

IHEA

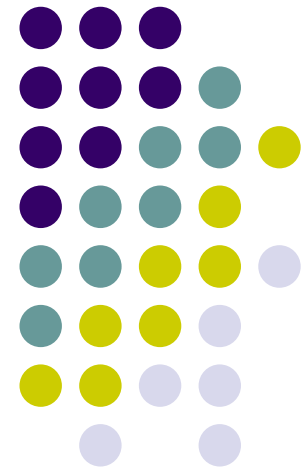
INSTITUTE OF HOSPITAL ENGINEERING, AUSTRALIA
SUPPORTING HEALTH FACILITIES MANAGEMENT

Energy Performance Contracting- Efficiency Opportunities in Health Care Facilities and Patient Environments

Presentation by

Scott Wells BEng, Grad Cert Health Mgmt

Royal Brisbane Women's Hospital



Overview



- Energy Management in Australia
 - Policies, legislation and energy targets
 - Social, economic and environmental benefits
 - Overview of best practices and EPC management tools
- Queensland Health Energy Performance Contracts (EPC)
 - area equivalent to the UK
 - How to meet the challenges of Energy performance contracting
 - The EPC process
 - Barriers to EPC
- Queensland Health Energy Efficiency Projects
 - Ipswich Hospital
 - The Prince Charles Hospital
 - Royal Brisbane Womens Hospital
 - Widebay Hospitals
- Post Evaluation of EPC
 - What has been learned from the experience
- Questions

Energy Management



- Australia's energy use is increasing at over 2%, leading to the growth in greenhouse pollution which is linked to global climate changes.
- Energy Management is the most effective strategy for reducing these emissions.
- Energy performance Contracting is a recognized strategy for reducing energy and greenhouse gases.

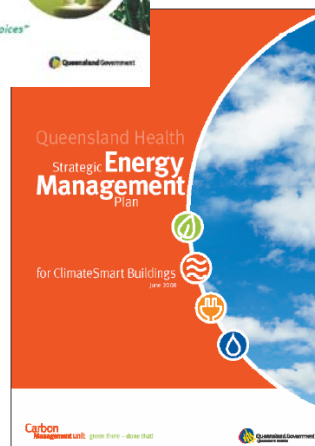
Source – NFEE (National Framework for Energy Efficiency)

Energy management in Australia



The challenge – Meeting legislation requirements including
The Government Energy Policies

- Energy Efficiency Opportunities Act
- National Framework for Energy Efficiency
- Renewable Energy Targets (eRET)
- Energy Efficiency in Government Operations
- Climate Smart 2050
- Government Strategic Energy Policy



QLD – QH Strategic energy efficiency policy
QLD – Green office resources guide

Social, Economic & Environment Benefit



Governments in Australia recognize the community expectations and deliver programs that are sustainable for meeting energy targets

- Deliver programs that are **green** and reduce carbon emissions
- Reduce energy intensity in government buildings
- Governance of public spending on energy programs
- Sustainability and environmental projects that improve operations and mitigate against energy price increases.
- Energy performance Contracts are monitored for validation of savings and to meet government targets
- Improved energy security and reliability of plant
- Energy costs are on the rise with projected forecasts in the order of 30%-50% over the next 2 years. Identifying energy efficiency opportunities early in the workplace and home are critical in avoiding the pressures that rising energy prices will bring.



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Best practices for EPC management

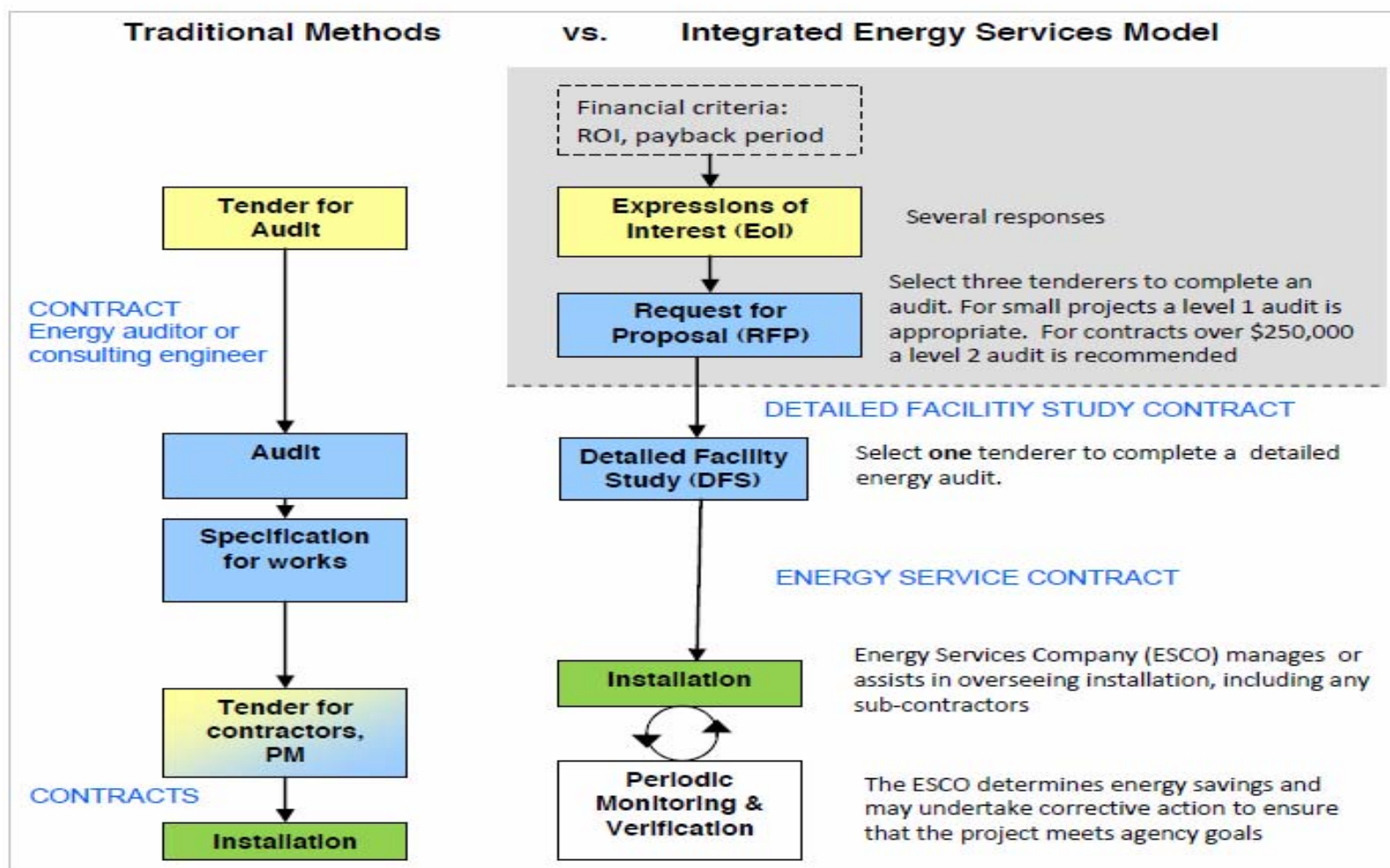


Energy Performance Contracts is a disciplined approach to fund facility improvements that are guaranteed to pay for themselves through reduced energy and water consumption, as well as lower maintenance costs.

