



The Right Approach

A report on the
Load Shifting Trial

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Contents

Executive Summary.....	4
Load Shifting Trial in Context	6
Background.....	6
Off-Peak Production and Load Shifting.....	8
Standby Generation and Load Shifting.....	8
Two Trials in One.....	10
Off-Peak Production Trial	11
Standby Generation Trial	14
Load Shifting Trial Results	15
Load Shifting in Practice: The Way Forward.....	17

Executive Summary

The DMPP Load Shifting Trial was an unequivocal success, with 100% execution by the 13 participants. On 24 July 2007, trial participants collectively reduced their demand on the grid by an average of 15.2 MVA between 12 noon and 4 pm. When measured at 15-minute intervals, the load on the grid was reduced within the range 12.1–18.3 MVA. This was actual load reduction measured and verified by the electricity provider EnergyAustralia. In percentage terms, the businesses collectively reduced their load by an average of 61%, ranging from 48% at 12:45 pm to 72% at 2.15 pm.

Contrary to the generally accepted view that load shifting is just ‘too difficult’, and the relatively small number of opportunities identified in the DMPP investigations, the trial demonstrated what can be achieved with the right approach.

In effect, there were two trials — off-peak production and standby generation; but as they were carried out on the same day for the same reason, together they constitute the DMPP Load Shifting Trial. Peak demand on the grid can be significantly reduced by shifting the load of electricity users. The challenge for off-peak production participants is to shift the electrical load from peak periods while maintaining normal production levels by stopping or reducing business activity during peak periods and making up production in off-peak periods. The challenge for the standby generation participants is to transfer the electrical load from the grid to the standby generators without disrupting electrical supply to the business.

Of the 13 sites that participated in the trial, six shifted production and seven met their electricity needs with their on-site standby generators. The off-peak production trial focussed upon the one local government area of Bankstown. Of the 22 sites in the area that the DMPP initially approached, only a few showed no interest at all in the trial. Many had good reasons for not participating but were still interested in future load shifting opportunities. For those that participated, it was the right approach at the right time.

The standby generation trial covered the wider DMPP study area, targeting sectors (such as hospitals, hospitality and infrastructure) that need to have and maintain significant standby generation capacity. Of the 33 sites that the DMPP initially approached, many that declined to participate did so because of the technical configuration of their standby generation systems. Typically, when a site switches over to the standby generators, its connection to the grid is disrupted. Those that participated had systems that can be activated without disrupting electrical supply to the business.

The procedures leading up to the trial, and the trial itself, revealed important insights into what works and why. The most important of these are:

- ❖ Businesses are keen to pursue load shifting opportunities but many cannot identify load shifting opportunities without assistance because load shifting is counter-intuitive to standard business practices. This assistance could be provided by EnergyAustralia and TransGrid. However, if businesses are also involved in

the assessment process and are confident that risks have been identified and addressed, they will be positive about the benefits to the business resulting in a high likelihood of implementation.

- ❖ Successful off-peak production trial participants have two very important characteristics: manufacturing processes that are either batch processes that can be interrupted or processes that cannot be interrupted once started but start up can be delayed or brought forward; and a flexible workforce that can also obtain benefit from the trial.
- ❖ The use of standby generators for grid support is not widely understood. In some cases, the very act of discussing the possibility of employing standby generators causes concerns that there is an increasing likelihood of supply interruptions or that the site might be deemed to be noncritical by the network provider because it can meet its own electricity needs. Other barriers to the use of standby generators for load shifting were identified, including constraints imposed by the Environment Protection Authority and similar regulatory bodies, and perceived higher costs associated with the maintenance of standby generators. In all cases, the DMPP team was able to show how these barriers could be addressed.
- ❖ The most important benefits to participants in the standby generation trial were the opportunity to undertake extended testing on real loads and being compensated for using their valuable assets.
- ❖ Participants from both trials now have a greater understanding of, and willingness to participate in, load shifting to relieve grid constraints and to generate additional revenue for their businesses.

These insights point the way for EnergyAustralia and TransGrid to successfully implement load shifting in the future, including the need to devote internal resources to building strong relationships with customers; to closely manage load shifting activities; and to negotiate acceptable financial arrangements, including capital funding and compensation for being 'available' to load shift, not just actual load shifting. Network providers need to understand the business practices of potential load shifting clients and be in a position to lead the process.

Finally, the DMPP Load Shifting Trial has barely 'scratched the surface' of load shifting opportunities in Sydney. The off-peak production trial focussed on only one local government area and only one visit was made to each site. There are many more local government areas with similar potential. Further, some electricity users have a large network of sites with standby generation capacity but the trial included only a couple of their locations. They may be keen to look at ways to include their larger networks. Other large electricity users with significant standby generation capacity have, with further development of their systems, the potential to participate in future load shifting activities.

