumption. Sustainability First adopted the DECC assumptions in their most recent report.[32] In a report for Centrica in 2007, Frontier Economics UK assumed a 2% base case reduction, with a sensitivity range of 1-3%.[33] Each of these estimates involved a judgment based on evidence from

31 DECC (2009a)., pp18-19

32 Sustainability First (2010), p84.

33 Frontier (2007). *Smart Metering*, prepared for Centrica, (2007), p45, 60.

various trial results. They did not involve calculations based on demand elasticities and tariffs because very few trials report estimates of elasticities.

The DECC estimates potential commercial energy savings of 2.8%.[34] Although there is limited evidence on the commercial response to advanced meters, we consider it likely that commercial savings will be less than residential savings.

3.2.5 Summary and conclusions on energy reduction

In our view it is appropriate to adjust forecast energy demand for the likely future impact of AMI. Our review of further studies on the assumed reduction of average energy use reveals considerable uncertainty regarding the potential benefits of AMI. Notwithstanding this, we consider the figure of 8% adopted by NIEIR overstates this potential effect. This is because:

- the information relied on by NIEIR has a number of flaws which make its relevance or appropriateness for the purposes of adjusting energy forecasts questionable;
- other, more robust and comprehensive studies, proffer alternative conclusions that in our view are based on more realistic and relevant assumptions.

The wide range of figures reflects a range of different approaches and assumptions. The MCE assumptions are generally reasonable with regard to take-up rates and tariffs, and NERA include a 'high demand response' scenario to account for higher elasticity of demand in Australia than in California. However, the application of take-up rates to discount energy savings is likely to understate the potential energy savings:

- Firstly, it is likely that a minority of customers will deliver the majority of energy savings, and these customers will be more likely to take-up TOU tariffs. As such, the 'conservation effect' should not be discounted linearly as per the MCE studies.
- Secondly, savings from the 'feedback effect' based on real-time information from IHD should not be discounted in line with take-up of TOU tariffs.

Based on the analysis above, we believe that NIEIR's assumed reduction in average energy of 8% is higher than can reasonably be expected. However, given our concerns with the application of the MCE estimates, we do not consider that these estimates should be directly applied. We recommend adopting a range within the estimates proposed by the DECC and Frontier UK (1%-4%), with a midpoint of 2.5%. This is consistent with the MCE high-demand response

34 DECC (2009b), p15.

scenario if we could correct for the discounting of savings in line with take-up rates.

NIEIR and the MCE assume that potential commercial energy savings in response to AMI are likely to be smaller than residential savings. We consider this approach reasonable, and so we assume commercial energy savings of 0.5% (20% of the residential saving, in accordance with NIEIR).

A comparison of the estimated adjustments is provided in Table 15. To derive the Frontier estimates, we (a) add back each of NIEIR's policy adjustments to derive the base case energy estimates and then (b) subtract Frontier's recommended policy adjustment in each instance. The difference is small but ensures consistency with our recommended adjustments. By calculating this adjustment after allowing for each other policy adjustment, this results in a lower estimate of energy savings and avoids any double counting of savings.

Table 15: Summary of AMI adjustments, CitiPower, GWh

Policy	Reduction	2010	2011	2012	2013	2014	2015
Residential	NIEIR	0.0	11.4	40.4	72.4	89.2	91.5
	Frontier	0.0	4.2	14.9	26.6	32.8	33.2
Commercial	NIEIR	0.0	7.0	24.9	44.6	54.9	56.3
	Frontier	0.0	2.9	10.1	17.9	21.5	21.8
Total	NIEIR	0.0	18.5	65.3	117.0	144.1	147.8
	Frontier	0.0	7.1	25.0	44.5	54.3	54.9

Double counting

Double counting has been avoided, since adjustments for AMI are made after reducing energy to account for other policy measures.

3.3 Incandescent Lighting MEPS

3.3.1 Overview

The Australian Government announced Minimum Energy Performance Standards (MEPS) for lighting products in 2007 to phase-out inefficient incandescent light bulbs. The new minimum standard is 15 lumens per watt (lm/W). Traditional tungsten filament incandescent bulbs[35] provide around 10

[35] Also known as Incandescent General Lighting Service (GLS)

lm/W (non-compliant), quartz halogen (QH) bulbs - typically used in down lighting - provide around 22lm/W and compact fluorescent lamps (CFLs) provide around 55lm/W. An import restriction on non-compliant lighting applied from 1 February 2009, followed by a sales restriction from November 2009.

DEWHA published a detailed report on residential energy use in 2008 which provides detailed estimates of lighting energy use and potential savings (DEWHA, 2008).[36] We review this study below and compare this against the findings of the Regulatory Impact Statement (RIS): *Proposed MEPS for incandescent lamps, compact fluorescent lamps and voltage converters* (Incandescent Lighting MEPS RIS, 2009).

3.3.2 Residential savings implied by DEWHA

DEWHA published a detailed report on residential energy use in 2008 which can be used to estimate lighting energy use and potential savings (DEWHA, 2008). The study provides a useful background to residential lighting trends in general, and detailed assumptions regarding lighting use and characteristics. The report identifies the following trends in residential lighting energy consumption:

> "Since the early 1990s there has been a strong growth in the use of quartz halogen (QH) low voltage lighting. This change in technology is greatly increasing energy consumption. Their relatively low efficiency (only marginally better than incandescent types) and high installation density means that energy consumption for these types has been rising rapidly.
>
> Compact fluorescent lamps (CFLs) have been slowly gaining market share since their introduction in the late 1980s. The penetration of this relatively efficient technology (approximately 50-65 lumens/watt) is expected to increase rapidly with the announced phase out of incandescent lamps in 2009. This is expected to drive lighting energy consumption downwards for the following five years.
>
> By 2015 it is expected that practically all standard incandescent lamps will have been removed and largely replaced by CFLs." [37]

DEWHA uses bottom-up modelling to derive estimates of residential energy by end-use by state. Lighting energy consumption is only reported separately in Figure 52 of the DEWHA report, and is generally grouped in "Appliances" when reported. However the underlying model assumptions are provided, including energy use by type of light (Tables 102-3), types of lighting used (in both living areas and non-living areas) (Tables 162-3), and housing stock/floor area (pages 371-374). We have used these assumptions to calculate projected lighting use by average household in Victoria, and to estimate the implied reductions in lighting

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36 DEWHA (2008).

37 DEWHA (2008), p62.

electricity as a result of lighting MEPS (compared with a base case scenario where lighting use continues to grow at average rates up to 2008).

The key assumptions are provided in Table 16. The lumens/watt is a measure of lighting efficiency, where a higher figure represents greater efficiency; fluorescent lights are more efficient than incandescent or quartz halogen. A standard of 15 lumens / watt means that incandescent lamps are non-compliant and will be replaced with higher efficiency lamps. In living areas, incandescent lamps have been declining and replaced with QH and CFL; in non-living areas, incandescent lamps are still used in 90% of cases. DEWHA assume that lighting is used for 2 hours per day in living areas and 0.5 hours per day in non-living areas.

We calculate average lighting energy for living and non-living areas as:

[% share of lighting type] x [watts per m2, by type] x 2 hours per day x 365 days

Given these assumptions, average lighting use is 13kWh per year per m2 in living areas, 1.9kWh per year per m2 in non-living areas, and 6.4kWh per m2 on average. Using DEWHA estimates of housing stock and floorspace (m2), we derive an average Victorian house size of 146m2, which means average lighting use of 930kWh per household per year in 2008.

Table 16: Residential lighting characteristics, 2008

Category	Incan-descent	QH	Linear Fluorescent	CFL
Lumens / Watt	10.9	21.8	64.5	54.7
Share of lighting type in living areas (40% of all areas in the home)	37%	33%	2%	27%
Share of lighting type in non-living areas (60% of all areas in the home)	87%	5%	1%	7%
% Share in total	67%	16%	2%	15%
Lighting density (Lux or Lumens per m2) (living areas)	180	700	400	180
Watts / m2 (Lux divided by lumens/watt)	16.5	32.1	6.2	3.3
Lighting density (Lux or Lumens per m2) (non-living areas)	120	400	200	120
Watts / m2 (Lux divided by lumens/watt)	11	18.3	3.1	2.2

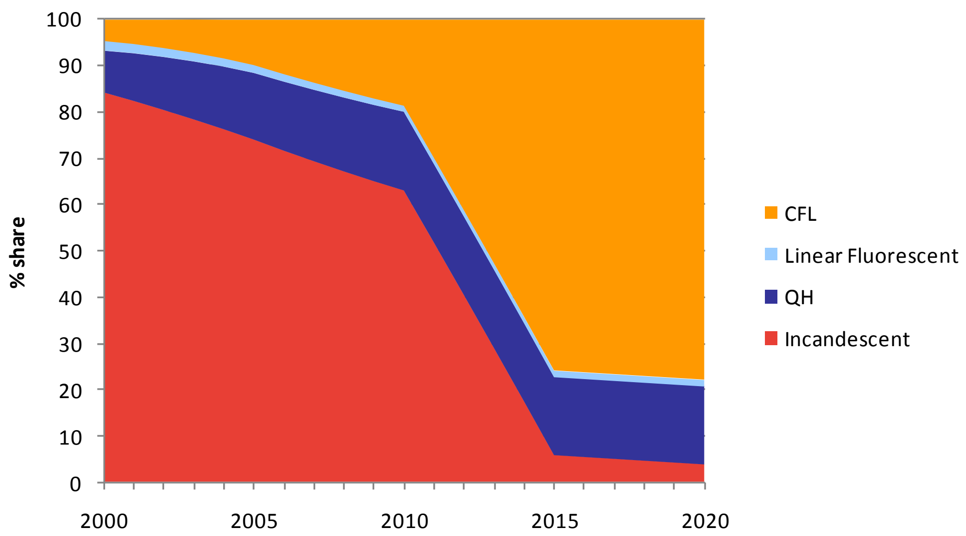
Source: DEWHA (2008)

In response to the introduction of the incandescent lighting MEPS, DEWHA assumes that:

- the share of incandescent lighting will fall from an average of 65% (2008) to 4% (2020).
- compact fluorescent lighting (CFL) will rise from 15% (2008) to 78% (2020).
- quartz halogen (QH) remains constant at around 17%.

These assumptions reflect averages across both living and non-living areas.

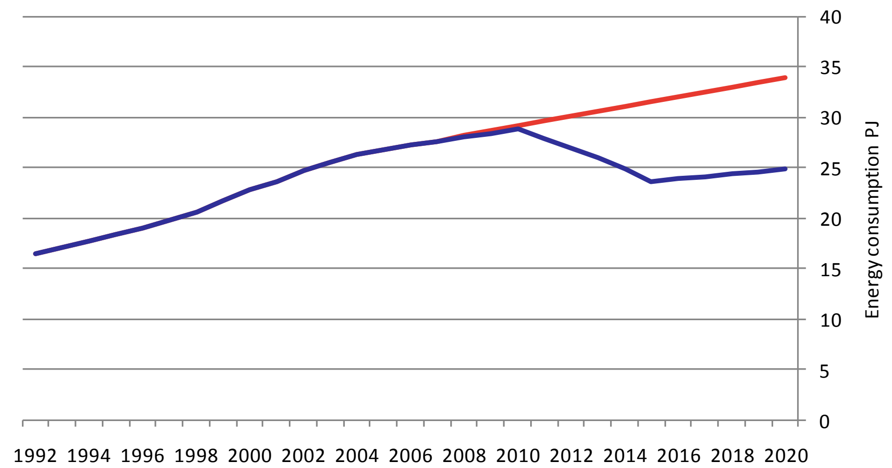
Figure 7: Residential lighting share in Australia



Source: DEWHA (2008), Frontier calculations

Figure 8 shows energy use for Australian residential lighting – the navy blue line represents DEWHA's projections as a result of the incandescent lighting MEPS; the red line represents our estimated proxy for a 'no policy change' scenario based on data in the DEWHA report (i.e. if the recent trend in growth to 2008 continues into the future).

