



Government of Western Australia
Department of Finance
Public Utilities Office

Presentation to AIRAH: Controls – managing building performance and environmental impact

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Program Facilitation and
Review



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Overview

“You can’t manage what you can’t measure” - It still holds

- Context
- Metering standards
- HVAC-HESS; measures and case studies
- National Metering Institute - update
- NABERS Commitment Agreements/Case studies
- The value of performance
- Commercial Building Disclosure (CBD) update
- Equipment Energy Efficiency E3
- Where to next
- Conclusion

Context – why monitor/measure?

Australian non-residential HVAC systems consume:

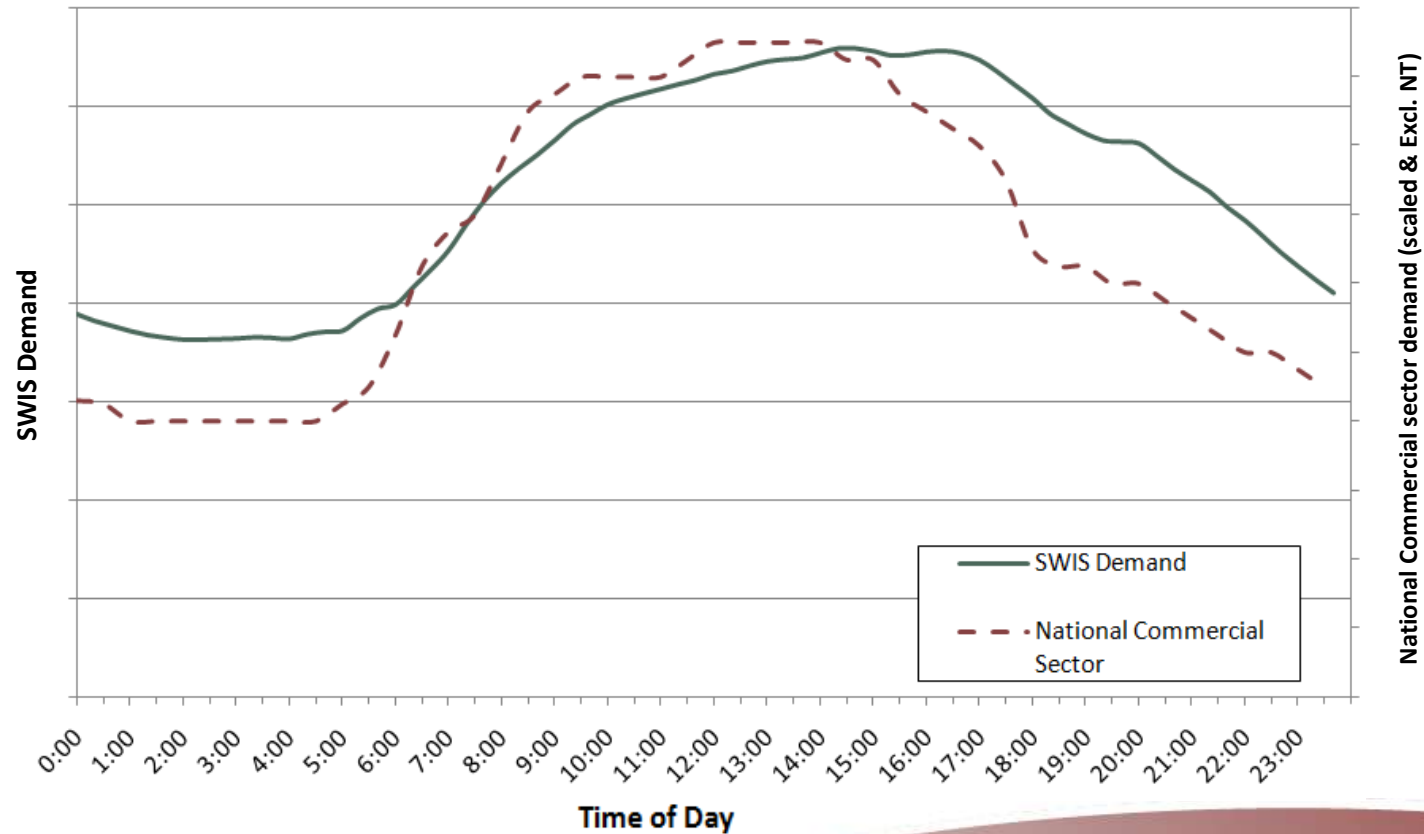
- Nine percent of electricity (>3.6 percent of GHG emissions)
- Responsible for between 40% - 60% of energy used in non-residential buildings
- Over 55% of electrical demand in CBD locations