The overwhelming conclusion is that there is a very large pool of load shifting capacity that could reward EnergyAustralia, TransGrid and the NSW Government with significant financial savings in deferred electrical network augmentation.

Load Shifting Trial in Context

The Load Shifting Trial is part of the demonstration works program of the DMPP. The DMPP was established to meet the conditions of consent for the MetroGrid project — an augmentation of the distribution network (the grid) by TransGrid (TG) and EnergyAustralia (EA) in the inner metropolitan region of Sydney. The DMPP was required to assess, quantify and cost the available demand management resources. Activities are split into three main components:

- ❖ Project management and administration
- ❖ Investigative works
- ❖ Demonstration works.

Demonstration works are intended to validate the results of DMPP investigations and to test technologies for demand management potential. DMPP demonstration programs include:

- ❖ Major sponsorship of the Warren Centre’s Low Energy High Rise Program aimed at identifying practical means to improve the energy performance of Australia’s stock of high-rise buildings
- ❖ Local council demand reduction programs in Manly and Randwick
- ❖ Innovative HVAC (heating, ventilation and air-conditioning) Program which provided funding assistance for leading-edge demonstration projects
- ❖ Newington photovoltaic technical review, demographic survey and financial analysis
- ❖ A report on the photovoltaic market in Australia
- ❖ Feasibility studies at large sites (demand greater than 5 MVA)
- ❖ St George and Sutherland energy efficiency program
- ❖ DMPP Load Shifting Trial.

Background

The Load Shifting Trial was initiated by the DMPP in response to the outcomes of its investigations. The investigations entailed demand reduction studies at approximately 1,000 sites in the study area with demand greater than 500 kVA (see Box 1 for an explanation of kVA, MVA and related concepts). The sites cover all classes of consumers, including hospitals and other health facilities; hotels, cinemas, clubs and other hospitality venues; factories; government agencies; multi-dwelling residences; educational facilities; and commercial and retail premises. The study area extends from Hornsby in the north to Sutherland in the south. At its widest point it extends from the coast to Ryde in the west. These are the boundaries of EA’s ‘default’ network area, which accounts for 1.1 million EA customers and 4,000 MVA of electrical demand (80% of EA’s total capacity).

BOX 1

Electric Power, Load and Rated Capacity

Electric power is measured in watts (W), and is a combination of electric current, measured in amperes (A), and force, measured in volts (V).

$$W = V \times A$$

The higher the current, the more energy; the higher the voltage, the more force and the further the electric current can travel. Power stations generate gigawatts (GW) of power; consumers tend to use kilowatts (kW), but it is all watts.

$$1 \text{ GW} = 1,000 \text{ MW} = 1,000,000 \text{ kW} = 1,000,000,000 \text{ W}$$

Electrical equipment power and standby generator capacity are denominated in kW. However, because the power used can be less than the power delivered due to inefficiencies in some equipment, 'real' power is measured in kVA and MVA. The difference is called the 'power factor' (PF), a number less than or equal to one such that:

$$\text{kW} = \text{kVA} \times \text{PF}$$

In this report, the electrical load recorded at the sites' meters is measured in kVA (or MVA) and the rated capacities of on-site equipment and standby generators are measured in kW (or MW). This has no material impact on the key results.

The investigations were undertaken over the period 2005 to 2007 by energy service companies (ESCOs) and energy sector consultants that were asked to include the following in their assessments of peak demand opportunities:

- ❖ Site demand and energy consumption characteristics and end-use breakdown
- ❖ Opportunities to reduce peak demand from six 'action' categories — power factor correction (PFC), standby generation, energy efficiency, load shifting/interruptibility, fuel switching and embedded generation
- ❖ Details of all installed standby generators
- ❖ Site payback criteria for energy-related investments.

Peak demand on the grid can be significantly reduced by shifting the load of electricity users. Load shifting delays the need to augment the grid and is financially attractive to TG, EA and, ultimately, the NSW Government.

In some cases, financial compensation for lost activity may be sufficient to secure participation. However, most commercial and industrial electricity users have commitments to their customers, and would need to maintain their productive capacity. Realistically, the challenge is to shift the load from peak periods while maintaining normal output levels. Electrical load can be shifted from the grid peak without loss of productive capacity either by, stopping or reducing activity during peak periods and making up production in off-peak periods or by transferring the load from the grid to a source of local power such as standby generation. In effect, load shifting is 'using what you've got' as opposed to investing in new equipment.