As a part of the global focus on sustainability and climate change there is an ongoing focus on greenhouse gas reduction. Best practices, EPC process tools have been developed to determine whether Energy Performance Contracting is the best way for your organisation to improve its energy efficiency.

A step-by-step process for setting your goals, hiring an Energy Service Company, scoping your project and setting up a contract

- A plain English guide to understanding and using EPCs
- The Standard Detailed Facility Study Agreement
- The National Standard Energy Performance Contract.



Source – Government Property Group

Qld Health legislation requirements



Key legislation

- QH Strategic energy efficiency policy
- Queensland Government Energy policy

Key targets

1. Energy consumption reduction by 5% by 2010 and 20% by 2015 based on 2005/06 figures
2. Gas fired electricity generation increase to 18% by 2020
3. ESD for new buildings to be 5- 8% of the capital budget.
4. Greenhouse gas emissions reduction to 60% by 2020 based on 2005/06 figures
5. Queensland Health adapts and extends sustainable practices in its culture, its strategy and practices.



QLD



Health Service Districts by Queensland Health Facilities



Prepared by: Statistical Output, Health Statistics Centre, 26 June 2011
Health Service Districts and Facilities as at 1 July 2011

Source –Queensland Government

Energy needs of Australia's fastest growing, most decentralised and energy-intensive state



Over the last 10 years, annual electricity consumption in Queensland has grown by over 53 percent or 23,000 GWh. Maximum electricity demand was more than 9200 MW, This demand growth is expected to continue with an estimated one million people anticipated to move to Queensland's south-east corner over the next 20 years.

www.energex.com.au

EPC in Queensland Health



The QH challenge – Meeting legislation requirements

The Policy Process:

- Carbon Management Unit has developed a SEMP (Strategic Energy Management Plan). The policy was approved by Cabinet in December 2007 as part of the government's commitment to meet the national greenhouse gas emissions reduction target of 60 per cent by 2050 and Energy saving of 20 per cent by 2015.
- Education and training programs will be introduced to change staff behavioral and usage patterns, and a central register will be maintained to record energy consumption and greenhouse emission levels.
- The policy forms an important step towards implementing the *Carbon Reduction Strategy* which establishes mandatory energy reduction targets in all Queensland Government buildings.



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Barriers to progress



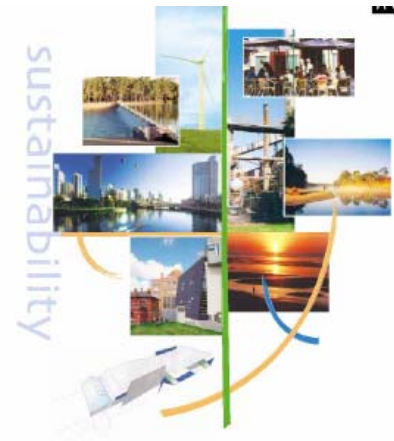
Barriers that have impeded the EPC process

- Transient relocation of ESCo staff with knowledge of energy principles
- Security of utilities (Gas supply) for Cogeneration plant
- Changes in government policies
- Capacity of ESCo to deliver program
- Industrial action impeding progress
- Financial risk (no variations or change of scope)
- Geographical location of works
- Expectations of delivery to programs has low impact to health facility services lines or patient care
- Low risk to facility live systems
- Security of Engineering supply services
- Verification and supplier performance accountability to prove that the savings were achieved.

Energy Audits



- Review of utility energy accounts
- Smart meters for each building supply
- Thermal losses in steam pipes
- Power factor correction
- Variable Speed Drive Motors with PID control
- Chilled water tertiary pumps
- Chiller Performance (tubes)
- Lighting efficiency program
- BMS control of plant Air Conditioning



An Australian Government Initiative

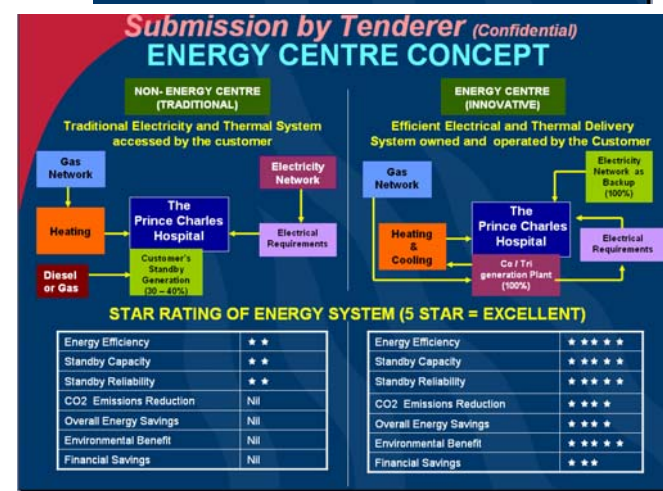
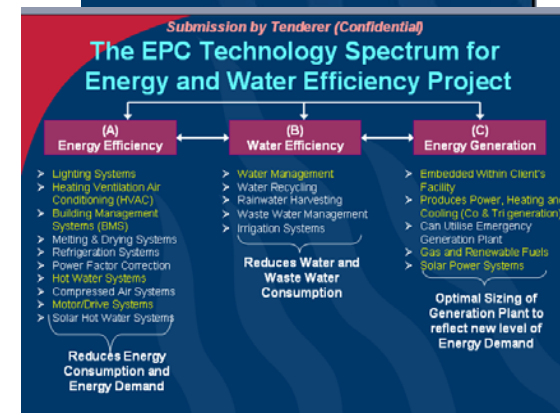
AusIndustry