Figure 8: Residential energy consumption – Lighting in Australia



Source: DEWHA (2008), Frontier calculations

The average electricity consumption of Victorian households for lighting (implied by DEWHA) is presented in Figure 9. DEWHA's implied average energy use for lighting (930kWh in 2008) compares with:

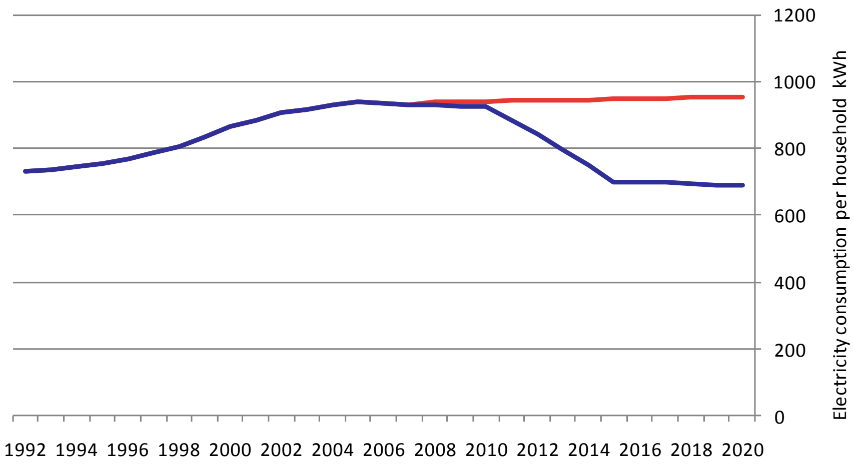
- Pears[38] (2007) estimates average residential lighting at 850kWh;
- GWA[39] (2007) argues that it should be greater than 770kWh given recent growth;
- The Lighting MEPS RIS (2009) estimates average residential lighting consumption at 684kWh per year in 2005 (p153).

Using 930kWh for lighting energy represents around 18% of all residential electricity consumption in Victoria, based on DEWHA's average household electricity use of 5,300kWh. DEWHA's estimated reduction in average lighting energy use is around 248kWh by 2015, a 26% reduction. Savings rise gradually in line with the fall in share of incandescent lighting.

38 Pears (2007), p3

39 GWA and EES (2007), p69.

Figure 9: Residential energy consumption - Lighting in Victoria (per household)



Source: DEWHA (2008), Frontier calculations

We estimate the implied DEWHA lighting savings for CitiPower by multiplying average household savings by Residential customers in the region. This is preferable to using state averages where possible, since energy use in the region may differ from the state average.

Table 17: Estimated lighting MEPS savings – GWh

Year	Average lighting use per Victorian household (kWh)		Total lighting energy use - CitiPower (GWh)		Saving (GWh)
	Before	After	Before	After	
2009	939	928	237.1	234.1	2.9
2010	940	927	241.8	238.6	3.2
2011	942	885	248.3	233.2	15.1
2012	944	841	253.6	225.8	27.8
2013	944	796	257.3	217.0	40.3
2014	947	752	262.0	208.0	54.0
2015	948	700	268.1	198.0	70.1

Source: DEWHA (2008), Frontier calculations

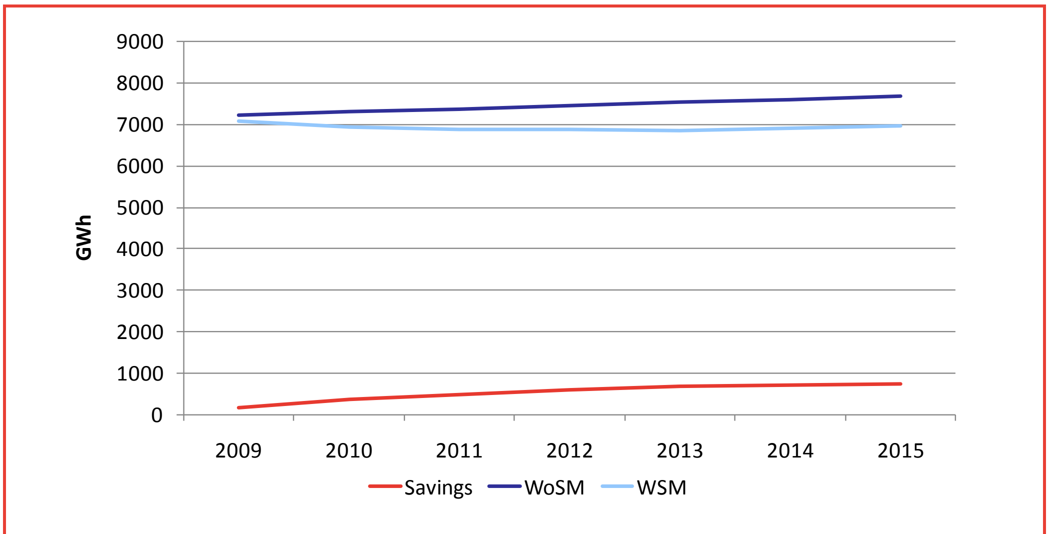
3.3.3 Incandescent Lighting MEPS RIS

Frontier has reviewed the RIS titled *Proposed MEPS for incandescent lamps, compact fluorescent lamps and voltage converters* (Incandescent Lighting MEPS RIS, 2009). The RIS calculates energy reduction savings due to the introduction of lighting MEPS by comparing two scenarios:

- without specific measures (WoSM) – a scenario that does not involve any lighting specific measures (e.g. MEPS) but which does include other non-lighting specific environmental policies such as the CPRS.
- with specific measures (WSM) – a scenario which involves both lighting-specific measures (e.g. MEPS) in addition to other non-lighting specific environmental policies such as the CPRS.

Appendix F of the RIS outlines total energy consumption for lighting for years 2000-2020 broken down by state for both the WoSM and WSM scenarios. This includes Residential, Commercial and Industrial uses. The difference between these scenarios, also reported, reflects the forecast energy savings due to introducing lighting MEPS. Data for Victoria is presented in Figure 10.

Figure 10: Total lighting MEPS savings in Victoria, 2009-2015



Source: Incandescent Lighting MEPS RIS (2009)

The lighting savings attributable to the CitiPower region could be estimated by prorating the RIS estimates by the CitiPower share of Victorian energy use. However, this would not reflect potential differences in customer types and the division of savings between residential and commercial is not explicit in the Lighting MEPS RIS. In any case, the RIS allocation of savings by state are simply based on population and do not reflect potential differences in customer type, so it is indicative only. Instead, we estimate savings based on:

(a) projected electricity use by category in the CitiPower region;

(b) electricity use for lighting as a proportion of total electricity use in each customer category; and

(c) estimates of relative lighting saving for each customer type.

3.3.4 Residential savings implied by the RIS

Lighting share of residential consumption

The RIS estimates average residential lighting consumption at 684kWh per year in 2005 (p153). Average residential electricity consumption in the CitiPower region is 5,181 kWh per year. This means that lighting represents 13.2% of all residential electricity consumption in the CitiPower region.

This estimate of lighting use per household is lower than the estimates provided by DEWHA (2008), Figure 5, which estimates Victorian residential lighting consumption at 939kWh. This implies that lighting contributes 18% of all residential electricity consumption. Pears[40] (2007) estimates residential lighting at 850kWh; GWA (2007)[41] suggests that it should be greater than 770kWh given recent growth.

Given the greater level of detail provided in the DEWHA analysis, we prefer the DEWHA estimates over the RIS estimates. This is consistent with our approach in other policy areas, which rely on the DEWHA end-use estimates. If the lower RIS estimates were correct, this would imply that energy use for other end uses (and potential policy savings) would be higher.

Residential lighting savings

The Lighting RIS estimates average residential lighting savings of 33% as a result of the MEPS: Table 18. The adapted DEWHA estimates project average residential lighting savings of 26%.

We also find that if we divide the RIS estimate of total residential lighting consumption (5,146GWh) by the average consumption (684kWh), this implies only 7.5m Australian households. This is lower than ABS estimates (8.2m) or DEWHA (8.3m occupied or 9.5m housing stock), which means that the RIS potentially understates the aggregate savings in GWh. While we can rely on the relative savings, any attempt to distribute the RIS estimated savings by state (in GWh) will likely understate the saving, even as intended by the RIS.

40 Pears (2007), p3.

41 GWA and EES (2007), p69.

Table 18: Lighting electricity use and savings (Australia)

Category	BaU lighting use (GWh)	'With Measures' lighting use (GWh)	Savings (GWh)	Savings (%)
Residential	5,146	3,472	-1,674	-33%
Commercial	15,714	14,051	-1,663	-11%
Industrial	4,637	4,585	-52	-1%
Outdoor	2,736	2,692	-44	-2%
Total	28,233	24,800	-3,433	-12%

Source: Lighting MEPS RIS (2009), Table D.4, p160

Residential lighting savings can be estimated by multiplying:

[Residential electricity use] x [lighting share] x [Relative lighting saving]

where total residential electricity use is as provided by NIEIR in the CitiPower region. Using the RIS estimates for lighting use and savings:

[1295GWh] x [13.2%] x [33%] = 55.4GWh

based on residential consumption in 2008. Savings increase over time in line with customer growth. We assume that this saving is achieved gradually over time, in proportion to the RIS estimate of savings for Victoria. The RIS projects that savings by 2015 reach 87% of the total potential.

For comparison, using the DEWHA figures for lighting energy and savings results in an estimate of:

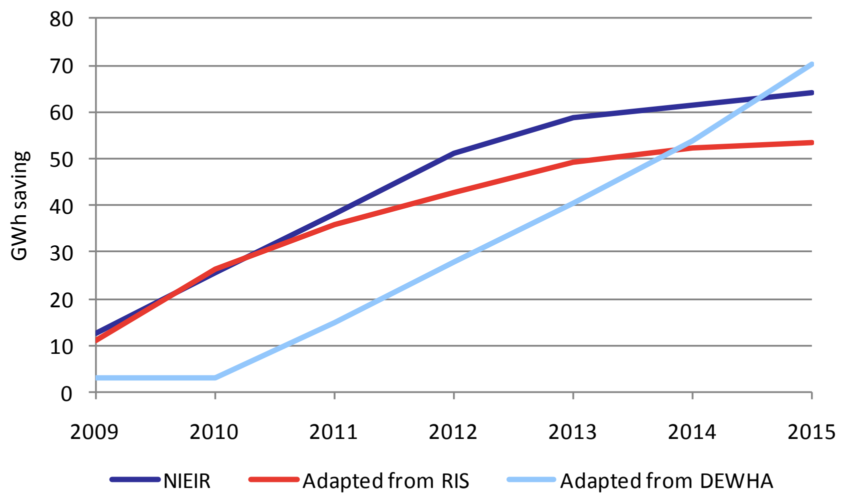
[1295GWh] x [18%] x [26%] = 60.2GWh[42]

Comparisons of the NIEIR estimates against our adaptations of the RIS and DEWHA estimates are provided in Figure 11. The DEWHA figures imply a larger share of average lighting consumption than the RIS, but a lower relative saving as a result of the MEPS. The net effect is that the DEWHA estimated saving is marginally higher than that derived from the RIS by 2015[43], though these savings will be achieved more gradually than the RIS estimates imply. This difference is largely accounted for in lighting savings considered under the Victorian Energy Efficiency Target (Section 3.7).

42 The saving reported in 2015 in Table 19 is marginally higher, since the table accounts for growth in customers over time, whereas this equation is based on customers in 2008.

43 The DEWHA savings in 2015 are higher in the chart than in the calculation above; this is due to growth in customer numbers over time, which is not reflected in the equation example.

Figure 11: Total residential lighting saving, GWh, CitiPower



Source: DEWHA (2008), NIEIR (2009), Lighting MEPS RIS (2009), Frontier calculations

Table 19: Residential lighting MEPS savings, CitiPower – GWh

Year	RIS: Total Victorian savings (GWh)	Adapted RIS residential saving (GWh)	Adapted DEWHA residential savings (GWh)	NIEIR residental (GWh)
2009	151	11.1	2.9	12.8
2010	361	26.5	3.2	25.6
2011	489	36.0	15.1	38.4
2012	582	42.9	27.8	51.2
2013	665	49.1	40.3	58.8
2014	707	52.3	54.0	61.4
2015	722	53.6	70.1	64.0

Source: DEWHA (2008), NIEIR (2009), Lighting MEPS RIS (2009), Frontier calculations

Policy adjustments

3.3.5 Commercial savings implied by the RIS

Savings in commercial lighting energy use are also considered in the Incandescent Lighting MEPS RIS (2009). The estimate depends on the lighting share of commercial electricity consumption and the assumed potential energy savings, which in turn results from assumptions regarding the relative share of each type of commercial lighting currently used. This is important, since commercial lighting is more reliant on linear fluorescent lamps than incandescent bulbs. Linear fluorescent lamps are subject to an earlier MEPS introduced October 2004. Only savings from incandescent lamps are considered here.

Lighting share of commercial consumption

Information about commercial lighting use is scarce. One basis for estimation is to compare the Incandescent Lighting MEPS RIS estimate of total commercial lighting use (15,714GWh) against an ABARE estimate of commercial electricity use (47,100GWh)[44]. This means that lighting use comprises 33% of total commercial electricity use.