With off-peak production there is negligible impact on overall energy consumption and therefore greenhouse gas emissions, but with the activation of diesel-powered standby generators there is a net reduction of greenhouse gas emissions since less electricity is drawn from the grid and some energy is generated on site.

OFF-PEAK PRODUCTION AND LOAD SHIFTING

Load shifting opportunities are likely to be found in industrial premises, but continuous production processes are likely to be more difficult to load shift than batch production processes. Sites that use electricity-intensive manufacturing processes are the best candidates for shifting load from peak to off-peak periods. At these sites, typically over 90% of power is applied to a few key processes that in some cases can be readily stopped and restarted.

In the earlier months of the calendar year when the demand peaks due to the air-conditioning load, many manufacturing businesses are operating at below capacity while their orders from the previous year (ie for Christmas) are being consumed. Not only does this relieve pressure on the grid but, because it shifts electricity consumption away from peak times when the wholesale electricity price is at its highest, there is the potential to participate in the NEM (National Electricity Market) and be compensated over and above the cost savings made by shifting from peak to off-peak electricity tariffs.

Altering production is inconvenient to the business. Primarily it is likely to be disruptive to the workforce because off-peak production implies changing working hours, including working overtime, overnight, and/or weekends. This inconvenience to the workforce can have negative social effects, particularly on family and other commitments. When only short notice is provided, say less than 24 hours, this inconvenience becomes more difficult to manage. If there is a willing workforce and a management team that is able to negotiate favourably for the workforce then this inconvenience can be overcome through various benefits such as penalty rates, bonuses and additional leave.

The investigations carried out by the ESCOs concluded that there is just over 40 MVA in load shifting potential in the entire study area. About half of the load shifting amount was identified at the larger sites (demand greater than 5 MVA). This relatively small amount — less than 10% of the total of all the DMPP investigations (excluding standby generation capacity) and less than 1% of the grid's summer peak — surprised the members of the DMPP team who, based on their interaction with electricity customers during the investigations, were certain there was more potential than identified. The results were lower than expected, and the DMPP also realised that not all the identified opportunities would be available when needed to relieve pressure on the grid. To achieve a useful quantity of load shifting in practice, a much larger quantity would need to be registered as potentially available. The DMPP noted during the investigations that ESCOs were unlikely to have sufficient time and skill to ask all of the correct questions and gain the level of understanding of business practices needed to adequately identify and cost the available load shifting opportunities.

STANDBY GENERATION AND LOAD SHIFTING

Standby generators are usually diesel-powered units installed on site to meet the site's electrical needs in an emergency loss of power. They are sized to meet all or part of a load with on-site fuel storage for up to two days continuous operation. Standby generators can be configured a number of different ways (see Box 2). These valuable

electricity generation assets could be utilised more effectively by timing maintenance testing to coincide with the grid or NEM peak periods. Using standby generators when the wholesale electricity price is highest would put these assets to remunerative use.

BOX 2

Standby Generation and Load Shifting

In a 'typical' standby generation situation, one or more generators are connected to an automatic transfer switch (ATS). If there is a loss of power from the grid, the voltage drops to a level that triggers the ATS to switch on the generator. There is a short lag of up to five minutes before the electrical supply from the generator is at full voltage. Therefore to use these generators for load shifting, they need to be isolated from the grid. If these generators were connected to the grid, they would disrupt the flow of grid power to the business.

A synchronised closed transfer trip (SCTT) prevents the loss of power by creating a smooth transition from grid power to generator power. To achieve this, the site can activate the SCTT while still connected to the grid and for a short time the generator and the grid operate in unison until the generator is synchronised to the grid. Once synchronisation has occurred, the grid is disconnected and the site has its electricity delivered by the generator without disruption to the business.

Further load shifting is available when the site's standby generation system has 'full parallel capability' with the grid. This requires additional wiring and controls, but gives the site the capacity to export surplus power to the grid without any disruption to the business.

Full parallel capability generators have 100% of their rated capacity available because the generator is connected to the grid. However, SCTT and typical standby generators respond to the site load that they are connected to. This is usually equal to about 60–75% of the generator's capacity. The extent to which exporting power can relieve load on the grid depends on the local area's configuration. It is costly to set up full parallel capability and there may be adverse impacts on the grid which need to be addressed. The 2007 NSW Service and Installation Wiring Rules explain how embedded generation can be parallel connected to the grid.

In summary, if an electricity customer was to activate its standby generators, then:

- ❖ a typical installation would disrupt the grid connection to the site while the standby generator re-establishes supply to the connected load, resulting in a disruption to the business.
- ❖ an SCTT installation would operate concurrently with the grid for a short period and then establish supply to the connected load without disruption to the business.
- ❖ a full parallel capability installation would operate concurrently with the grid for a short period, then establish supply to the connected load and the grid, delivering the entire capacity of the generator without disruption to the business.

