



INTERNATIONAL

## FINAL REPORT

**Prepared For:**

EnergyAustralia

570 George Street

Sydney NSW 2000

# Independent Review of the Demand Management & Planning Project Results for the Sydney Inner Metropolitan Area

**Prepared By:**

CRA International

Level 31, Marland House

570 Bourke Street

Melbourne Vic 3000, Australia

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## 1. EXECUTIVE SUMMARY

CRA was engaged by EnergyAustralia to conduct an independent review of the potential for demand management (DM) to defer the construction of a new 330/132kV Bulk Supply Point (BSP) near the western edge of the Sydney inner metropolitan area. The review is based on the results of the Demand Management Planning Project (DMPP) – a joint initiative of the NSW Government Department of Planning (formerly Planning NSW), EnergyAustralia, and TransGrid. The objective of the DMPP is to identify load reduction opportunities on Sydney’s electrical network as a means of deferring expenditure on supply-side upgrades to meet short-term spikes in peak demand. To this end, the DMPP has, inter alia, established a comprehensive peak demand load reduction opportunity database incorporating details of on-site investigations by three consultants, and ‘roll-up’ reports aggregating the results of these investigations.

The specific terms of reference, and key deliverables, for CRA’s engagement were as follows:

- Quantifying the undiversified DM load reduction potential<sup>1</sup> for the opportunities related to the BSP catchment area listed in the DMPP database;
- Establishing the DM load reduction targets required to achieve a 1-year and a 2-year deferral of the proposed supply-side augmentation;
- Quantifying the technical potential, or diversified DM load reduction capacity<sup>2</sup> coincident with the system peak in the BSP catchment area;
- Reviewing the appropriateness of the up-front costs associated with the load reduction opportunities listed in the DMPP’s database;
- Developing a screening parameter to rank each of the identified DM opportunities from most cost-effective to least cost-effective;
- Estimating the overall costs of implementing a DM program to achieve a 1-year and a 2-year deferral of the BSP, and assessing the cost-effectiveness of such a DM program relative to EnergyAustralia’s preferred supply-side option.

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<sup>1</sup> Undiversified DM load reduction potential refers to the sum of the individual load reduction capacities identified in the DMPP database which are referenced to the time of the peak demand at each customer’s site. This addition ignores the timing of the customer’s peak demand relative to the system peak demand.

<sup>2</sup> Diversified DM load reduction capacity is an estimate of the proportion of the peak load reduction capacity at individual customer’s sites that is coincident with the system peak.

## 1.1. KEY FINDINGS

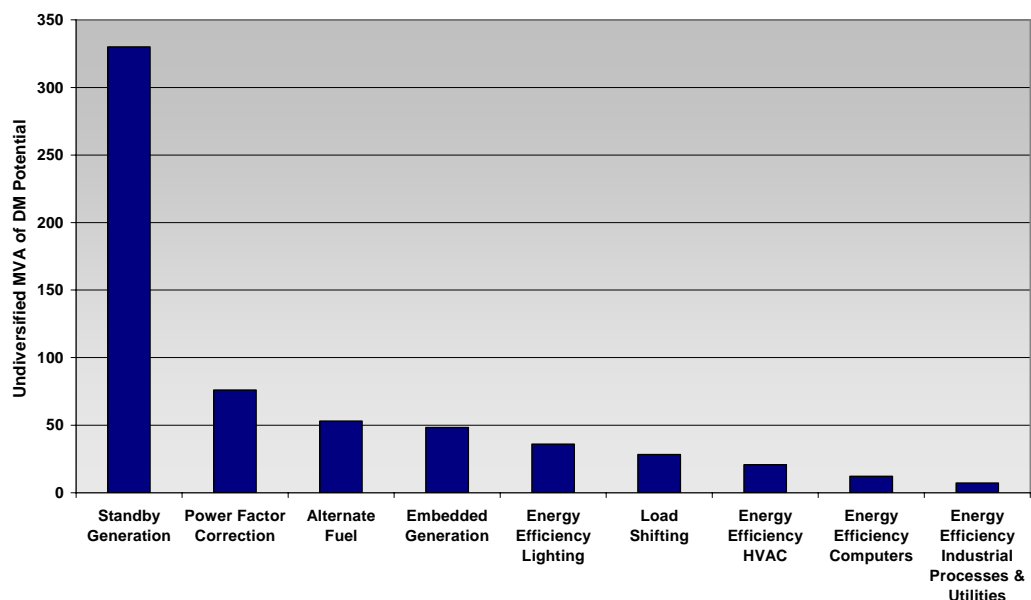
CRA's main conclusions for each of the key deliverables for this study are presented below. With the exception of the discussion regarding the up-front costs listed in the database and their 'reasonableness', the key findings presented in the Executive Summary are discussed in terms of aggregate totals for the Sydney inner metropolitan area, and in addition by disaggregated regional totals. This approach reflects the fact that the value of the DM opportunities as a means to defer the BSP varies from region to region within the Sydney inner metropolitan area.

### *Undiversified DM Load Reduction Potential*

The DMPP database lists some 3,800 opportunities to reduce the electrical demand in the catchment area associated with the BSP upgrade. CRA has estimated that, in aggregate, these opportunities have the potential to provide approximately 600MVA of undiversified DM load reduction capacity. This capacity is derived from some 600 sites and includes DM opportunities in the industrial, commercial, education, infrastructure, health, and government segments.

CRA's estimates of the undiversified DM potential for each of the major technical categories contained in the DMPP database are presented in Figure 1.

**Figure 1: Undiversified DM Potential in the Sydney Inner Metropolitan Area by Technology Category**



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Table 1 presents a breakdown of the estimated undiversified DM capacity in the Sydney inner metropolitan area by technology category and region.

**Table 1: Undiversified DM Potential in the Sydney Inner Metropolitan Area by Technology Category and Region**

Technology Category	East Zetland MVA	North Hornsby MVA	South Oatley MVA	West Homebush MVA	Total MVA
Standby Generation	86.1	4.8	12.9	46.9	333.5
Power Factor Correction	13.2	8.0	6.9	27.4	55.5
Alternate Fuel	42.4	2.7	1.6	6.2	53.0
Embedded Generation	14.8	3.0	7.0	23.5	48.3
Energy Efficiency Lighting	25.8	2.1	2.5	5.5	35.9
Load Shifting	7.1	2.6	10.9	7.7	28.3
Energy Efficiency HVAC	16.6	0.6	1.8	1.8	20.7
Energy Efficiency Computers	11.1	0.3	0.2	0.5	12.2
Energy Efficiency Industrial Processes & Utilities	3.2	0.6	0.6	2.7	7.2
<b>Total</b>	<b>220.3</b>	<b>24.7</b>	<b>44.4</b>	<b>122.2</b>	<b>594.6</b>

As can be seen from this analysis:

- The total undiversified DM potential identified in the BSP catchment area is estimated to be approximately 600MVA;
- Standby generation opportunities are by far the most significant DM opportunity with this technology accounting for approximately 55% of the total;
- Power factor correction opportunities are the next largest technical category, providing just over 9% of the identified undiversified DM resource. It should be noted that power factor correction opportunities at individual sites within the Sydney CBD, although included in the DMPP database, were excluded from CRA's analysis based on advice from EnergyAustralia. As all load within the CBD is fully corrected at the zone substation level, installing capacitors at customer's sites would only negate the zone substation correction and no net reduction in peak demand would be achieved;
- Alternate fuel (fuel switching end-use services from electricity to gas) and embedded generation (cogeneration and photovoltaics) offer a similar magnitude of peak load reduction capacity to power factor correction, and account for 9% and 8% of the total undiversified DM potential, respectively;

- East Zetland provides the largest DM potential, as a result of the high concentration of standby generation capacity, accounting for approximately 35% of the total undiversified load reduction capacity identified in the inner Sydney BSP catchment area; and
- The West Homebush region contains the next largest quantity of DM resource – estimated at 20% of the total.

#### *Diversified DM Load Reduction Technical Potential*

Multiplication of the undiversified load reduction capacity for each of the technology categories presented in Table 1 by CRA's estimate of the associated coincidence diversity factor (CDF) provides the diversified peak load reduction potential for that DM resource. For standby generator opportunities, load factors ranging from 65% to 90% of nameplate capacity were also applied – depending upon the types of end-use services connected to the machines.

The CDF estimates for this study ranged from 0.65 to 0.9. The lowest CDF of 0.65 was applied to sites and opportunities where there is unlikely to be a high degree of correlation between the timing of a customer's peak demand and the system peak demand.

Opportunities in industrial sites tended to fall into this category, as the timing of their peak demand is driven by internal processes and end-uses, the operation of which, may or may not coincide with the system peak. In contrast, opportunities associated with end-uses like air conditioning were assumed to have a much higher CDF – reflecting the fact that on a peak summer day, temperature dependent end-uses like HVAC chillers and related ancillaries are likely to be highly loaded and operating almost continuously. The higher CDF of 0.9 was also applied to the majority of the lighting opportunities as this end-use tends to operate continuously throughout the day. Intermediate values were applied to opportunities associated with other end-uses.

As can be seen from Table 2, on the next page, which presents the results by technical category and region, CRA's analysis suggests that there is a total diversified DM load reduction potential of over 370MVA in the Sydney inner metropolitan area.

A scenario where CBD generation is excluded from the total DM capacity, in the event that air quality or noise issues preclude the co-ordinated use of this peak load reduction resource, was also analysed. This analysis suggests that the estimated diversified DM technical potential is reduced by approximately 80MVA to give a total of 290MVA.

**Table 2: Diversified Technical Potential of Peak Demand Opportunities in the Sydney Inner Metropolitan Area by Technology Category and Region**

Technology Category	East Zetland MVA	North Hornsby MVA	South Oatley MVA	West Homebush MVA	Total MVA
Standby Generation (Located outside the Sydney CBD)	35.8	2.3	5.0	30.7	73.7
Standby Generation (Located within the Sydney CBD)	79.5	0.0	0.0	0.0	79.5
Alternate Fuel	37.7	2.3	1.3	5.5	46.7
Power Factor Correction	9.9	6.0	5.2	20.5	41.6
Embedded Generation	11.6	2.3	5.3	17.6	36.8
Energy Efficiency Lighting	21.4	1.7	2.0	4.6	29.7
Load Shifting	6.4	2.3	9.8	6.9	25.5
Energy Efficiency HVAC	14.8	0.5	1.6	1.6	18.5
Energy Efficiency Computers	8.9	0.2	0.2	0.4	9.8
Energy Efficiency Industrial Processes & Utilities	2.1	0.4	0.4	1.8	4.7
<b>Total (Including All Standby Generators)</b>	<b>228.1</b>	<b>18</b>	<b>30.8</b>	<b>89.6</b>	<b>366.5</b>
<b>Total (Excluding CBD Standby Generators)</b>	<b>148.6</b>	<b>17.9</b>	<b>30.8</b>	<b>89.6</b>	<b>287.0</b>

Three quarters of the DM load reduction potential shown in Table 2 is associated with four technology categories, as follows:

- Standby generators
  - 40% if all generators are included, or
  - Just under 30% if generators located in the Sydney CBD are excluded;
- Alternate fuels – 13%;
- Power factor correction – 11% (it should be noted that the estimated 42MVA of DM capacity associated with power factor correction opportunities may not directly translate to peak demand load reduction potential at the transmission level. The actual potential associated with power factor correction will need to be calculated by Energy Australia/Transgrid using system modelling software); and
- Embedded generators – 10%.

### *DM Opportunity Up-front Costs*

CRA's high level review of the reasonableness of the costs listed in the DMPP database used a simple analysis of the up-front costs required to achieve a kVA of DM capacity for each record in the database. The record by record results were aggregated by technology category, and the average \$/kVA and standard deviation developed for each category. These results are shown in Table 3.

**Table 3: Utilised Up-front Costs of Undiversified DM Opportunities in the DMPP Database**

Technology Category	Average \$/kVA	St Dev \$/kVA
Standby Generation <sup>3</sup>	N/A	N/A
Power Factor Correction	300	600
Alternate Fuel	1,900	2,600
Embedded Generation	6,000	5,300
Energy Efficiency – Lighting	3,300	5,800
Load Shifting	200	1,200
Energy Efficiency – HVAC	3,800	6,900
Energy Efficiency – Computers	4,100	2,500
Energy Efficiency – Industrial Processes & Utilities	4,300	8,000

Note: Results have been rounded to the nearest hundredth.

CRA's analysis indicates that, in general, the up-front costs listed in the DMPP database are reasonable, and within the order of magnitude expected, given that the specific capital expenditure required to achieve a particular amount of DM capacity will vary significantly from site to site for each technology and technology category.

### *DM Load Reduction Commercial Potential*

DM commercial potential has been defined as the amount of peak load reduction capacity available in the Sydney inner metropolitan area at lower cost than the net present values (NPVs) of deferring the supply-side augmentation for one or two years. Thus the NPV caps the DM expenditure for each scenario examined. It should be noted that commercial potential does not consider the proportion of eligible customers that will actually participate in a DM program. Hence, CRA's estimates of commercial potential will be somewhat higher than estimates of market potential which do include the effects of potential customer participation rates on the estimated DM capacity.

<sup>3</sup> The DMPP database did not contain record by record information on any costs that might be incurred to enable the standby generator resource to be used as DM capacity.

Detailed analysis of the DM market potential in the Sydney inner metropolitan area was outside of CRA's terms of reference for this study; however, at the request of EnergyAustralia an order of magnitude estimate was made based on the information on customer's willingness to participate in a DM program in the DMPP database.

Three supply-side deferral scenarios were assessed, as follows.