Detailed Feasibility Study

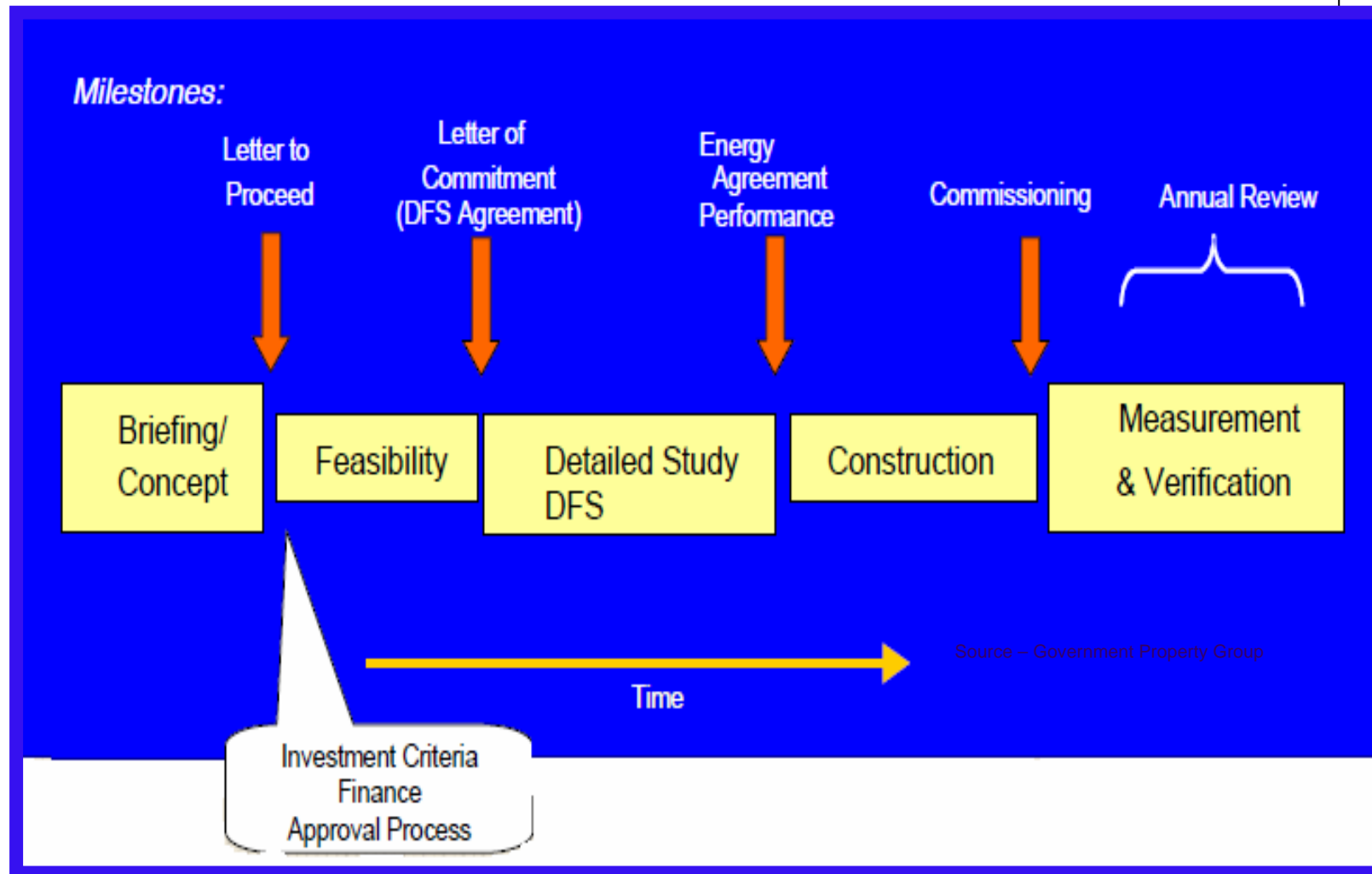
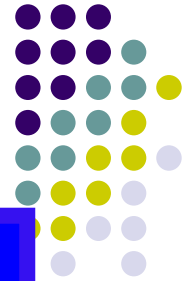
- Services to be provided by ESCo
- Obligations of ESCo
- Obligations of customer in this case QH
- Historical and Diagnosis Data collated
- Methodology to identify process and performance of plant
- Objectives to minimize energy wastage
- Technology needs analysis aligned with business plans
- Performance Guarantee on completion time and delivered outcomes
- Report to have pay back of investment
- Computation to Guarantee savings
- Commissioning procedures
- Measure & Data Validation process
- The measure and validation process is paramount to operational success or failure of the contract.

Submission by Tenderer (Confidential)
EPC Project Outcomes

ITEM	RESULT
TOTAL PROJECT COST	\$3,999,475
TOTAL PROJECT SAVINGS per year	\$676,878
GREENHOUSE GAS SAVINGS per year	11,404 tonnes of CO ₂
WATER SAVINGS per year	10,676 kL
FIXED COST DFS FEE	\$28,000
M&V COST ESTIMATE (3 years)	\$5,000
INTERNAL RATE OF RETURN	22.06%



Process & Milestones



Energy Efficiency Benefits from EPC in Health Facility



- 1. Prince Charles EPC project includes:
- Installation of 1.6MW Natural Gas fired Cogeneration plant, Comprising
- 1.6MWe Gas Engine
- 500kW (thermal) Heat Recovery Boiler
- 808kW (thermal) Hot Water Recovery plant
- Worlds Best Practice Emissions Reduction System
- 1.6 MW Cogeneration Plant supplying electricity, hot water and steam
- Extensive lighting upgrade of 3,000 luminaires
- Heating, Ventilation and Air Conditioning projects
- Building Management System additions
- Minimum Annual Electricity kWh savings
 - 12,119, 787 kWh
- Minimum Annual CO2 savings
 - 11,700 Tonnes CO2

Activity	Date	
Submission of RFT	03/03/2005	(Confidential)
Evaluation of RFTs	04/04/2005	
Negotiate DfES Agreement	02/05/2005	RESULT
TOTAL PROJECT COST		\$3,999,475
TOTAL EPC JETS SAVINGS	02/05/2005	\$676,878
GREENHOUSE GAS SAVINGS per year	11,404 tonnes of CO ₂	
WATER SAVING per year	19/09/2005 – 20	10,676 kL
FIXED COST FEE	weeks	\$28,000
M&V COST ESTIMATE (3 years)	03/10/2005 – 2	\$5,000
INTERNAL RATE OF RETURN	weeks	22.06%
Sign EPC Agreement	21/11/2005 – 7 weeks	
Complete initial designs	19/12/2005 – 4 weeks	
Start Construction	30/01/2006 – 6 weeks	
Commission	27/11/2006 – 43 weeks	
Practical Completion	11/12/2006 – 2 weeks	
Guaranteed Completion millstone	11/12/2006	

Energy Efficiency Benefits from EPC in Health Facility



Delivery of the 79 Litre,
V16 MTU Engine and
Generator

1.6 MW naturally gas
fired Co-Generator
Plant



Energy Efficiency Benefits from EPC in Health Facility



Ipswich Hospital Solar Field Project

- **This was the first operational absorption chiller cooling system in Australia using solar radiation as its primary source of energy**

Results for December to May

- Period 143 days,
- 65 days of chilled water production
- Total heat collected 17,899 kWh
- Average daily heat collected –
- 559.4 kWh over 6.2 hours

The Solar Field

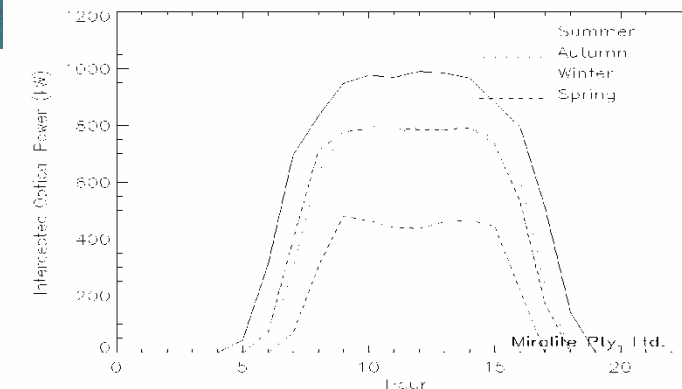
- Area of 920 sq.m.
- 255 kW thermal capacity
- 650 litres of oil
- Temperature: up to 175°C

Solar Collectors

- 43 parabolic troughs
- 14 fields
- Vacuum insulated tubes

Achievements at Ipswich Hospital

- Electricity – 2,002 MWh (16%) reduction
- Water – 25.8 MI (32%) reduction.