Standby generators are generally maintenance tested periodically — typically on a monthly basis — to ensure reliable starting when required. Testing can be carried out using the site's own electrical load or a 'dummy' load. Where a dummy load is used it is generally a set of resistor banks that generate heat, and the fuel consumed for the test is wasted. If maintenance testing on actual loads is undertaken utilising SCTT, and also

timed to assist with network constraints, then testing reduces the energy consumed by the site and reduces its load on the grid.

Some sites are better candidates for shifting load to their standby generators than others. Inner-city multi-storey commercial and residential building generators are usually not suitable for extended use (other than in the emergencies which the standby generators are designed for) because of the associated noise, vibration and fumes created and the high costs associated with addressing these issues. Hospitals would appear to be ideal candidates because all hospitals have significant standby generation capacity, reflecting the nature of their activities. The Australian Standard requires operating theatres to have secondary supply and this tends to be standby diesel generators. The NSW Health technical standard (TS11) recommends the capacity required and calls for SCTTs and maintenance testing on actual (not dummy) loads.

The other sites with significant standby generation capacity are clubs (to keep the gaming machines going) and infrastructure sites, such as telecommunications exchanges, data centres, and sewage treatment plants (STPs). Some locations, for example data centres, require very high reliability and have installed an uninterrupted power supply (UPS). A UPS stores electricity in a battery bank which is connected to the site's load. Therefore, if the grid power is interrupted, the UPS ensures that there is no disruption to the site. Then, standby generators take over from the UPS. If the generators fail to start, the batteries maintain power supply to the site. Even if UPS is installed, when a shift to standby generation is planned it is still advantageous to have SCTT installed so as not to rely solely on the UPS for a smooth transition.

The investigations found more than 300 MW of standby generator capacity in the study area, and a total estimated demand reduction potential of 160 MVA. Of these generators,

- ❖ nearly 90% of the capacity is from typical standby generators
- ❖ less than 10% have SCTT
- ❖ only 4% have full parallel capability.

For the investigations, the DMPP conservatively assumed 50% of rated capacity to be available from generators without full parallel capability. Because the majority of generators are typical, the actual potential is likely to be much lower than rated capacity. Further, more than one-third of capacity is in commercial buildings where the use of standby generators for load shifting is not viable.

Two Trials in One

In effect, there were two trials — off-peak production and standby generation — but, as they were carried out on the same day for the same reason, together they constitute the DMPP Load Shifting Trial. Of the 13 sites that participated in the trial, six shifted production ('off-peak production trial') and seven met their electricity needs with their on-site standby generators ('standby generation trial'). The participants are listed below in Table 1.

TABLE 1: LOAD SHIFTING TRIAL PARTICIPANTS

Off-Peak Production Trial Participants	Standby Generation Trial Participants
Amcor Aerosols Milperra Plant	ADI Garden Island Docks
Cutting Edges Revesby Metal Fabrication Plant	Bankstown District Sports Club
Primo Smallgoods Greenacre	Fairfax Printing Chullora Facility
Quality Castings Revesby Foundry	Global Switch Ultimo Telecommunications Building
Riverside Metal Industries Revesby Foundry	Sydney Water Malabar STP
Snaith Industries Revesby Plastics Factory	Telstra Bankstown Telecommunications Exchange
	Telstra Burwood Telecommunications Exchange

(Note, confidential site summaries including trial strategies, estimated load reductions, actual load reductions and issues identified were provided to EA and TG. The conclusions presented in this public report are drawn from the information in these summaries as well as interviews with the DMPP team and site managers.)

OFF-PEAK PRODUCTION TRIAL

The DMPP initiated the off-peak production trial to ascertain whether there were more opportunities than identified in the investigations and whether businesses would be willing to participate in load shifting. The DMPP team knew that they would need to take a facilitative approach to understand the technical and commercial realities of load shifting opportunities and they would need to work closely with electricity consumers to negotiate a mutually beneficial outcome.

Preliminary Work

Reports from the investigations provided a valuable foundation for the trial, even though at some sites where the investigation had identified load shifting opportunities these were not feasible, and at other sites with potential the opportunities had been missed. The DMPP focused its efforts on the local government area (LGA) of Bankstown, primarily in the suburbs of Greenacre, Milperra, Padstow and Revesby. A broad range of industries was captured in this area, including process industries, food preparation, packaging, plastics manufacture and metal smelting. The size of businesses ranged from SMEs (small to medium-sized enterprises) to subsidiaries of multinational companies, operating with both continuous and batch processes. With more time and resources, the DMPP could have involved other significant industrial areas in Sydney.