- Base case – \$200 m supply-side capex, 1-year and 2-year deferrals, and the DM resource from each of the four regions is of equal value;
- Locational impacts case – \$200 m supply-side capex, 1-year and 2-year deferrals, and the DM resource from North Hornsby is discounted by a factor of 0.75 relative to the other three regions; and
- Capex impacts case – supply-side capex increases by 5%, 1-year and 2-year deferrals, and the DM resource from each of the four regions is of equal value.

Table 4 summarises the DM targets, NPVs and unitised NPVs for the discounted cash flow (DCF) analysis undertaken for each of the scenarios.

**Table 4: DM Commercial Potential Scenarios**

DCF Summary	Base Case	Locational Impacts Case	Capex Impacts Case
DM Target 1-Year Deferral	75MVA	75MVA	75MVA
NPV Cap 1-Year Deferral	\$14 m	\$14 m	\$22 m
Average \$/kVA 1-Year deferral	\$187	\$187	\$300
DM Target 2-Year Deferral	175MVA	175MVA	175MVA
NPV Cap 2-Year Deferral	\$26 m	\$26 m	\$35 m
Average \$/kVA 2-Year deferral	\$149/kVA	\$149/kVA	\$200/kVA

Note: NPVs have been rounded to the nearest million.

The 1-year and 2-year deferral caps must cover the total expenditure to administer and manage the DM program. These costs include one-off 'start-up' expenditure on items such as detailed program design and development, establishment of evaluation and monitoring mechanisms and databases, legal and contracts, and tendering for third party specialist DM/energy efficiency service providers. Ongoing costs are incurred for items like program management and administration, analysis and reporting, marketing and customer education, and technical and financial advice. CRA's order of magnitude costs for the administration and management of a DM program in the Sydney inner metropolitan area is estimated at \$3 m over a three year period.

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Deducting the administration and management costs from the deferral caps yields the capital available for program and implementation costs to induce customer participation in the DM program. The program and implementation costs used in the analysis for this project were as follows:

- Parallel and single close trip transfer (SCTT) standby generators (modelled as dispatching at the commencement of a load reduction event and operating only until its conclusion)
  - fuel and maintenance at \$200/MVAh with 50 hours of dispatch per year (10 events of 5 hours of dispatch per event) and \$750/MVAh, which equates to approximately \$50/kVA, and
  - no up-front costs for generator upgrades;
- Break before make standby generators (modelled as dispatching their capacity in the morning prior to the start of business and then continuing to run throughout the day until after the close of business to avoid disruption to tenants or critical services)
  - fuel and maintenance at \$200/MVAh with 120 hours of dispatch per year (10 events and 12 hours of dispatch per event) and \$750/MVAh, which equates to approximately \$60/kVA, and
  - no up-front costs for generator upgrades or reconfiguration to parallel or SCTT operation;
- Temporary load shifting – variable program and implementation costs required to reduce the payback of an opportunity (calculated as the total up-front and operating cost divided by the total energy, demand and ancillary savings) to the customer's payback criteria as recorded in the DMPP database, plus \$150/kVA for dispatch;
- Energy efficiency and permanent load shifting – variable program and implementation costs to align the payback of an opportunity with the customer's criteria as recorded in the DMPP database, plus \$100/kVA to overcome barriers to the uptake of the opportunity; and
- Power factor correction – variable program and implementation costs to align the payback of an opportunity with the customer's criteria as recorded in the DMPP database, plus \$50/kVA to overcome barriers to the uptake of the opportunity.

Table 5, on the next page, presents a summary of the cost-effective DM resource in the Sydney inner metropolitan area for the three scenarios analysed.

**Table 5: Summary of Cost-effective DM Resource in the Sydney Inner Metropolitan Area**

DCF Summary	Base Case	Locational Impacts Case	Capex Impacts Case
DM Resource 1-Year Deferral	177MVA	No material change from the Base Case	232MVA
Average \$/kVA 1-Year Deferral	\$79/kVA	\$79/kVA	\$82/kVA
DM Resource 2-Year Deferral	252MVA	No material change from the Base Case	277MVA
Average \$/kVA 2-Year Deferral	\$91/kVA	\$91/kVA	\$114/kVA

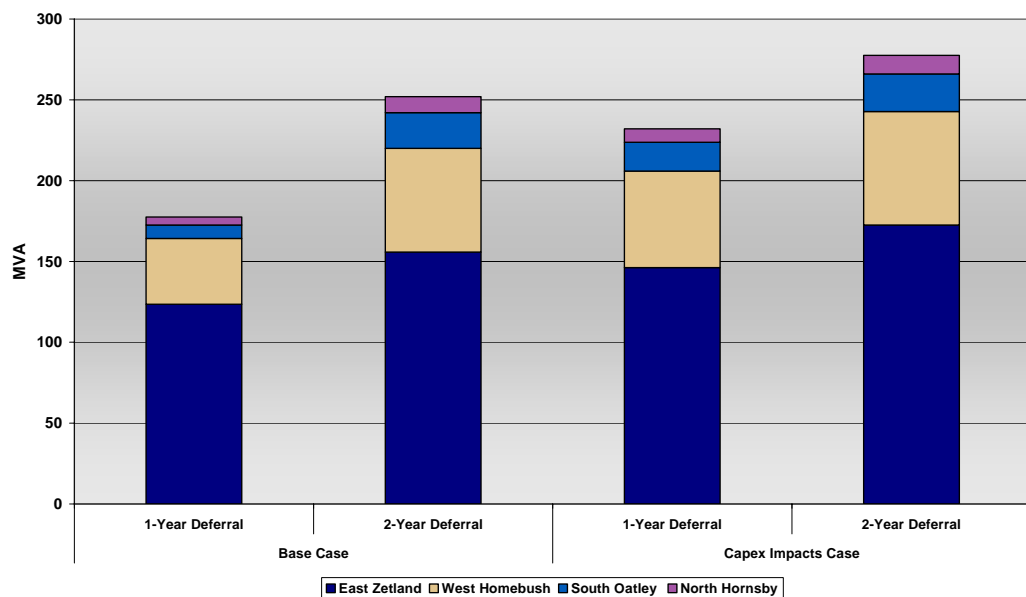
CRA's analysis indicates that:

- Base Case
  - Aggregating all of the 550 opportunities up to the 1-year deferral NPV cap indicates that approximately 180MVA of DM load reduction is commercially viable – more than double the projected requirement of 75MVA. The unitised total cost of the DM resource averages \$79/kVA. Over 65% of the total DM resource is obtained from standby generators in the East Zetland region, while power factor correction across all regions contributes an additional 11% with the majority of these located in West Homebush,
  - Excluding the DM potential associated with standby generators located in the CBD reduces the estimated commercial potential to 134MVA. The 43MVA reduction is somewhat lower than the 80MVA of diversified DM potential estimated for CBD generators. This reflects the fact that DM resource from other technology categories can be substituted for a proportion of the standby generator capacity while remaining within the \$11 m project/implementation cost cap,
  - Capping the total cost of the DM resource at the 2-year deferral NPV is estimated to provide just over 250MVA of load reduction capacity representing just over 1,900 opportunities in the constrained areas. This resource is approximately 45% more than the 175MVA requirement for a 2-year deferral. Again the DM potential is dominated by standby generator and power factor correction opportunities located in East Zetland and West Homebush, and
  - Eliminating the peak load reduction potential associated with standby generators located in the CBD reduces the DM commercial potential for a 2-year deferral to 187MVA. This magnitude of DM capacity is approximately equal to the total required for a 2-year deferral of the supply-side augmentation;

- Locational Impacts Case
  - The location of the DM appears to have no substantive impact on the analytical results. Opportunities in the DMPP database listed as being in North Hornsby contribute only approximately 3% and 4% of the total base case DM resource for the 1-year deferral and 2-year deferral cases, respectively. Therefore no further analysis was undertaken;
  
- Capex Impacts Case
  - It is estimated that a total of approximately 230MVA of DM capacity is available from some 1,500 cost-effective opportunities listed in the DMPP database, at an average total cost of \$82/kVA. This is almost 3 times the current projected requirement of 75MVA to achieve a 1-year deferral. Over 75% of the total DM resource is obtained from standby generation, power factor correction and load shifting opportunities in East Zetland and West Homebush; and
  
  - With a 2-year deferral, there is an estimated 280MVA of cost-effective DM resource available in the Sydney inner metropolitan area derived from 2,290 opportunities. Again, opportunities associated with standby generators, power factor correction and load shifting opportunities in East Zetland, West Homebush and South Oatley account for the majority of the total.

Figure 2 presents the estimated DM commercial potential in each of the four regions facing network constraints for the Base Case and the Capex Impact Case.

**Figure 2: Regional Breakdown of Cost-effective DM Resource in the Sydney Inner Metropolitan Area**



### *DM Load Reduction Market Potential*

The DMPP database contains information on the willingness of customers with standby generators to participate in a DM program. CRA has provided an order of magnitude overview of the market potential of the DM resource in the Sydney inner metropolitan area based on this information.<sup>4</sup>

Customers with standby generators were asked to specify their interest "...in operating the generator in a commercial arrangement with their energy retailer or network service provider...."<sup>5</sup> Responses to this question were as follows:

- In total, 60% of the customers listed in the DMPP standby generator database were 'willing' – reducing the estimate of commercially viable DM capacity from this technology category from 153MVA to 92MVA; and
- Excluding standby generators located in the CBD, 67% of customers were 'willing' – reducing estimated DM capacity from 74MVA to 50MVA.

As noted, a decrease in the DM capacity, and associated program/implementation costs, from one technology category makes available capital for expenditure on capacity from other technology category – although total expenditure is still bound by the appropriate cap (\$11 m for a 1-year deferral and \$23 m for a 2-year deferral). Therefore, although the estimate of total DM potential decreases, the impact of reducing DM capacity from standby generators based on the 'willingness' parameter is somewhat mitigated. Results are shown Table 6.

**Table 6: Order of Magnitude Estimate of the DM Market Potential in the Sydney Inner Metropolitan Area Including Standby Generator Capacity Willingness**

<b>Case A: Include All Standby Generators</b>	<b>1-Year Deferral</b>	<b>2-Year Deferral</b>
MVA Standby Generators	92	92
MVA Other Technologies	55	113
<b>MVA Total</b>	<b>147</b>	<b>205</b>
<b>Case B: Exclude CBD Standby Generators</b>	<b>1-Year Deferral</b>	<b>2-Year Deferral</b>
MVA Standby Generators	50	50
MVA Other Technologies	68	117
<b>MVA Total</b>	<b>118</b>	<b>167</b>

<sup>4</sup> Willingness to participate in a DM program for other technology categories was not determined during the on-site investigations.

<sup>5</sup> Email from Neil Gordon of EnergyAustralia.

### *Conclusions*

CRA's analysis of the information contained in the DMPP database indicates that there is significant DM potential in the network constrained regions within the Sydney inner metropolitan area. More specifically:

- The undiversified DM capacity in the BSP catchment area is estimated at approximately 600MVA;
- Diversification of this load reduction capacity to account for coincidence with system peak demands is estimated to provide a DM technical potential of;
  - 370MVA if all standby generator opportunities listed in the DMPP database are included in the analysis, and
  - 290MVA if standby generator opportunities located in the CBD are excluded from the analysis.

Based on customer's payback criteria, CRA's estimation of DM program costs, and the NPVs associated with deferring the proposed supply-side augmentation, if all standby generator opportunities listed in the DMPP database are included in the analysis, the commercially viable DM potential is estimated at:

- 177MVA for a 1-year deferral – more than double the projected requirement of 75MVA; and
- 252MVA for a 2-year deferral – almost one and a half times the projected requirement of 175MVA.

If the standby generators located in the CBD are excluded from the analysis, the DM capacity associated with a 1-year deferral decreases to 134MVA – still significantly more than the requirement. Similarly excluding the standby generators located in the CBD reduces the 2-year DM potential to an estimated 187MVA – again a DM resource of sufficient magnitude to meet the peak load reduction requirement.

Finally, including the information in the DMPP database on the willingness of customers with standby generators to participate in a DM program suggests that there is still sufficient load reduction potential to achieve at least a 1-year deferral of the supply-side augmentation. This result is unaffected by the inclusion or exclusion of standby generators located in the CBD in the analysis. The DM capacity for these two scenarios is estimated at 147MVA and 118MVA, respectively. In the case of a 2-year deferral, the DM potential reduces to 205MVA if all standby generators are included, and 167MVA if the CBD generators are excluded. Therefore, a 2-year deferral may be possible if environmental concerns over the operation of the standby generators located in the CBD can be overcome.

## 2. INTRODUCTION

The DMPP is a joint initiative of the NSW Government Department of Planning, EnergyAustralia, and TransGrid. It was established following the approval of the MetroGrid project with the aim of identifying and quantifying the available DM in the inner metropolitan region of Sydney. Within this context, the DMPP has undertaken a number of investigations into the DM load reduction capacity at facilities in the region of interest. The results of these investigations have been compiled into a database recording the outcomes of over 750 DM reviews. This database forms part of the framework for evaluating the likely potential for DM opportunities to defer supply-side augmentations to the transmission and distribution networks in the Sydney inner metropolitan area.

EnergyAustralia and Transgrid have retained CRA to undertake an independent review of the information developed by the DMPP, and to prepare a report on the potential for cost-effective DM opportunities to defer the construction of a new 330/132kV BSP near the western edge of the Sydney inner metropolitan area.

In addition to CRA's review of the DMPP, EnergyAustralia is seeking submissions from interested parties for non-network DM options. Submissions are also being sought on the overall DM investigation process. To this end, EnergyAustralia has published a document entitled "Demand Management Options Consultation Sydney Inner Metropolitan Area."<sup>6</sup> This document is the first step in the consultation process and investigation of non-network options.