The industry is worth \$7 billion per annum and employs 95,000 people

Source: HVAC High Efficiency Systems
Strategy – The Measures, March 2007

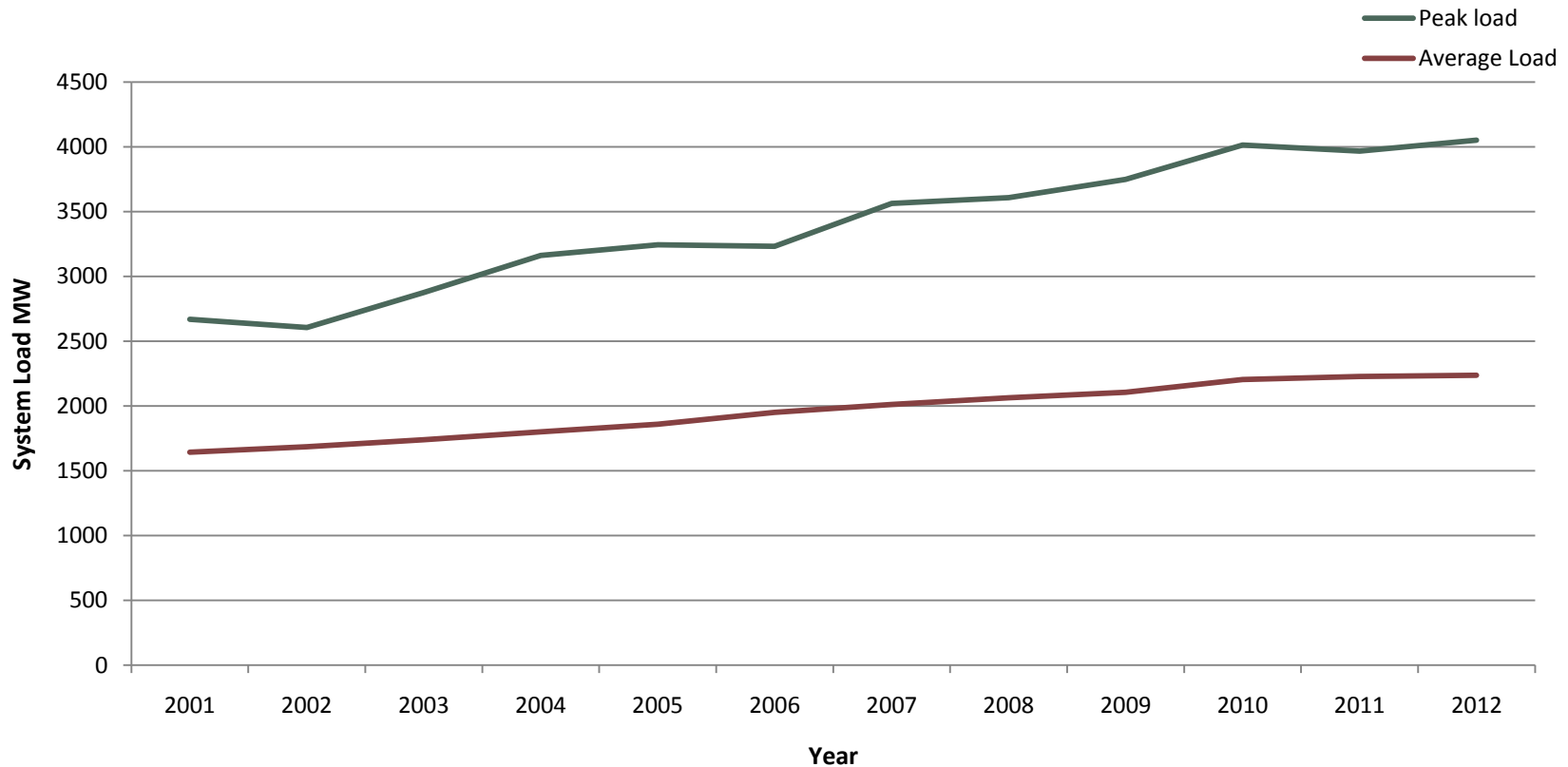
Context – what do we know?