The *Linear Fluorescent Lamps MEPS RIS* (2003) cites an earlier estimate from 1999 that lighting contributes 25% of commercial electricity consumption. An EMET report for the Sustainable Energy Authority of Victoria[45] (EMET, (2004)) estimates the lighting contributes 38% of total commercial electricity consumption (comprising 25% from internal lighting, 12% from external lighting and 1% from car parking). Given the range of estimates, we have chosen the mid-point (33%) implied by the Incandescent Lighting MEPS RIS (2009).

Commercial lighting savings

The Incandescent Lighting MEPS RIS estimates average commercial lighting savings of 10.6% as a result of the MEPS: Table 18. Total commercial lighting savings can be estimated by multiplying:

[Total Commercial electricity use] x [lighting share] x [relative lighting saving]

where total commercial electricity use is as provided by NIEIR.

Using the RIS estimates, this becomes a total saving of:

[4290GWh] x [33%] x [10.6%] = 151.7GWh

based on commercial consumption in 2008.

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44 ABARE (2009), Australian Energy Statistics, Tables F and I http://www.abareconomics.com/publications_html/data/data/data.html#engHIST

45 EMET (2004), calculated from Tables 2.3-2.4.

We assume that this is achieved gradually over time, in line with the RIS reported savings for Victoria. The RIS projects that savings by 2015 reach 87% of the total potential.

Discounting the RIS estimate

The Incandescent Lighting MEPS RIS (2009) uses an adaptation of a US model to derive its estimate of commercial lighting in Australia: Figure 12 (p156-7). The RIS makes arbitrary adaptations to the US model to achieve a level of energy use consistent with Australia but to reflect the mix of lighting in the US. This is relevant because savings under the MEPS are a function of the share of incandescent (tungsten filament) lighting; no savings are expected from linear fluorescent lighting. The resulting mix in the RIS implies that incandescent lighting (tungsten filament) represents 25.3% of total commercial lighting use[46].

Figure 12: Commercial lighting model from Lighting MEPS RIS (2009)

Table D.3 Non-residential lighting matrices: 2005

	Number of lamps/ELVCs	Average lamp hours	Efficiency (lamps, lumens/w) (ELVCs, %)	Average wattage	Average light (kLh)	Average energy (kWh)
COMMERCIAL (per million square meters of floor-space)						
Tungsten filament - non-reflector	32,882	6.7	10.9	77.7	67,913,201	6,221,545
Tungsten filament - reflector	11,705	6.2	10.2	93.6	25,362,560	2,482,511
MV tungsten halogen - non-reflector	1,414	7.6	12.4	91.3	4,437,868	357,914
MV tungsten halogen - reflector	1,696	6.2	11.8	70.0	3,176,980	269,042
LV tungsten halogen - non-reflector	3,128	8.2	13.7	20.0	2,581,590	188,148
LV tungsten halogen - reflector	14,259	8.2	14.1	50.0	30,223,073	2,144,303
Linear	154,809	7.7	70.0	40.2	1,220,396,565	17,434,237
CFL - non-reflector	16,934	6.8	53.2	15.0	38,705,025	633,395
CFL - reflector	546	6.6	26.6	14.4	503,247	18,926
HID	3,824	8.1	58.2	363.6	238,708,088	4,100,361
SSL	219	18.4	18.9	4.5	125,066	6,604
ELVCs for reflector lamps	792	8.2	89.9%	94.2	-	36,201
ELVCs for non-reflector lamps	13,711	8.2	82.8%	62.8	-	445,367
All lamps	241,415	7.5	47.4	52.3	1,627,133,264	34,338,553

Source: Lighting MEPS RIS (2009)

Data on the Australian commercial lighting mix is poor, so this is difficult to verify. An estimate contained in the *Fluorescent lamp ballasts MEPS RIS* (2003) suggests that fluorescent lamps comprise 90% of commercial lighting (11,940GWh / 13,230GWH), which suggests that incandescent lighting contributes 9.8% of commercial lighting: Figure 13.

46 Based on average energy per million sq m floorspace: Tungsten filament per /Total lighting = 8,704MWh/34,338MWh.

Figure 13: Lighting mix from Fluorescent lamp ballasts MEPS RIS (2003)

Table 3 Components of lighting-related energy use, 2000

	Business			Residential			Total		
	GWh	$M	Mt CO_2-e	GWh	$M	Mt CO_2-e	GWh	$M	Mt CO_2-e
Linear fluorescent lamps (a)	7,370	993	8.05	200	24	0.22	7,570	1,017	8.27
Fluorescent lamp ballasts	1,930	260	2.11	60	8	0.07	1,990	267	2.18
Indirect	2,640	356	2.89	NA	NA	NA	2,640	356	2.89
Total fluorescent-related	11,940	1,608	13.05	260	32	0.29	12,200	1,640	13.34
Other lamp types (b)	1,000	135	1.09	4,150	494	4.53	5,150	629	5.62
Indirect	290	38	0.31	NA	NA		290	38	0.31
Total non-fluoro related	1,290	173	1.41	4,150	494	4.53	5,440	667	5.93
Total lighting related	13,230	1,782	14.45	4,410	526	4.82	17,640	2,307	19.27
Total ballast related	**2,480**	**334**	**2.71**	**60**	**8**	**0.07**	**2,540**	**341**	**2.78**

Source: cost-benefit model detailed in Chapter 4 of this RIS, which has been calibrated to estimates in EMET (1999) and EES (1999). (a) Commercial sector fluoro lighting plus 5% allowance for fluoro lighting use in other sectors. (b) Includes incandescent, compact fluorescent, halogen etc.

Source: Fluorescent lamp ballast MEPS RIS (2003)

If we assume that the estimate from the Fluorescent Lamp Ballast MEPS RIS more accurately reflects Australian commercial lighting, this means that the estimated savings from the Incandescent Lighting MEPS RIS (2009) should be multiplied by 38%[47] to reflect the lower share of incandescent lighting in commercial use. This would imply commercial lighting savings of 4.0%, rather than the 10.6% estimated by the Incandescent Lighting MEPS RIS (2009).

A discounted estimate is supported by NIEIR data. The Incandescent Lighting MEPS RIS (2009) implies that there are 4.6m incandescent (tungsten filament) lamps in Victoria. We estimate this based on the following:

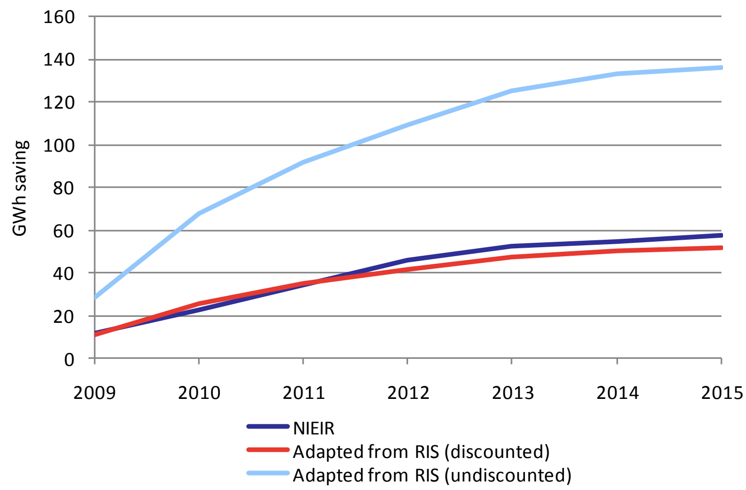
- The Incandescent Lighting MEPS RIS assumes (a) 15,714GWh of total commercial lighting use and (b) 34.39GWh per million sqm floor-space. (a) divided by (b) implies total Australian commercial floor-space of 457m sqm;
- The Incandescent Lighting MEPS RIS assumes (32,882 + 11,705) incandescent bulbs per million sqm floor-space (Figure 12). Multiplying this by 457m sqm implies 20.3m incandescent lamps in commercial use in Australia;
- If we assume that Victoria has a 23% share of commercial floor-space (based on population share), this implies 4.6m incandescent bulbs.

However, NIEIR report an estimate of 1.3m commercial incandescent bulbs in Victoria (p51), which suggests that the Incandescent Lighting MEPS RIS overstates the share of commercial incandescent lamps. Comparisons of the NIEIR estimates against our adaptations of the RIS estimates (both discounted

47 This is because the share of incandescent lighting in commercial use is estimated as 9.8% in the Fkuorescent Lamp Ballast MEPS RIS, which is 38% of the estimated share of commercial lighting in the Incandescent Lighting MEPS RIS (25.3%): 9.8% / 25.3% = 38%.

and undiscounted) are provided in Figure 14. The undiscounted RIS estimate is based on the commercial lighting savings of 10.6% as reported by the RIS. The discounted RIS estimate is based on commercial lighting savings of 4.0% to reflect a lower share of incandescent lighting in the commercial sector than the RIS assumes.

Figure 14: Commercial lighting MEPS saving, CitiPower, GWh



Source: NIEIR (2009), Lighting MEPS RIS (2009), Frontier calculations

Table 20: Commercial lighting MEPS savings, CitiPower – GWh

Year	RIS: Total Victorian savings (GWh)	Adapted RIS commercial saving (GWh) - undiscounted	Adapted RIS commercial saving (GWh) - discounted	NIEIR commercial (GWh)
2009	151	28.1	10.7	11.4
2010	361	67.5	25.6	22.9
2011	489	91.6	34.8	34.3
2012	582	109.2	41.5	45.8
2013	665	124.9	47.5	52.6
2014	707	133.0	50.5	54.9
2015	722	136.2	51.8	57.2

Source: NIEIR (2009), Lighting MEPS RIS (2009), Frontier calculations

3.3.6 Double counting

The lighting MEPS RIS calculates savings relative to a scenario that does not involve lighting-specific measures (e.g. MEPS) but which does involve non-lighting specific measures such as the CPRS. Assuming that increased retail prices due to carbon or other greenhouse policies result in reduced energy consumption for lighting, then to the extent that NIEIR have:

- relied on the RIS in calculating relative savings due to lighting MEPS; or
- have referenced their own calculation of savings to a state-of-the-world that involves non-lighting specific measures such as the CPRS;

there should not be double counting of savings between these non-lighting measures and lighting MEPS. An important area where double counting could still occur, however, is cross-over between behaviour driven by lighting MEPS and that driven by the Victorian Energy Efficiency Target (VEET), which recognises savings in residential lighting. This is further discussed in section 3.7.2 below, and adjustments for double counting are addressed in that category.

3.3.7 Summary

In our view, it is reasonable to make adjustments to energy consumption forecasts to account for the introduction of the Incandescent Lighting MEPS. The lighting MEPS imposes an import restriction on non-compliant lighting applied from 1 February 2009, followed by a sales restriction from November 2009. The effect of this would not be apparent in recent energy data, and we do not believe that this change would be reflected in NIEIR's energy consumption modelling.

We have reviewed the Incandescent Lighting MEPS RIS (2009) and DEWHA (2008), and the resulting energy savings will be material enough to warrant an adjustment to NIEIR's model forecasts.

For the purposes of providing estimates of lighting MEPS savings by customer class (as reported in Table 2, Table 3 and Table 4) we have adopted the DEWHA estimates for residential savings due to the transparency of the DEWHA report as compared to the RIS. Compared with the RIS, the DEWHA adapted estimates are:

- marginally higher than the RIS-based estimates by 2015, though the transition to achieving these savings is slower;
- based on higher average lighting use per household compared with the RIS, though this is supported by other sources;
- based on lower estimated saving per household.

For commercial lighting use, we accept the RIS estimate that lighting contributes 33% of all commercial use, but we recommend discounting the RIS estimated savings to reflect a lower share of incandescent lighting in the commercial sector than the RIS assumes. This ensures that the estimated savings are unlikely to be overstated.