### 2.1. TERMS OF REFERENCE

The specific terms of reference for CRA's engagement were as follows:

- Mapping the DMPP results to the catchment area associated with the proposed BSP upgrade to quantify the undiversified DM load reduction potential<sup>7</sup> of the opportunities in the DMPP database;
- Reviewing the nature of the network constraint (time of day, magnitude, frequency and duration) in order to establish the DM load reduction targets required to achieve a 1-year and a 2-year deferral of the proposed supply-side augmentation;
- Determining the technical potential of the load reduction opportunities identified by the DMPP, where technical potential is defined as the quantity of diversified DM load reduction capacity<sup>8</sup> coincident with the system peak;

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6 EnergyAustralia. "Demand Management Options Consultation Sydney Inner Metropolitan Area." 2007

7 Ibid, p.1.

8 Ibid, p.1.

- Assessing the accuracy of the capital costs of the load reduction opportunities listed in the DMPP's database;
- Developing a screening parameter that relates the diversified load reduction potential to associated capital and operating costs ( $\$/\text{kVA}_{\text{coincident with system peak demand}}$ ) to rank the DM opportunities from most cost-effective to least cost-effective;
- Producing budget estimates of the additional costs not contained in the DMPP database that would be incurred in the implementation of a DM program, including items such as customer incentive payments, marketing costs and administration overheads; and
- Estimating the overall costs of implementing a DM program to achieve a 1-year and a 2-year deferral of the BSP, and comparison of these costs with the associated net present value benefits of the supply-side deferrals to determine the cost-effectiveness of such a DM program.

As noted in EnergyAustralia's demand management consultation paper for the Sydney inner metropolitan area,<sup>9</sup> the location of the DM opportunities impacts on their ability to defer the supply-side augmentation. Specifically, although DM load reduction can come from anywhere within the network areas facing a constraint, reductions south of the Parramatta River will be more effective. Therefore, CRA has disaggregated the results of the analysis undertaken to meet the Terms of Reference into four regions, based on advice from EnergyAustralia, as follows:

- East Zetland – south of the river,
- North Hornsby – north of the river,
- South Oatley – south of the river, and
- West Homebush – south of the river.

## 2.2. STUDY METHODOLOGY

The DMPP database of load reduction opportunities provided the basis for CRA's review and analysis of the potential for DM to defer the construction and commissioning of the Sydney inner metropolitan BSP upgrade. Prior to undertaking any analytical work, CRA refined the contents of the database to meet the specific requirements of this study, as follows:

- A post code map received from EnergyAustralia was incorporated into the database to limit the opportunities analysed to those located in the BSP catchment area, and to enable presentation of the results on a regional basis;

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<sup>9</sup> Ibid, p13.

- Duplicate records for power factor correction were removed from the database. More specifically, for sites which had both an SKM desktop analysis and an on-site investigation by one of the consultants, the database record for the SKM result was deleted – the logic being that the on-site investigations were more recent, therefore based on more up to date information, and they included an onsite review of the practicality and actual costs of installing power factor correction capacitors which the SKM desktop review could not do. For sites where there was only an SKM desktop analysis, the SKM record was retained;
- Opportunities listed in the database as not being a 'Primary Opportunity' were removed. This was done on the advice of the DMPP Manager, who indicated that in some instances multiple opportunities had been identified for the same end-use in some of the site investigations, and that if the primary opportunity were implemented then the alternatives – indicated by a 'N' in the 'Primary Opportunity' field – would become redundant; and
- Fields were added to the database to:
  - enable a count of the total number of sites included in CRA's study,
  - calculate the diversified DM peak demand load reduction potential for the identified opportunities, and
  - calculate the cost-effectiveness index in terms of  $\$/kVA_{\text{coincident with system peak demand}}$  for the identified opportunities.

Following 'cleanup' of the database, the analysis steps undertaken included:

- Summation of the individual peak demand reduction listed in the database to estimate the undiversified DM load reduction potential by technology category and by region. In the case of standby generator opportunities a load factor was applied to the peak demand reductions listed in the database to reflect the differences between nameplate ratings and total connected load;
- Development of CDFs developed for each of the technologies listed in the DMPP database, based on previous consulting assignments for network service providers and regional regulators into the benefits of implementing DM programs to defer supply-side augmentations;
- Multiplication of the undiversified DM load reduction potential in each technical category by the undiversified CDFs to estimate the diversified DM peak demand load reduction potential;
- Comparison of the capital costs listed in the DMPP database with internal CRA and external published data sources to provide a high level check of the reliability of the costs developed from the site investigations;

- Determination of the net present values (NPVs) of a 1-year and a 2-year deferral of the BSP via discounted cash flow analysis;
- Development of unitised capital and operating costs in terms of  $\$/\text{kVA}_{\text{diversified}}$  to rank each of the opportunities listed in the DMPP in order of their cost-effectiveness, and to determine the magnitude of the DM resource available at a cost lower than the NPVs for a 1-year, and a 2-year deferral of the BSP; and
- Estimation of the total costs of implementing a DM program to achieve the deferral.

### 2.3. ORGANISATION OF THIS REPORT

Section 3 describes the load constraint in the inner Sydney metropolitan area, and the targets that a DM program would need to meet in order to defer the supply-side augmentation.

Section 4 reviews EnergyAustralia's preferred supply-side option, the associated costs and the value of deferring the supply-side augmentation

Section 5 discusses the undiversified and diversified DM load reduction potential of the opportunities identified in the DMPP database for the Sydney inner metropolitan area.

Section 6 presents CRA's high level review of the capital costs for the opportunities.

Section 7 discusses the amount of commercially viable DM load reduction capacity available in the Sydney inner metropolitan area, relative to the deferral values of the supply-side augmentation.

Appendices included are as follows:

- Appendix A: Discounted Cash Flow Analysis of the NPVs of Deferring the BSP; and
- Appendix B: Sensitivity of Base Case 1-Year and 2-Year Deferrals to Program/Implementation Costs.

### 3. EMERGING SUPPLY-SIDE CONSTRAINTS

Section 3 describes the nature, timing, duration and expected frequency of the load constraint in the inner Sydney metropolitan area, and therefore the targets that a DM program would need to meet in order to defer the supply-side augmentation.

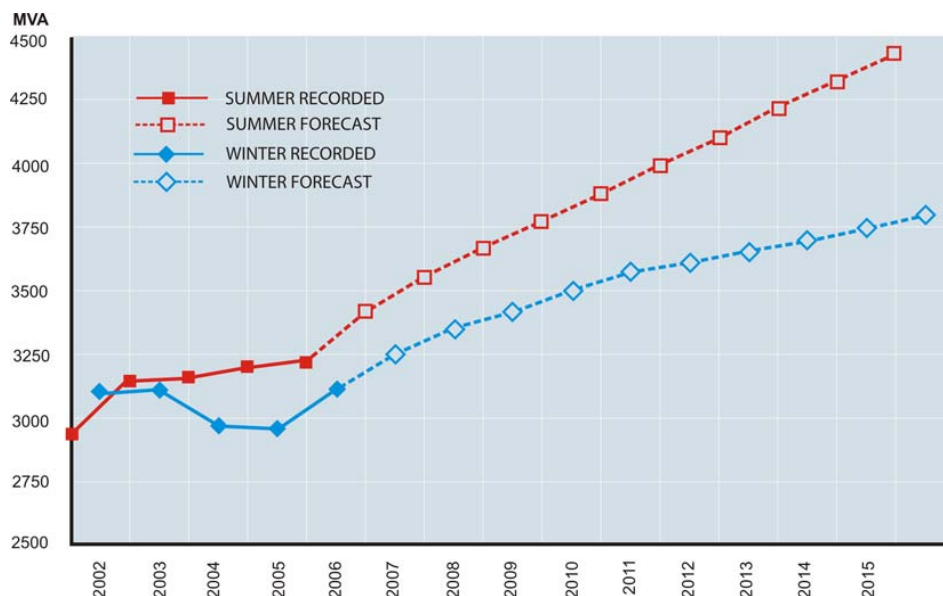
#### 3.1. AREAS FACING NETWORK CONSTRAINTS

According to EnergyAustralia's DM options consultation paper<sup>10</sup>, network constraints have been identified in the Sydney inner metropolitan area supplied from TransGrid Supply Points at Beaconsfield West, Haymarket, Sydney North and Sydney South. Some parts of the Ryde, Hunters Hill and Lane Cove Local Government Area's are also within the areas facing network constraints.

#### 3.2. DEMAND FORECAST FOR THE AREAS FACING NETWORK CONSTRAINTS

In summer 2005/06, the peak load recorded on the system in the areas facing network constraints was 3,226MVA. The peak load in the following winter was 3,110MVA. Summer peaks, which are expected to continue to grow more quickly than winter peaks, are forecast to increase at an average rate of about 3% (about 100MVA per year) for the next ten years.

**Figure 3: Seasonal Peak Demand in the Region of Interest**

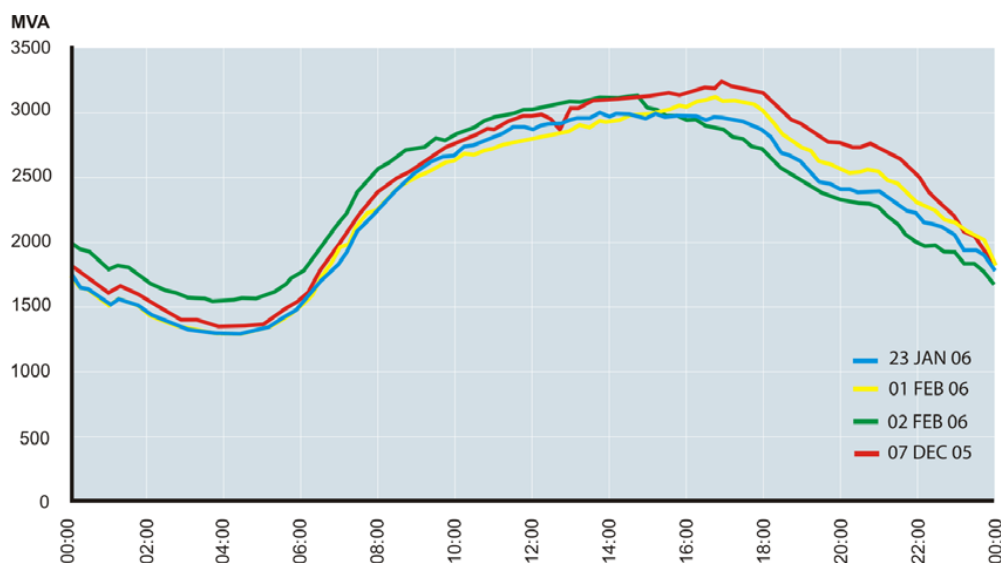


Source: EnergyAustralia.

10 Ibid, p.13.

As noted by EnergyAustralia in its DM options paper<sup>11</sup>,...“summer peak demands typically occur on the hottest weekdays from mid November to mid March between midday and 6:00pm. The profiles for the top four days of summer 2005/06 are shown in the following chart. In summer 2005/06, the load exceeded 95% of the seasonal peak on only three days for a total of 9 hours.”

**Figure 4:** Summer Peak Day Demand Profile in the Region of Interest



Source: EnergyAustralia.

### 3.3. DM TARGETS FOR THE SYDNEY INNER METROPOLITAN AREA

EnergyAustralia has established the following criteria for DM opportunities aimed at deferring the Sydney inner metropolitan area BSP:<sup>12</sup>

- Load reduction capacity would be required to reduce customers' peak demand between 12 noon and 6:00pm on hot weekdays during summer 2012/13;
- DM reductions could come from any location in the areas facing network constraints, but reductions south of the Parramatta River would be more effective. Based on advice from EnergyAustralia, the locational priorities are as follows
  - East Zetland – south of the harbour with DM locational value of 1,
  - North Hornsby – north of the harbour with DM locational value of 0.75 (i.e. 10MVA in North Hornsby equals 7.5MVA effective DM compared to the south,

<sup>11</sup> Ibid, p. 13.

<sup>12</sup> Ibid, p.13.

- South Oatley – south of the harbour with DM locational value of 1, and
- West Homebush – south of the harbour with DM locational value of 1;
- A total of about 75MVA of peak load reduction DM resource would be sufficient to achieve a 1-year deferral of the BSP upgrade, if ideally located. Contributions to this overall reduction from north of the river will assist, but a larger amount will be needed to have the same impact;
- The reductions would be needed on less than five occasions for a total of less than 50 hours during summer 2012/13.
- The amount required would increase by about 100MVA in each year after that, and the likely frequency and duration would also increase.

## 4. SUPPLY-SIDE OPTIONS TO ALLEVIATE THE CONSTRAINT

### 4.1. DEFAULT SUPPLY-SIDE OPTION

EnergyAustralia's preliminary analysis of potential supply-side alternatives to alleviate the constraint suggests that the preferred option would be to construct a new substation near the western edge of the inner metropolitan area and connect it to TransGrid's Sydney West BSP via a new 330kV cable from Holroyd.<sup>13</sup>

### 4.2. COST AND TIMING OF SUPPLY-SIDE OPTION

Preliminary estimates by EnergyAustralia indicate that this project is likely to cost in excess of \$200m and would need to be completed by summer 2012/13 to deal effectively with the emerging limitations.<sup>14</sup>

### 4.3. NET PRESENT VALUE OF DEFERRING THE SUPPLY-SIDE OPTION

DCF analyses have been undertaken to assess the value of the avoided supply-side cost attributable to the deferral of the Sydney inner metropolitan area BSP for a 1-year period, and a 2-year period. Key inputs into the DCF were as follows;

- Capex – \$200 m in total, with expenditure of \$50 m in 20010/11, \$150 m in 2011/12, and \$50 m in 2012/13;
- Opex – maintenance costs calculated as 2% of the cumulative depreciated capex per annum;
- Forecast period – 15 years starting financial year 20007/08; and
- Discount Rate – 7%.

Based on these parameters, CRA has estimated the NPV of the deferrals at:

- 1-year deferral;
  - \$14 m, in total, and
  - \$187/kVA (based on 75MVA of peak load reduction capacity).