The DMPP identified 21 sites within the LGA of Bankstown worthy of consideration, and contacted each site to gauge the level of interest in participating in the trial. At first contact, the DMPP explained how load shifting could be effectively incorporated into the site's business activities and how it might bring value to the business. It became clear from these conversations that some businesses had little understanding of the concept of load shifting and whether it was viable at their sites. Therefore, the DMPP helped them understand the concept in the broader context of energy management within their operations. The DMPP also explained that the trial was a great opportunity to find out what was possible at no cost to the business. The DMPP team would visit the site, help them identify the opportunities and then compensate them for any costs incurred in participating in the trial. Of the 22 sites identified, only three sites were unable to arrange a site visit (despite repeated approaches by the DMPP).

Site Visits

During the site visits, businesses voiced their concerns that using load shifting to delay investment in the grid could have adverse long-term effects on industry. To allay these concerns, the DMPP highlighted the benefits, including:

- ❖ Lower costs/higher earnings — through cheaper electricity (use of off-peak tariffs and deferred investment by the network provider).
- ❖ Financial compensation for load shifting from the network provider.
- ❖ The opportunity to earn an alternative income stream through the NEM and associated organisations.
- ❖ Reliability/disaster recovery — prior warning of a possible loss of the grid provides the business the opportunity to shift load in a controlled manner.
- ❖ An opportunity to implement positive change.

Each site visit included a walk-through of the operations to gain an understanding of business practices. The discussions focussed upon production processes, including workflow, existing bottlenecks, and various capacity constraints, including storage for product, with a view to developing different load shifting scenarios for consideration. In some cases, the DMPP found itself re-engineering the production processes to reveal opportunities.

Gaining Agreement

Asking a business to shift or interrupt its business practices to alleviate pressure on the grid may appear to be a strange proposition. Businesses exist to create products resulting in profit, and electricity is an input to production. Businesses are not primarily in the electricity market other than as consumers. Therefore, to engage businesses in the trial took considerable time and effort. The DMPP team undertook extensive follow-up communication to develop the scenarios and negotiate adequate compensation, reassuring potential participants that the trial would not be a financial burden for them.

That being said, the participants in the Load Shifting Trial agreed to compensation that only covered their incremental operating costs. Some participants were not sure what costs to include and how to calculate them. “A ‘rule of thumb’ — a rough \$/kVA going rate — would be useful,” said one participant. Another participant deducted the savings in electricity charges to arrive at the net incremental cost, which indicates how genuine the business operators were in seeking a win-win outcome. The main costs for off-peak production are the penalty rates and bonuses required to gain the cooperation of employees. In some cases, these rates are protected by the award agreement for the site. For example, under the EBA (Enterprise Bargaining Agreement) of one participating company, employees are paid penalty rates if they start a shift before 6 am. It was clear that the compensation amounts negotiated incorporated a large amount of goodwill towards the DMPP and the trial, and should not be seen as an indication of the amounts to be negotiated for actual load shifting arrangements in the future.

For each site, a Funding Agreement was developed. The agreement clearly documented the possible scenarios. In many situations a number of scenarios were feasible, and it would not be known until the day of the trial which would be implemented. Payment of the negotiated financial compensation would be conditional upon actual participation.

Nonparticipation (does not imply a lack of interest)

The largest nonparticipant operates continuously 24 hours, 7 days, and the load cannot be shifted; only stopped. The resulting loss of production cannot be recovered, and product must be purchased from a competitor to meet its customers' needs. Such enterprises are naturally reluctant to do this on a regular basis.

Another nonparticipant had just commissioned new machinery, and it was pointless to measure the new electrical load before the old equipment was decommissioned. Therefore, the timing was not good, but management at the site would be prepared to consider load shifting once the new machinery has been successfully commissioned and operational for a while. Site management at another location informed the DMPP that, on hot summer days, many staff actively reduced electrical load by switching off high bay lights. This is an effective solution in summer, but not viable for the trial which was held in winter. Timing also affected other potential participants — one was relocating to a new site and another is vacating its premises in 2009. Closing down was not the issue at the factory where years of downsizing have left employees very sensitive to any change to the production schedule. There, not wanting to look like it was closing down was the issue. After an earlier blackout, some workers left the company because they thought it was a sign that the plant was going to close down permanently. Employee relations were also the issue at one other potential site.

For some producers, July is one of the busiest months with production ramped up in preparation for the spring and summer seasons. Load shifting at these sites would be more feasible in the quieter months of January and February which coincides with the grid's summer peak. Storage space may also be needed to support load shifting, and this is at a premium in busy periods. The DMPP noted that two plants had the potential to implement cogeneration which would result in significant permanent load reductions.