SWIS Load / Nat. Commercial building demand – 9 February, 2010



Source: SWIS load data & Energetics, Building our savings: July 2010

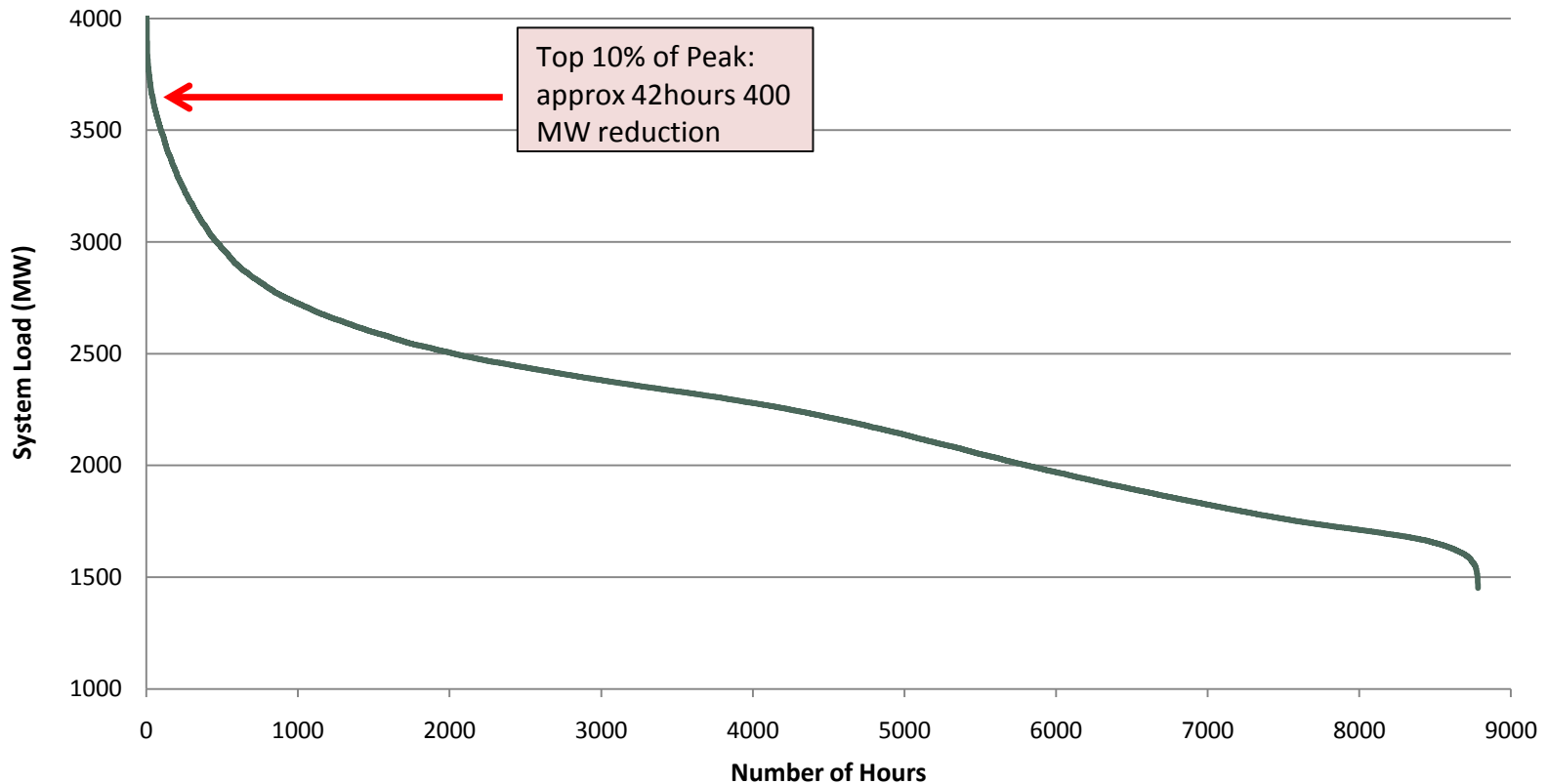
Context – what do we know?