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13 Ibid, p.13.

14 Ibid, p.13.

- 2-year deferral;
  - \$26 m, in total, and
  - \$149/kVA (based on 175MVA of peak load reduction capacity).

Details of the DCF analysis are presented in Appendix A.

## 5. TECHNICAL POTENTIAL OF DM OPTIONS TO ALLEVIATE THE CONSTRAINT

The DMPP database provides statistics on the undiversified load reduction potential of 611 customer sites located within the new BSP catchment area. This section of the report discusses CRA's analysis of the coincidence of this undiversified DM resource with the timing and duration of the system peak in the Sydney inner metropolitan area, and the technical potential of the DM resource to alleviate the load constraint in the Sydney inner metropolitan area.

### 5.1. UNDIVERSIFIED LOAD REDUCTION POTENTIAL, CDFs AND DIVERSIFIED TECHNICAL POTENTIAL

#### 5.1.1. Detailed Estimates by Region and Technology Type

##### *Standby Generators*

Table 7 presents a summary of the MVA nameplate rating of the approximately 300 standby generators listed in the DMPP database for each of the regions included in this study.

**Table 7: Nameplate Rating of Standby Generators in the Study Area**

Region	Essential Services MVA	Other MVA	Whole Building MVA	Total MVA
East Zetland	136.4	26.4	106.2	268.9
North Hornsby	3.8	0.0	0.9	4.8
South Oatley	8.0	0.0	4.9	12.9
West Homebush	7.8	0.0	39.1	46.9
<b>Total</b>	<b>156.1</b>	<b>26.4</b>	<b>151.0</b>	<b>333.5</b>

It should be noted that the 333MVA total includes all generators with standby rating greater than 300kVA listed in the database. This contrasts with previous work undertaken by Energetics<sup>15</sup> which applied a number of additional screening criteria to generators identified during site investigations. These criteria included: 'date of manufacture' and 'frequency of scheduled maintenance'. CRA has elected not apply these criteria in the present study. Firstly, eliminating the older generators has only a marginal effect on the load reduction potential for this opportunity – reducing it by approximately 20%.

<sup>15</sup> Energetics. "Investigation of the Potential to Reduce Electricity Demand in the Sutherland and St George Regions of Sydney." 2005.

Secondly, from prior experience, older generators are not necessarily less capable of providing DM peak load reduction potential compared to installations less than 20 years old, and decisions on their load reduction potential would be made on a site-specific basis at the time of implementation a DM program. Regarding the 'frequency of scheduled maintenance' criteria, as noted in the Energetics study, this measure screened out very few installations. This is to be expected as standby generators are costly items of plant which are often supporting critical site services with low tolerance for supply interruptions, and so, in general, tend to be well maintained.

The nameplate capacity of a standby generator will generally be somewhat higher than its average loading. This results from factors such as inaccuracies in the estimated aggregate maximum demand at the design stage, oversizing to handle future load growth, limits on cable and switchgear ratings, and power factors of less than one. CRA has assumed the following load factors for the purposes of this study:

- Parallel and SCTT – 90% of nameplate capacity;
- Break before make serving 'Essential Services' Loads – 65% of nameplate capacity; and
- Break before make serving 'Whole Building' and 'Other' Loads – 75% of nameplate capacity.

Essential services generally include fire pumps, lifts, critical electronic equipment, instrumentation and emergency lighting. It is unlikely that the peak demand of these loads across all sites will be highly coincident with each other, or with the system peak. Therefore a CDF of 65% has been assumed. In contrast, whole building peak loads will be driven by air conditioning and lighting, which on a hot summer day are likely to have a very high coincidence with each other, and with system peak demand. A CDF of 90% has been assumed for the 'Other' and 'Whole Building' standby generator categories.

Further, it has been assumed that 25% of the generators configured as break before make cannot tolerate an interruption to critical services at any time of the day, and therefore are not available to contribute to the DM technical potential for the Sydney inner metropolitan area. It should be noted that if these generators were re-configured to operate as SCTT, or in parallel with the grid, this barrier could be removed in a number of installations and additional cost-effective capacity obtained. The cost of such upgrades will vary from site to site depending on switchboard layouts, protection requirements, and whether the generator is re-configured to operate as SCTT or in parallel. An overview of these costs is presented in Section 6.1. Re-configuring generators was not considered in CRA's analysis for this study.

As shown in Table 8, on the next page, based on the load factors, CDFs, and availability factors presented above there appears to be some 150MVA of diversified standby generator capacity in the Sydney inner metropolitan area.

**Table 8: Diversified Technical Potential of Standby Generation Opportunities in the Sydney Inner Metropolitan Area by Region**

	Essential Services MVA		Whole Building & Other MVA		Total MVA
	Parallel & SCTT	Break Before Make	Parallel & SCTT	Break Before Make	All
East Zetland	4.2	40.9	8.0	62.1	115.2
North Hornsby	1.2	0.6	0.0	0.5	2.3
South Oatley	0.0	2.5	0.0	2.5	5.0
West Homebush	0.2	2.4	22.2	5.9	30.7
<b>Total</b>	<b>5.6</b>	<b>46.4</b>	<b>30.2</b>	<b>71.0</b>	<b>153.2</b>

At the request of EnergyAustralia, a scenario where CBD generation is excluded from the total DM capacity was included as a sensitivity analysis, in the event that air quality or noise issues preclude the co-ordinated use of this peak load reduction resource. This analysis suggests that the estimated diversified DM capacity from standby generators would be reduced by approximately 80MVA. Details by region are presented in Table 9.

**Table 9: Diversified Technical Potential of Standby Generation Opportunities Excluding Generators Located in the Sydney CBD**

	Essential Services MVA		Whole Building & Other MVA		Total MVA
	Parallel & SCTT	Break Before Make	Parallel & SCTT	Break Before Make	All
East Zetland	2.8	13.7	0.0	19.3	35.8
North Hornsby	1.2	0.6	0.0	0.5	2.3
South Oatley	0.0	2.5	0.0	2.5	5.0
West Homebush	0.2	2.4	22.2	5.9	30.7
<b>Total</b>	<b>4.2</b>	<b>19.2</b>	<b>22.2</b>	<b>28.1</b>	<b>73.7</b>

### *Power Factor Correction*

The review of the potential of power factor correction equipment to reduce the peak demand for electricity in the study area is based on 570 opportunities located in sites outside of the Sydney CBD where power factor correction was listed as a primary opportunity in the database. Power factor correction opportunities at individual sites within the CBD, although included in the DMPP database, were excluded from CRA's analysis as all load within the CBD is fully corrected at the zone substation level. Hence, adding capacitors at customer's sites would only negate the zone substation correction and no net reduction in peak demand would be achieved. In total, the undiversified load

reduction potential estimated for power factor correction at customer's sites is estimated at 56MVA.

Given that this load reduction resource comes from a broad mix of commercial and industrial sites it is expected that there will be some spread in the timing of their peak demands relative to that of the system peak. Therefore, CRA proposes a CDF of 0.75, which is in agreement with that used by SKM in their power factor correction study.<sup>16</sup> This yields a diversified peak demand load reduction potential of 42MVA at customer's sites located outside of the Sydney CBD.

It should be noted that the estimated 42MVA of DM capacity cited above does not directly translate to peak demand load reduction potential at the transmission level. This will need to be calculated by Energy Australia/Transgrid using system modelling software.

Table 10 presents the regional results for power factor correction.

**Table 10: Diversified Technical Potential of Power Factor Correction Opportunities in the Sydney Inner Metropolitan Area by Region**

	Power Factor Correction MVA
East Zetland	9.9
North Hornsby	6.0
South Oatley	5.2
West Homebush	20.5
<b>Total</b>	<b>41.6</b>

### *Alternate Fuel*

The key fuel switching initiatives listed in the database comprise the replacement of electrical hot water units with gas-fired units, and the substitution of gas driven or absorption HVAC chillers for conventional electrically driven units. The DMPP database lists the following undiversified load reduction capacities for sites with these technologies listed as primary opportunities:

- gas hot water units – 2MVA from 38 opportunities;
- absorption and gas driven chillers – 48MVA from 109 opportunities; and
- industrial processes – 2MVA from 16 opportunities.

<sup>16</sup> Sinclair Knight Mertz. "Power Factor Correction Assessment Of The Potential To Reduce Electricity Demand In The Inner Metropolitan Sydney Region." 2004.

CRA's estimates of CDF's for these opportunities are: (a) 0.65 for hot water reflecting the highly diversified duty cycle of this end-use; (b) 0.9 for chiller conversions owing to the fact that the majority of chillers will be operating nearly continuously at full load on peak days; and (c) 0.75 for process fuel substitution. These assumptions yield the results presented in Table 11 for each of the regions included in this study.

**Table 11: Diversified Technical Potential of Fuel Switching Opportunities in the Sydney Inner Metropolitan Area by Region**

Region	Hot Water MVA	Chillers MVA	Process MVA	Total MVA
East Zetland	1.1	36.2	0.2	37.5
North Hornsby	0.4	1.8	0.1	2.3
South Oatley	0.03	0.8	0.5	1.33
West Homebush	0.0	4.8	0.7	5.5
<b>Total</b>	<b>1.5</b>	<b>43.5</b>	<b>1.5</b>	<b>46.5</b>

#### *Embedded Generation*

Embedded generation opportunities include the use of photovoltaic cells and cogeneration. The undiversified load reduction potential for these technologies is 5MVA from 40 opportunities, and 42MVA from 55 opportunities, respectively.

CRA's CDF estimates are (a) 0.75 for cogeneration, as an average across a range of industrial sites; and (b) 0.85 for photovoltaics reflecting the fact that these opportunities occur in the commercial sector where end-use loads are likely to be fairly coincident with system peaks. Table 12 presents the results for embedded generation.

**Table 12: Diversified Technical Potential of Embedded Generation Opportunities in the Sydney Inner Metropolitan Area by Region**

Region	Cogeneration MVA	PV MVA	Total MVA
East Zetland	7.0	4.7	11.7
North Hornsby	2.3	0.0	2.3
South Oatley	5.3	0.0	5.3
West Homebush	17.3	0.3	17.6
<b>Total</b>	<b>31.9</b>	<b>5.0</b>	<b>36.9</b>

### *Energy Efficiency – Lighting*

Based on the information in the DMPP database, reduction in peak demand through improvements to the efficiency of lighting technologies is estimated at 36MVA. This total has been disaggregated into three categories as follows:

- controls (including occupancy sensors and dimming controls) – 8MVA from 459 opportunities;
- de-lamping – 0.3MVA from 17 opportunities; and
- high efficiency lamps and fittings – 28MVA from just over 1,000 opportunities.

CRA has estimated a CDF of 0.75 for improvements to control technologies as many of these opportunities are in areas likely to be intermittently occupied. The CDF used for the remaining opportunities is slightly higher at 0.85. This reflects the higher occupancy rates likely to be associated with these opportunities. Table 13 summarises the regional lighting opportunities for the constrained Sydney inner metropolitan areas.

**Table 13: Diversified Technical Potential of Lighting Energy Efficiency Opportunities in the Inner Sydney Metropolitan Area by Region**

Region	Controls MVA	De-lamping MVA	High Eff Lamps/Fittings MVA	Total MVA
East Zetland	4.2	0.2	17.1	21.5
North Hornsby	0.3	0.0	1.5	1.8
South Oatley	0.8	0.0	1.3	2.1
West Homebush	0.8	0.1	3.7	4.6
<b>Total</b>	<b>5.9</b>	<b>0.3</b>	<b>23.5</b>	<b>29.7</b>

### *Load Shifting*

The DMPP database identifies 55 opportunities with 25MVA of 'temporary' load shifting or interruption opportunities. An additional 4MVA of peak demand reduction potential is listed as being available from 5 sites where a permanent change in their operations could be used to effect load reduction. These opportunities include rescheduling processes in industrial sites, as well as interrupting pool heating and water features, or non-essential lighting in commercial premises.

CRA has assumed that the kVA peak load reduction potential identified in the database for interruptible load are targeted at customers whose peak demand tends to be coincident with the timing of the system peak, and therefore a CDF of 0.9 is proposed. On this basis, interruptible load opportunities could provide a total of 29MVA of peak load reduction in the Sydney inner metropolitan area. A breakdown of the capacity by region is given in Table 14, on the next page.

**Table 14: Diversified Technical Potential of Load Shifting Opportunities in the Sydney Inner Metropolitan Area by Region**

	Temporary Load Shift MVA	Permanent Load Shift MVA	Total MVA
East Zetland	4.3	2.1	6.4
North Hornsby	0.9	1.4	2.3
South Oatley	9.8	0.0	9.8
West Homebush	6.9	0.0	6.9
<b>Total</b>	<b>21.9</b>	<b>3.6</b>	<b>25.5</b>

*Energy Efficiency – HVAC*

The key HVAC energy efficiency initiatives listed in the DMPP database encompass control upgrades, installation of high efficiency motors (HEMs), replacement and retrofit of HVAC plant (disaggregated into major and minor components) and modernisation of car park ventilation control systems. The undiversified load reduction capacity associated with each of these technologies has been estimated to be as follows:

- control upgrades – 4MVA from 86 opportunities;
- high efficiency motors – just over 1MVA from 59 opportunities;
- HVAC plant retrofits and replacements – 13MVA from 498 opportunities; and
- carpark ventilation modernisation – 1MVA from 100 opportunities.

Again, assuming that the majority of HVAC systems and equipment will be heavily loaded on peak summer days, a CDF of 0.9 has been assigned to opportunities associated with improving their energy efficiency. The CDF for the carpark ventilation initiatives will depend on factors such as occupancy levels which are not necessarily related to temperatures and the timing of system peak loads. Therefore, a lower CDF of 0.75 has been used for opportunities associated with this technology.