Participation at other sites would have been more likely had the DMPP had the time to undertake more than one site visit. Two manufacturers could not have their load shifting opportunities developed in the time frame of the trial, but would be worth reconsidering for future load shifting opportunities.

Participating

One site participated in the Load Shifting Trial because it was a genuine program. "We usually avoid government programs," said the managing director, "We find the paperwork outweighs the benefit. The DMPP team of intelligent professional people were straightforward and honest, and that is why we participated."

Two plants were able to stop and restart major pieces of equipment; one has plant lines that can be started with the 'flick of a switch' and automatically turn themselves off if there is no production activity. At other plants, machines take about two hours to warm up before production can begin. Although, metal smelting furnaces once started, cannot be switched off until the melt is complete, their operation can be delayed or started early.

For all participants, once a clear understanding had been gained incorporating all risks with respect to the shifting of production from one period to another, the load shift was deemed technically straightforward. However, shifting production means changing the working hours of employees to 'family-unfriendly' working hours, and the sites that participated had good workplace relations. Management is asking the employees to be inconvenienced and, even if the workers are financially compensated, there still needs to

be trust and open communication. At five of the six participating sites the affected shift either started early, finished late or worked on their usual day off. At one site, the workers had a large amount of accumulated leave and, as the plant was not busy, they took the day off. Whether the workplace is unionised or not does not seem to make any difference. One site has two unions on site and all workers are employed under union awards. However, they are accustomed to changing shifts in response to production requirements. The other unionised site was able to negotiate for the affected shift to work overtime on the day of the trial. The remaining sites operate under nonunion NSW award EBAs and they negotiated similar arrangements. What matters are flexibility, open communication and trust.

In summary, the off-peak production trial participants have two very important characteristics:

- ❖ Manufacturing processes that are either batch processes that can be interrupted or processes that cannot be interrupted once started but start up can be delayed or brought forward; and
- ❖ A flexible workforce that can also obtain benefit from the trial.

By June 2007, six of the 22 remained in the trial, confirmed by a signed Funding Agreement. The estimated combined load shift ranged from 2.9 to 4.7 MVA. Participants knew that on a day in July 2007 (they did not know in advance which day) they would be contacted with a request to take some, or all of, their electrical load off the grid the following day. Participants were expected to make every effort to take the agreed action but were not obliged to.

STANDBY GENERATION TRIAL

The DMPP employed a similar process for the standby generation trial. The main costs for standby generation are fuel and labour. As one participant noted, “If we were doing this more regularly, we would also need to be compensated for depreciation of the generators.”

Using the list of standby generators from the investigations, the DMPP selected sites across many sectors, identifying 33 sites (including 14 hospitals) with total rated standby generation capacity of 104 MVA. The other 19 included sites in hospitality, media, utilities, telecommunications, data management, and manufacturing. They also included sites that form part of larger networks of locations spread across the study area.

The main reasons for nonparticipation were the lack of SCITs and, to a lesser degree, issues around fumes and noise as well as the restarting of equipment.

Other barriers to the use of standby generators for load shifting were identified by potential participants. These include constraints imposed by the EPA (Environment Protection Authority) and similar regulatory bodies; perceived higher costs associated with the maintenance of standby generators; and the risk of business disruption. In all cases, the DMPP team was able to show how these barriers could be addressed. Interestingly, management at another site showed early enthusiasm then made the comment, “Like other government programs we thought you just wanted us to say ‘Yes’ and tick the box”, and withdrew when they realised that the DMPP was going to ask them to actually switch on the generators.

All participants agreed that the most important aspect of the trial was the opportunity to undertake extended testing on real loads and to be compensated for fuel and labour. Maintenance testing is important for management to be confident in the reliability of the standby generation system. For large networks, the participating sites were seen as a useful trial.

During the site visits, the DMPP discovered that the use of standby generators for load shifting is not widely understood. In some cases, the very act of discussing the possibility of employing standby generators causes concerns that there is an increasing likelihood of supply interruptions or that the site might be deemed to be noncritical by the network provider because it can meet its own electricity needs. In these situations constant reassurance was provided by the DMPP to emphasise that reliability associated with the grid was not the issue.

By June 2007, risks and concerns had not deterred the seven participants remaining of the original 33 approached for the trial, and this was confirmed by a signed Funding Agreement. The estimated combined load reduction was 18.3 MVA. Participants knew that on a day in July 2007 (they did not know in advance which day) they would be contacted with a request to activate their standby generators to reduce their electrical load on the grid the following day. Participants were expected to make every effort to take the agreed action but were not obliged to.