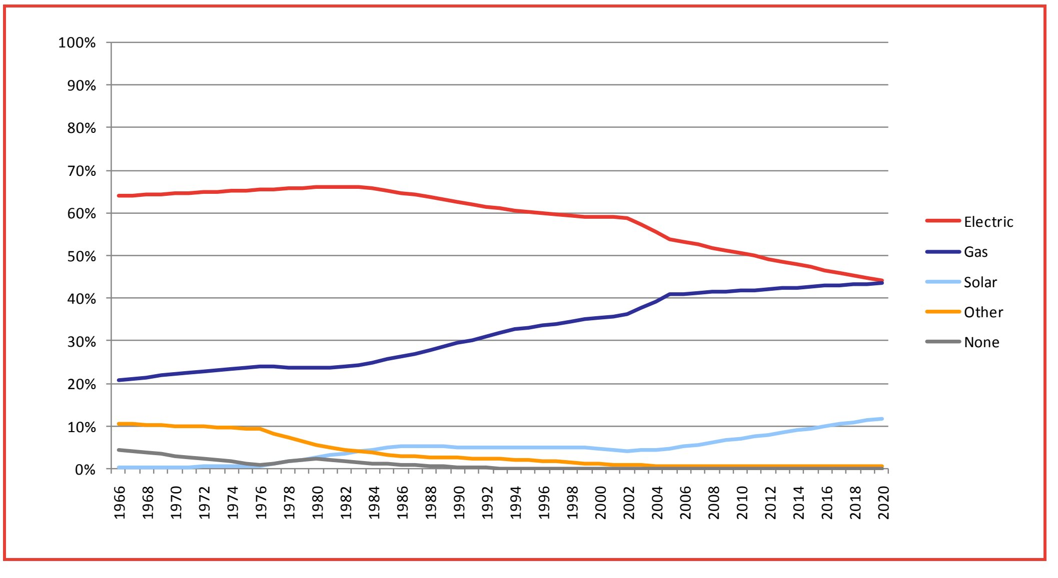
3.4 Phase out of electric hot water

At its meeting on 2 July 2009, the Council of Australian Governments (COAG) endorsed the National Strategy on Energy Efficiency, which includes a provision to "phase-out conventional electric resistance water heaters". Under the proposal, only electric water heaters that need to be replaced will be covered; working electric water heaters will not fall under this requirement until they need to be replaced.

3.4.1 Residential savings implied by DEWHA

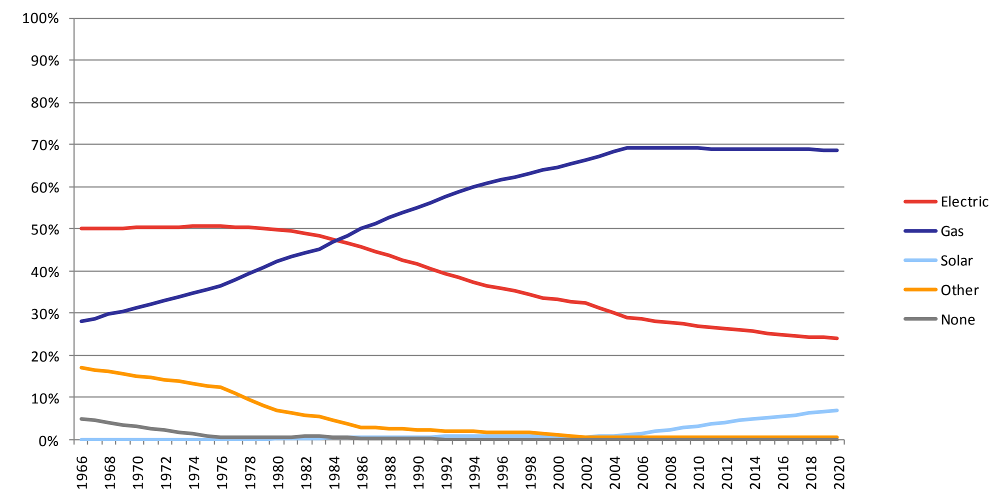
DEWHA (2008) provides estimates of existing and projected hot water heaters by region and type. In Victoria, DEWHA estimates that average household electricity consumption for hot water use is 787kWh in 2008, or 15% of total residential electricity consumption. This is lower than the national average due to much lower share of electric storage water heating in Victoria (28% in 2008 compared with 52% across Australia). DEWHA report historic and projected type of units in Australia (Figure 15) and Victoria (Figure 16), though these projections were published prior to the announcement to phase-out conventional electric storage heaters. As such, the future share of electric water heating is overstated in these estimates.

Figure 15: Main form of water heating, Australia



Source: DEWHA (2008)

Figure 16: Main form of water heating, Victoria



Source: DEWHA (2008)

We do not have data on existing water heater type in the CitiPower region specifically. Rather than rely on the Victorian averages (reported in DEWHA) we have estimated the regional electricity use for hot water based on available information from the NIEIR report and DEWHA (2008). For example, NIEIR reports average electricity use in 2007 for existing customers (excluding hot water) at Table 5.4 of their report:

- This is divided by 'old customers' connected at 2003 and new customers connected in 2004, 2005 and 2006. We assume that 'old customers' will be more representative of the majority of customers than new connections.
- Average electricity use (excluding hot water) per 'old customer' household in 2007 is reported as 4,804 kWh. NIEIR also report average electricity use per household (including hot water) of 5,181 kWh.
- Subtracting the former from the later leaves an estimate of hot water electricity use of 377 kWh.

Based on annual energy use of 2,500 kWh per electric storage hot water system[48], this implies that approximately 15% of existing hot water systems in the CitiPower region are electric storage[49], which is much lower than the State average.

48 Annual energy use of 2,500kWh is based on an average of various sources, including DEWHA (2008)

49 Based on 377kWh average electricity use in the CitiPower region, divided by 2,500Wh per average electric storage heater. A minor adjustment is made to account for the small contribution of solar-electric water heaters.

We also require an estimate of the future mix of water heaters to determine future energy savings. In their report for CitiPower, NIEIR assume a replacement rate of 6.7% per year based on an average life of 15 years. This is more conservative than NIEIR's assumed replacement rate for ETSA,[50] which is 10% per year (based on a 10 year life). NIEIR's assumptions regarding the type of replacement are not provided. However, in their report for ETSA, NIEIR assume that 5% of these are replaced with electric storage, 14% with gas storage or solar-gas and 81% with solar electric. For new homes, NIEIR assumed 1% electric storage, 81% gas storage or solar-gas and 18% solar electric.

We view these assumptions as reasonable (Table 21) and adopt them to calculate current electricity use for hot water by multiplying the number of units by average electricity use, which equals 95GWh per year (377kWh per household) in 2008. The replacement rate of 6.7% per year means replacement of almost 2,400 electric units per year; 120 of these are replaced with a new electric storage heater.

Table 21: Hot water replacement/installation type, CitiPower

Year	Electric storage	Gas / Solar Gas	Solar electric
Existing share	14.7%	83,7%	1.3%
Existing number	36,741	210,072	3,129
Average electricity/yr	2,500kWh	-	750kWh
Replacement share	5%	14%	81%
New home share	1%	81%	18%

Source: Frontier calculations

The implications for total and average hot water energy consumption are reported in Table 22. This assumed rate of replacement means that total energy consumption falls by around 4% per year, while average household consumption falls by around 6% - the difference is due to around 2% annual growth in customer numbers.

To calculate savings relative to BaU without the policy, we assume that BaU consumption falls in line with the DEWHA (2008) average over the next 10 years. Hot water electricity consumption falls by an average of 1.3% per year across Victoria due to the declining share of electric hot water in DEWHA (Figure 16).

50 ETSA Utilities (2010), p65.

Table 22: Residential hot water energy consumption: total, average and saving, CitiPower

Year	Total GWh	% growth	Average kWh	% growth	BaU GWh	Saving GWh
2011	92.0	-3.5%	349	-5.8%	93.0	1.0
2012	88.5	-3.9%	329	-5.6%	91.8	3.3
2013	84.8	-4.2%	311	-5.6%	90.6	5.8
2014	81.1	-4.3%	293	-5.8%	89.4	8.3
2015	77.7	-4.2%	275	-6.2%	88.2	10.5

Source: Frontier calculations

3.4.2 Summary

In our view, it is reasonable to make adjustments to energy consumption forecasts to account for the introduction of the phase out of electric hot water heaters. The proposed phase out was announced mid-2009, hence the effect would not be evident in recent energy data.

We have reviewed DEWHA (2008) and other publicly available information to account for material differences in energy use by region. We have adopted assumptions regarding replacement rates and types that are consistent with other public estimates, and the resulting energy savings are material enough to warrant an adjustment to NIEIR's original model forecasts. Our estimated energy savings in the residential sector are similar to NIEIR's proposed adjustments. We have not attempted to estimate energy savings in the commercial sector, but we consider that NIEIR's estimates are reasonable given (a) the similarities in our residential sector estimates and (b) that NIEIR's estimated commercial savings are relatively small.

3.5 Air-conditioning MEPS

3.5.1 Overview

In Australia, three phase air conditioners have been subject to MEPS since October 2001. In October 2004, MEPS were applied to single phase air conditioners for the first time. In October 2007, MEPS for single and three phase air conditioners were increased. More stringent MEPS and energy labelling requirements for air conditioners came into force on 1 April 2010.

NIEIR's post-model adjustments to account for energy savings due to the introduction of revised air conditioning MEPS are relatively modest. Savings attributable to CitiPower due to revised air conditioning MEPS amount to roughly 5.5 GWh by 2015. These savings reflect the incremental benefits of the revised 2010 MEPS. The energy savings associated with previous MEPS are included in the Base Case.

3.5.2 NIEIR's approach

NIEIR do not describe in detail the methodology they employ to determine energy savings due to the revised air conditioning MEPS. On page 52 of their report, NIEIR state:

> The RIS indicates that the new MEPS for air conditioners under 4 KW would generate savings of about 9.2 per cent (page 80) for units previously just meeting the current MEPS of 3.03 EER/COP. For all split systems the savings by MEPS alone, on this basis, would be the order of 6 per cent. For units over 10 KW there would be no change. For ducted systems the improvement would be about 10 per cent, again on the above basis.

In their report NIEIR state their belief that the potential savings from revised air conditioning MEPS is likely to be small (p.51). NIEIR argue that savings are likely to be small given that the majority of applicable air conditioners currently available already conform to the revised standards.

3.5.3 Savings implied by the RIS

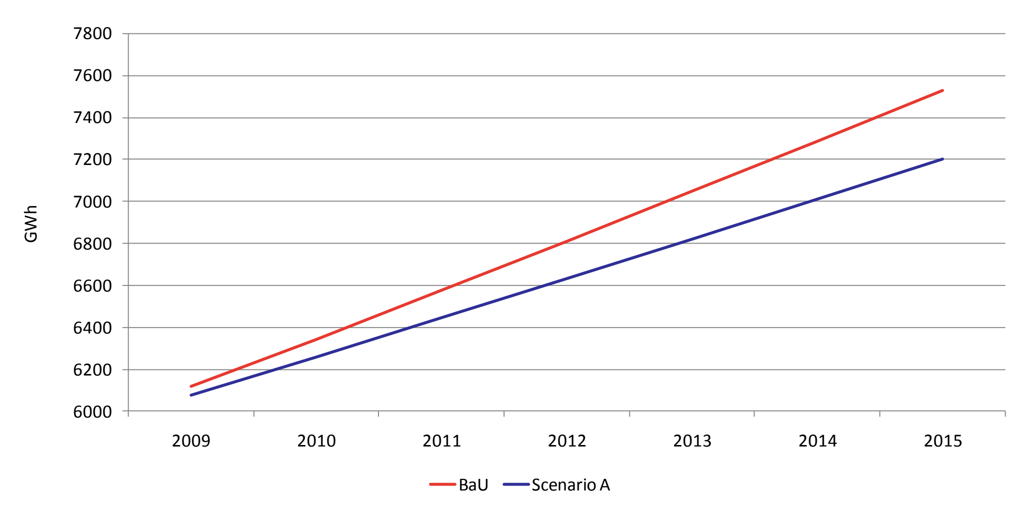
Frontier has reviewed the RIS, titled *Revision to the Energy Labelling Algorithms and Revised MEPS levels and Other Requirements for Air Conditioners,* prepared by Energy Efficient Strategies (Air con MEPS RIS, 2008)

The RIS calculates energy savings by comparing two scenarios:

- Base case – in this scenario neither the current energy labelling algorithm nor MEPS levels are changed going forward. The RIS makes reference to an assumed 'marginal carbon intensity for electricity supply' but notes that in the base case a \$0/tCO_2-e carbon price is assumed (p.136).
- Scenario A – in this scenario both the energy labelling algorithm and MEPS levels are upgraded to more stringent levels. Other assumptions are consistent with the base case.

Table 75 of the RIS reports annual electricity consumption for air conditioners under both the base case and Scenario A for Australia as a whole. The savings due to revised air conditioning MEPS (the difference between base case and Scenario A energy consumption) is also reported. This data is presented in Figure 17 below.

Figure 17: Air conditioning MEPS savings in Australia, 2009-2015



Source: Air con MEPS RIS (2008)

Based on this data Frontier has calculated the energy savings due to revised air conditioning MEPS attributable to CitiPower customers. In order to attribute national savings to CitiPower, it is necessary to:

- attribute a portion of national MEPS savings to Victoria – this has been done by prorating national savings in accordance with air conditioning electricity use for each State (taken from Table 168 of DEWHA, 2008). An alternative would be to allocate Victorian savings based on air conditioner penetration. However, Victoria has a rate of air conditioner penetration similar to the national average, with 24% of national stock (in line with population share); average use is much lower than the national average (just 7% of Australia's air conditioning use, from DEWHA). Our approach results in a much lower estimate of savings.
- attribute a portion of Victorian MEPS savings to CitiPower – this has been done by prorating Victorian savings in accordance with CitiPower's estimated market share based on total Victorian distributed energy as outlined in AER (2008).