Energy Efficiency Benefits from EPC in Health Facility



- **Logan Hospital**
- **The EPC project includes:**
- **Lighting upgrade – over 2500 lights**
- **HVAC** – upgrade to entire system that will incorporate the installation of VSD's to cold and hot water pumps, condensers, air handling units; install heat pump central hot water generation system and high efficiency motors
- **BMS** upgrade
- **Water Management** – installation of flow reducers to all tap ware; install waterless urinals and reset water levels in cisterns; potable water recovery for the CSSD sterilisers; water tanks; water compactor to reduce waste disposal costs
- **Renewable Energy** – installation of a grid connected solar 10 kW photovoltaic (PV) system
- .
- Minimum Annual Electricity kWh savings – 2,125,482 kWh
- Minimum Annual CO2 savings – 2,253.



Energy Efficiency Benefits from EPC in Health Facility



Hervey Bay Hospital Solar project

- The 266 kilowatts of solar panels are expected to provide approximately 385 megawatt hours of energy annually or enough energy from the sun to power 50 homes for a year. The clean energy produced will reduce greenhouse gas emissions by around 400 tonnes per year
- 3. Hervey Bay Hospital
- Hervey Bay Hospital has been recognised by the W.H.O as a Health Facility demonstrating best practice in Energy Efficiency.
- The EPC project includes
- Lighting upgrade
- Heating, Ventilation and Air Conditioning (VSD, HDW)
- New BMS system
- Minimum Annual Electricity kWh savings – 1,534,014 kWh
- Minimum Annual CO2 savings – 1,625



Energy Efficiency Benefits from EPC in Health Facility



- Installing solar panels will reduce energy consumption by 20%
- Carbon footprint reduced ~ 600 cars off the road ~ 374.4T of CO₂/yr
- Generate 360MWh of energy/yr
- Annual electrical savings ~ \$15,912 based on 4.42c/kWh
- Change in work practices “**GREEN**”



\$4m solar farm makes Bay renewable capital

Hervey Bay is positioning itself to become the renewable energy capital of a Sunshine State with a \$4 million solar farm to power the hospital and a water treatment plant.

Premier Anna Bligh and Energy Minister Stephen Robertson visited Hervey Bay on Friday to announce funding for the state's first community solar farm which will produce 200-500 kilowatts of clean power from next year. Half the \$4 million funding will go towards developing the solar park, on 10ha at the Fraser Coast Water Recycling Innovation Centre and forest on Hebblewhite Road in swampan.

The other \$2 million will be used to stall solar panels on the roof of the Hervey Bay Hospital with excess energy fed into the grid.

The solar park will consist of 1500 solar panels each measuring 1.5 metres by 1 metre, taking up two hectares.

A further eight hectares will be left vacant for future solar farm expansion.

A 2009 election promise, the solar farm was initially proposed for the library and art gallery and we will have them on separate projects.

some of the best sunshine in the world," Premier Bligh said.

"Hervey Bay Hospital will not only treat people, but it will now provide energy for us."

Energy Minister Stephen Robertson said if successful, the community solar farm could be replicated throughout the state.

"Energy savings provided by a 400kW solar installation have the potential to save 600 tonnes of carbon emissions every year, or the equivalent energy use of 70 households," Mr Robertson said.

"The solar power generated at health service facilities, including Hervey Bay Hospital and the Wide Bay community solar farm, will help Queensland create a virtual solar power station by doubling our solar energy generation over the next five years."

Fraser Coast Mayor Mick Kruger said council had already taken a greener approach to new buildings and had appointed an energy efficiency officer to oversee construction.

"We have solar panels on our library and art gallery and we will have them on the new community centre once it



Premier Anna Bligh flew into Hervey Bay on Friday to announce a \$4 million solar scheme as part of her 2009 election commitment. She is pictured with a solar panel similar to the ones to be installed on the roof of Hervey Bay Hospital, and Hospital



World Health Organisation



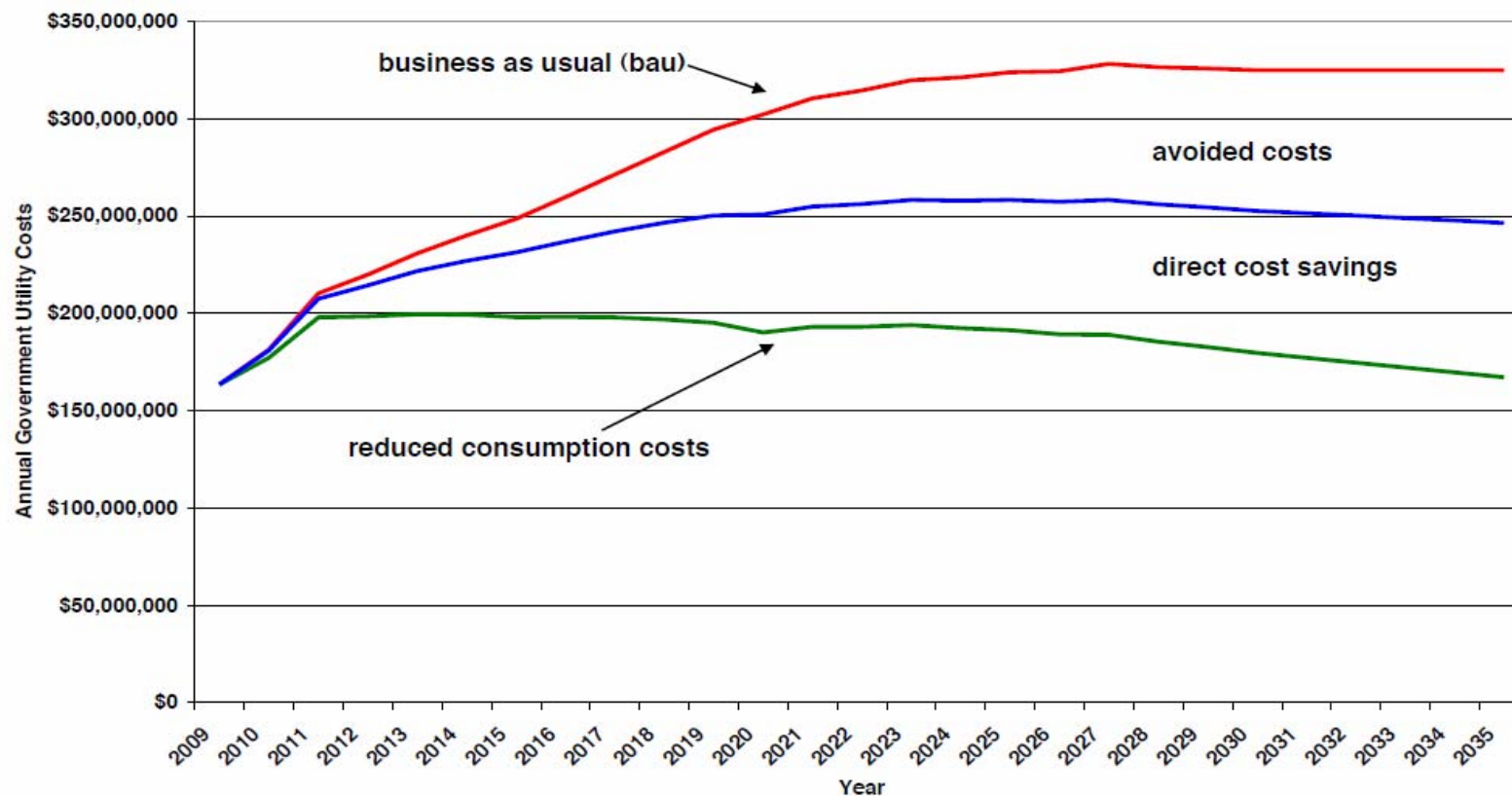
Hervey Bay Hospital recognised as top 10 for energy efficiency

Australia: Hervey Bay Hospital, Queensland. The government of the state of Queensland has launched an ambitious programme to reduce its health system's climate footprint, and Queensland Health introduced energy efficiency measures at its health-care facilities. One facility, Hervey Bay Hospital, with 104 beds, reduced its energy consumption by 20% between 2005 and 2007 - an annual carbon reduction equivalent to taking 600 cars off the road, according to Patrick McGuire, the head of Queensland Health's Eco-Efficiency Unit. The hospital made the cuts by improving its lighting and air conditioning system, and by upgrading its computerized building management system which monitors and controls building functions, including air conditioning, medical gases, water heating and steam production. The hospital has stepped up water conservation efforts by installing flow restriction devices and by recycling water for air conditioning and irrigation.