Applying these diversity factors gives CRA's estimates of the diversified technical potential for the opportunities listed in the DMPP database for improvements to the energy efficiency of HVAC equipment in the Sydney inner metropolitan area.

**Table 15: Diversified Technical Potential of HVAC Energy Efficiency Opportunities in the Inner Sydney Metropolitan Area by Region**

Region	HVAC Controls MVA	HEMs MVA	HVAC Plant MVA	Carpark Ventilation MVA	Total MVA
East Zetland	2.6	0.8	9.6	0.7	13.7
North Hornsby	0.02	0.1	0.4	0.04	0.56

Region	HVAC Controls MVA	HEMs MVA	HVAC Plant MVA	Carpark Ventilation MVA	Total MVA
South Oatley	0.3	0.1	1.2	0.1	1.7
West Homebush	0.5	0.1	0.8	0.02	1.42
<b>Total</b>	<b>3.4</b>	<b>1.1</b>	<b>11.9</b>	<b>0.9</b>	<b>17.3</b>

### *Energy Efficiency – Computers*

Two opportunities to enhance the energy efficiency of computer equipment, and reduce associated peak demand, are listed in the DMPP database. These are to replace CRT screens with LED technology, and to activate Energy Star. Over 250 opportunities in the commercial, education, hospitality and industrial segments have been targeted as potential candidates for these initiatives.

In aggregate, these opportunities are forecast to represent 12MVA of undiversified peak demand reduction capacity – with screen replacements accounting for 97% of the total.

Given that there is a broad mix of segments identified in the database as having the potential to improve the energy efficiency of their computer installations, there will be some diversity in the timing of the peak demand impacts. CRA proposes a CDF of 0.8 for these opportunities, resulting in a diversified peak demand reduction potential of 10MVA. A regional breakdown of this potential is presented in Table 16.

**Table 16: Diversified Technical Potential of Computer Energy Efficiency Opportunities in the Inner Sydney Metropolitan Area by Region**

Region	Screen Replacement MVA	Energy Star Activation MVA	Total MVA
East Zetland	8.9	0.03	8.9
North Hornsby	0.2	0.0	0.2
South Oatley	0.2	0.01	0.2
West Homebush	0.4	0.0	0.4
<b>Total</b>	<b>9.7</b>	<b>0.04</b>	<b>9.7</b>

### *Energy Efficiency – Industrial Processes and Utilities*

Improvements to the energy efficiency of industrial processes, compressed air, and refrigeration systems across the 100 plus opportunities listed in the DMPP database is forecast to yield about 7MVA of undiversified load reduction potential.

As the peak demands in industrial sites is unlikely to be closely aligned with each other, or with the system peak, a CDF of 0.65 has been used to estimate the coincident CDF

**Table 17: Diversified Technical Potential of Industrial Processes and Utilities Energy Efficiency Opportunities in the Inner Sydney Metropolitan Area by Region**

Region	Industrial Process MVA	Compressed Air MVA	Refrigeration MVA	Total MVA
East Zetland	1.9	0.2	0.01	2.11
North Hornsby	0.3	0.01	0.04	0.35
South Oatley	0.3	0.05	0.1	0.45
West Homebush	0.9	0.5	0.4	1.8
<b>Total</b>	<b>3.4</b>	<b>0.7</b>	<b>0.5</b>	<b>4.6</b>

#### 5.1.2. Summary of the Diversified DM Potential in the Inner Sydney Metropolitan Area

The total diversified peak demand load reduction potential for the Sydney inner metropolitan area is forecast to be just under 370MVA. A breakdown of this total by technical category and region is presented in Table 18.

**Table 18: Diversified Technical Potential of Peak Demand Opportunities in the in the Sydney Inner Metropolitan Area by Technology Category and Region**

Technology Category	East Zetland MVA	North Hornsby MVA	South Oatley MVA	West Homebush MVA	Total MVA
Standby Generation	115.2	2.3	5.0	30.7	153.2
Alternate Fuel	37.7	2.3	1.3	5.5	46.7
Power Factor Correction	9.9	6.0	5.2	20.5	41.6
Embedded Generation	11.6	2.3	5.3	17.6	36.8
Energy Efficiency Lighting	21.4	1.7	2.0	4.6	29.7
Load Shifting	6.4	2.3	9.8	6.9	25.5
Energy Efficiency HVAC	14.8	0.5	1.6	1.6	18.5
Energy Efficiency Computers	8.9	0.2	0.2	0.4	9.8
Energy Efficiency Industrial Processes & Utilities	2.1	0.4	0.4	1.8	4.7
<b>Total</b>	<b>228</b>	<b>18</b>	<b>30.8</b>	<b>89.6</b>	<b>366.5</b>

By far the largest DM resource in the Sydney inner metropolitan area appears to be standby generation. The total diversified peak demand reduction capacity estimated for this DM resource is 152MVA or 40% of the total. Approximately 75% of the capacity associated with standby generators is located in the East Zetland region. As noted, with the exclusion of standby generators located in the Sydney CBD, the diversified DM potential for standby generator opportunities is reduced by 80MVA.

Alternate fuel opportunities provide a diversified technical potential of 48MVA, with over 80% of the DM capacity associated with this technology category located in East Zetland.

Power factor correction, with a diversified technical potential of 42MVA, is the third largest peak load reduction resource. Approximately half of the power factor correction opportunities are located in West Homebush.

Embedded generation opportunities account for approximately 10% of the diversified DM potential in the Sydney inner metropolitan area.

Energy efficient lighting has a technical potential of almost 30MVA, and again East Zetland makes the most significant contribution to this resource, accounting for just over 7% of the total. The technical potential associated with load shifting is of a similar magnitude to that of lighting. The load shifting DM resource is spread across South Oatley (38%), West Homebush (27%) and East Zetland (25%).

HVAC DM opportunities total 18.5MVA, with 80% of this resource located in East Zetland. Improvements to the energy efficiency of computers and industrial processes and utilities are estimated at 9.8MVA and 4.7MVA, respectively.

## 6. REVIEW OF LOAD REDUCTION OPPORTUNITIES UP-FRONT EXPENDITURE

In the DMPP database, the up-front and operating costs that would be expected to be incurred in operationalising the DM resource were derived from four different sources. CRA undertook a high level analysis of the up-front costs to check for consistency of results. The results of this review are presented below.

### 6.1. UNITISED UP-FRONT COSTS BY TECHNOLOGY CATEGORY

#### *Standby Generators*

The DMPP database does not provide information on up-front costs associated with the use of standby generators to reduce peak system loads. For completeness, CRA has provided a brief overview of the up-front costs associated with the use of standby generator as a DM resource.

Parallel or SCTT generators, owing to their configuration, tend to provide a highly reliable DM technology that can be readily dispatched shortly before the commencement of a peak load reduction event and then operate until its conclusion. Break before make generators, again provide DM resource of high reliability. However, with this configuration there is frequently a need to dispatch their capacity prior to the start of business on the day of a load reduction event, and the generator must then continue to operate throughout the day until after the close of business to avoid disruption to tenants or critical services. In some installations, where no interruption can be tolerated, the break before make configuration precludes their use as a DM resource.

Re-configuring break before make generators to parallel or SCTT operation can often overcome the need for extended run times (which imposes additional fuel costs on their use for DM) and the 'no interruption' barrier. Based on CRA's experience with DM program design in Australia, the average up-front cost for converting a break before make generator to SCTT is in the order of \$70,000 to \$100,000 per unit, but this is highly dependent on the protection requirements of the network service provider. According to Energy Australia, this type of re-configuration is typically \$100,000 for a single generator, relatively independent of the size of the unit, while conversion to full parallel operation is much more variable – in the order of \$300,000 per generator – but the up-front cost is quite site specific.<sup>17</sup>

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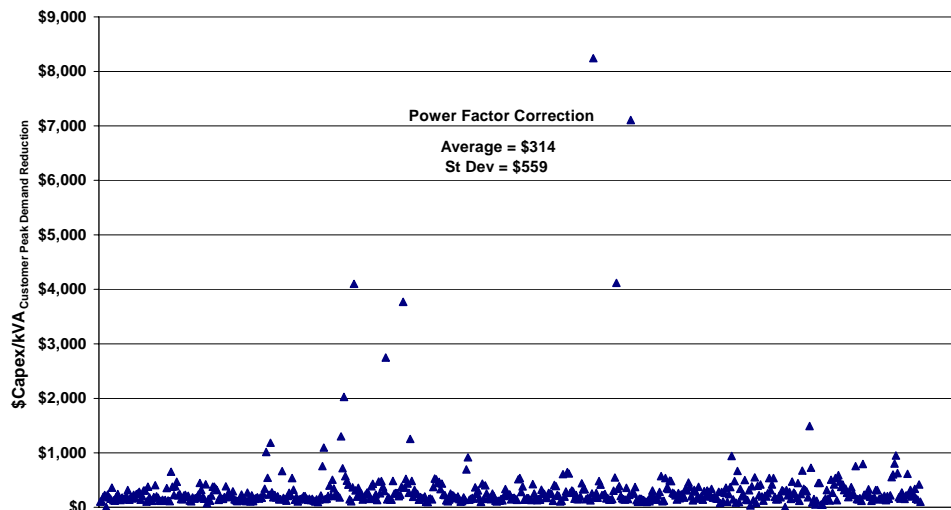
<sup>17</sup> Email from Neil Gordon of EnergyAustralia.

Running costs can be a significant component of the costs of utilising standby generator resources for DM purposes. This will particularly be the case for break before make generators owing to the lengthy dispatch times – typically 10 to 12 hours – on the day of peak load reduction event. In contrast, as noted, the run times of parallel and SCTT generators can generally be ‘matched’ to the duration of a load reduction event. The opex for fuel, and maintenance for standby generators is typically in the order of \$200/MVAh to \$300/MVAh.

### *Power Factor Correction*

Figure 5 illustrates the up-front costs listed in the DMPP database for power factor correction capacitors relative to the kVA of peak load reduction at individual customer sites located outside of the Sydney CBD. The average cost of approximately \$300/kVA for this technology is within the range expected by CRA. Outliers with very high relative costs of over \$1000/kVA appear to be associated with records where an insignificant amount of DM peak load reduction exists – i.e. less than 5 to 10kVA is achievable. There are also 5 records where the up-front cost of power factor correction capacitors is listed as being less than \$10/kVA. The DMPP may wish to review for accuracy the data inputs for the records with either very high or very low unitised up-front cost estimates.

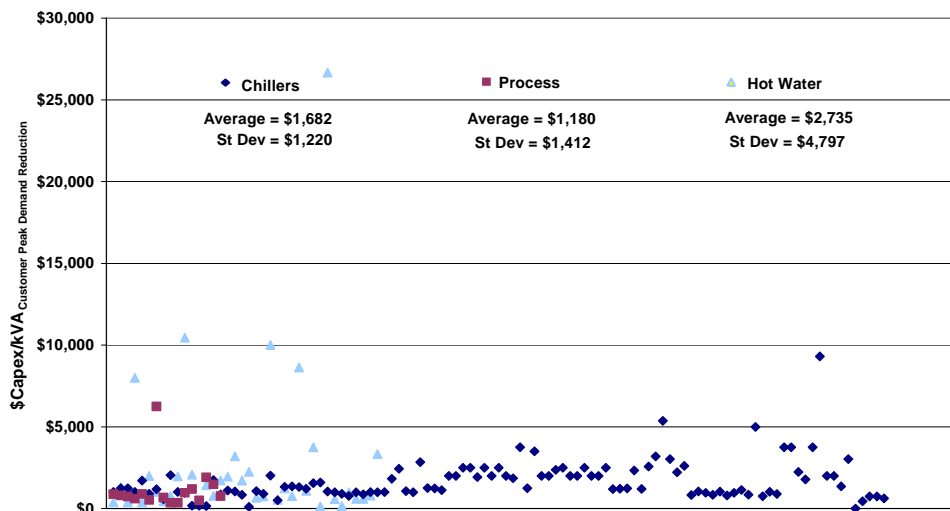
**Figure 5: Unitised Up-front Costs of Power Factor Correction Opportunities Located Outside the Sydney CBD Listed in the DMPP Database**



### Alternate Fuel

Figure 6 presents the results of the cost analysis for the fuel switching opportunities listed in the DMPP database.

**Figure 6: Unitised Up-front Costs of Fuel Switching Opportunities Listed in the DMPP Database**



The average unitised cost of conversion of electrically driven chillers to absorption or gas-engine driven is approximately \$1,700/kVA. Although not shown on Figure 6, this can be further broken down into: (a) approximately \$150/kVA for sites where the installation of new chiller equipment was imminent, and therefore the marginal up-front cost of absorption chillers over electrical chillers has been used as the basis; and (b) approximately \$1,800/kVA where the total up-front cost of a non-electric chiller is used. These values are considered to be reasonable order of magnitude estimates.

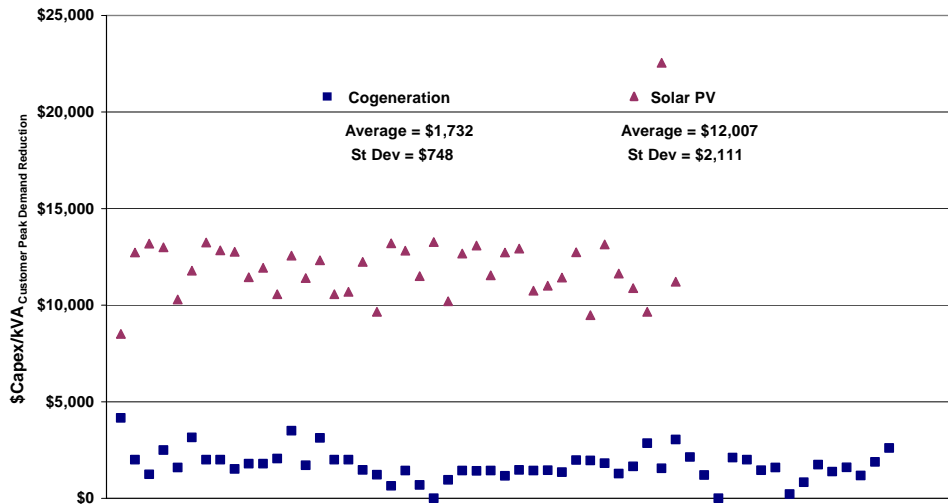
Of the 38 hot water opportunities, 7 have unitised costs of over \$3000/kVA, and of these 4 are over \$8,000/kVA and one is over \$26,000/kVA. The DMPP may wish to review the input data for these opportunities. Removal of these outliers reduces the average to approximately \$1,000/kVA.