Table 23 outlines the results of this analysis.

Table 23: Air conditioning MEPS savings, CitiPower

Year	National savings (GWh)	Victorian share of Australian aiconditioner energy use	VIC savings (GWh)	CitiPower share of Victorian energy	CitiPower savings (GWh)	NIEIR estimate (GWh)
2009	41	7%	2.8	17%	0.5	0.0
2010	84	7%	5.8	17%	1.0	0.5
2011	130	7%	9.0	17%	1.5	1.3
2012	178	7%	12.3	17%	2.1	2.4
2013	227	7%	15.7	17%	2.6	3.5
2014	277	7%	19.2	17%	3.2	4.5
2015	327	7%	22.6	17%	3.8	5.4

Source: Air con MEPS RIS (2008), AER (2008), NIEIR (2009), DEWHA (2008)

3.5.4 Double counting

The revised air conditioning MEPS RIS states;

> For the purposes of modelling costs and benefits, a constant real electricity price is assumed for both the BAU scenario and the proposal (p.110);

It appears that the savings calculated and reported in the RIS are referenced to a base case that **does not** consider the impact of higher electricity prices (due to the CPRS) on energy use for air conditioners. A reduction in energy use as a result of the CPRS (higher electricity prices) would likely reduce the potential energy savings associated with the air-conditioning MEPS, though this reduction would be small. Given the low level of savings related to the air conditioning MEPS estimated by NIEIR, we do not consider this to be a material issue.

3.5.5 Summary

In our view, it is reasonable to adjust the energy forecasts to account for the impact of the revised air-conditioning MEPS introduced in 2010. The estimates take into account savings already achieved as a result of prior MEPS. Based on Frontier's analysis of the air conditioning MEPS RIS, and given the very small impact on overall energy use, NIEIR's estimates of energy savings due to the revised air conditioning MEPS are reasonable.

3.6 Standby power

3.6.1 Overview

In 2000, all Australian jurisdictions endorsed the International Energy Agency's One-Watt program for standby power.[51] This was developed into a 10 year National Standby Strategy, released in 2002. The MCE describes Australia's 10 year standby power strategy as a two-stage process:

- Stage 1 – a product profile is developed for all key products. These profiles outline standby power performance and targets for standby power. Stage 1 allows industry to take voluntary actions to improve standby power performance. These voluntary interim targets apply to 2007, though the targets are not at strict as the final 1W target.
- Stage 2 – in instances where voluntary action under stage 1 is shown to be inadequate and/or where the MCE accepts that regulation is necessary to achieve the standby target, stage 2 involves mandatory standby performance measures. The mandatory targets apply to 2012.

As an example of the differences between the interim and final targets, DVD players, VCRs, Stereos, Home Theatre Systems and Set-Top Boxes all face a voluntary interim 2007 target of 4W and a mandatory 2012 target of 1W for standby mode. This means that there will be significant scope for further gains in the near future, and the product profiles estimate that most gains will be achieved after 2010.

The presence of mandatory 'stage two' measures indicates that achievement of the 'One Watt' standby target is likely to occur in the future – products or industries that do not voluntarily achieve the One Watt target are likely to be faced with direct regulation (e.g. MEPS) to ensure compliance.

3.6.2 NIEIR's approach

NIEIR state that ABS catalogue 6402.0 and the Residential Power Store Survey 2008-9 were used in deriving standby power savings. NIEIR's post-model adjustment to account for policies regarding standby power represent a material share of total post-model energy adjustments – by 2015 NIEIR's standby power adjustment amounts to 25 GWh for CitiPower.

3.6.3 Frontier's approach

We have derived residential saving estimates using a report prepared by Energy Efficient Strategies titled *Standby Power – Current Status* (EES, 2006). This report

51 MCE (2002).

was prepared by EES for the Equipment Energy Efficiency Committee in October 2006 and presents the findings of a detailed household standby power survey conducted by the Equipment Energy Efficiency Committee in 2005 involving 120 households in Brisbane, Melbourne, Sydney and Gippsland.

Based on data provided in EES (2006), Frontier has consolidated estimates of standby power usage for a range of common household appliances. These estimates are outlined in Table 24.

Table 24: Standby power usage for common household appliances (watts/household)

Product	Category	Watts per household	Contribution to total (%)
Television	Television	6.20	7.5%
VCR	Home entertainment	5.90	7.1%
Stereos (integrated)	Home entertainment	5.40	6.5%
Computers	Computer/peripheral	5.10	6.2%
Cordless phone	Telephones/other	3.70	4.5%
Modems	Computer/peripheral	3.40	4.1%
Monitors	Computer/peripheral	3.30	4.0%
Air con	Major appliance	2.70	3.3%
Clock radio	Other	2.7	3.3%
DVD	Home entertainment	2.40	2.9%
Misc	Home entertainment	2.3	2.8%
Microwave	Major appliance	2.20	2.7%
Misc	Computer/peripheral	2.1	2.5%
Printers	Computer/peripheral	2.10	2.5%
Computer speakers	Computer/peripheral	2.00	2.4%
Scanners/other	Computer/peripheral	2.00	2.4%
Set-top boxes	Set-top box	1.90	2.3%
Washing machine	Major appliance	1.50	1.8%
Pool	Other	1.4	1.7%

Product	Category	Watts per household	Contribution to total (%)
Facsimile	Computer/peripheral	1.3	1.6%
Gas heaters	Major appliance	1.30	1.6%
Garage door	Monitoring/continuous	1.20	1.4%
External power supplies	External power supplies	1.00	1.2%
Stereos (portable)	Home entertainment	1.00	1.2%
Gas water heaters	Major appliance	1.00	1.2%
Home theatre	Home entertainment	0.70	0.8%
Dishwasher	Major appliance	0.70	0.8%
Burglar alarms	Monitoring/continuous	0.70	0.8%
Answering machine	Telephones/other	0.50	0.6%
Game consoles	Other	0.40	0.5%
Smoke alarms	Monitoring/continuous	0.20	0.2%
Photocopiers	Telephones/other	0.20	0.2%
Cookers/ovens	Major appliance	0.10	0.1%
Dryers	Major appliance	0.10	0.1%
Portable heaters	Major appliance	0.10	0.1%
Motion sensors/lights	Monitoring/continuous	0.10	0.1%
Rangehoods	Major appliance	0.00	0.0%
Breadmakers	Other	0.00	0.0%
Coffee machine	Other	0.00	0.0%
Total	–	**68.90**	**83.2%**

Source: EES (2006).

In estimating standby power savings, Frontier has made several modifications to this set of data:

- given that both air conditioners and televisions are subject to MEPS, the contribution of these appliances to total standby energy use has been excluded;
- the EES (2006) report finds that the sample-weighted standby power usage of computers surveyed was 14.5 watts (p.47). However, this estimate included roughly 8% of computers that were left in continual operation (servers, etc). For this reason we have used the average 'off mode' power usage estimate of 5.1 watts (p.47) since more stringent standby power measures are unlikely to deliver any savings from the 8% of computers left in continual operation. This will result in a lower estimate of potential energy saving;
- the standby power usage for appliances reported in EES (2006) covers roughly 83% of estimated household standby power. Grossing up the total standby power usage reported in Table 24 for the remaining 17% results in an average household standby power estimate of 82.8 watts.

To calculate potential savings due to the One Watt standby target, we have compared total average household standby energy consumption under two scenarios:

- Business as Usual – household appliance standby usage is as outlined in Table 24 above.
- One Watt Standby – all household appliances listed in Table 24 conform to a 1 watt standby target. Remaining household standby usage is equivalent to usage under Business as Usual.

To convert watt savings to annual GWh savings, we assume that all appliances listed in Table 24 operate in standby mode 67% of the time (equivalent to 16 hours a day, 365 days a year).

Average household kWh savings are multiplied by the number of CitiPower residential customers to estimate total energy savings (GWh). The 17% of household standby power usage not captured by the appliances in Table 24 is assumed to remain at existing levels across both scenarios. The results are reported in Table 25. We include estimates with and without TV and air-conditioning in the Table, though we base our final estimates on the savings excluding TV and air-conditioning.

Table 25: Total standby power savings, CitiPower - GWh

Standby energy use	Business as Usual	One Watt Standby	Savings
Average household (kWh/year) – including TV and air-conditioning	478	234	244
Average household (kWh/year) – excluding TV and airconditioning	427	220	207
Total: CitiPower (GWh) – including TV and air-conditioning	119.7	58.6	61.1
Total: CitiPower (GWh) – excluding TV and air-conditioning	106.8	55	51.8

Source: EES (2006), AER (2008), Frontier calculations

The GWh estimate of standby power savings presented in Table 25 reflects the **maximum** achievable residential savings assuming that all appliances in Table 24 achieve the One Watt target. This maximum total saving can be presented as an annual saving by:

- making an assumption regarding when standby power savings are likely to have commenced and when they are likely to be fully realised.
- making an assumption regarding how total standby power savings accrue each year (i.e. front/back-loaded, linear, etc).

To annually apportion total savings, we have made the following simplifying assumptions:

- that savings start from 2005 and are completely realised by 2020. This reflects a 15 year 'replacement window' during which existing appliances can be replaced with substitutes that conform to the 1 watt target. This is likely a conservative timeframe, as appliance replacement is likely to be quicker than 15 years. Assuming that savings commence from 2005 results in a discount on potential policy savings from 2011, as it includes these savings in the business as usual scenario. Savings prior to 2010 are not included in our estimate of savings resulting from the policy.
- that savings accrue linearly over this time. That is, an equal portion of total standby power savings is realised each year. This is likely to be conservative given that the targets will become mandatory and more stringent between 2007 and 2012.

Based on the data reported in Table 25 and the above two assumptions, we have calculated annual residential savings for CitiPower for 2011-2015. The results and a comparison with NIEIR's estimates are reported in Table 26.

Table 26: Residential standby power savings, CitiPower (GWh): 2011-2015

	2011	2012	2013	2014	2015
Frontier	3.2	6.5	9.7	13.0	16.2
NIEIR	2.9	8.6	14.4	18.0	19.4

Source: EES (2009), AER (2008), Frontier calculations, NIEIR (2009).

3.6.4 Double counting

It is unlikely that there would be significant overlap between policies directed at standby power and the other policies considered, since most other policies are directed at either greater efficiency of appliances in active use, or reduced use of appliances. Neither of these purposes overlap with reduced power consumption in standby.

3.6.5 Summary

In our view it is reasonable to make adjustments to energy forecasts to account for the One Watt Standby policy because although there are existing interim targets for standby power in 2006-8, these targets are voluntary and more lenient than the proposed mandatory targets from 2012.

Frontier's estimates are marginally lower than the standby power savings reported by NIEIR, though these are within reason given uncertainty regarding the impacts. Our estimates are considerably lower than the estimates provided by Maunsell|AECOM[52], who estimate that standby power savings for CitiPower will be 9.1 GWh in 2011 rising to 46 GWh in 2015.

Maunsell|AECOM do not make any adjustment for computers – they assume that average standby is 14.5 W. As discussed above, we believe that this overstates the potential standby power savings given that this 14.5W includes computers left in continual use (such as servers). More stringent standby power measures are unlikely to deliver any savings from computers left in continual operation.

Frontier has not calculated standby power savings attributable to commercial customers due to a lack of transparent data regarding appliance usage in the commercial sector. Given that NIEIR's estimated standby savings for

52 Maunsell|AECOM (2009).

commercial customers are very low and NIEIR's estimate for residential savings is sound, we recommend accepting the NIEIR estimates for commercial savings.

3.7 VEET

3.7.1 Overview and NIEIR approach

NIEIR discuss the Victorian Energy Efficiency Target (VEET) in section 6.6 of their report. The scheme commenced on January 1, 2009 with a targeted greenhouse gas reduction of 2.7Mt per year in Phase 1 (2009, 2010 and 2011). Prescribed activities include:

- Lighting
- Water heating
- Space heating
- Space conditioning (insulation, window replacement, weather sealing)
- Low-flow shower heads
- Purchase of high efficiency refrigerator/freezer.

To avoid double counting of insulation under the Federal Government Energy Efficient Homes package, insulation was removed from the prescribed activities mid-2009. DPI initially estimated that this would contribute around 1.4Mt of abatement toward the three year target of 8.1Mt, though the target was not revised when this activity was removed. This removes any prospect of double counting of insulation activities.