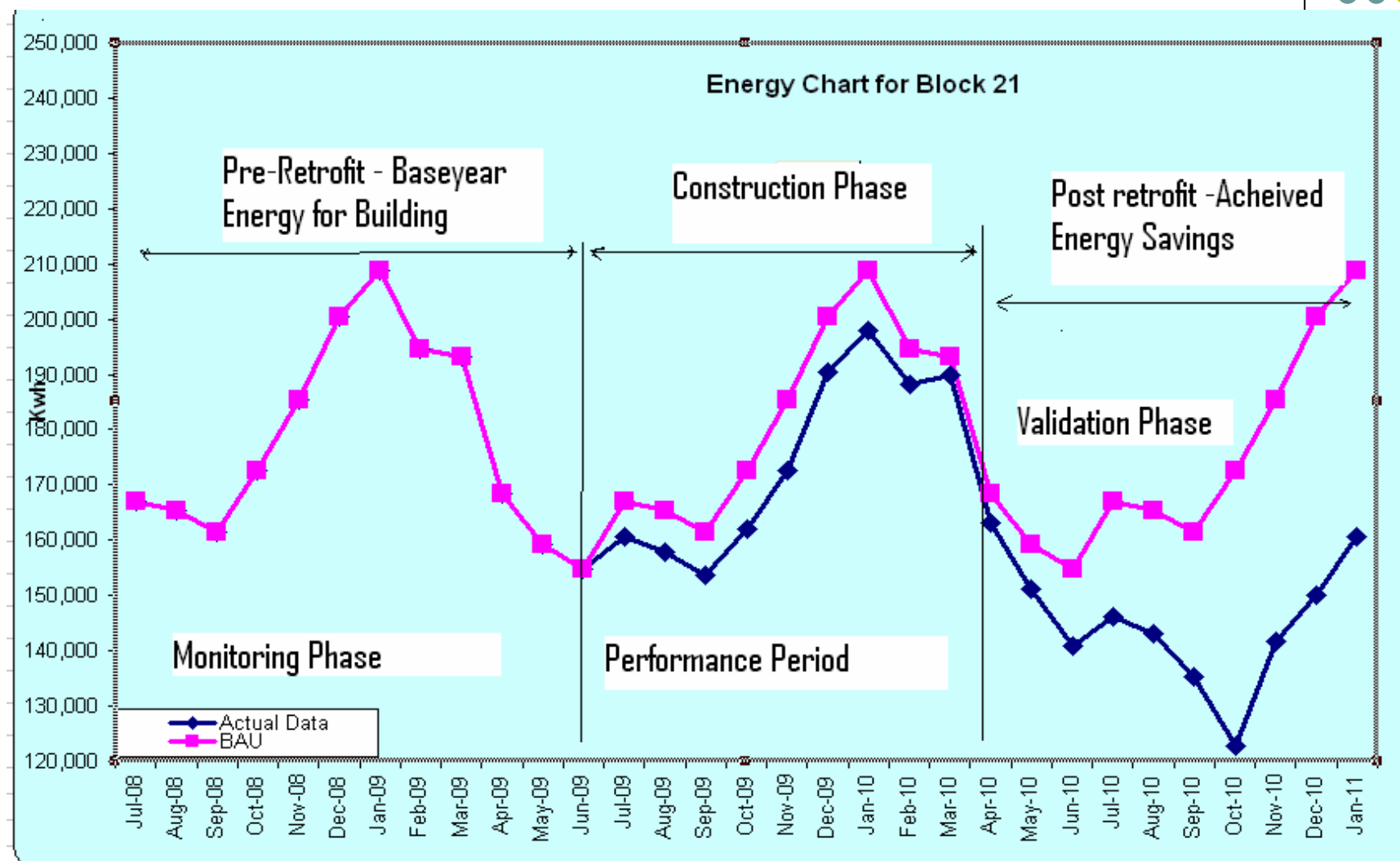
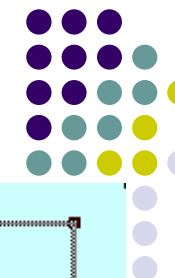


Forecast Energy Costs to Government

(resulting from CPRS - DTF scenario 1 and an investment in energy efficiency)



Monitoring & Validation Phases



Energy Efficiency Benefits from EPC in Health Facility



- **General information**
- Queensland Health has successfully delivered over 100 EPCs throughout the 21 Health districts during the period 2005 - 2011
- saving more than 36,000 tonnes of carbon dioxide emissions (CO₂) annually already that's equivalent to 100,000 cars off the road.
- We have annual savings of:
 - more than 40 million kilowatt hours of electricity (41,038,077kWh),
 - almost 90,000 gigajoules of gas (89,423Gj),
 - and in excess of 300 Olympic size pools of water (338,370KL).
- Currently 27 facilities are at some stage of participating in Energy Efficiency Programs
- Implementing greenhouse gas abatement programs involving awareness and training programs.