Load Shifting Trial Results

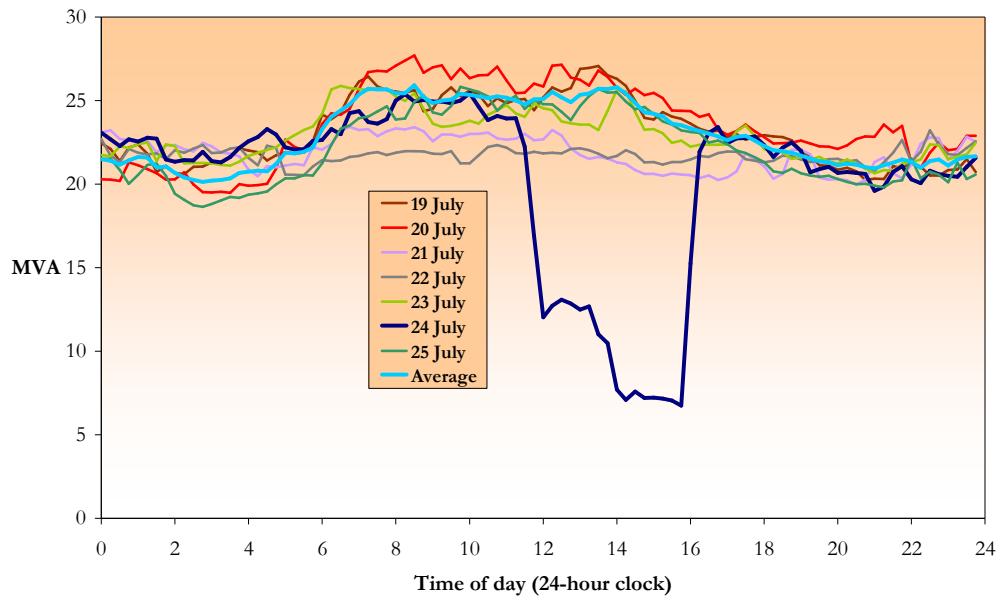
On 23 July 2007 at midday, the DMPP team contacted the 13 sites that had signed a Funding Agreement, aiming for a total reduction in load on the grid of 20 MVA on the following day, 24 July 2007, between 12 noon and 4 pm. To confirm participation, EA would make the relevant load profiles at the participants' existing revenue meters available to participants and the DMPP. On 24 July 2007, the Load Shifting Trial participants reduced their collective load on the grid by 15.2 MVA (when compared to the remaining other four business days of that week and averaged across the four hours from 12 noon to 4 pm). When measured at 15-minute intervals, the participants reduced their collective load on the grid within the range of 18.3 MVA at 2.15 pm to 12.1 MVA at 12:45 pm.

On the numbers alone, the DMPP Load Shifting Trial was an unequivocal success.

The figures are not estimates or simulations but actual load reductions measured and verified by EA. The aggregate daily load profiles for the trial participants for the week surrounding the trial day are illustrated in Figure 1 below.

The shortfall of actual compared to estimated reduction was mainly due to the difficulties in accurately predicting the load in advance — difficulties associated with production schedules, and seasonal and other factors.

FIGURE 1: LOAD SHIFTING TRIAL PARTICIPANTS' AGGREGATE LOAD CURVES, 19–25 JULY 2007



All of the 13 participants that signed a Funding Agreement actually participated on the day, with only 24 hours notice for activation. This 100% participation rate was a pleasant surprise because activation is usually somewhat less. It is generally accepted that to achieve a certain level of load reduction, more participants need to be registered as available than are needed to meet the target, to allow for some not actually participating on the day.

The trial and the follow-up discussions with participants revealed considerable enthusiasm for load shifting on a regular basis with insights into how this might be achieved. All participants declared they were keen to negotiate with EA and TG to undertake regular load shifting in summer peak periods. In fact, summer is the preferred period for off-peak production (rather than winter when the trial was conducted) because it is usually a quieter time of year and the weather is more favourable to changing shifts to the cooler early mornings. Businesses using their standby generators for load shifting claimed they usually need only hours of notice (ranging from one to 24 hours) to deliver peak load reductions. Businesses shifting production to off-peak periods prefer days (ranging from one to three days) to allow adequate time for employees to make alternative arrangements. Workforce issues are the largest potential barriers to participation. For example, at one participating site the workers took a four-hour break and caught up with cleaning and paperwork, then restarted their shift at 4 pm working through to 6 pm. To compensate for these ‘unfriendly’ hours the shift was paid both overtime and a bonus. The workers also got some satisfaction from making a contribution to the community. For another participant, being organised would be the main benefit of regular load shifting. Businesses prefer to respond to an emergency in a controlled manner, rather than deal with an unplanned outage. Participants also pointed out that they could not be obligated to use generators. They will switch over if they can, but must have the right to say ‘Yes’ or ‘No’.