As expected, the process opportunities for fuel switching cover a wide range of initiatives. The least cost is replacing electric cookers with gas at \$349/kVA and the costliest is replacing an auto paint baking oven with gas at \$6,250/kVA. The average of \$1,180 appears to be reasonable.

### Embedded Generation

As shown in Figure 7, on the next page, the average up-front unitised costs for cogeneration and photovoltaics are approximately \$1,700/kVA and \$12,000/kVA, respectively.

**Figure 7: Unitised Up-front Costs of Embedded Generation Opportunities Listed in the DMPP Database**

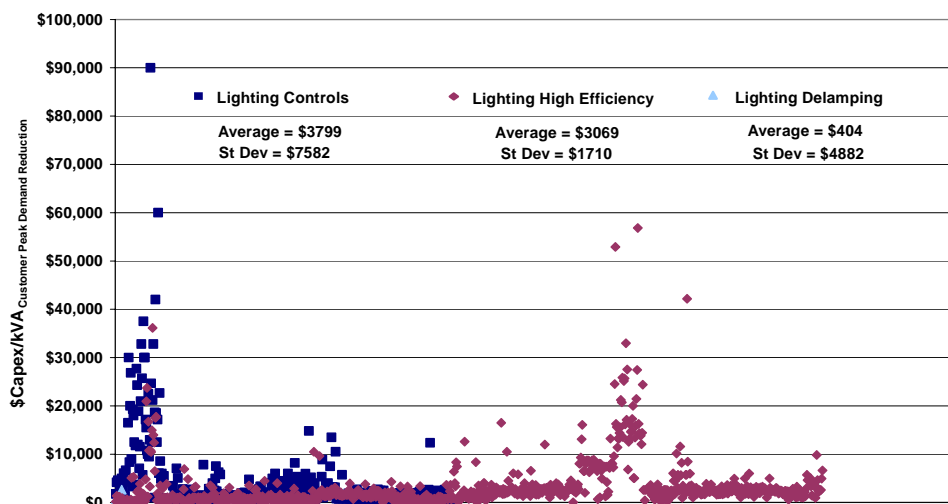


Cogeneration opportunities range from a low of \$9/kVA for a commitment to have an existing cogeneration unit available during peak periods, to just over \$4,000/kVA for new installations. The costs listed for cogeneration opportunities are in the range expected. Photovoltaic costs are also reasonable, with the exception of one record, for which the unitised cost is over \$20,000/kVA.

*Energy Efficiency – Lighting*

The ranges of the unitised costs for the three technology categories associated with improvements to the energy efficiency of lighting are shown in Figure 8.

**Figure 8: Unitised Up-front Costs of Energy Efficiency - Lighting Opportunities Listed in the DMPP Database**



The unitised costs for each of the technology categories shown in Figure 8 can further be broken down into the costs for specific lighting technologies as presented in Table 19.

**Table 19: Unitised Up-front Costs for Specific Lighting Technologies**

Technology Category	Technology	Average \$/kVA	St Dev \$/kVA
Lighting – Controls	Lighting – Occupancy	\$7,913	\$12,627
	Lighting – Dimming	\$2,002	\$1,864
Lighting - De Lamping	Lighting – De Lamping	\$404	\$597
Lighting - High Efficiency Lamps and Fittings	Lighting – Decorative	\$2,994	\$5,865
	Lighting – Downlights	\$1,169	\$1,053
	Lighting – Egress	\$5,891	\$2,155
	Lighting - High Bay	\$1,926	\$2,053
	Lighting - Linear Fluorescent	\$4,704	\$6,033

The average cost of \$7,193/kVA for the installation of occupancy, timer and daylight sensors is somewhat higher than expected. Review of the database records for this technology show an extremely wide range of unitised costs from a low of \$8/kVA (excluding one record for which the up-front cost was zero) to a high of \$90,000/kVA. Some of the lower end of the cost range tends to be for straightforward items such as timers, BMS re-programming or manual switching, but there are a number of records for which a high peak demand reduction potential has been projected for a seemingly low capital cost. In contrast, the high end \$/kVA estimates tend to be associated with the installation of relatively costly control systems that are projected to achieve only 2 or 3 kVA of demand reduction.

Dimming control opportunities listed in the database average just over \$2,000/kVA, which is considered to be a reasonable average, but range from about \$50/kVA to almost \$15,000/kVA.

The de-lamping costs in the DMPP database appear to be reasonable.

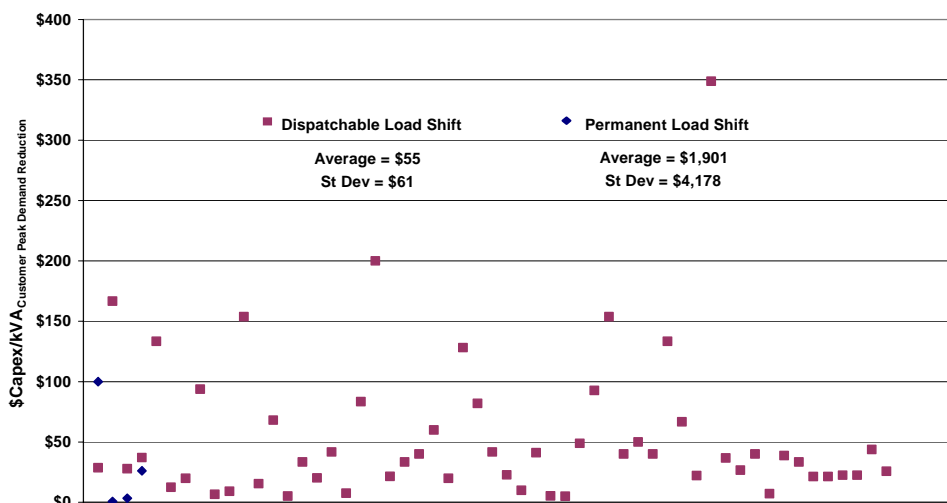
As regards the five opportunity categories that focus on replacing standard lamps and fittings with high efficiency equipment there again appears to be a number of records where the unitised capital cost is either lower or higher than expected when compared with the unitised cost calculated for the majority of the records in this technology category. The higher average cost of the 'lighting egress' records, compared to the other lamp replacement categories, likely reflects the relatively high cost of LED lights, at present, to non-LED lamps.

From a very cursory review of readily available case studies, CRA considers that lighting control costs in the order of \$1,000/kVA to \$3,000/kVA are reasonable order of magnitude estimates – although there will be considerable variation from site to site. Given that a number of the lighting opportunities in the database are significantly outside of this range, the DMPP may wish to check the consistency of the capital cost and customer kVA demand reduction listed for records with extremely high or low unitised \$/kVA capex.

*Load Shifting*

As can be seen in Figure 9, the average unitised cost of the dispatchable load shifting opportunities is \$66/kVA. This is in line with CRA’s expectations. Based on previous consulting assignments, the majority of strategies employed by customers to temporarily shift end-use loads do not require significant capital expenditure. The unitised costs for the permanent load shifting opportunities range from \$1/kVA to over \$9,000/kVA (not shown in Figure 9). The DMPP may wish to review the capital costs and peak demand reductions for the five permanent load shifting opportunities listed in the database.

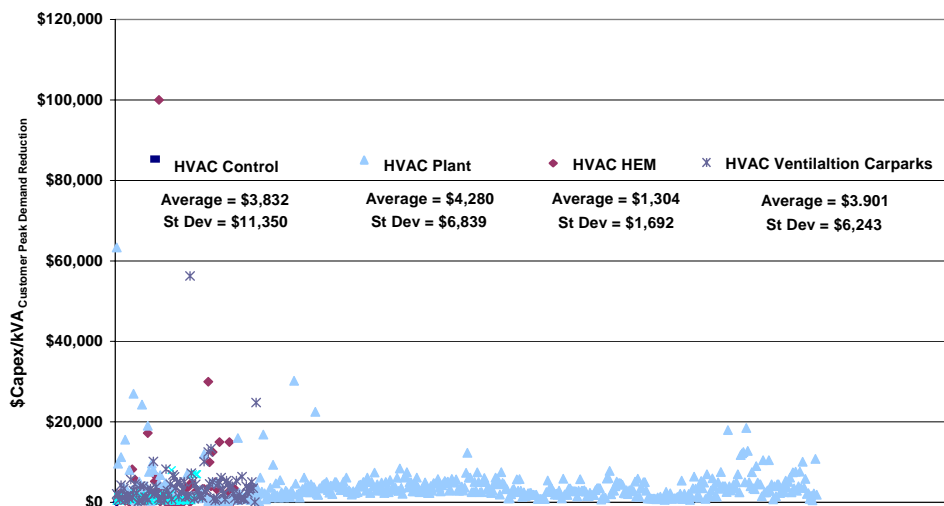
**Figure 9: Unitised Up-front Costs of Load Shifting Opportunities Listed in the DMPP Database**



*Energy Efficiency – HVAC*

Figure 10, on the next page, presents the results of the unitised up-front costs for the opportunities related to improving the energy efficiency of HVAC systems listed in the DMPP database

**Figure 10: Unitised Up-front Costs of Energy Efficiency – HVAC Opportunities Listed in the DMPP Database**



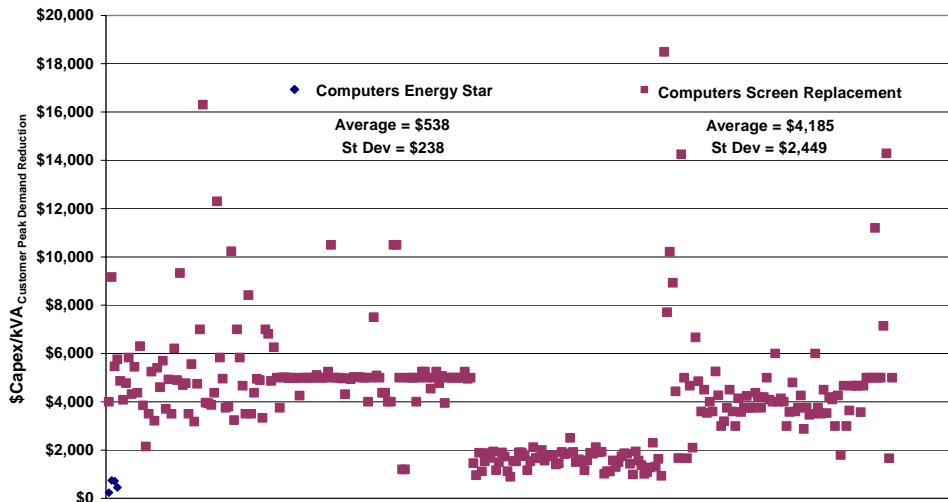
The highest average unitised cost of approximately \$4,300/kVA for the HVAC opportunities shown in Figure 10 relates to the technical category of HVAC plant. HVAC control upgrades and CO<sub>2</sub> controls on carpark ventilation fans are of a similar order of magnitude at approximately \$3,900/kVA. As expected, the average for the installation high efficiency motors is significantly less at approximately \$1300/kVA.

Given the significant diversity in the type of projects and the specific scope of work included in the opportunities associated with energy efficiency improvements to HVAC controls and plant, it is difficult to make generalisations regarding the capital costs in the database for these technology categories. On balance it is considered that the majority of the capital costs in the database will be reasonable budget estimates as the site investigation work was carried out by professional organisations. However, as discussed previously for the lighting technology categories, there appears to be number of records where the peak demand reduction achieved may be out of line with the proposed capital expenditure, resulting in either very low or very high \$/kVA costs. The DMPP may wish to re-examine these anomalies.

### *Energy Efficiency – Computers*

Activation of Energy Star has been estimated to cost approximately \$500/kVA, on average, which appears to be reasonable. Replacing CRT screens with LED screens tends to have a relatively high capital cost in comparison to load reduction capacity obtained. As shown in Figure 11, on the next page, the average unitised cost for replacing CRT screens with LED screens is, as expected, much higher than simply activating Energy Star options, and averages approximately \$4,200/kVA.