NIEIR correctly point out that the VEET recognises deeming; energy savings over 10 years are recognised upfront, so a solar water heater that delivers 3t saving per year will earn 30 certificates upon installation. This is equivalent to borrowing future energy savings to create credits/permits today, so the 2.7Mt per annum target in 2009, requires 0.27Mt of energy savings per year over ten years. This means that the effective required savings are 0.27Mt in 2009, 0.54Mt in 2010 and 0.81Mt in 2011. To convert electricity greenhouse savings to energy (GWh), we adopt the same assumption as DPI in their calculations (0.9tCO2/MWh). This reflects the emissions intensity of the marginal generator displaced, not the average (which would be higher). This results in an annual increase in required savings of 300GWh, or 1,800GWh/year if the target continues to increase to 2014.

NIEIR assume that two-thirds of the target will be met through electricity measures, as opposed to gas. To account for potential overlap with other policies (lighting, hot water, insulation and heating), NIEIR only include 10% of savings as 'additional' to savings delivered from other policies. This safely addresses any issues of potential double-counting of energy savings. We have attempted to replicate these calculations in Table 27.

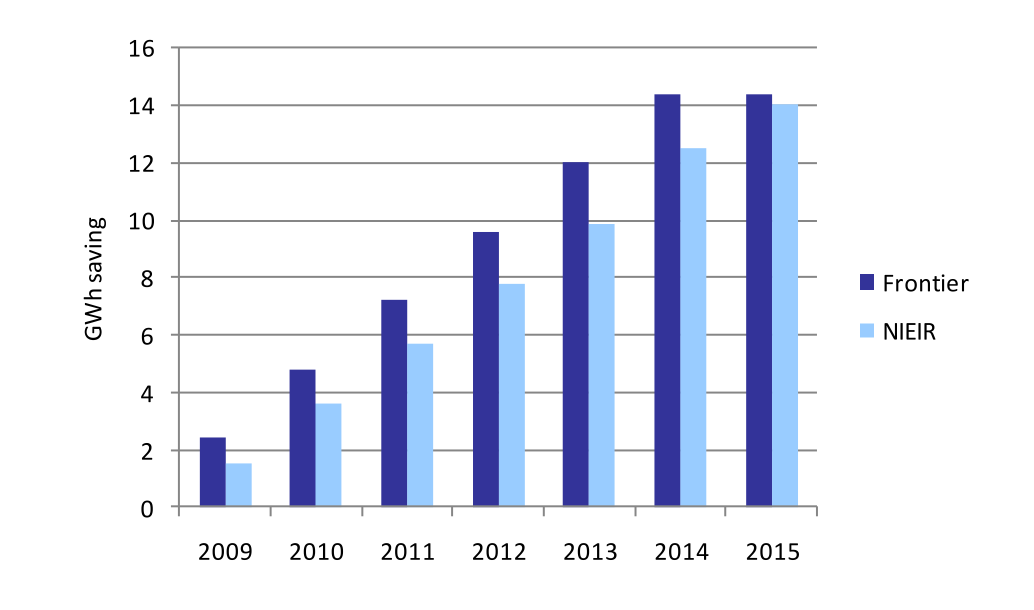
CitiPower's share is calculated based on residential customer share – 12% of Victoria. If we assume that only 10% of savings are 'additional' to other policies, then the annual savings are very similar to the NIEIR estimates (based on essentially the same assumptions). We test this assumption in the following section.

Table 27: VEET savings for CitiPower (2009-2015)

Year	Annual savings required (Mt)	Annual target (GWh) (0.9tCO2/ MWh)	Electricity contribution (GWh) (66%)	CitiPower Savings (GWh) (12%)	CitiPower savings counted* (GWh)	NIEIR estimate (GWh)
2009	0.27	300	200	24	2	2
2010	0.54	600	400	48	5	4
2011	0.81	900	600	72	7	6
2012	1.08	1200	800	96	10	8
2013	1.35	1500	1000	120	12	10
2014	1.62	1800	1200	144	14	12
2015	1.62	1800	1200	144	14	14

Source: NIEIR, Frontier calculations
*Notes: * 10% of actual savings to avoid double-counting*

Figure 18: VEET savings for CitiPower (2009-2015)



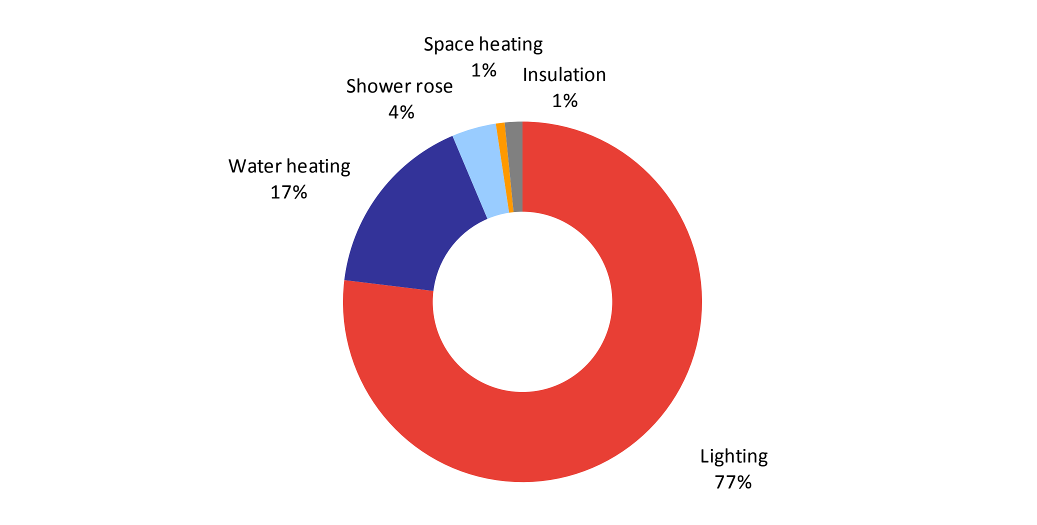
Source: NIEIR, Frontier calculations

3.7.2 Double counting

NIEIR's assumption that 10% of savings are in addition to savings from other policies is conservative, particularly in light of the fact that insulation has since been excluded as a prescribed activity to avoid the problem of double counting.

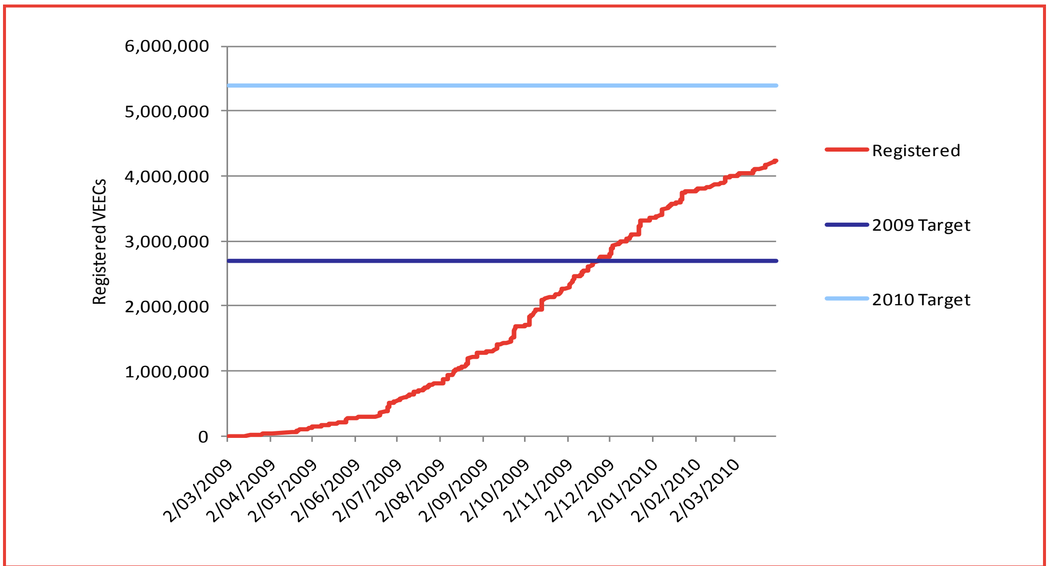
Recent information from the ESC regarding registered VEECs is useful in assessing the extent of potential overlap. Approximately 77% of VEECs registered have been for energy efficient lighting in the first 15 months of the scheme, while water heating accounts for another 17% (Figure 19). We can compare this against the savings predicted by the lighting MEPS to determine how much of this saving is 'additional' to savings generated by other policies.

Figure 19: VEET activities (by registered certificates, 2009-10)



Source: ESC information session, VEET (2010).

Figure 20: Registered VEECs



Source: VEET Registry.

Given that the vast majority VEECs to date have been created by lighting (77%), we have focussed on comparing lighting savings under the VEET against the lighting MEPS. Our methodology for this test is as follows:

- we adapt the analysis from above to consider the lighting contribution to the VEET targets and compare this against the DEWHA lighting analysis to see whether the VEET savings can be sustained. Put differently, we test whether the lighting savings inferred from VEET are plausible based on DEWHA data;

- we compare this against the estimated lighting MEPS savings (Section 3.3); the difference represents the 'additional' savings generated by the VEET in lighting electricity alone; and
- we calculate the CitiPower share of these additional savings.

To estimate the future contribution of lighting savings to VEET, we assume that:

- each activity creates permits for 10 years worth of future energy savings in year 1 (due to deeming), so we divide the annual target (2.7Mt) by 10 to estimate annual savings (0.27Mt). In other words, a solar hot water system will create 30 RECs when installed, reflecting annual savings of 3 tonnes over 10 years;
- each MWh energy saving results in 0.9tCO2 saving in emissions. So the 3 tonnes annual emissions saving from a solar hot water unit reflects an annual energy saving of 3.3MWh;
- lighting contribution to the total VEET target commences at 77% of all savings (the current level) and declines by 10% per year to 17% by 2015:

Given that the annual savings implied by VEET grows to 1800GWh by 2014, Victorian residential lighting *savings* would have to grow to nearly 1400 GWh per year by 2015 to continue to contribute 77% of the VEET savings. Total Victorian residential lighting use is currently around 2100 GWh (without MEPS) and is predicted to fall to 1550 GWh (with MEPS) – a reduction of 550GWh. This would need to fall a further 900GWh for lighting to continue to contribute 77% of all VEECs. On the face of it, this appears unlikely under the DEWHA lighting analysis; it would require a reduction in the share of quartz halogen in living areas from 35% (which DEWHA assume is maintained) to around 6%.

The lighting share of VEECs actually fell from 79% (2009) to 69% in the first quarter of 2010, which is consistent with the decline assumed above. This suggests that lighting may be the 'low-hanging fruit' which contributes the bulk of initial savings, though it's contribution to VEET will likely decline over time. The implication is that the VEET will bring forward the lighting savings predicted by the MEPS.

To understand whether these savings are plausible, we consider the implied savings from residential lighting under VEET (column 4) against the residential MEPS savings implied by DEWHA (column 2) in Table 28. The maximum savings implied under the VEET (564 GWh) is less than the maximum savings implied under DEWHA's estimated impact of the MEPS (609GWh), which suggests that the lighting share of VEET is reasonable and that VEET will bring forward savings that would be achieved later. We subtract (a) the residential lighting MEPS savings from (b) the lighting contribution to VEET to determine

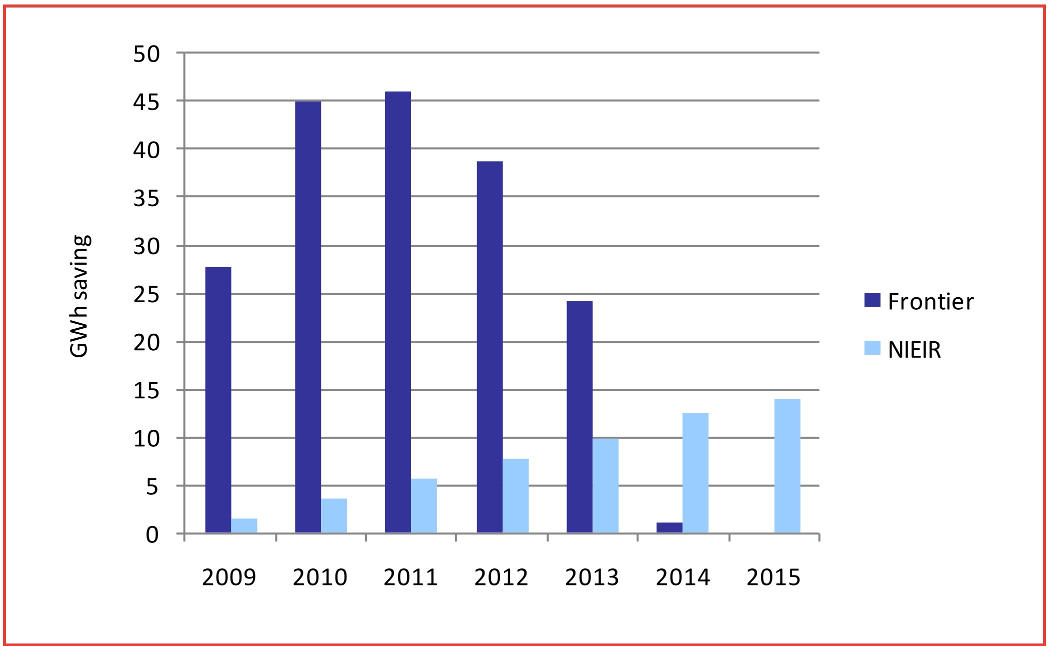
(c) the additional lighting savings from VEET. These estimates are then used to calculate the additional residential savings in the CitiPower region.