Source: SWIS load data

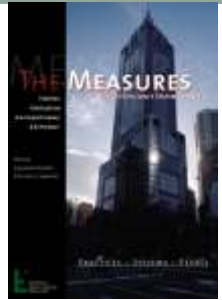
Context – what do we know?

Utilisation curve



Source: SWIS load data

Context – why monitor/measure?



HVAC
'The measures'

2007



Commercial
Building Disclosure

Feb 2010

NABERS validation
requirements



Nov 2010

Jan 2013

Elec.
meters



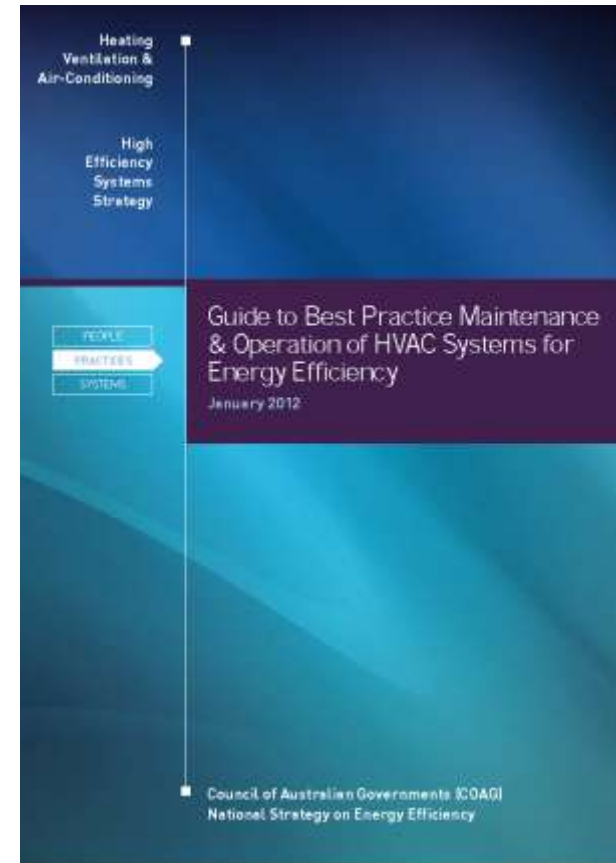
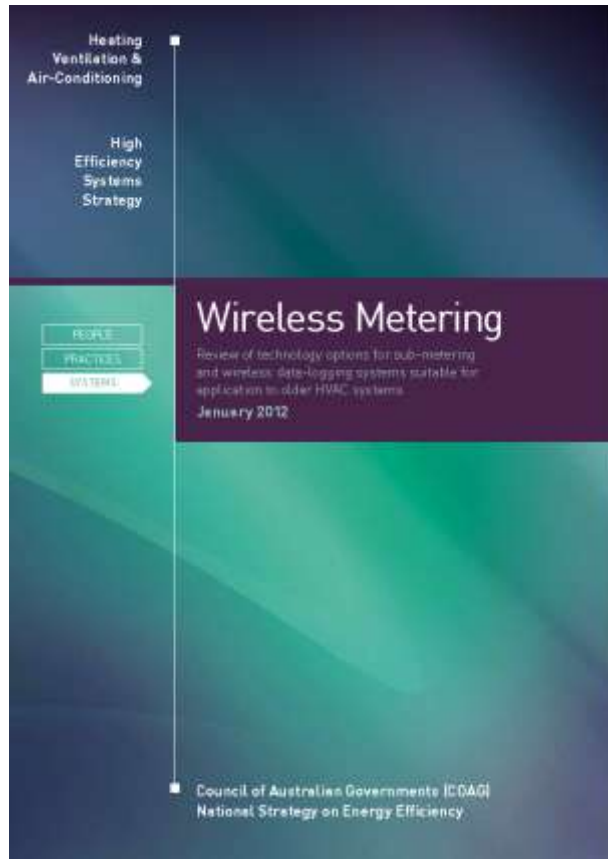
Gas meters

