Design Guide

Managing Peak Energy Demand In Live Performance Venues

Greener Live Performances

through energy efficiency

Peak demand; the highest amount of electricity consumed at any one time, has a major impact on network charges and has a considerable impact on retail energy prices across Australia. When peak demand approaches the capacity limits of network infrastructure, network service providers are faced with the challenge of maintaining reliable electricity supply to customers. This is known as supply side management. While investment in network infrastructure to increase peak capacity results in increased costs for customers, effective demand management reduces both the maintenance costs of the network, and results in lower electricity bills for consumers.

A device of demand-side management is network tariffs, which are incentives for consumers to manage the peaks of their energy consumption. Commonly known tariffs include:

- residential off-peak tariffs,
- time of use tariffs, and
- peak demand kVA tariffs for larger customers.

For many live performance venues, peak demand charges account for a considerable proportion of their energy bill. Understanding your energy bill and how demand charges are calculated is a crucial step toward identifying opportunities to reduce your peak demand loads and the associated costs.

Is Your Venue Charged For Peak Demand?

To find out whether your venue is charged for demand, check the network charges section in your energy bill. Figure 1 shows an extract of an energy bill with the relevant charges highlighted in blue. If you are not charged for demand, this fact sheet does not apply to you.

Date	01 Jul 2012 to 31 Jul 2012
NMI	0202020202
Supply Address	ADDRESS 1 BRISBANE QLD 4000

Electricity Usage and Service Calculation

Network Tariff: Energex-4500

Energy Charges	Contract Rate	DLF* MLF	Loss Adjusted Rate	Volume	Cost
Peak Energy	6.92100	1.0630 * 1.0151	7.4681 c/kWh	187,050.30 kWh	$13,969.13
Off Peak Energy	4.64900	1.0630 * 1.0151	5.0165 c/kWh	131,404.02 kWh	$6,591.90
These rates may contain commissions. Please refer to your contract for details.				Total	$20,561.03
Market Charges	Contract Rate	DLF* MLF	Loss Adjusted Rate	Volume	Cost
AEMO	0.04000	1.0630 * 1.0000	0.0425 c/kWh	318,454.32 kWh	$135.41
AEMO - Ancillary Charges	0.05100	1.0630 * 1.0000	0.0542 c/kWh	318,454.32 kWh	$172.64
L.R.E.T Charges	0.38041	1.0630 * 1.0000	0.4044 c/kWh	318,454.32 kWh	$1,287.75
S.R.E.S. Charges	0.70168	1.0630 * 1.0000	0.7459 c/kWh	318,454.32 kWh	$2,375.31
G.E.C. Charges			0.0197 c/kWh	318,454.32 kWh	$62.77
				Total	$4,033.88
Network Charges			Loss Adjusted Rate	Volume	Cost
Fixed Charge			185.3200 $/Day	31.00 Day	$5,744.92
Demand Charge			7.0330 $/kVA	613.38 kVA	$4,313.90
Capacity Charge			272.7000 c/kVA	0.00 kVA	$0.00
Off Peak Energy			0.1860 c/kWh	131,404.02 kWh	$244.41
Peak Energy			0.2070 c/kWh	187,050.30 kWh	$387.19
				Total	$10,690.42
Other Charges			Loss Adjusted Rate	Volume	Cost
Meter Charge			2.1500 $/Day	1.00 Meter(s)/Day	$66.65
Retail Service Fee			1.0000 $/Day	31.00 Days	$31.00
				Total	$97.65
				Total Charges	$35,382.98
				GST	$3,538.30
Current Charges (incl. GST) 01 Jul 2012 to 31 Jul 2012					**$38,921.28**

Useful Links

Energy Action has developed an interactive resource including a sample bill and a glossary that may be helpful in understanding your energy bill and demand charges. This resource is available at: **http://www.energyaction.com.au/australian-energy-market/get-to-know-your-bill.html**

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Energy Bills And Network Charges Explained

Your energy bill may include some of the following cost components:

- Retail costs (billing and customer service)
- Wholesale costs (cost of buying and producing electricity)
- Green energy
- Carbon abatement costs (government programs to save energy and support the development of renewable energy)[ii], and
- Network charges (typically only large consumers with annual energy bills exceeding $20,000 or 160,000 MWh are billed for network charges)

Network charges can account for approximately 50% of your energy bill and represent the cost of delivering energy to your building, the maintenance and operation costs of replacing and upgrading electricity poles, wires and other equipment.