All participants in the standby generation trial had systems with either SCIT, UPS or full parallel capability. However, those with UPS, but without SCIT, were concerned that the

UPS might fail during the transition between grid power and standby power. So, even for these sites, the installation of SCTT is of benefit as it reduces the reliance upon UPS, and participants were keen to discuss with EA and TG the potential for collaboration to install SCTTs at some of their sites.

Other participants stated their preference for exporting to the grid. If something goes wrong while on standby power, sensitive equipment may take considerable time to restart. Businesses with full parallel capability can export standby power to the grid while operating their equipment with power from the grid, eliminating this risk.

In summary, load shifting (off-peak production and standby generation) needs considerable effort on the part of the network provider as well as adequate financial compensation; but it is not impossible. Some participants were concerned that the DMPP’s payment process was quite slow; they incurred the cost months before receiving payment. The payment approvals process would need to be streamlined for ongoing participation in load shifting. The other cost — the DMPP’s time in facilitation and negotiation — was not accounted for in the trial.

Load Shifting in Practice: The Way Forward

The DMPP Load Shifting Trial has shown that there are three steps to the way forward:

1. Identifying the opportunity, including technical, risk and commercial issues.
2. Providing sufficient compensation and sharing the benefits with businesses.
3. Maintaining close relationships through an active account management process.

Strategy	Actions	Opportunities
1. Identifying the opportunity	<p>Allocate sufficient internal staff with the right set of skills to identify load shifting opportunities for customers.</p> <p>This may require recruiting people with a skill set different to that of current staff.</p> <p>Adopt an ‘active facilitative’ approach that includes the customer as a partner in finding load shifting solutions that generate mutual benefits.</p>	<p>Businesses are keen to pursue load shifting opportunities but many cannot identify load shifting opportunities without assistance because load shifting is counter-intuitive to standard business practices.</p> <p>If businesses are involved in the assessment process and are confident that risks have been identified and addressed, they will be positive about the benefits to the business resulting in a high likelihood of implementing load shifting.</p> <p>EA and TG will need to understand the business practices, and then suggest how load shifting can be incorporated into production processes.</p> <p>It is important to consider social issues. For example, off-peak production affects workers’ lives, and their needs must be taken into consideration.</p> <p>If customers are confident with the process and various players involved, they will be more cooperative and proactive in finding load shifting opportunities.</p> <p>While at the business premises EA and TG will have the opportunity to identify other demand reduction opportunities that would benefit the businesses, because they will have created trust.</p>

Strategy	Actions	Opportunities
2. Remuneration	<p>Negotiate fair remuneration for customers.</p> <p>Consider an ‘availability charge’.</p> <p>Consider capital funding.</p>	<p>Businesses are mostly satisfied with a fair return, but they rightly expect to share in all the financial benefits of load shifting.</p> <p>As a minimum, they need to be compensated for any costs associated with the load shift.</p> <p>Ideally an ‘open-book’ approach where a profit sharing arrangement is established would create trust and goodwill, as well as commercial returns, for both parties.</p> <p>In agreeing to an ‘availability charge’, EA and the customer agree upon the technical and financial conditions of load shifting. An ‘availability charge’ appropriately places value on a customer’s willingness to shift its electrical load during periods of peak demand. It also offers certainty of income for customers that are willing to participate in load shifting activities. The charge will vary by customer, reflecting the conditions agreed, such as:</p> <ul style="list-style-type: none"> ❖ Notice required ❖ Response time to the notice ❖ Activation mechanism ❖ Frequency of load shift ❖ Maximum duration of load shift ❖ Overall occasions per year. <p>Although investment in the customers’ equipment (eg SCTT) may seem to be solely their responsibility, there may be an argument for EA and TG to assist with capital funding to bring on investments that facilitate load shifting for demand management.</p>
3. Account Management	<p>Recognise the importance of ongoing, open communication. This could be achieved by the appointment of dedicated load shifting facilitators to key electricity customers.</p> <p>Manage change.</p>	<p>The role of customer management cannot be overstated; it is critical. By developing a close relationship with each customer, EA and TG will be in the best position to implement significant load shifting opportunities and to discover other opportunities.</p> <p>Businesses change — they have busy times and slack times and they may be able to participate in load shifting some times and not others. There are many human variables, and load shifting activities need to be continually reviewed to ensure that the opportunity is still current.</p>