Soon?

Water meters

July 2014?

HVAC-HESS Measures



<http://ee.ret.gov.au/energy-efficiency>

HVAC-HESS – what we now know

Wireless metering – the project:

- Procurement of commercially available wireless metering products
- Two buildings, six month continuous assessment of:
 - installation, commissioning, operation & maintenance, cost effectiveness
- Wireless measurement of: electrical sub-metering, temperature, humidity and real-time comfort

Key findings:

- Trade-off between **equipment cost** and **installation complexity + resultant accuracy**
- **Wireless** sub-metering infrastructure, **cheaper** than equivalent wired power meter
- **Wireless** sensors proved to be **technically viable** and cost effective
- Lower cost metering solutions tended to overestimate power measurements

HVAC-HESS – fact sheets

HVAC HESS
Factsheet

PEOPLE
PRACTICES
SYSTEMS

Building Management Systems

The HVAC and communications lighting systems of a 15-year old 140,000 m² commercial office building in Canberra (Fig. 1) were upgraded in 2010, resulting in a HANZS Energy Saving Improvement from 2 to 4 stars. This resulted in a reduction in annual energy usage saving \$20,000, a 70% reduction in annual greenhouse gas emissions, and an increase in occupant comfort. One third of the savings is credited to the BMS, other components of the retrofit are detailed in case study 4 fact sheet 4.

Fig. 1: Street view of 4 Mort Street, Canberra, ACT



Some BMS Features

- providing data for on-charging occupants for when to turn on and for energy consumption when the electricity power supplies are provided by the grid
- meeting HANZS Energy targets are met
- providing diagnostic capabilities to proactively improve user productivity

Some BMS Issues

The BMS in most buildings have a mixture of direct digital control (DDC) systems located with the systems (BMS) equipment in plant rooms. These controllers are linked together through a bus area network that connects to a local and/or regional data centre which typically provides the user interface to installing and setting control loops.

BMS communication protocols, which are often not electronic or open protocol, make it difficult to use when connecting with one another. There are several types of communication either from a point to a point or broadcast.

The specification of open standard protocols for BMS offers interoperability across different building control systems with advantages to open data access and wider integration. Open standard protocols also simplify the integration between components and between systems such as HVAC, lighting controls, access control and elevators with provision for future planning.

BMS systems are made up of various control equipment including boilers for heating, chillers for cooling, air handling units for air conditioning and a range of variable components such as pumps and fans. The BMS controls the operation of the various HVAC elements based on information received from sensors which monitor key parameters such as temperature, relative humidity, carbon dioxide levels, flow, pressure and return air quality, system pressure and occupancy.

Keynote: Smart and Modern Buildings that proactively optimising resource consumption offers a pathway to energy efficiency.

<http://ee.ret.gov.au>

HVAC HESS
Factsheet

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Air Handling Units

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Fig. 1: Street view of 4 Mort Street, Canberra



Air Handling Units (AHUs)

AHUs provide conditioned air to occupied spaces in a building. The function of an AHU is to condition and distribute air throughout a building in order to maintain satisfactory indoor air quality (IAQ) and control conditions including temperature and humidity. Maintaining IAQ requires an AHU to ensure air flow performance and surface of a duct is clean to reduce pollutants and moisture, CO₂ and volatile organic compounds (VOCs) generated within the building.