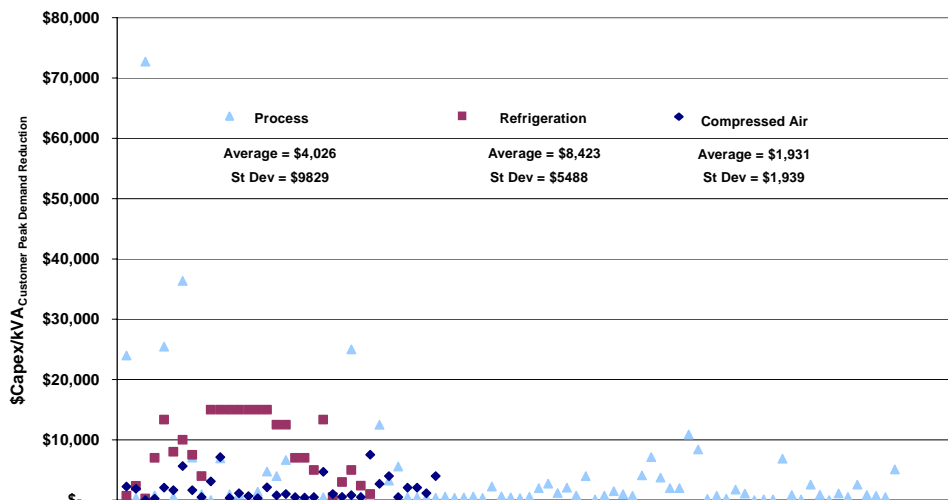
**Figure 11: Unitised Up-front Costs of Energy Efficiency – Computers Opportunities in the DMPP Database**



*Energy Efficiency – Industrial Process and Utilities*

The average unitised costs for energy efficiency improvements in the industrial segment are approximately \$4,000/kVA (process upgrades), \$8,000/kVA (refrigeration upgrades), and \$2,000/kVA (compressed air upgrades). Given the substantial variation in the types of works proposed to achieve the load reductions listed in the database, it is not possible to make generalisations about the reasonableness of the estimates. Figure 12 shows the range of unitised up-front costs for the opportunities to improve the energy efficiency of industrial processes and utilities.

**Figure 12: Unitised Up-front Costs of Energy Efficiency – Industrial Process and Utilities Opportunities in the DMPP Database**



## 7. MAGNITUDE OF THE COST-EFFECTIVE DM RESOURCE IN THE SYDNEY INNER METROPOLITAN AREA

The discussion on the technical potential of the DM resource presented in Section 5 does not take into account the commercial viability of contracting the resource for peak load reduction. This section of the report examines the amount of DM load reduction capacity available in the Sydney inner metropolitan area, relative to the value of deferring the supply-side augmentation; hence it provides estimates of the commercially viable DM capacity available. This analysis does not consider the likelihood of customers participating in a DM program, which would be the 'market potential' of the DM resource. The market potential will be significantly lower than the commercial potential, and an accurate assessment would require further research to determine customer's willingness to participate in a DM program. In response to a request from EnergyAustralia, CRA has provided an order of magnitude review of the market potential of the DM resource in the Sydney inner metropolitan area.

### 7.1. KEY ANALYTICAL ASSUMPTIONS

#### 7.1.1. Administration and Management Costs

Implementation of any DM program will require one-off 'start-up' expenditure on items such as detailed program design and development, establishment of evaluation and monitoring mechanisms and databases, legal and contracts, and tendering for third party specialist DM/energy efficiency service providers. Ongoing costs will also be incurred for items like program management and administration, analysis and reporting, marketing and customer education, and technical and financial advice. CRA has developed order of magnitude costs for the implementation of a DM program in the Sydney inner metropolitan area, as presented in Table 20.

**Table 20: Budget Expenditure for Administration and Management of a DM Program in the Sydney Inner Metropolitan Area**

Item	Budget (\$ m)	Comment
Program Design	0.5	One-off for internal resources and consultant fees for establishment of delivery mechanisms, DM targets, and customer participation schemes
Program Evaluation	0.25	One-off for internal resources and consultant fees to develop evaluation criteria and databases
Legal	0.1	One-off for internal resources to develop contracts for customers and third party serviced providers
Third Party Tenders	0.2	Preparation of RFPs and tender evaluation
Program Management	0.3	One full time internal resource for a 3 to 4 year period

Item	Budget (\$ m)	Comment
Program Administration	0.1	One 50% internal resource for a 3 to 4 year period
Program Marketing	1.0	Assumes marketing is via a combination of individual customer visits for standby generator and load shedding opportunities, mass marketing and leveraging off of third party service providers
Technical/Financial Advice	0.5	Internal resources to assist customers with the implementation of major projects
Analysis and Reporting	0.1	One 50% internal resource for a 3 to 4 year period
<b>Total</b>	<b>\$3.0</b>	

### 7.1.2. Additional DM Program and Implementation Costs

In addition to the generalised administration and management costs outlined above, acquiring the peak load reduction capacity in the Sydney inner metropolitan area will incur program costs to engender customer participation and operationalise the DM program. For the purposes of this study, CRA has assumed the following based on previous DM consulting projects:

- Parallel and SCTT standby generators (modelled as dispatching at the commencement of a load reduction event and operating only until its conclusion)
  - fuel and maintenance at \$200/MVAh with 50 hours of dispatch per year and \$750/MVAh of operation, which equates to approximately \$50/kVA, and
  - no up-front costs for generator upgrades;
- Break before make standby generators (modelled as dispatching their capacity in the morning prior to the start of business and then continuing to run throughout the day until after the close of business to avoid disruption to tenants or critical services)
  - fuel and maintenance at \$200/MVAh with 120 hours of dispatch per year and \$750/MVAh of operation, which equates to approximately \$60/kVA; and
  - no up-front costs for generator upgrades or reconfiguration to parallel or SCTT operation;
- Temporary load shifting – variable program and implementation costs required to reduce the payback of an opportunity (calculated as the total up-front and operating cost divided by the total energy, demand and ancillary savings) to the customer's payback criteria as recorded in the DMPP database, plus \$150/kVA for dispatch;
- Energy efficiency and permanent load shifting – variable program and implementation costs to align the payback of an opportunity with the customer's criteria as recorded in the DMPP database, plus \$100/kVA to overcome barriers to the uptake of the opportunity; and

- Power factor correction – variable program and implementation costs to align the payback of an opportunity with the customer’s criteria as recorded in the DMPP database, plus \$50/kVA to overcome barriers to the uptake of the opportunity.

## 7.2. ANALYTICAL SCENARIOS AND RESULTS

### 7.2.1. Scenario 1: Base Case with Capex of \$200 m for Supply side Augmentation

#### *1-Year Deferral and All Regions of Equal DM Value*

As discussed in Section 4.3, the NPV of achieving a 1-year deferral of the \$200 m capital expenditure projected for the new inner Sydney 330/132 kV BSP is estimated at \$14 m, equivalent to approximately \$190/kVA. Deducting the budgeted amount of \$3 m for administration/management of the DM program leaves a balance of \$11 m for additional DM program/implementation costs, as described in Section 7.1.2. Sorting the opportunities in the DMPP database by ‘\$/kVA<sub>Diversified Peak Demand Reduction</sub>’ ascending and ‘coincident MVA’ descending, and then including all opportunities up to the \$11 m program/implementation cost cap indicates that approximately 180MVA of DM load reduction is financially viable. This is more than double the projected requirement of 75MVA for a 1-year deferral. The unitised program cost of the DM resource averages \$79/kVA, with program/implementation costs ranging from a low of \$50/kVA to a high of \$111/kVA. It is derived from just over 550 opportunities listed in the DMPP database.

Table 21, which presents the results disaggregated by technology category and region, shows that almost 65% of the total DM resource is obtained from standby generators in the East Zetland region.

**Table 21: Summary of DM Commercial Potential to Achieve a 1-Year Deferral with \$200 m Supply-side Capex**

Technology Category	East Zetland MVA	North Hornsby MVA	South Oatley MVA	West Homebush MVA	Total MVA
Standby Generator	115.2	2.3	5.0	30.7	153.2
Power Factor Correction	5.2	2.6	2.5	9.0	19.4
Load Shifting	2.1	0	0	0	2.1
Alternate Fuel	0	0	0.8	0.7	1.6
Energy Efficiency HVAC	0.9	0	0	0.3	1.2
<b>Total</b>	<b>123.5</b>	<b>4.9</b>	<b>8.3</b>	<b>40.8</b>	<b>177.4</b>

Sensitivity analyses were undertaken to determine the impact of: (a) excluding standby generators in the CBD; and (b) program and implementation costs, on the results.

As noted in Section 5.1.1, excluding the standby generators located in the CBD decreases the diversified DM potential of this technology category by approximately 80MVA. However, this reduction does not directly translate to a decrease in the commercial potential of the DM resource in the Sydney inner metropolitan area. Rather, there is a substitution effect, and the program/implementation expenditure that would have been associated with acquiring DM capacity from standby generators located in the CBD can now be used to obtain DM capacity from other technology categories. The end result is that the estimated commercial DM potential under the \$14 m 1-year deferral cap decreases by 46MVA to a total of 134MVA. This resource is obtained from just over 1,200 opportunities listed in the DMPP database. Details of the analysis are shown in Table 22.

**Table 22: Summary of DM Commercial Potential Excluding Standby Generators Located in the CBD to Achieve a 1-Year Deferral with \$200 m Supply-side Capex**

Technology Category	East Zetland MVA	North Hornsby MVA	South Oatley MVA	West Homebush MVA	Total MVA
Standby Generator	35.8	2.3	5.0	30.7	73.7
Power Factor Correction	8.3	4.3	3.8	17.6	34.0
Energy Efficient Lighting	7.4	0.3	0.3	1.0	9.0
Energy Efficiency HVAC	5.6	0.1	0.2	0.5	6.4
Alternate Fuel	1.4	0	0.8	1.5	3.7
Energy Efficiency Industrial Processes & Utilities	2.1	0	0	0	2.1
Load Shifting	2.1	0	0	0	2.1
Embedded Generation	0	0	0.6	1.4	2.0
Energy Efficiency Computers	0.1	0	0	0	0.1
<b>Total</b>	<b>62.1</b>	<b>7.3</b>	<b>10.6</b>	<b>53.5</b>	<b>133.5</b>

Increasing the program/implementation cost to \$200/kVA reduces the DM capacity slightly, to approximately 166MVA, while decreasing it to \$50/kVA increases the DM capacity below the cap to 187MVA. This result reflects the fact that standby generators are one of the most cost-effective DM resources and account for over 60% of the total resource. Therefore a change to the incentive for power factor correction, energy efficiency and permanent load shifting opportunities does not have a significant impact on the outcome of the analysis. It does however alter the mix of technologies contributing to the total capacity. The results of this analysis are presented in Appendix B.

### *2-Year Deferral and All Regions of Equal DM Value*

Based on the DCF analysis presented in Section 4.3, a 2-year deferral of the BSP has an NPV of \$26 m. Capping the total program/implementation cost of the DM resource at \$23 m would provide an estimated 250MVA of load reduction capacity – approximately 50% more than the 175MVA requirement for a 2-year deferral. As shown in Table 23, standby generators and power factor correction opportunities in East Zetland and West Homebush account for approximately 70% of the total resource.

The total unitised cost of the DM resource averages \$91/kVA, and is obtained from just over 1,900 opportunities in the constrained areas. Unitised program/implementation costs for these opportunities range from a low of \$50/kVA to a high of \$285/kVA.

**Table 23: Summary of DM Commercial Potential to Achieve a 2-Year Deferral with \$200 m Supply-side Capex**

Technology Category	East Zetland MVA	North Hornsby MVA	South Oatley MVA	West Homebush MVA	Total MVA
Standby Generator	115.2	2.3	5.0	30.7	153.2
Power Factor Correction	9.8	5.7	4.9	20.1	40.5
Load Shifting	6.4	0.9	9.8	6.9	24.0
Energy Efficiency Lighting	8.6	0.3	0.5	1.2	10.6
Alternate Fuel	6.4	0.3	1.0	1.7	9.4
Energy Efficiency HVAC	7.3	0.2	0.3	1.1	8.8
Energy Efficiency Industrial Processes & Utilities	1.8	0.3	0.0	0.9	3.0
Embedded Generation	0	0	0.6	1.6	2.1
Energy Efficiency Computers	0.3	0	0.0	0	0.3
<b>Total</b>	<b>155.8</b>	<b>10.0</b>	<b>22.0</b>	<b>64.2</b>	<b>251.9</b>

Eliminating the peak load reduction potential associated with standby generators located in the CBD reduces the DM commercial potential for a 2-year deferral to 187MVA. This magnitude of DM capacity is approximately equal to the total required for a 2-year deferral of the supply-side augmentation.

### *1-Year Deferral and DM in Regions North of the Harbour Discounted by 25%*

As can be seen from the regional analysis for a 1-year deferral presented in Table 21, DM opportunities in North Hornsby contribute only 4.9MVA to the 180MVA total, and represent less than 3% of the peak load reduction resource. Therefore discounting, the 'value' of the DM opportunities located in North Hornsby will have no material effect on the outcome of this study, and no further analysis was undertaken.

### *2-Year Deferral and DM in Regions North of the Harbour Discounted by 25%*

Similarly, in the case of the analysis of the level of cost-effective DM to achieve a 2-year deferral, the contribution from load reduction opportunities located in North Hornsby account for less than 4% of the total DM resource, and again, discounting the DM resource located in North Hornsby will not have a substantive impact on the results of the study. No further analysis was undertaken.

### **7.2.2. Scenario 2: 5% Increase in Capex for Supply side Augmentation**

CRA undertook additional analysis to "...consider all measures up to a portfolio cost of \$300/kVA..." in order to determine the impact of increases in the capital cost of the 330/132kV BSP augmentation, as requested by EnergyAustralia.<sup>18</sup>

This level of expenditure equates to NPVs \$22m and \$35 m for a 1-year and a 2-year deferral, respectively.

### *1-Year Deferral and All Regions of Equal DM Value*

Again deducting the \$3 m estimate for DM program administration and management, the total budget for program/implementation costs to acquire customer's DM resource is \$19 m. As can be seen from Table 24, which presents a breakdown of the peak demand load reduction resource by technology category and region, it is estimated that there is a total of approximately 230MVA of DM opportunities available at this cap. This is 3 times the current projected requirement of 75MVA to achieve a 1-year deferral. Over 75% of the total DM resource is obtained from standby generation, power factor correction and load shifting opportunities in East Zetland and West Homebush. Table 24 presents a summary of the results of this analysis by technology category and region.

A total of approximately 1,550 opportunities contribute to the estimated DM resource. The average cost for the resource totals \$82/kVA, with unitised program/implementation costs ranging from \$50/kVA to just over \$169/kVA.

