

Demand Management Investigation Report

Eastern St. George Area

Summary

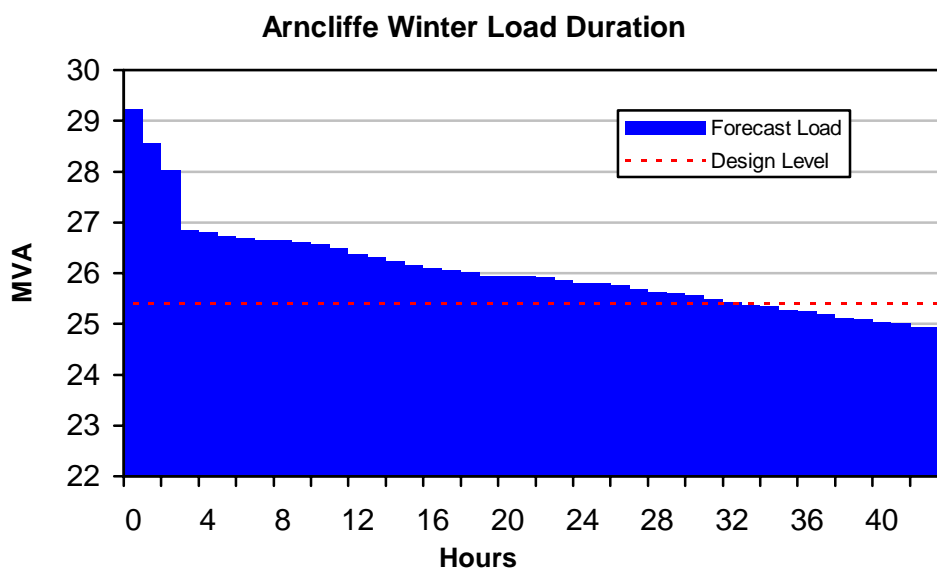
EnergyAustralia carried out an investigation of demand management (DM) options in the Eastern St. George area in 2008. The aim was to determine if there were cost effective demand management measures that could reduce peak electrical loads during the peak period, to help maintain network performance at the required level through the winter 2009 and summer 2009/10. This report concludes that a cost effective demand management option is available.

DM Requirements

A new substation at Kogarah will provide additional capacity in the eastern St George area in 2010. An analysis showed that the demand reductions required to enable the need for this project to be delayed were sufficiently large that it was not reasonable to expect that to be achievable. However, the forecast load at several of the zone substations would be above the level in the applicable planning design criteria in winter 2009 and summer 2009/10. Reductions in demand during these seasons would reduce the amount and duration of the load above the design level, reducing the possibility that customers would lose supply if a significant outage occurred during peak load times.

The requirements changed over the period of the investigation due to changes in the load forecast. Unfortunately this meant that some options we investigated would no longer be effective.

Based on the latest forecasts for Arncliffe, Blakehurst, Hurstville North and Sans Souci zones, an aggregate reduction of 27.6 MVA would be required to reduce the forecast peak load to the design levels. While smaller reductions would not reduce the load to below the design levels at all times, there would be a proportional benefit that can be calculated in terms of MVAh of load above the design level. As an example, the following chart shows the forecast load duration curve for Arncliffe in winter 2009. It shows that the load would be above the design level for 32 hours during winter 2009, and for most of that period the difference would be less than one MVA. The total area above the line is 34MVAh.



Across all four zones in winter 2009, there would be 447MVAh of load above the design level, while in summer 2009/10 there would be 78MVAh. The distribution of these amounts is shown on the table below.