Network charges are typically reviewed annually and vary depending on the state you operate in, your network provider and the tariff you are on.

Charges making up a Tariff

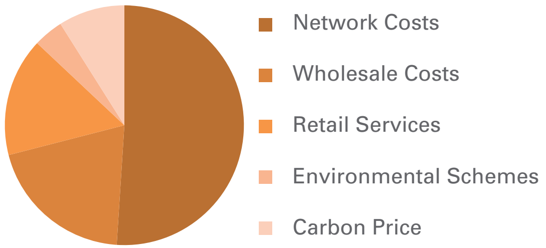

Figure 2: Average Retail Customer's Electricity Bill [Adapted from averages provided by Simply Energy (Commonwealth Treasury) 2012[iii]]

Network charges are comprised of:

- Access (connection fee to network)[iv]
- Consumption *(Quantity and time)*
- Peak demand and Capacity Charges *(Max. amount of electricity used during the billing period)*

Peak demand charges may be identified separately on your electricity bill as they typically account for a large proportion of your network charges. These charges may also be split into time of use periods, depending on your network tariff. Your maximum monthly demand will be multiplied by a fixed dollar per kVA rate.

Demand Charge:

Volume (maximum kVA of billing period)

$$\text{x local adjusted rate} \left(\frac{\$}{\text{kVA}} \right) = \text{Cost}$$

Table 1: Glossary Adapted From Energex, 2013 [V]

Term	Description
Apparent Power	The total of Real and Reactive
Reactive Power	The inefficient component of electricity supply
Real Power	Electricity turned into work
kW	Kilowatt; a measure of Real Power
kVA	Kilovolt Ampere; a measure of Apparent Power
kWh	Energy consumed in kilowatt hours
MWh	Energy consumed in megawatt hours (i.e. 1MWh = 1000kWh)
GWh	Energy consumed in gigawatt hours (i.e. 1 GWh = 1,000 MWh = 1,000,000 kWh)

[1] *The Australian Government will abolish the carbon tax from 1 July 2014.*

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Measurement of kilovolt Amperes (kVA)

In 2013, many Australian power distribution companies (such as Energex) have introduced tariffs based on kVA for their largest customers to replace the application of an adjustment factor.[vi]

A tariff based on Apparent Power (kVA) is a more accurate measure of the impact on the network relative to a tariff based on Real Power (kW) alone. Apparent Power reflects the capacity and costs of the network more accurately and the pricing offers an opportunity for customers to take initiative to improve the electrical efficiency of their site and reduce their electricity costs. [vii] Reactive and real power consumption at large customer sites are recorded for every 15-30 minute period (aggregated for sites with multiple meters).[viii]

Distribution Use of System (DUOS)

There are two Apparent Power charges related to the Distribution Use of System (DUOS):

DUOS demand charges are based on the recorded maximum demand (kVA) being drawn from the grid over a 15-30 minute interval within your billing period (usually one month).

DUOS capacity charges reflect the costs associated with providing network capacity required by a customer on a long-term basis. It is levied either on contracted demand or the maximum demand volumes from the previous calendar year. The charge is applied as a fixed dollar amount per kVA per month.[ix] Capacity charges are charged monthly regardless of fluctuations in peak demand and if monthly peak demand exceeds fixed capacity, excess charges or penalty rates may apply.[x] Generally, electricity suppliers will notify customers of these fixed capacity values.

Understanding Your Peak Demand

The first step toward reducing the peak demand charge on your venue's energy bill is determining what causes the peak demand in your venue. Figure 3 on page 5 shows an energy demand curve of the Mackay Entertainment and Convention Centre and exemplifies how great the difference between base load and peak load can be. Questions to consider when looking at reducing your peak demand are:

When did the peak take place?

- Knowing when your energy usage is highest is essential to tackle peak demand. Your energy provider should be able to provide you with information detailing the dates and times of your monthly peak demand load.

Why did the peak occur at that time?

- *What was happening in your venue at the time?* It is most likely that the peak occurs during performance times.
- *What equipment was running at the time?* Investigate what equipment was running inside and outside your performance space when the peak occurred.

What contributes to peak demand?