**Table 24: Summary of DM Commercial Potential to Achieve a 1-Year Deferral with Increased Supply-side Capex**

Technology Category	East Zetland MVA	North Hornsby MVA	South Oatley MVA	West Homebush MVA	Total MVA
Standby Generator	115.2	2.3	5.0	30.7	153.2
Power Factor Correction	8.3	4.4	3.8	17.7	34.2
Load Shifting	6.2	0.9	7.3	6.1	20.5

<sup>18</sup> Email from Neil Gordon of EnergyAustralia.

Technology Category	East Zetland MVA	North Hornsby MVA	South Oatley MVA	West Homebush MVA	Total MVA
Energy Efficiency Lighting	7.4	0.3	0.3	1.0	9.0
Energy Efficiency HVAC	5.7	0.1	0.2	0.5	6.5
Alternate Fuel	2.0	0	0.8	1.5	4.3
Energy Efficiency Industrial Processes & Utilities	1.3	0.3	0	0.7	2.4
Embedded Generation	0	0	0.6	1.4	2.0
Energy Efficiency Computers	0.1	0	0.0	0	0.1
<b>Total</b>	<b>146.2</b>	<b>8.3</b>	<b>17.9</b>	<b>59.7</b>	<b>232.1</b>

### *2-Year Deferral and All Regions of Equal DM Value*

With a 2-year deferral, the cap for expenditure on DM program/implementation costs increases to \$32 m. Based on aggregation of the opportunities listed in the DMPP database, this level of expenditure brings forth a total estimated peak load reduction capacity of approximately 280MVA from about 2,260 opportunities.

The average cost for the resource is \$114/kVA, with the least cost being standby generators at \$50/kVA and the highest being approximately \$440/kVA.

A breakdown of the total DM resource by technology category and region is shown in Table 25.

As can be seen from Table 25, over 75% of the total DM resource is derived from standby generation, power factor correction and load shifting opportunities in East Zetland, South Oatley and West Homebush.

**Table 25: Summary of DM Commercial Potential to Achieve a 2-Year Deferral with Increased Supply-side Capex**

Technology Category	East Zetland MVA	North Hornsby MVA	South Oatley MVA	West Homebush MVA	Total MVA
Standby Generator	115.2	2.3	5.0	30.7	153.2
Power Factor Correction	9.9	6.0	5.1	20.5	41.4
Load Shifting	6.4	0.9	9.8	6.9	24.0
Alternate Fuel	17.4	1.2	1.0	2.2	21.8
Energy Efficiency Lighting	10.6	0.5	1.0	1.7	13.8
Energy Efficiency HVAC	8.1	0.3	0.5	1.1	10.0

Technology Category	East Zetland MVA	North Hornsby MVA	South Oatley MVA	West Homebush MVA	Total MVA
Embedded Generation	2.5	0	0.6	5.9	8.9
Energy Efficiency Industrial Processes & Utilities	1.8	0.3	0.2	1.1	3.4
Energy Efficiency Computers	0.8	0	0	0	0.9
<b>Total</b>	<b>172.6</b>	<b>11.4</b>	<b>23.3</b>	<b>70.2</b>	<b>277.4</b>

### 7.3. MARKET POTENTIAL OF THE DM RESOURCE

CRA has provided an order of magnitude overview of the market potential of the DM resource in the Sydney inner metropolitan area based on information on customer's willingness to participate in a peak load reduction program.<sup>19</sup>

During the on-site investigations which provide the framework for CRA's analysis in this study, the consultants undertaking the assessments asked customers with standby generators to specify their interest "...in operating the generator in a commercial arrangement with their energy retailer or network service provider...."<sup>20</sup> Details of what the offer would comprise were not discussed. Willingness to participate in a DM program for other technology categories was not determined during the on-site investigations.

In response to the 'willingness' question:

- If all customers in the DMPP database with standby generators are included, 60% were 'willing to participate in a DM program' – the estimated DM potential decreases to 92MVA; and
- If customers with standby generators located in the CBD are excluded, 67% of customers were 'willing to participate in a DM program' – the estimated DM potential decreases to 50MVA.

As noted, a decrease in the DM capacity, and associated program/implementation costs, from one technology category makes available capital for expenditure on capacity from other technology category – although total expenditure is still bound by the appropriate cap. Therefore, although the estimate of total DM potential decreases, the impact of reducing DM capacity from standby generators based on the 'willingness' parameter is somewhat mitigated.

<sup>19</sup> Detailed analysis of the market potential of the DM resource in the Sydney inner metropolitan area was not included in CRA's scope of work for EnergyAustralia in this study.

<sup>20</sup> Email from Neil Gordon of EnergyAustralia.

Therefore, based on the program/implementation cost caps of \$11 m for a 1-year deferral and a \$23 m for a 2-year deferral and the 'willingness' parameters above, CRA's analysis indicates the order of magnitude DM market potential in the Sydney inner metropolitan is as follows:

- All standby generators included
  - Program/implementation costs for standby generators are approximately \$5 m,
  - For a 1-year deferral, there is a balance of \$6 m for project/implementation costs for other technologies – enabling procurement of an additional 40MVA of capacity, and
  - For a 2-year deferral, there is a balance of \$18 m for project/implementation costs for other technologies – enabling procurement of an additional 113MVA of capacity;
- Generators located in the CBD excluded
  - Program/implementation costs for standby generators are approximately \$3 m,
  - For a 1-year deferral, there is a balance of \$8 m for project/implementation costs for other technologies – enabling procurement of an additional 68MVA of capacity; and
  - For a 2-year deferral, there is a balance of \$20 m for project/implementation costs for other technologies – enabling procurement of an additional 117MVA of capacity.

Table 26 presents a summary of these results.

**Table 26: Order of Magnitude Estimate of the DM Market Potential in the Sydney Inner Metropolitan Area Including Standby Generator Capacity Willingness**

<b>Case A: Include All Standby Generators</b>	<b>1-Year Deferral</b>	<b>2-Year Deferral</b>
MVA Standby Generators	92	92
MVA Other Technologies	55	113
<b>MVA Total</b>	<b>147</b>	<b>205</b>
<b>Case B: Exclude CBD Standby Generators</b>	<b>1-Year Deferral</b>	<b>2-Year Deferral</b>
MVA Standby Generators	50	50
MVA Other Technologies	68	117
<b>MVA Total</b>	<b>118</b>	<b>167</b>

## **APPENDIX A: DCF ANALYSIS FOR 1-YEAR AND 2-YEAR DEFERRALS OF THE BSP**

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**NPV of 1-Year Deferral of the Sydney Inner Metropolitan Area BSP**

<b>Cash Flow Without DM Program</b>																		
<b>FY Ending</b>	<b>07</b>	<b>08</b>	<b>09</b>	<b>010</b>	<b>011</b>	<b>012</b>	<b>013</b>	<b>014</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>
<b>Capex (\$m)</b>					50	100	50	-	-	-	-	-	-	-	-	-	-	-
<b>Opex (\$m)</b>						1	3	4	4	3	3	3	3	3	3	2	2	2
<b>Total (\$m)</b>				50	101	53	4	4	3	3	3	3	3	3	2	2	2	2
<b>Cash Flow With DM Program</b>																		
<b>FY Ending</b>	<b>07</b>	<b>08</b>	<b>09</b>	<b>010</b>	<b>011</b>	<b>012</b>	<b>013</b>	<b>014</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>
<b>Capex (\$m)</b>						50	100	50	-	-	-	-	-	-	-	-	-	-
<b>Opex (\$m)</b>							1	3	4	4	3	3	3	3	3	3	2	2
<b>Total (\$m)</b>					50	101	53	4	4	3	3	3	3	3	3	2	2	2
<b>Calculation of NPV of Deferral of Supply-side Augmentation</b>																		
<b>FY Ending</b>	<b>07</b>	<b>08</b>	<b>09</b>	<b>010</b>	<b>011</b>	<b>012</b>	<b>013</b>	<b>014</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>
<b>Difference in Cash Flows (\$m)</b>	0	0	0		50	51	-48	-49	0	0	0	0	0	0	0	0	0	0
<b>NPV of 1-Year Deferral (\$m)</b>	14				14													
<b>NPV of 1-Year Deferral (\$kVA)</b>	187																	

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**NPV of 2-Year Deferral of the Sydney Inner Metropolitan Area BSP**

<b>Cash Flow Without DM Program</b>																		
<b>FY Ending</b>	<b>07</b>	<b>08</b>	<b>09</b>	<b>010</b>	<b>011</b>	<b>012</b>	<b>013</b>	<b>014</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>
<b>Capex (\$m)</b>					50	100	50	-	-	-	-	-	-	-	-	-	-	-
<b>Opex (\$m)</b>						1	3	4	4	3	3	3	3	3	3	2	2	2
<b>Total (\$m)</b>					50	101	53	4	4	3	3	3	3	3	3	2	2	2
<b>Cash Flow With DM Program</b>																		
<b>FY Ending</b>	<b>07</b>	<b>08</b>	<b>09</b>	<b>010</b>	<b>011</b>	<b>012</b>	<b>013</b>	<b>014</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>
<b>Capex (\$m)</b>							50	100	50									
<b>Opex (\$m)</b>								1	3	4	4	3	3	3	3	3	3	2
<b>Total (\$m)</b>							50	101	53	4	4	3	3	3	3	3	3	2
<b>Calculation of NPV of Deferral of Supply-side Augmentation</b>																		
<b>FY Ending</b>	<b>07</b>	<b>08</b>	<b>09</b>	<b>010</b>	<b>011</b>	<b>012</b>	<b>013</b>	<b>014</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>
<b>Difference in Cash Flows (\$m)</b>					50	101	3	-97	-49	0	0	0	0	0	0	0	0	0
<b>NPV of 2-Year Deferral (\$m)</b>	26																	
<b>NPV of 2-Year Deferral (\$kVA)</b>	148																	



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## **APPENDIX B: SENSITIVITY OF BASE CASE 1-YEAR AND 2-YEAR DEFERRALS TO PROGRAM/IMPLEMENTATION COSTS**

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### *\$50/kVA Program/Implementation Cost*

No change to standby generator or load shifting opportunities but power factor correction, energy efficiency and permanent load shifting given variable incentives to align the payback of an opportunity with the customer's criteria, plus program/implementation costs of \$50/kVA to overcome barriers to the uptake of the opportunity.

#### *1-Year Deferral -*

<b>Technology Category</b>	<b>East Zetland MVA</b>	<b>North Hornsby MVA</b>	<b>South Oatley MVA</b>	<b>West Homebush MVA</b>	<b>Total MVA</b>
Standby Generator	115.2	2.3	5.0	30.7	153.2
Power Factor Correction	4.1	1.1	1.5	3.0	9.7
Energy Efficiency Lighting	6.8	0.3	0.3	0.9	8.3
Energy Efficiency HVAC	5.1	0.1	0.2	0.5	5.8
Alternate Fuel	0.9	0	0.8	1.5	3.2
EE Industrial Processes & Utilities	1.3	0.3	0.0	0.7	2.4
Load Shifting	2.1	0	0	0	2.1
Embedded Generation	0	0	0.6	1.4	2.0
Energy Efficiency Computers	0.1	0	0	0	0.1
<b>Total</b>	<b>135.6</b>	<b>4.0</b>	<b>8.3</b>	<b>38.8</b>	<b>186.7</b>

#### *2-Year Deferral*

<b>Technology Category</b>	<b>East Zetland MVA</b>	<b>North Hornsby MVA</b>	<b>South Oatley MVA</b>	<b>West Homebush MVA</b>	<b>Total MVA</b>
Standby Generator	115.2	2.3	5.0	30.7	153.2
Power Factor Correction	9.8	5.6	4.9	20.1	40.4
Load Shifting	6.4	0.9	9.8	6.9	24.0
Energy Efficiency Lighting	9.1	0.3	0.7	1.4	11.6
EE Industrial Processes & Utilities	1.8	0.3	0.2	1.0	3.3
Energy Efficiency HVAC	7.6	0.2	0.4	1.1	9.3
Energy Efficiency Computers	0.5	0	0	0	0.5
<b>Total</b>	<b>162.3</b>	<b>10.9</b>	<b>22.4</b>	<b>65.5</b>	<b>261.1</b>

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*\$200/kVA Program/Implementation Cost*

No change to standby generator or load shifting opportunities but power factor correction, energy efficiency and permanent load shifting given variable incentives to align the payback of an opportunity with the customer's criteria, plus program/implementation costs of \$200/kVA to overcome barriers to the uptake of the opportunity.

*1-Year Deferral*

Technology Category	East Zetland MVA	North Hornsby MVA	South Oatley MVA	West Homebush MVA	Total MVA
Standby Generator	115.2	2.3	5.0	30.7	153.2
Load Shifting	1.3	0.9	4.7	6.1	13.0
<b>Total</b>	<b>116.5</b>	<b>3.1</b>	<b>9.6</b>	<b>36.8</b>	<b>166.1</b>

*2-Year Deferral*

Technology Category	East Zetland MVA	North Hornsby MVA	South Oatley MVA	West Homebush MVA	Total MVA
Standby Generator	115.2	2.3	5.0	30.7	153.2
Power Factor Correction	4.8	2.1	2.2	7.3	16.4
Load Shifting	6.4	0.9	9.8	6.9	24.0
Energy Efficiency Lighting	7.5	0.3	0.3	1.0	9.1
Energy Efficiency HVAC	5.9	0.2	0.2	0.6	6.9
Alternate Fuel (fuel switching)	1.8	0	0.8	1.5	4.2
Embedded Generation	0	0	0.6	1.4	2.0
EE Industrial Processes & Utilities	0.0	0	0	0.0	0.1
Energy Efficiency Computers	0.1	0	0	0	0.1
<b>Total</b>	<b>149.89</b>	<b>4.88</b>	<b>18.21</b>	<b>28.14</b>	<b>201.12</b>