AHUs have a number of components including mixing dampers that mix outside air with recirculated air from within the building. AHUs, ceiling fans, ceiling lights, fans, heat exchangers and air filters.

Monthly or typically filtered from the conditioned air by the cooling coil which is supplied with chilled water from a chiller. As the conditioned air is cooled below the dew point, moisture in the air is removed. Some AHUs have humidifiers installed to increase moisture content, allowing those air to be recirculated in high performance buildings due to high energy consumption and costs.

Heating is typically provided by the heating coil through which hot water is circulated. The heat is also usually being provided by hot water radiators. The installation of electric heating was not included in this upgrade due to its high greenhouse gas intensity.

The energy consumption of an AHU is directly related to the fan coil air flow, and additionally the return air flow in large buildings. AHUs also have the potential to significantly reduce the energy consumed by other HVAC equipment such as chillers, boilers and air handlers when installed, as well as the operation of AHUs increases the conditioning demand. Some designs, operation and maintenance are essential functional operational AHUs associated plant.

VAV Type Systems

All air flow either conditioned or unconditioned is via a return (RUE) fan volume of supply air is regulated in VAV systems depending on the amount of cooling or heating required, including the energy to operate the end energy savings associated with air heating when the heating system contracts the cooling system. Green field typical office type buildings have VAV, fixed volume type who have not met the energy performance. VAV type AHUs are more efficient. Return of air volume systems are developed and a general concept.

Although most modern offices are served by VAV type air handling units these systems are not a best practice general approach due to design complexity, poor commissioning and poor maintenance and operation. The net result is that many VAV systems are operated as constant volume systems, leading to energy and cooling capacity wastage.

Factors Affecting AHU Efficiency

Other key factors that contribute to inefficiency include poor operation of the supply fan coil system, a low static pressure, the use of a duct air to cool the building and/or a duct system of variable air flow (VAV) in a duct. The installation of a fixed VAV plant at the end of the duct is a total waste and the programming of the controls of the fan pressure will vary only air pressure conditions which are too complex to control for control conditions.

Keynote: Smart and Modern Buildings that proactively optimising resource consumption offers a pathway to energy efficiency.

<http://ee.ret.gov.au>

HVAC HESS
Case Study

PEOPLE
PRACTICES
SYSTEMS

Commercial Building Energy Efficiency Retrofit – 4 Mort Street, Canberra

In 2010, 4 Mort Street, Canberra (Fig. 1) was upgraded to significantly improve its energy performance. The retrofit was performed with the dual constraints of a limited budget and the building remaining occupied during the upgrade. The Green Star certification has been achieved for 41 year old commercial office building achieving a 3.5 star HANZS Energy Saving Improvement. Including the performance and the fact sheet 4.

Fig. 1: Street view of 4 Mort Street, Canberra



Background

The building:

1. 140,000 m² office building owned by Hodge Peltus Fund
2. 15 storey with an attached 50,000 m² GADP
3. 2 star HANZS Energy Saving, as assessed
4. Greenhouse gas emissions, with single wheel based heating coil at ground floor, Greenhouse gas emissions at 150 tonnes per annum
5. Heating HVAC, including level of operational, level of maintenance, level of commissioning
6. 200,000 m² of air conditioning control using existing HVAC systems

In order to meet a target of 4 stars HANZS Energy Saving, the building to target a 41 star HANZS Energy Saving.

Fig. 2: Chilled water boiler system at 4 Mort Street, Canberra



Keynote: Smart and Modern Buildings that proactively optimising resource consumption offers a pathway to energy efficiency.