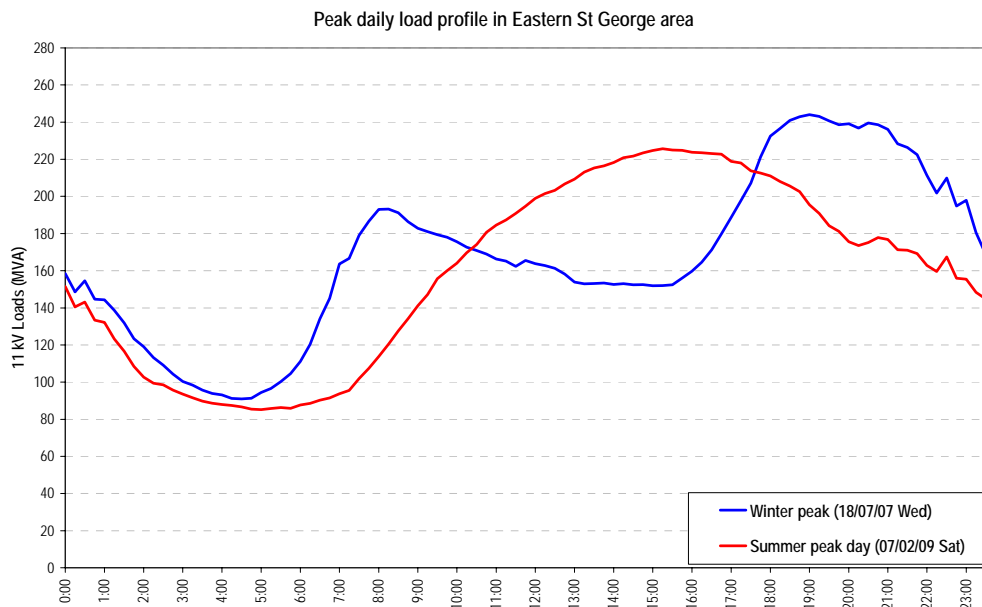
Zone	2009 Winter season (MVAh)	2009/10 Summer season (MVAh)
Arncliffe Zone	34	48
Blakehurst Zone	398	0
Hurstville North Zone	2	30
Sans Souci Zone	14	0
All Zone Total	447	78

The level at which reductions in peak load would be considered cost effective is determined using a methodology that compares the proportional benefit from the reduction to the cost that would be incurred to bring forward the completion of the new Kogarah substation. This cost would be \$11.5m and would eliminate all excess loads. Therefore, reductions would be cost effective below \$22,000 for each MVAh of reduced excess load.

Eastern St. George area Peak Day Load Profiles

The following charts show the winter and summer combined peak load profiles in eastern St George.

The load profiles suggest a mixture of residential and commercial loads. DM solutions would need to be effective during business day between 3:00pm to 6:30pm in summer and 6:00pm to 9:00pm in winter. The load profiles of the top 10 days for summer in Appendix A show that the load profiles are quite consistent.



Demand Management Investigation

The overall investigation approach was to identify potential DM options, assess the likely size of the demand reduction and rank them based on their cost and effectiveness. The most cost-effective options might result in a feasible project. We undertook a public consultation process in 2008 seeking potential options for investigation. We identified major customers based on their maximum monthly peak

demand, visited the potential sites and collected information about the usage of energy and possible DM options. We also reviewed existing investigation reports from the Demand Management and Planning Project (DMPP) in eastern St. George area. Using all this information, we prepared a list of potential DM options for further development.

For each of the options we assessed the likely size of demand reduction that would result at the time of network peak at the zone substation and calculated the impact on the amount of load above design limit. We also estimated the cost of implementing DM options to EnergyAustralia. Based on these estimates, we ranked the options and compared them to the benefits.

Identified DM options

- Power factor correction
- Customer load shifting
- Relocatable generators
- Electric hot water conversion
- Residential behaviour change
- Customers' standby diesel generators
- Residential energy efficiency (EE) program
- Commercial lighting upgrades and fixed dimming unit
- Commercial air conditioning (HVAC) system upgrade
- Small-to-medium enterprises (SME's) energy efficiency program
- Control of residential air conditioners, pool pumps and solar PV systems

Demand Management Options and Analysis

Power factor correction

Where customer's loads exhibit poor power factor, peak demands on the network are higher than they would otherwise be. Based on actual electrical demand data from 2007/08, we identified that twelve customers had poor power factor. The estimated potential demand reduction effective at subtransmission level is about 0.49MVA in summer and 0.53MVA in winter. From our experience, the estimated cost of facilitating the program is about \$20,000.