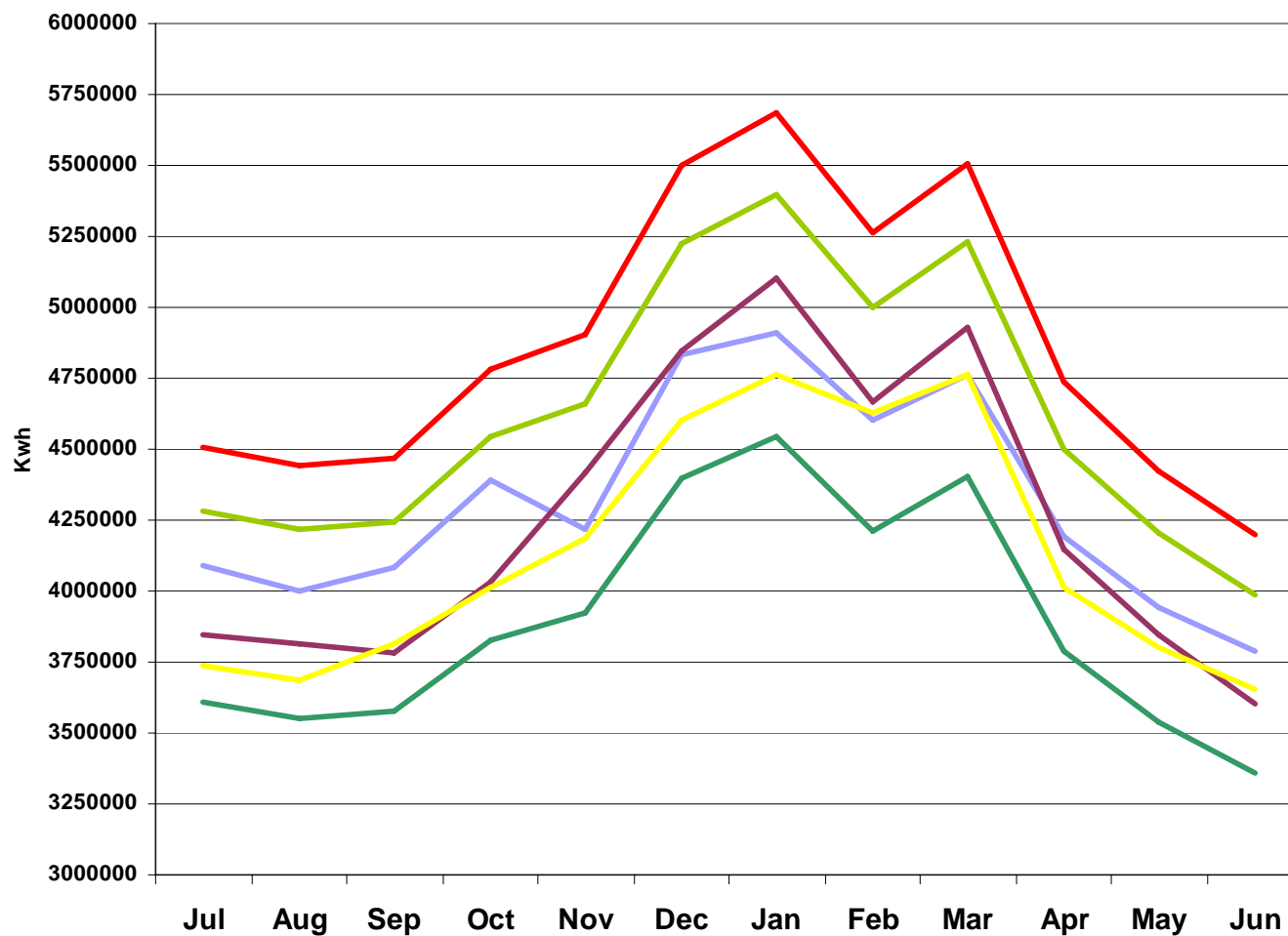




ROYAL BRISBANE WOMENS HOSPITAL	Project Details
Accumulative Project implementation cost for 5 EPCs (+gst)	\$5,957,628
DFS fee* (+gst)	\$120,000
Accumulative Energy cost savings (+gst)	\$1,770,403
Maintenance cost savings (+gst)	\$249,668
Total Cost Savings (+gst)	\$2,020,071
Internal rate of return	16.29 %
Greenhouse emission reduction (Tonnes)	18,090
Summary of Annual Electricity Saving (kWh)	17,741,896
Annual Water Saving (kL)	63,688



Electricity Consumption RBWH



Total 2005/06B 58,340,625 Total 2008/09 51,822,622

Total 2009/10 51,039,262 Est 2010/11 (49,671,000)

— 2005/06 B — 2008/09 — 2009/10 — 2010/11 — 2010 T95 — 2015 T80

DEPT OF ENGINEERING & BUILDING SERVICES



INNOVATIVE ENERGY MANAGEMENT

THERMAL ICE STORAGE 26 * 1250 kwrh 32,500kwrh \$200,000pa savings

VSD'S INSTALLED ON ALL LARGE VARIABLE LOAD MOTORS.