Table 28: Additional VEET savings for CitiPower (2009-2015)

Year	Residential lighting saving from MEPS, GWh (DEWHA)	Assumed lighting contribution to VEET		Additional lighting savings from VEET (GWh)	
		%	GWh	Vic	CitiPower
2009	0	77%	231	231	27.7
2010	27	67%	402	375	45.1
2011	129	57%	513	384	46.1
2012	241	47%	564	323	38.8
2013	353	37%	555	202	24.2
2014	477	27%	486	9	1.1
2015	609	17%	306	0	0.0

Source: DEWHA (2008), VEET registry, lighting MEPS RIS, Frontier calculations

Figure 21: Additional VEET savings for CitiPower (2009-2015)



Source: NIEIR, Frontier calculations

Policy adjustments

These savings are larger in aggregate when compared with NIEIR's estimated additional savings (which assume that 10% of VEET savings are additional), and the projected savings are realised more quickly than under NIEIR's assumption (Figure 18). The cumulative savings under our estimates from 2009-2015 would be equivalent to NIEIR assuming that 25% of the VEET target is 'additional'. This only includes the potential additional savings from lighting; other sources (such as hot water) would increase the additional savings.

While we have used an estimate of the DEWHA residential lighting savings to derive 'additional' savings, an alternative is to use an estimate of the residential lighting savings implied by the RIS. In aggregate, the RIS concludes that residential savings comprise 49% of total savings (Table D4, p160), which implies annual Victorian savings of 360 GWh by 2015. Using this lower estimate of residential savings from the MEPS will result in a higher estimate of the additional residential lighting savings driven by the VEET. We have tested this alternative and the combined effect of both policy effects is almost equivalent under each set of assumptions (though the relative mix between Lighting and VEET savings is different).

3.7.3 Summary

In our view, it is reasonable to adjust the energy forecasts to account for the impact of the VEET. The VEET was only introduced in 2009 and the bulk of certificates were registered in the latter half of the year – this means that energy savings associated with these are unlikely to be reflected in the model forecasts.

Whilst there is overlap between lighting MEPS savings and the VEET, our analysis suggests that the VEET will result in greater savings prior to 2015 than under the lighting MEPS alone. We consider the NIEIR figures on VEET to be too low because they simply assume that 10% of VEET savings are additional to other programs. When we consider actual VEEC activity to date, it implies that lighting savings under the VEET will contribute material savings additional to the lighting MEPS. These gains would be achieved more quickly, and at a level that equates to 25% of the VEET savings being additional to other programs.

3.8 Federal insulation program

3.8.1 Overview

The Australian Government's Energy Efficient Homes Package (EEHP, February 2009) was a $3.9 billion package to improve the energy efficiency of Australian homes. Under this program the Australian Government offered:

- free ceiling insulation worth $1,200-$1,600 in around 2.7 million Australian homes with limited or no ceiling insulation or

- a $1,600 rebate on the costs of installing a solar hot water system

The program was intended to run until 2012. The Home Insulation Program (HIP) was discontinued 19 February 2010, though it was announced that it would be replaced with an alternative program from June 2010. On 22 April 2010 the Australian Government announced that it was abandoning the scheme that was to replace the Home Insulation Program.[53] This announcement was made after the NIEIR report was released, so it is not reflected in the NIEIR estimates.

3.8.2 NIEIR's approach

NIEIR estimate annual residential savings of 15.4 GWh as a result of the Home Insulation Program. NIEIR refer to the proportion of homes without insulation (or those that do not know whether they have insulation) and the potential space conditioning (heating and cooling) energy savings resulting from ceiling insulation (30-35%). NIEIR then discuss factors which would discount the potential savings, such as a rebound effect for higher comfort levels, less than 100% coverage and potential Business as Usual savings.

3.8.3 Frontier's approach

The NIEIR estimates were provided prior to the cancellation of the program that was to replace the HIP. However, given the rapid take-up of insulation prior to the cancellation of the scheme, this does not necessarily mean that the potential savings should be entirely discounted.

Take-up rate

Data available from the Insulation Council of Australia and New Zealand[54] (ICANZ, 2009) suggests that gains would already have been achieved (Table 29). The cumulative claims provided by ICANZ show that 835,803 – 30% of the estimated 2.7 million uninsulated homes – were insulated under the scheme. This is only until December 2009, while more recent evidence suggests that total claims were 1.1 million by the time of cancellation.[55] As such, the ICANZ estimates for Victoria are conservative. This implies a take-up rate of 28% of uninsulated homes prior to the cancellation of the scheme.

53 http://www.environment.gov.au/eehp/index.html

54 Submission to Senate Standing Committee on Environment, Communications and the Arts, Inquiry into the Energy Efficient Homes Package

55 http://www.climatechange.gov.au/minister/combet/2010/media-releases/April/mr20100401a.aspx

Table 29: Insulation claims under EEHP, to December 2009

	Insulated under EEHP	Remaining uninsulated	Total uninsulated (prior to EEHP)	% Insulated under EEHP
NT	1,490	26,510	28,000	5%
TAS	10,421	38,579	49,000	21%
SA	18,995	114,005	133,000	14%
WA	46,653	218,347	265,000	18%
VIC	133,096	337,904	471,000	28%
QLD	265,775	577,225	843,000	32%
NSW	356,730	620,270	977,000	37%
ACT	2,643	19,357	22,000	12%
Total	835,803	1,952,197	2,788,000	30%

Source: ICANZ(2009)

Victoria has a relatively low share of uninsulated homes, estimated at around 23% in 2008 (Table 30). This is based on 8.5% without insulation, plus 80% of those who don't know if they have insulation (17.7%). Those who don't know are typically renters, and rental properties are less likely to have insulation than owner-occupied. Multiplying the share of uninsulated homes taking up insulation (28%) by the share of uninsulated homes as a proportion of all homes (23%) results in overall take-up across all households of 6.6%.

Table 30: Victoria homes with/without insulation (%)

	1994	1999	2002	2005	2008
With	69.5	71.3	72.1	72.3	73.8
Without	17.0	12.4	12.1	9.2	8.5
Don't know	13.5	16.3	15.8	18.5	17.7
Without + 80% of Don't Know	28	25	25	24	23

Source: ABS 4602.0.55.001, Table 2.12

Space conditioning energy use

Data available from DEWHA (2008) is used to estimate electricity use for space conditioning (heating and cooling) in Victoria (Table 31). Although Victoria has a very low share of households with electric heating, average use of electricity for heating in those households is particularly high. Conversely, despite Victoria's high penetration of air-conditioning, the average use per household is relatively low compared with other states. In total, Victorian households consume around 550 kWh per year for heating and cooling, or 10.6% of total residential consumption.

Table 31: Average electricity use for heating/cooling, Victoria

Category	Average
Dwellings with electric heating (%)	15.1%
Average electricity use for heating (MWh/yr)	0.45
Heating electricity use in dwellings with electric heating (MWh/yr)	3.01
Dwellings with air-conditioning (%)	70%
Average electricity use for air-conditioning (MWh/yr)	0.10
Cooling electric use in dwellings with air-conditioning (MWh/yr)	0.14

Source: DEWHA (2008), Frontier calculations

Savings

NIEIR's estimate of 35% saving is more conservative than the Commonwealth Government, which assumed savings of 40% of energy[56]. Adopting NIEIR's estimated 35% energy saving as a result of insulation gives 195 kWh annual electricity saving per household that retrofits insulation. Based on a take-up of 6.6% across all households (prior to cancellation of the scheme) this implies an average of 13 kWh/year across all households, or 0.25% of average residential consumption. Given the 249,000 residential customers in the CitiPower region, this would equate to annual savings of 3.2 GWh. This represents 20% of

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56 Senator the Hon. Penny Wong, Minister for Climate Change, Energy Efficiency and Water Government response to recommendations of the strategic review of Australian Government climate change programs, 12 May 2009. http://www.climatechange.gov.au/minister/wong/2009/media-releases/May/Budget%202009-10/budmr20090512h/wilkinsresponse.aspx

The Hon Peter Garrett MP, Minister for the Environment, Heritage and the Arts, New Liberal Party solar panel policy, Media release 5 January 2010 http://www.environment.gov.au/minister/garrett/2010/mr20100105a.html

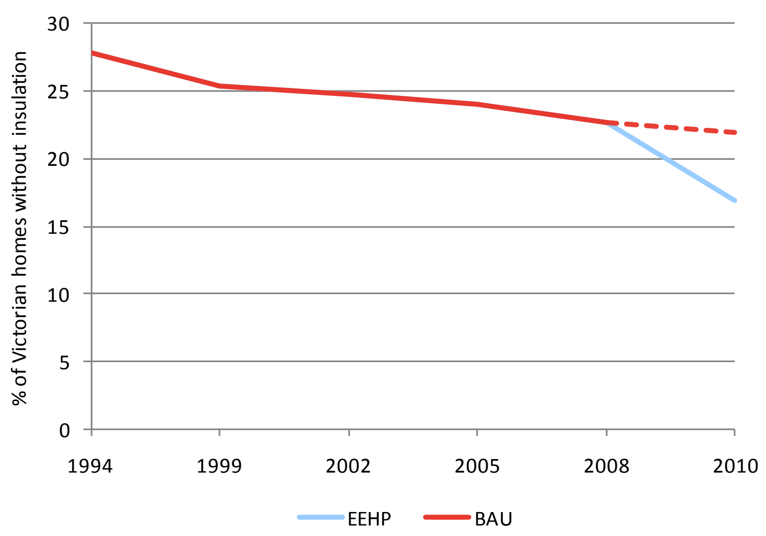
NIEIR's estimated 15.4 GWh saving, which would largely be explained by the early termination for the scheme.

Like NIEIR, we would discount these savings to account for the fact that there is invariably a rebound effect whereby part of the insulation benefits are realised as reduced energy consumption while the rest is still consumed as households enjoy higher comfort levels. However, energy use for heating/cooling in uninsulated homes is likely to be greater than in insulated homes while the calculations above are based on average heating/cooling consumption across all homes (insulated and uninsulated). This would tend to understate the potential savings from insulation. On balance, it would appear reasonable to assume that these effects (or biases in estimation) would cancel out.

3.8.4 Double counting

The estimated savings are additional to business as usual projections: the rate of uptake under the EEHP (Table 29) clearly shows a deviation from the recent trend for Victorian insulation rates (Table 30). This is illustrated in Figure 22. The largest potential for double counting of energy savings would be possible overlap with the VEET scheme. However, insulation was specifically excluded as a recognised activity under the VEET to avoid this issue.

Figure 22: Share of Victorian homes without insulation



Source: ABS 4602.0.55.001 Table 2.12, Frontier estimates

3.8.5 Summary

It is reasonable to include an adjustment for the insulation scheme because:

- The introduction of the policy in 2009 means that none of the gains would be reflected in NIEIR's initial projections, which justifies a post-model adjustment;
- Evidence suggests that at least 30% of uninsulated homes have already received insulation as a result of the scheme, before its cancellation.

The general approach and estimates provided by NIEIR are reasonable if the scheme had continued in its proposed form. The subsequent cancellation of the scheme means the NIEIR estimates overstate the potential energy savings; we have adjusted these downwards to account for this.

3.9 Solar Photovoltaic (PV)

3.9.1 Overview

Solar panel systems can earn revenue under a number of Federal and State Government programs, including:

- A rebate under the Federal Government's Solar Homes and Communities Plan (SHCP). This started out as the Photovoltaic Rebate Program offering $4,000 rebates in 2000. When the program was changed in November 2007, the rebate was increased up to $8,000 per installation. In May 2008, a means test was introduced ($100,000 income per household). In June 2009 the SHCP was cancelled and replaced with the Solar Credits scheme;
- The Solar Credits Scheme (Renewable Energy Certificates under the MRET). Prior to the cancellation of the SHCP (June 2009), small scale solar PV systems were eligible for 1 REC per MWh generated. The SHCP was replaced by a multiplier on RECs for systems up to 1.5kW. This means that small scale solar systems can create 5 RECs for each MWh generated in 2009/10, 2010/11 and 2011/12; 4 RECs per MWh in 2012/13; 3 RECs per MWh in 2013/14 and 2 RECs per MWh in 2014/15. From 2015/16, each MWh creates 1 REC.
- A Net Premium Feed-in Tariff in Victoria, introduced November 2009. Households can earn at least $0.60c per kWh of unused energy generated and fed back into the Victorian grid (for systems up to 5kW).