Customer load shifting

Data from the DMPP suggested that there were three customers who had potential to shift peak electrical loads. We visited all these three sites. One of the sites has already implemented the load shifting strategy to maximise their energy and cost savings. The other two sites have not implemented the load shifting option due to the high cost involved. Both customers showed interest in the initial meetings, but after detailed discussion, they indicated that the option is impractical due to process requirements. We did not pursue these options further.

Relocatable generators

EnergyAustralia has used relocatable generators to provide reliable temporary load reductions in other areas. In the event that large amount of peak electrical demand reduction is required, this would provide a reliable project that would be under our control and could be delivered at a well-defined cost.

We identified a potentially suitable location for installation of up to four 1.2MVA generators. The estimated cost to EnergyAustralia would be approximately \$1.41m for one season only.

Electrical hot water conversion

One respondent to our Consultation Paper suggested we could shift peak load in the targeted area by replacing existing continuous electrical hot water systems with natural gas, solar or heat pump hot water systems. We found these options would have limited impact due to the poor correlation between hot water peaks and summer peaks, and because our data analysis showed that large numbers of the hot water systems in the area are on off-peak tariffs. We estimated that the potential peak demand reduction would be about 87kVA in summer and 136kVA in winter.

Residential behaviour change

One respondent to our Consultation Paper suggested an innovative demand management solution using residential behaviour change to reduce peak electrical load permanently in the targeted area. The type of options included:

- Turning off unused appliances/lights to reduce standby consumption
- Reducing duration of showers (hot water consumption) where electric heating is used
- Changing air-conditioner settings to higher settings (cool mode) or lower settings (heating mode)
- Changing pool pump time settings to shorter period and avoiding peak time (15:00 – 22:00)
- Changing electric appliances to gas (heating, cooking)
- Installation of solar hot water systems or pool heating
- Replacing appliances with higher efficiency models (A/C, fridges, washers, TV and PC screening)
- Improving house insulation
- Replacing incandescent light bulbs
- Washing at times to avoid times when cooking is being done (electric cooking)

The respondent's approach was based on a successful project in travel behaviour in Melbourne. The time for project implementation is about 15 months. We conducted a further analysis of these ten potential measures and estimated that the likely peak demand reduction would be about 277kVA in summer and 459kVA in winter at a cost of about \$2.95m.

Customer standby diesel generator

One respondent to our Consultation Paper suggested reducing peak load by using two customers' standby diesel generators.

We inspected both sites. At the first site, a new 275kVA standby generator was proposed to be installed. Our further analysis showed that peak demand reduction would be limited to the customer's peak load – about 130kVA in winter and 250kVA in summer. The estimated total project cost is about \$610,000.

At the second site, a new diesel generator was installed but has not been finally commissioned. The demand reduction would be limited to the customer's own peak load – about 750kVA in winter and 920kVA in summer. We estimated that total project cost would be \$205,000 which includes monitoring and dispatch equipment, project management, contracting and one year's operation cost. Unfortunately this project is not located in an area where the load reduction would be beneficial.

Residential energy efficiency (EE) program

One respondent suggested residential energy efficiency including:

- Replacement of continuous tariff hot water heating systems with either solar hot water off peak boosting systems or with gas hot water systems
- Replacement of old working air conditioning system with new energy efficient reverse cycle air conditioning system
- Replacement of electric cook tops with gas equivalent cook tops
- Replacement of electric heater with gas space heating
- Installing ceiling fans to delaying purchasing air conditioning unit
- Removal of old working refrigerators

Such a program would involve large numbers of residential homes. The suggested target area was in Sans Souci zone.

We attempted an analysis of these measures but found that it was very difficult to confirm the likely peak reduction due to a lack of similar example projects and the very large number of assumptions necessary. The estimated cost of the program to EA is very high. Because of this it is not possible to consider this option for this project. A pilot program may need to be implemented, potentially under the new DMIA scheme in 2009/10 to test this approach and verify the cost and performance parameters for future consideration.