- *What are the largest energy consumers in your venue?* Understanding which equipment accounts for the highest energy consumption will help you to find out where to start on reducing your peaks.
- *Is all the equipment in use at time of peak demand needed?* Identify non-essential equipment that was running and consider switching it off for limited periods.
- *Can energy consumption of the required equipment be reduced?* Assess the energy efficiency of your equipment and whether it could be improved. If switching off nonessential equipment for a short period is not an option, consider whether running your equipment at lower power demand is feasible.

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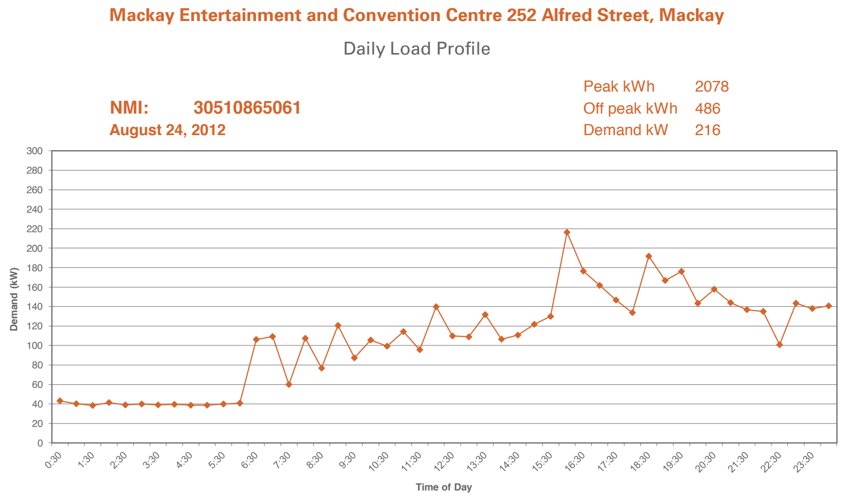

Figure 3: Energy demand curve measured at the Mackay Entertainment and Convention Centre on 24 August 2012 (measured in kW)

Peak Demand Reduction

Once the energy efficiency of equipment is optimised, peak demand reduction is essentially about limiting the amount of high power drawing equipment running simultaneously. Peak demand can be reduced in a number of ways including:

- Rescheduling loads,
- Load shedding and operating appliances at lower power demand for limited periods, and
- Power Factor correction.

Rescheduling Loads

When possible, schedule operations that require large amounts of energy when your venue's total energy demand is low, and ensure that redundant equipment is not running during performance times.

If you have a Building Management System (BMS) in place, you can use this to assess and revise your equipment start-up schedules.

Case Study

Dalby Football Club reduced their peak load by 30%, reducing their energy bill by nearly $12,000 per annum. The Club achieved this reduction by staging the timing of their peak demand use, which is primarily the field lighting, by not turning all the outside field lights on at the same time. Even though this is not an example from the live performance industry, the lesson is to think about the total site and the impact simply rescheduling loads can have on your energy bill.

Load Shedding

Shutting power off to equipment or parts of the building that are not critical is also referred to as load shedding. As above, a BMS can also be programmed to incorporate demand limiting algorithms for load shedding.[xi] Peak electrical demand can also be reduced dramatically by implementing automated demand management strategies. Such strategies can help to smooth the electrical demand peaks by monitoring use and when demand is about to exceed a predefined limit, equipment identified as non-critical can be shut down temporarily or operated at lower power demand for limited periods. Such strategies can be implemented through a BMS or other control systems.

Power Factor Correction

Power Factor is a measure of how efficiently power is being put to use, and is defined as the ratio of 'real' electrical power (kW) to 'apparent' electrical power (kVA) (see Table 1 for definitions). The Power Factor of your venue can also have an enormous impact on your demand charges. Ideally, real and apparent power would be equal. However, many consumers are billed for wasted electricity. A power factor of 0.8 is considered 'low' because it means that only 80% of the power supplied to your equipment is being used effectively, and 20% is being wasted. Each state has its own power factor requirements and penalties. For example, businesses with a low power factor may pay additional charges while those with high power factors may get discounted network charges.