It is difficult to generalise on the net effect of these policies: within a short period the SHCP rebate was increased, a means test was introduced and then the scheme was cancelled and replaced with the REC multiplier. This means that net rebates (and incentive to install solar PV) will generally increase for households on incomes above $100,000, but will generally decrease for households on incomes below $100,000. It is difficult to know the marginal rebate required for each type of household to install a solar PV system, and hence the net effect of these changes. Early evidence suggests that this led to an initial increase in installations. However, the REC multiplier declines over time, which suggests that the rate of installations will slow. The value of the Victorian Feed-in Tariffs depends on household energy use and the proportion of excess energy fed into the grid.

3.9.2 NIEIR's approach

Energy demand reductions due to the take-up of small-scale photovoltaic systems accounts for a very small proportion of NIEIR's total post-model policy adjustments – for CitiPower savings amount to roughly 1.1 GWh in 2009 rising to 4.0 GWh in 2015.

Based on the discussion provided, it appears NIEIR have used the following key assumptions:

- initial stock of installed PV in Victoria is assumed to be 5 MW as at the beginning of 2008/9.
- annual assumed installations in Victoria (Table 6.14 of NIEIR's report) are assumed to be 10,000 in 2008/9, 14,000 in 2009/10, 5000 over the period 2010/11 to 2012/13, 4000 in 2013/14 and 3000 in 2014/15.
- a 'typical' 1 kW system in Melbourne is assumed to produce approximately 1.2 MWh per year. This implies an approximate assumed annual capacity factor of 1.2/8.76 = 13.7%.
- that 56.7% of PV energy generated is used by household, with the remaining 43.3% being fed back into the grid.
- an average PV system size of 1.2 kW.

3.9.3 Frontier's approach

Frontier has estimated energy savings using key assumptions and data from the Solar Homes and Communities Plan provided by DEWHA (DEWHA, 2010).[57] The DEWHA data ranges from Jan-2000 to Mar-2010 and provides monthly PV installations (watts and number of units) under the SHCP scheme. Total cumulative kW and unit installations over the period for Victoria are shown in Figure 23.

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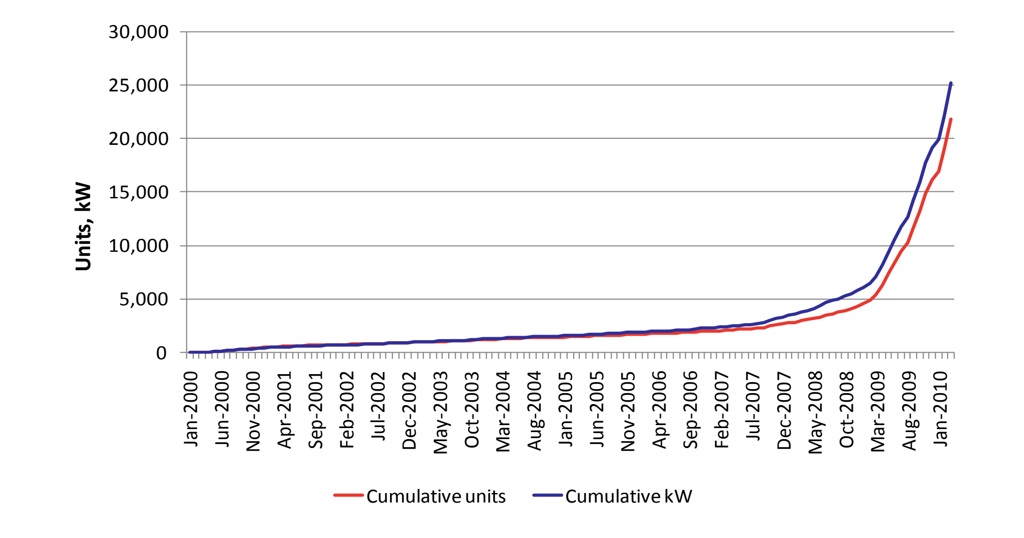
[57] http://www.environment.gov.au/sustainability/renewable/pv/history.html.

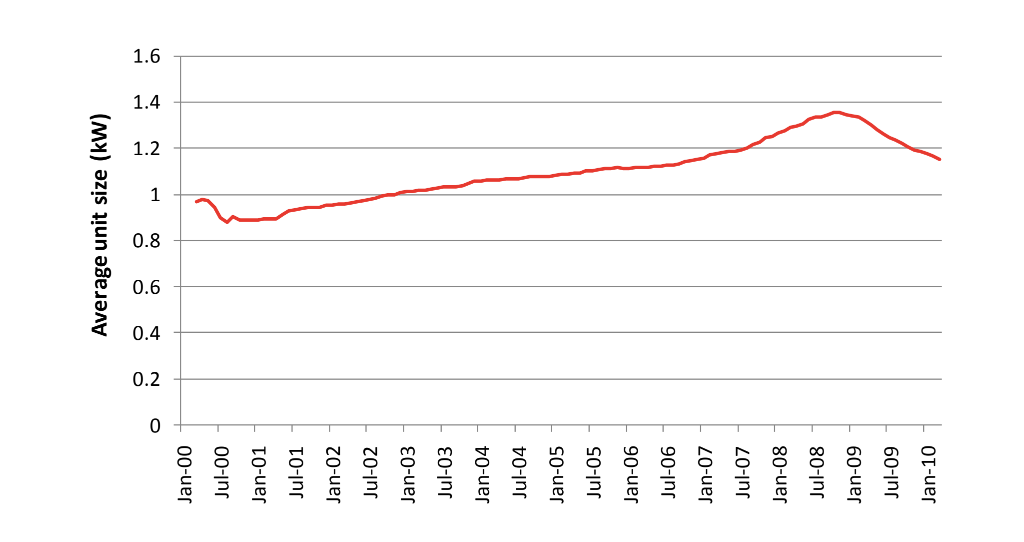
Figure 23: Monthly cumulative installed PV systems - Victoria



Source: DEWHA (2010), Frontier calculations

Using this data it is possible to calculate a monthly average installed PV system size (kW), based on cumulative unit and watt installations. The results for Victoria are presented in Figure 24. Average system size was rising until mid-2008, peaking at roughly 1.35 kW, but has fallen since changes were made to the SHCP . The average installed unit size as of March 2010 is 1.15 kW.

Figure 24: Monthly average system size – Victoria (kW)



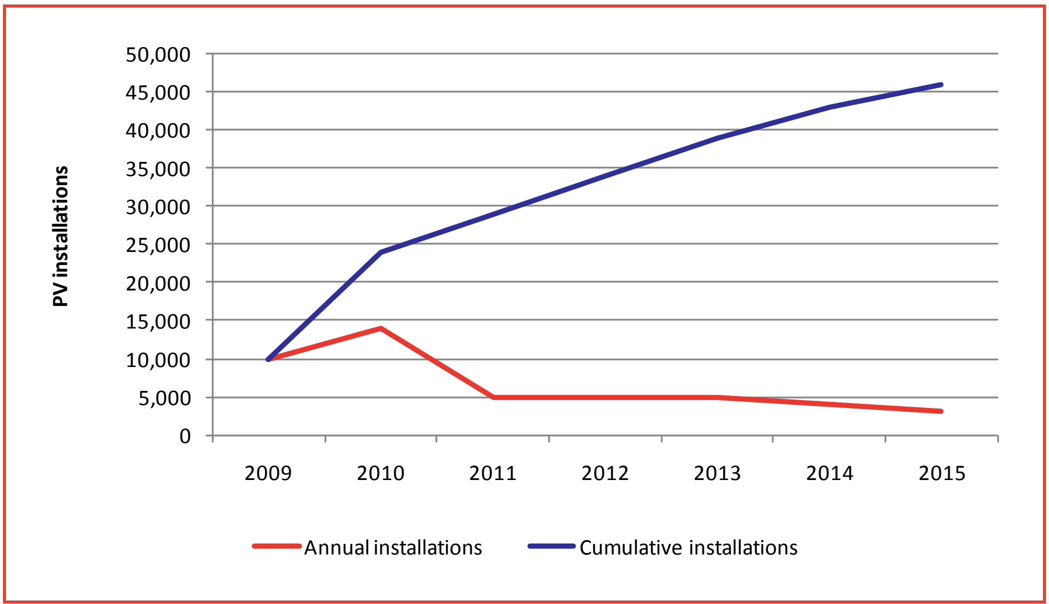
Source: DEWHA (2010), Frontier calculations

The key assumption in determining savings due to small-scale PV up-take is the likely number of units installed going forward. The large increase in installations evident from Figure 23 was likely driven by two key factors:

- Government rebates – firstly under the SHCP ($8/watt up to $8000, later means-tested) and more recently under the Solar Credits (REC multiplier) scheme and the Victoria Feed-in Tariff;
- The falling cost of PV units.

The NIEIR report estimated PV installations for Victoria over the period 2008/9 to 2018/19 in Table 6.14 of their report. The data (presented in Figure 25) shows that NIEIR assumed that annual installations of PV systems are likely to fall over the period 2010-2015. This drop is likely predominately due to NIEIR's assumptions regarding PV uptake under the (declining) Solar Credits (REC multiplier) scheme as compared to up-take under the former SHCP scheme. This assumed rate of installations is reasonable given the considerable uncertainties discussed in the Overview of this section.

Figure 25: Victorian PV installations: 2009-2015



Source: NIEIR (2009)

We regard NIEIR's assumed rate of new installations and their assumption regarding the share of PV energy consumed relative to energy fed back into the grid as reasonable. Frontier has sought to derive energy savings estimates based on the following assumptions:

- the stock of installed PV systems in Victoria in 2009 is taken to be 8,386 units (10,573 kW) based on the DEWHA data.
- NIEIR's implied growth rates in the cumulative stock of installed Victorian PV systems from 2009 for the period 2010-15 (calculated from data reported in Table 6.14 of NIEIR's report).

- it is assumed that 56.7% of PV energy generated is used by household, with the remaining 43.3% being fed back into the grid (as assumed by NIEIR)
- the average size of installed PV systems in Victoria over the period 2010-15 is 1.15kW – this is the average size of installed units as of March 2010 (based on the DEWHA data).
- an annual average capacity factor for PV systems in Melbourne of 13.53%. This is calculated from the Zone 4 Solar Credits rating (1.185) for Melbourne provided by the Office of the Renewable Energy Regulator.[58]
- state-wide savings can be pro-rated to CitiPower based on CitiPower's estimated share of customers.

The results of this analysis are presented in Table 32.

Table 32: Savings due to small-scale PV, CitiPower

Year	% increase: cumulative installed units*	Cumulative installed units (VIC)	Cumulative installed MW (VIC)	GWh produced (VIC)	GWh savings (VIC)**	GWh savings (CitiPower)***
2009	-	8386	10.6	12.5	7.1	0.85
2010	140%	20126	23.2	27.5	15.6	1.87
2011	190%	24319	28.1	33.2	18.8	2.26
2012	240%	28512	32.9	39.0	22.1	2.65
2013	290%	32705	37.7	44.7	25.3	3.04
2014	330%	36059	41.6	49.3	27.9	3.36
2015	360%	38575	44.5	52.7	29.9	3.59

Source: Frontier Economics

Notes: * *Inferred from NIEIR (2009).*
** *Assumes 56.7 % used and 43.4% exported back into grid*
*** *Pro-rated based on share of total customers*

58 http://www.orer.gov.au/sgu/index.html. A rating of 1.185 implies a 1 kW PV system generates 1.185 MWh annually. The implied capacity factor is output divided by hours of the year: 1185/8760 = 13.53%.

3.9.4 Summary

The material change in rate of PV installations in Victoria (Figure 23) suggests that an adjustment to the energy projections is warranted. Policy changes have occurred as late as November 2009, with the introduction of the Victorian feed-in tariff.

We have established that NIEIR's estimated energy savings are reasonable if we accept NIEIR's assumed rate of new PV installations. Given the considerable uncertainty regarding the effect of recent policy changes, NIEIR's projections for new installations are reasonable. Most importantly, they reflect a slowing of growth in new installations in line with the decline in the solar credit multiplier.

4 Declaration

In preparing this review, I, Matt Harris, have made all the inquiries that I believe to be desirable and appropriate, and no matters of significance that I regard as being relevant have, to my knowledge, have been withheld.

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