Commercial lighting upgrade and fixed dimming units

From the survey and reviewing DMPP investigation reports, we identified some commercial customers who have the potential to reduce their peak demand by modifying their lighting system. We classify them into three categories - lighting voltage reduction units (dimming devices); replacing high wattage dichroic down lights with efficient low wattage ones; and upgrading light fittings to efficient T5 fittings.

Based on our own cost analysis, we estimated that the program would cost EA up to \$398,000. The potential peak demand reduction is expected to be about 218kVA in summer and 69kVA in winter. Based on typical take-up rates we would expect about 16 customers to be involved in this program.

Commercial air conditioning (HVAC) system upgrade

Improvements to HVAC systems can be achieved with equipment changes or control improvements. Major equipment changes (to more efficient models) are generally only practical if replacement of plant is being considered for other reasons. About six customers were identified with potential for replacing their chillers with more efficient ones, which could reduce peak demand by 455kVA. The estimated cost is about \$1,098,000.

Small-to-medium enterprises (SME's) energy efficiency program

Through DM public consultation, we received a submission that proposed to promote energy efficiency measures in SMEs sector to reduce summer late afternoon and winter early evening peak demand. The goal would be achieved by educating the business owners and staff about actions they can take to reduce the electricity peak demand in summer and winter, as well as providing free energy assessments and financial incentives to implement DM measures. The proposed program would include:

- Lighting upgrades
- Air conditioning retrofits
- Commercial refrigerator/freezer and cool room retrofits
- Electric motor and air compressor upgrades
- Boiler operation optimizing and proper insulation
- High-efficiency rated equipment replacements
- Switching to low-flow pre-rinse spray valves

We conducted further analysis of these potential measures. From our previous project experience, we estimated that the potential peak demand reduction would be about 790kVA in summer and 500kVA in winter. The cost to EA is about \$500,000. However, the project requires an extended implementation time and would be unlikely to deliver significant savings in the available time.

Control of residential air conditioner, pool pumps and solar PV system

Two respondents to our Consultation Paper suggested they could shift peak load in the targeted area by controlling residential air conditioners, pool pumps and installing PV systems. These options have limited impact on the target peak demands reduction primarily because the reduction patterns are not well correlated with the peak demand times. We estimated that the potential demand reduction would be about 123kVA in summer and 179kVA in winter.

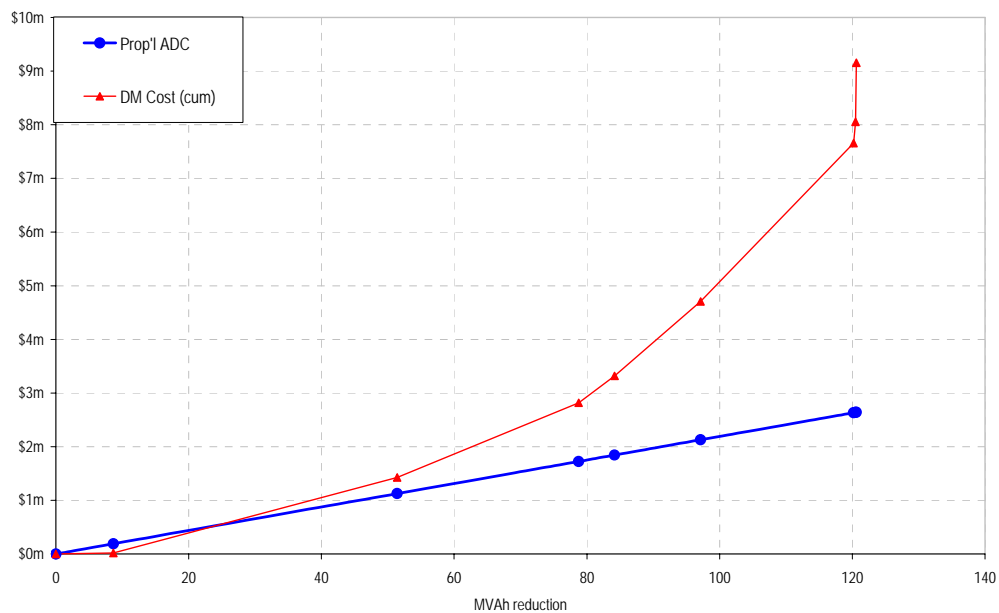
Summary of DM Project Cost and Load Reduction

The following table summarises results of our investigation results. We ranked the options according to their approximate cost effectiveness if each option was implemented on its own.