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For venues with a power factor under 0.9, power factor correction equipment may be recommended to minimise inefficiencies.[xii] Capacitors are part of power factor correction equipment and work to correct energy supply inefficiencies and thereby reduce reactive power (see Table 1). By reducing the amount of excess electricity less electricity is drawn from the grid, which means demand on the electricity network is reduced. [xiii]

Payback periods for power factor correction equipment typically range between one to five years.[xiv]

Useful Links

Energy Action has conducted a power factor correction implementation analysis on one of their customers, which helps in understanding the difference between corrected and uncorrected power demand and the impact on your monthly bill.

http://www.energyaction.com.au/images/stories/PFC-Post-Implementation-Analysis.pdf

Energy Efficient Equipment

Peak Demand Management works in tandem with overall energy efficiency. Reducing energy demand is the first step, adjusting the timing comes after. One way to reduce peak demand is to increase the overall energy efficiency of the equipment in your venue. In live performance venues, energy demand peaks are bound to occur during performance times with air-conditioning systems and stage lighting being major power consumers. Refer to the *Energy Efficiency Implementation Checklist* for Venues to assess your venue's energy efficiency.

High energy consuming equipment such as **HVAC equipment** can increase demand charges significantly and it is worth evaluating if potential retrofits of your HVAC system will increase energy efficiency.[xv] Refer to our *Design Guide on Retrofitting HVAC systems* for more information.

Energy efficient **stage lights** can reduce the energy load from lighting, and can also reduce pressure on the air conditioning system. Heat generated from stage lights accounts for a considerable share of an auditorium's air conditioning loads. Energy efficient light sources such as LEDs do not emit heat. Refer to our resources on *Energy Efficient Lighting Design* for more information.

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Endnotes

[i] Ausgrid, 2013. Demand Side Engagement Strategy; *http://www.ausgrid.com.au/Common/Ournetwork/Demand-management-and-energyefficiency/~/ media/Files/Network/Demand%20Management/Aus grid%20 Demand%20Side%20Engagement%20Strategy.pdf*

[ii] Australian Competition and Consumer Commission (ACCC), 2012. Energy Bills Explained, *http://www.aer.gov.au/sites/default/files/Energy%20b ills%20 explained%20-published%20version_1.pdf*

[iii] Simply Energy, 2012. My Resources,*http://www.simplyenergy.com.au/my-resources/carbon/*

[iv] Energy Action, 2013. Fact Sheet: Network Charges, *http://www.energyaction.com.au/network-charges.html*

[v] Energex, 2013. kVA Charges for Large Customers, *https://www.energex.com.au/__data/assets/pdf_file/0003/158718/Form-8313-kVA-Charges-for-Large-Customers.pdf*

[vi] Energex, 2013. kVA Charges for Large Customers, *https://www.energex.com.au/__data/assets/pdf_file/0003/158718/Form-8313-kVA-Charges-for-Large-Customers.pdf*

[vii] Energex, 2013. kVA Charges for Large Customers, *https://www.energex.com.au/__data/assets/pdf_file/0003/158718/Form-8313-kVA-Charges-for-Large-Customers.pdf*

[viii] Energex, 2013. kVA Charges for Large Customers, *https://www.energex.com.au/__data/assets/pdf_file/0003/158718/Form-8313-kVA-Charges-for-Large-Customers.pdf*

[ix] Energex, 2013. kVA Charges for Large Customers, *https://www.energex.com.au/__data/assets/pdf_file/0003/158718/Form-8313-kVA-Charges-for-Large-Customers.pdf*

[x] Energy Action, 2013. Get to your bill - Capacity, *http://www.energyaction.com.au/australian-energymarket/get-to-know-your-bill/176.html*

[xi] Australian Department of Industry, 2010, Building Management System Guide, *http://ee.ret.gov.au/buildingmanagement-system-guide*

[xii] Energy Conservation, 2014. Power Factor Correction, *http://www.energyconservation.com.au/pdf/Power_Factor_Correction_Services.pdf*

[xiii] Energex, 2012. Power Factor Correction. *https://www.energex.com.au/__data/assets/pdf_file/0005/111686/8083.pdf*

[xiv] Energy Action, 2014. Power Factor and Power Factor Correction, *http://www.energyaction.com.au/australian-energymarket/power-factor.html*

[xv] Department of Climate Change and Energy Efficiency, 2012.Guide to Best Practice & Maintenance & Operation of HVAC Systems for Energy Efficiency by Lasath Lecamwasam, John Wilson and David Chokolich (GHD) *http://ee.ret.gov.au/energy-efficiency/non-residentialbuildings/heating-ventilation-and-air-conditioning-hvac/guidebest-practice-maintenance-operation-hvac-systems-energyefficiency*

[xv] Energex, 2013. kVA Charges for Large Customers, *https://www.energex.com.au/__data/assets/pdf_file/0003/158718/Form-8313-kVA-Charges-for-Large-Customers.pdf*

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