CHILLERS PERFORMANCE SUPERIOR HEAT TRANSFER CHILLER TUBE SURFACES
DESIGN 0.75 KW / TON ACTUAL 0.65KW /TON

SHIMMING OF CW PUMPS SAVINGS OF \$60,000 ANNUALLY

**POWER FACTOR CORRECTION CAPS EVERY BUILDINGS POWER FACTOR AND ENERGY
USAGE HAS BEEN PROFILED**

DEPT OF ENGINEERING & BUILDING SERVICES

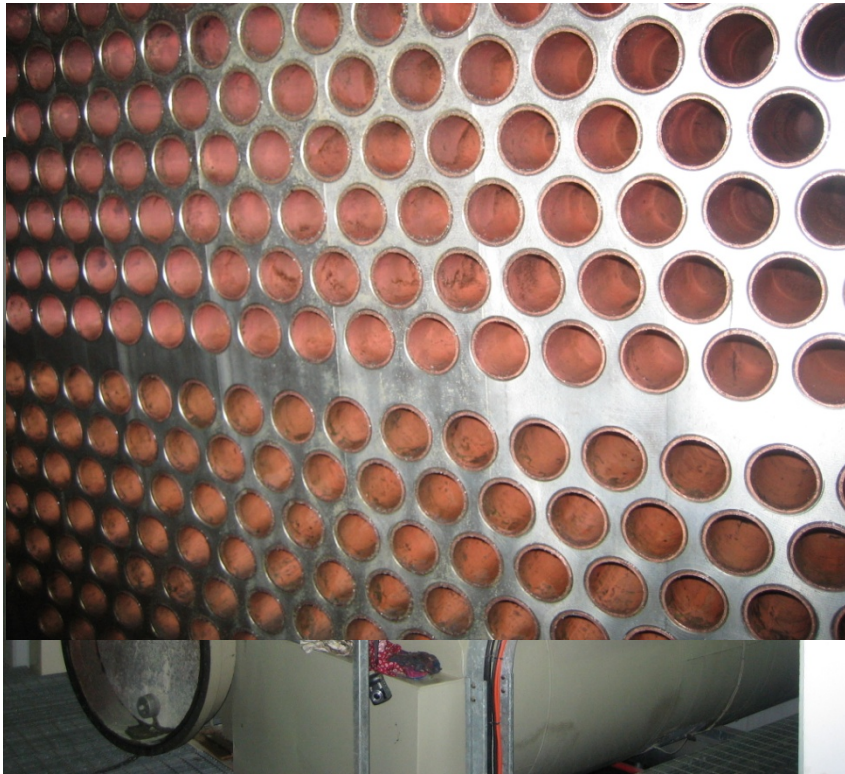


THERMAL ICE STORAGE

26 ICE TANKS OF 1250kwrh EACH

***RECURRENT SAVINGS OF JUST
OVER \$150,000 EACH YEAR***

DEPT OF ENGINEERING & BUILDING SERVICES



TRANE CHILLERS

**6 * 4000 KWr CENTRIFUGAL
CHILLERS**

**2 * 3000 KWr CENTRIFUGAL
CHILLERS**

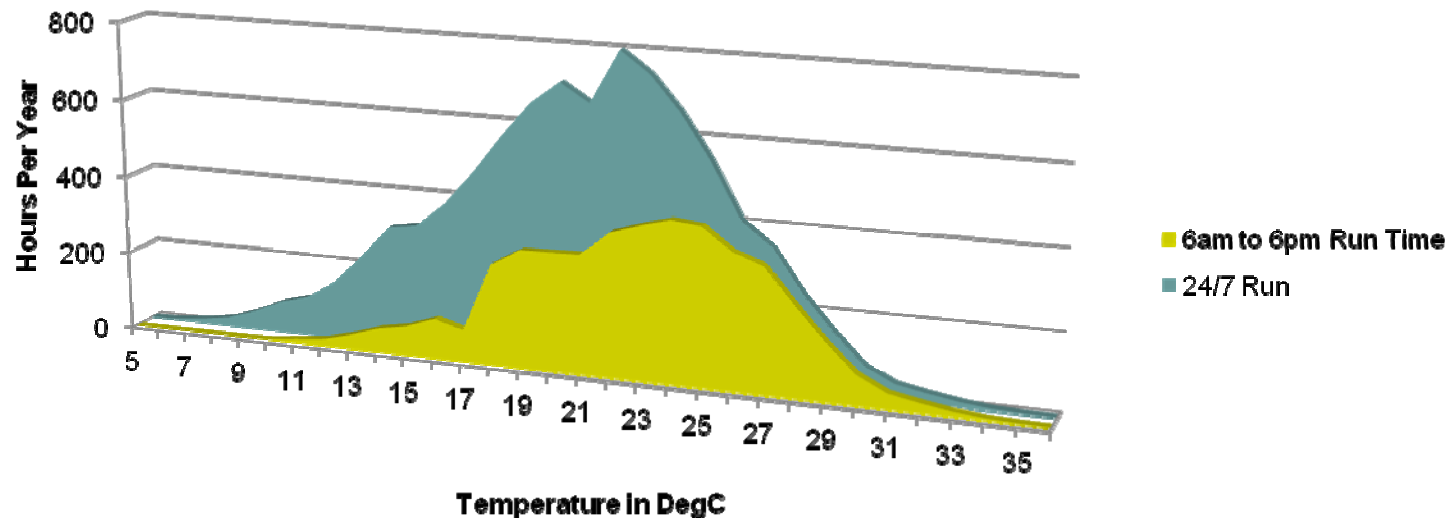
**TOTAL COOLING CASPACITY
30,000 KWr**

ECM – 1 Economy Mode Conversions



- Exploits the free cooling ability of ambient air at the right temperature and humidity

Brisbane Average Temperature vs Time

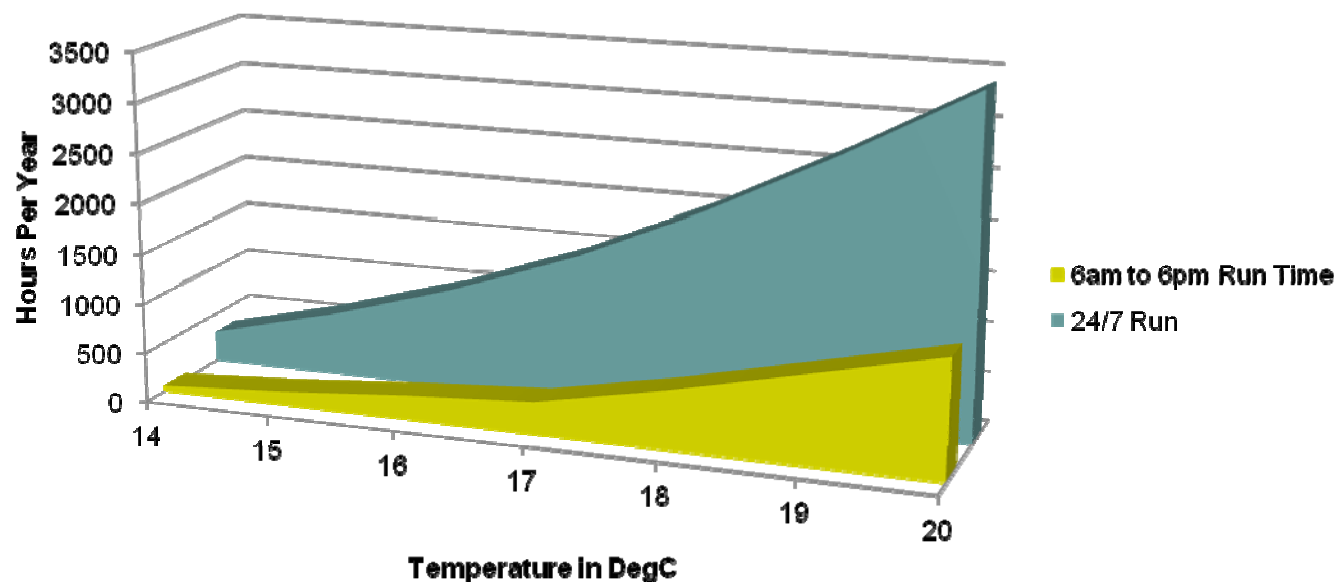


Economy Mode Conversions



- Free cooling is enabled by the BMS when the outside air Enthalpy is less than 38kj/kg

Accumulated time between 14° and 20 °



[illegible]

Plantroom is now a mixing plenum. Mixed air is drawn through the return air damper