DM Options	Peak Load Reduction (s – summer) (w – winter)	Impact MVAh	Total cost to EA (\$NPV)	Cost to EA (\$/kVAh)	Time for Implementation
Power factor correction	0.49MVA(s) 0.53MVA(w)	8.6	\$20,000	\$2.30	0.5 – 1 year
Relocatable generator (Arncliffe zone area)	5.0MVA(s&w)	43.2	\$1,408,000	\$32.50	1 year
Relocatable generator (Hurstville zone area)	3.75MVA(s&w)	29.7	\$1,390,000	\$46.80	1 year
SME's energy efficiency program	0.79MVA (s) 0.50MVA (w)	7.0	\$500,000	\$71.40	1 – 2 years
Relocatable generator (Sans Souci zone area)	3.75MVA(s&w)	13.6	\$1,390,000	\$102.40	1 year
Residential voluntary behaviour change	0.28MVA(s) 0.46MVA(w)	26.7	\$2,950,000	\$110.50	1 – 1.5 years
Commercial lighting upgrade project	0.22MVA(s) 0.07MVA(w)	2.6	\$398,000	\$153.00	1 – 2 years
Air conditioning upgrade	0.45MVA(s)	0.9	\$1,098,000	\$1,220.60	2 – 3 years

Based on this ranking, we have constructed a portfolio of projects and calculated the incremental benefits from each as more expensive options were added. The results are summarised in the following table and on the chart below.

DM Options	Incremental Impact	Cost to EA	Cost to EA (\$/MVAh)	Cost to EA (cum)	Proportional benefit (cum)
Power factor correction	8.6MVAh	\$20,000	\$2,315	\$20,000	\$0.189m
Relocatable generator (Arncliffe)	42.8MVAh	\$1,408,000	\$32,909	\$1,428,000	\$1.126m
Relocatable generator (Hurstville)	27.3MVAh	\$1,390,000	\$50,853	\$2,818,000	\$1.725m
SME's energy efficient program	5.4MVAh	\$500,000	\$92,567	\$3,318,000	\$1.843m
Relocatable generator (Sans Souci)	13.0MVAh	\$1,390,000	\$107,160	\$4,708,000	\$2.128m
Residential voluntary behaviour change	23.0MVAh	\$2,950,000	\$128,010	\$7,658,000	\$2.632m
Commercial lighting upgrade and fixed dimming unit	0.3MVAh	\$398,000	\$1,367,710	\$8,056,000	\$2.639m
Air conditioning upgrade	0.1MVAh	\$1,098,000	\$8,286,792	\$9,154,000	\$2.642m