<http://ee.ret.gov.au>

<http://ee.ret.gov.au/energy-efficiency>

The National Metering Institute (NMI)

- From 1 January 2013, electricity meters used for trade must be **pattern approved** and **verified**
- Gas meters: comments on gas utility meter technical and testing requirements **closes 28 June 2013**
- Proposal for lifting of exemptions for water meters on 1 July 2014 (consultation paper on NMI website)
- www.measurement.gov.au



NABERS – recognising performance

CASE STUDY www.nabers.gov.au	
A CLEAR VISION FOR SUSTAINABILITY – ACHIEVED USING GREEN GLASS	
<p>HOW GREEN IS YOUR GLASS?</p> <p>Glass is one of those things you only notice it's in there, but paying attention to glass really paid off for the developers of an office complex at 30-40 St Johns Street, Sydney.</p>	
	
<p>Despite their eco-friendly appearance, the savings on the western side of the building can pretty much be seen.</p>	
<p>The project moved into the design phase when the developer, Webster Knight, conducted an assessment of the plan to see where it might fall on the NABERS scale.</p> <p>A Mutual Authority Commitment Agreement is a contract between the NABERS Regional Administrator, the Public Utilities Office, and a commercial office building proponents to conserve energy, build environmental resilience, the promise to achieve a 4 star or higher NABERS Design rating. This allows the building proponent to proactively be included into the current NABERS Design rating, while the building is under construction. A NABERS Compliance Agreement encourages design proponent, project manager and building owners to take on achieving the agreed performance target through all phases of a new development or refurbishment.</p>	
<p>Building: 30-40 St Johns St Developer: Webster Knight NABERS: 4 Star Client/contract reference: Design & Construct Commercial Office Bldg NABERS Project Coordinator: ANP/PLB Building management: Webster Knight</p> <p>Photo courtesy of Webster Knight</p>	
	

CASE STUDY www.nabers.gov.au	
SOME FRIENDLY COMPETITION KEEPS THIS BUILDING ON TOP OF SUSTAINABILITY	
<p>A TEAM APPROACH PAYS DIVIDENDS</p> <p>Starting 263 years ago on the land, Central Park is the tallest and was until recently the largest building in Perth. The building was one of the first to have its environmental performance measured with NABERS and the results have been in regular contact with the top over a decade.</p>	
	
<p>Owned by Perini Investments and Fraser Property Australia Pty Ltd, it was the first building to achieve a 4.5 NABERS Energy rating (then known as 4.0/5.0) in Australia. It has a 4.5 NABERS Energy rating of 4.5 stars and the building's management is steadily looking to Perfection.</p> <p>But when this secondary energy efficiency achievement is the product of Central Park, it is the holistic approach to sustainability taken by the current and incoming that sets apart the building apart.</p>	
<p>Completed in 1982, the 263 George Terrace premises have been rated with the NABERS Energy rating, while the 1000 George Terrace tower, which has a 4.5 NABERS Energy rating, the building's highest 4.5 star rating is a testament to the fact that this building has the whole suite of sustainability qualifications as the owners are considering about doing the right thing, they want to ensure tenant comfort and productivity is good for the bottom line.</p>	
<p>Photo courtesy of American Global</p>	
	

www.nabers.gov.au

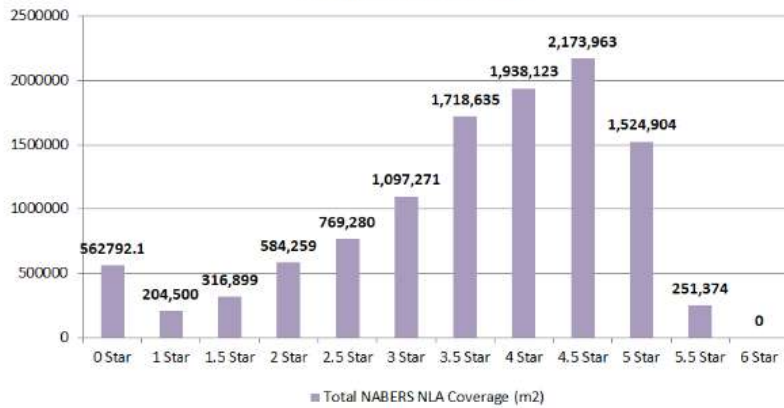
NABERS – recognising performance

- A 1 star improvement in NABERS Energy rating = 15 percent reduction in energy costs
- NABERS Energy 5 star rating = 9% premium in value
- Buildings with < 4 stars NABERS Energy = vacancy rates of over 11 percent
- Buildings with 4 stars or higher NABERS Energy = 3.7 percent vacancy rates
- Since early 2011, 8 Perth office buildings with a combined NLA of nearly 125,000m² have achieved an average of NABERS Energy 5 stars for commitment agreement ratings