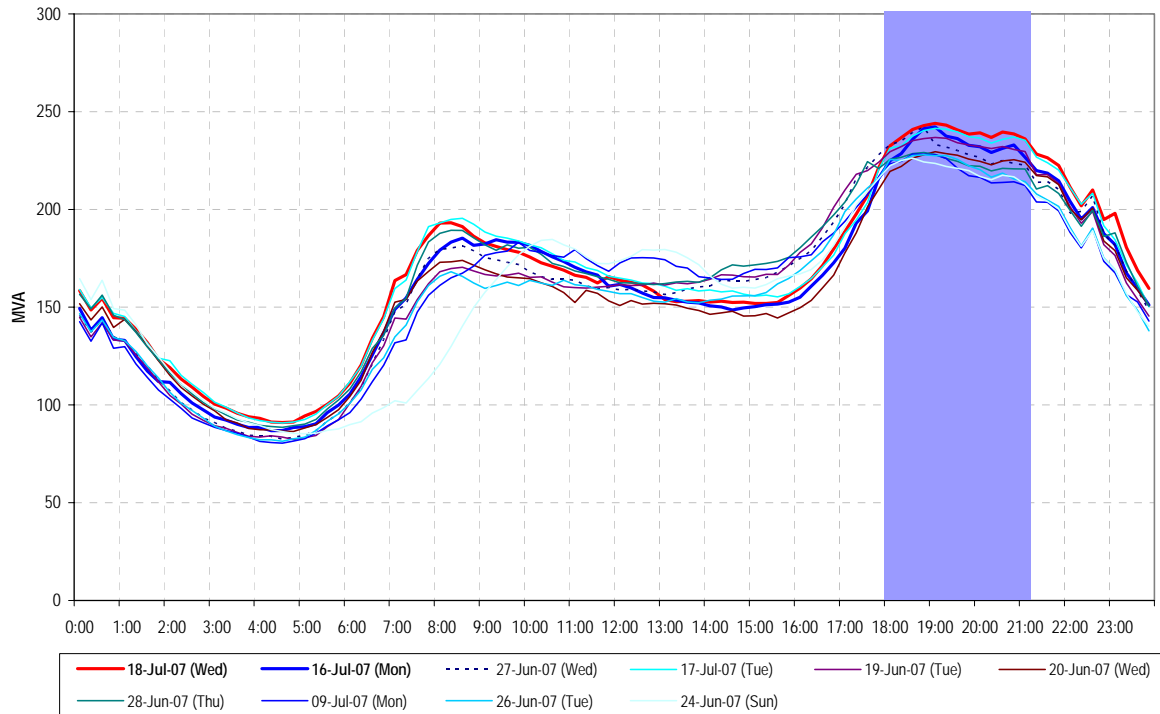


Conclusion

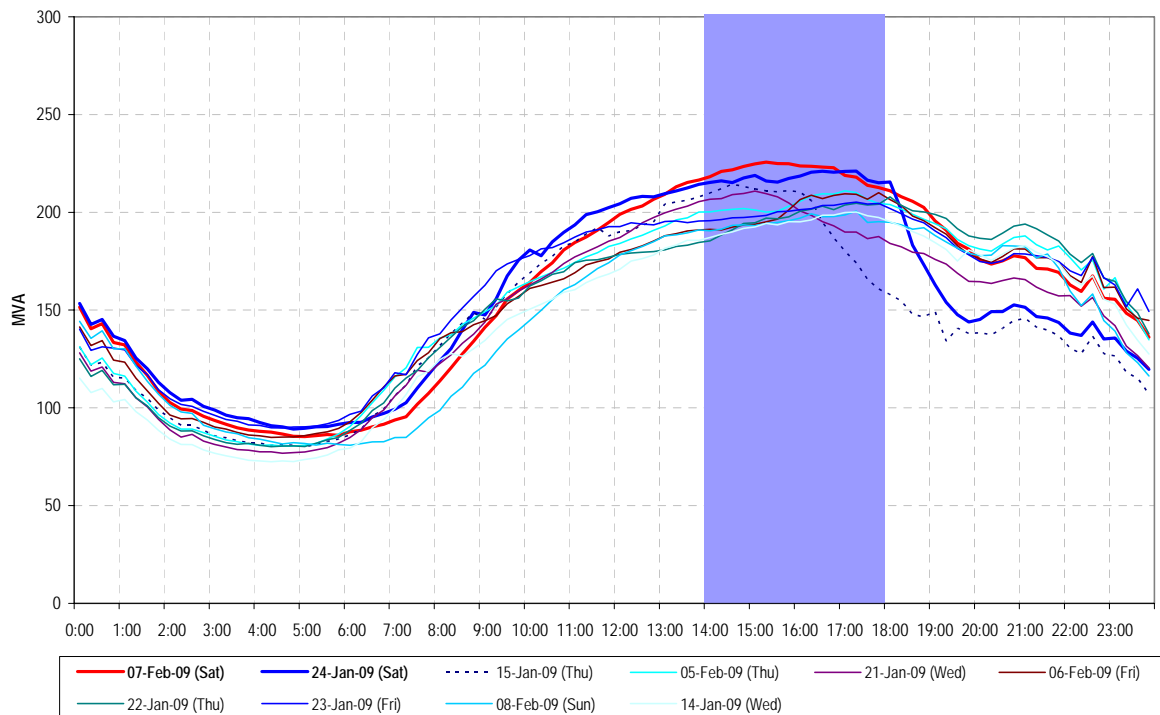
Based on the cost benefit analysis and the available time to implement options before winter 2009, only the power factor correction project would be considered feasible and cost effective.

Appendix A: Additional Data

- Top 10 days winter 2007 daily load profiles in Eastern St. George area



- Top 10 days summer 2008/09 daily load profiles in Eastern St. George area



Appendix B: Public Consultation

EnergyAustralia prepared the eastern St George Demand Management Options Consultation Paper and advertised it in the Sydney Morning Herald and St George & Sutherland Shire Leader in July 2008. We also sent a notification to interested parties in the EA register. The Options Paper was also available on EA website for any interested parties to submit responses before the 31st October 2008.

The objective of this consultation was to invite responses from industry experts, consultants, manufacturers of energy efficient equipment, parties interested in demand management and any other member of the public who wished to suggest or offer any energy reduction option or alternative for investigation. We assessed all these options.

Results

We received 9 submissions

No	Company	Proposed Technology	Suggested kVA demand reduction	Suggested cost	Sites or Clients
1	Energy Response	Advanced control technique Load shedding	1.4MVA	N/A	1 commercial site
2	Nicholls Solar	<ul style="list-style-type: none"> ▪ Solar photovoltaic ▪ Led lighting ▪ Residential solar PV 	1.2MVA 186kW	\$12m (school PV) \$785k (school LED) \$1.5m (residential PV)	<ul style="list-style-type: none"> ▪ 60 Schools ▪ 1,000 Residential ▪ Commercial business
3	Sinclair Knight Merz	Residential voluntary behaviour change	Up to 21MVA	\$2.95m	60,000 Residential
4	Fieldforce	Commercial and residential energy program <ul style="list-style-type: none"> ▪ A/C direct load control ▪ Home CFL ▪ Solar hot water ▪ Heat pump, PV system 	N/A	N/A	N/A
5	Steplight Pty Ltd	Home Energy Assessment	N/A	N/A	N/A
6	Sustainability Today	Standby generators	confidential	confidential	
7	Sustainability Today	Residential EE program	confidential	confidential	
8	Ethnic Communities' Council of NSW Inc.	SME energy efficient program <ul style="list-style-type: none"> ▪ Lighting ▪ Air conditioner ▪ Refrigerator/freezer ▪ Electric motors ▪ Boilers, insulation 	1,000kVA(s) 600kVA(w)	\$500k	200 participation small to medium business
9	Advanced Power P/L	<ul style="list-style-type: none"> ▪ Prime Power ▪ Standby Generator ▪ Battery system ▪ Domestic solar PV 	Up to 10 – 15MVA	N/A	<ul style="list-style-type: none"> ▪ Commercial business ▪ 20,000 homes

Appendix C: Specific Site Investigations

As part of the scoping investigation, we visited 20 large customers and assessed another 62 major customers' reports written by DMPP for sites in eastern St George.

No.	Customers' Name
1	St George Leagues Club
2	Kogarah RSL Club
3	Hurstville Westfield
4	Tyco Electronics Pty Ltd
5	George River Sailing Club
6	NSW Police Service – Joint Emergency Service
7	Bexley RSL Club
8	Superfine Printing Co Pty Ltd
9	Security Mailing Services Pty Ltd
10	St George Hospital
11	Calvary Health Care Sydney
12	St George Bank, Kogarah
13	Darrell Lea Chocolate Shops Pty Ltd, Kogarah
14	Mercure Sydney Airport Hotel
15	St George Private Hospital
16	Ramsgate RSL Memorial Club
17	Australian Taxation Office, Hurstville
18	Allkotes Pty Ltd
19	Sydney Water Allawah Pumping Station
20	Goodman Fielder Ltd (Allied Mills, Kingsgrove)