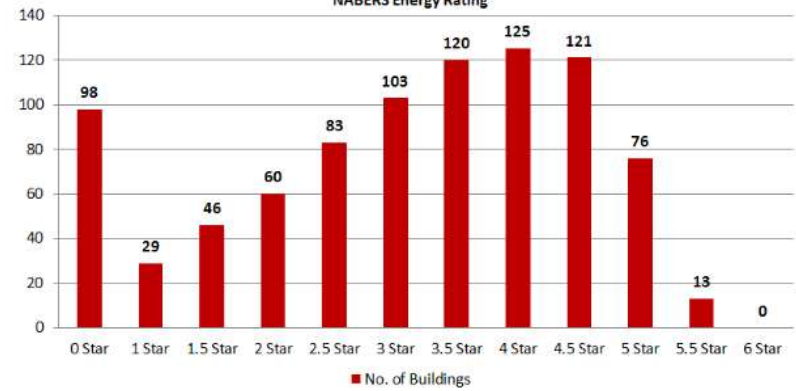
Commercial Building Disclosure - snapshot

- From Nov 2011 – Nov 2012: Total rated area of 874 buildings = 11.1 million m², 3 star average

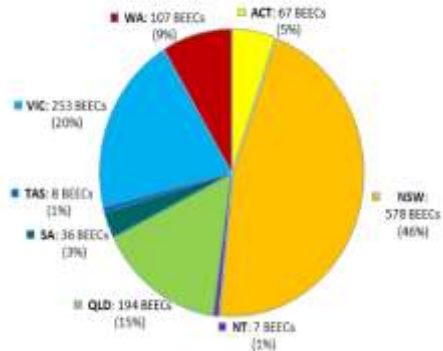
Total NABERS NLA Coverage (m2)
by
NABERS Energy Star Rating



Number of Certified Buildings (BEEC)
by
NABERS Energy Rating



Number of BEECs Certified per State



Source: www.cbd.gov.au

Equipment & Appliance Energy Efficiency

It is estimated that 25% of retail electricity costs is accounted for by peak demand that occurs for less than 40 hours per year (less than 0.5% of the year)

- E3 is working **to remove least efficient products** from the market
- Introduction of Greenhouse and Energy Minimum Standards (GEMS), late 2012
- Direct Load Control (DLC): Consultation paper examining benefits of mandating inclusion of **'smart interfaces'** in devices such as air conditioners
- Industrial fans, motors, packaged boilers – **MEPS** (voluntary/mandated)



• www.energyrating.gov.au

Where to next?

- Greater understanding of **peak load efficiency**
- **Retrofits** as office space comes offline? Increased efficiency of CBD rated stock?
- **NABERS**: Greater uptake of data centres, Shopping centre and Hotel ratings
 - Expanded use of Hospital and School tools
- Ongoing success and **shared learning's** from NABERS commitment agreements
- Calculating Cool project – **efficient design & operation** of HVAC systems
- Current and future **AIRAH initiatives**

Conclusion

- **Government working with industry** has provided great energy efficiency outcomes
- Monitoring and metering; now firmly **embedded** in the commercial office sector
- **High NABERS ratings** are correlated with **high asset values** in commercial buildings
- **Peak demand**: the tools, the knowledge - still to come
- Expanding requirements for meter validation/verification/accuracy

Resources & Questions?

- EEX website: www.eex.gov.au
- Commonwealth Department of Resources, Energy and Tourism: www.ret.gov.au
- Equipment Energy Efficiency: www.energyrating.gov.au
- National Metering Institute: www.measurement.gov.au
- NABERS: www.nabers.gov.au

Questions?