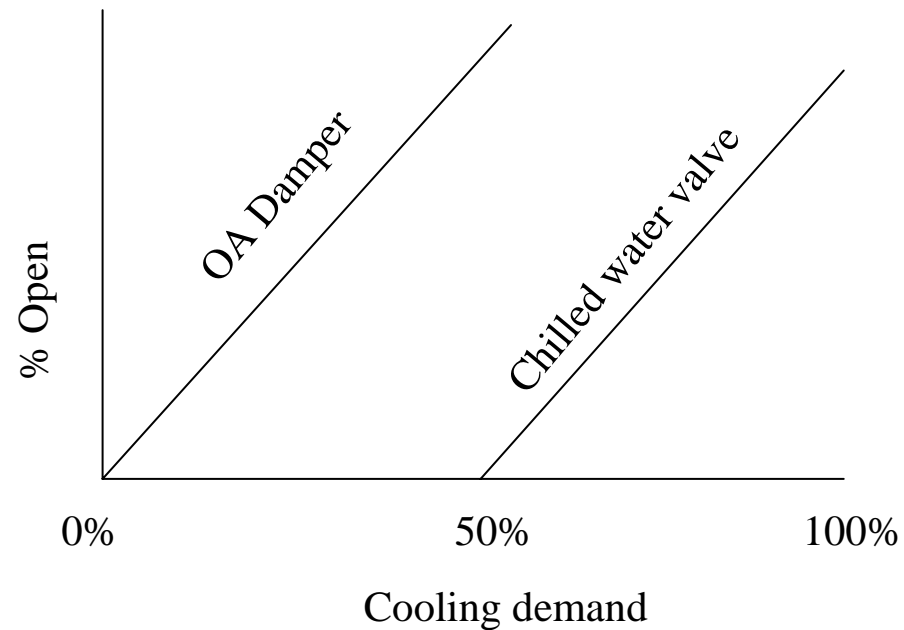
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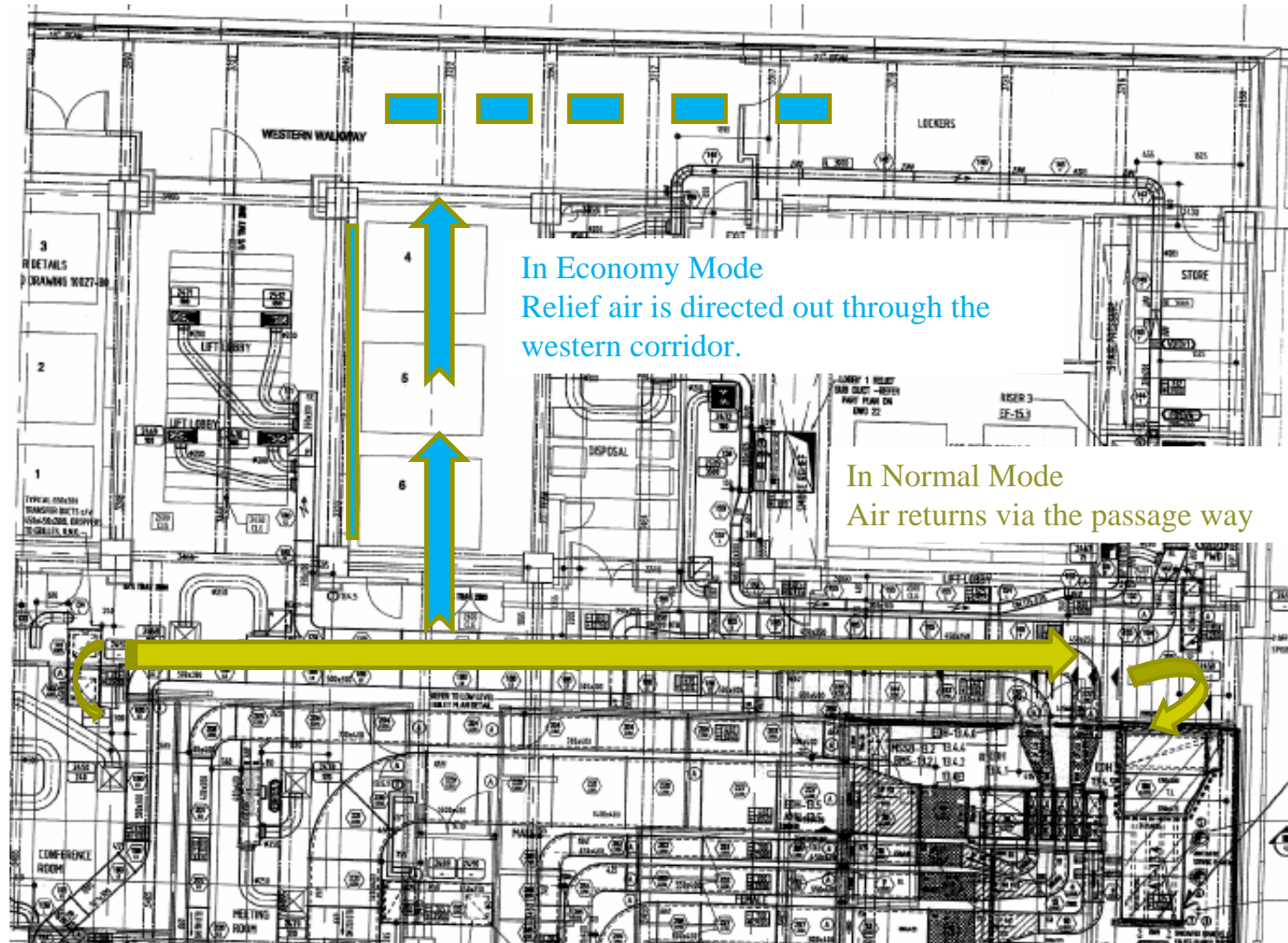
ECM – 1 Economy Mode Conversions



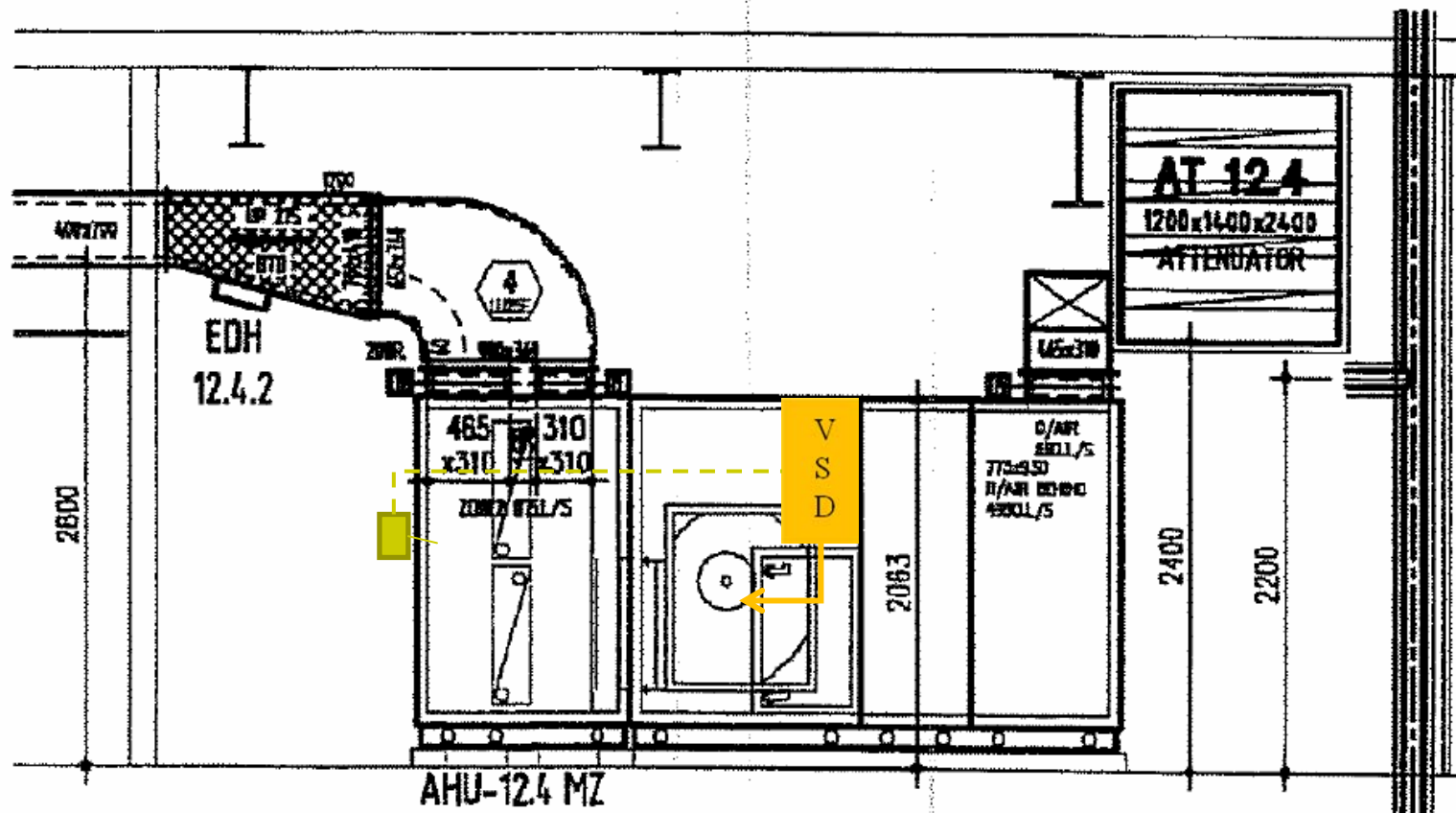
- In Economy Mode the OA dampers will modulate to fully open before the chilled water valve starts in order to maintain the required OFF-COIL temperature.



Economy Mode Conversions



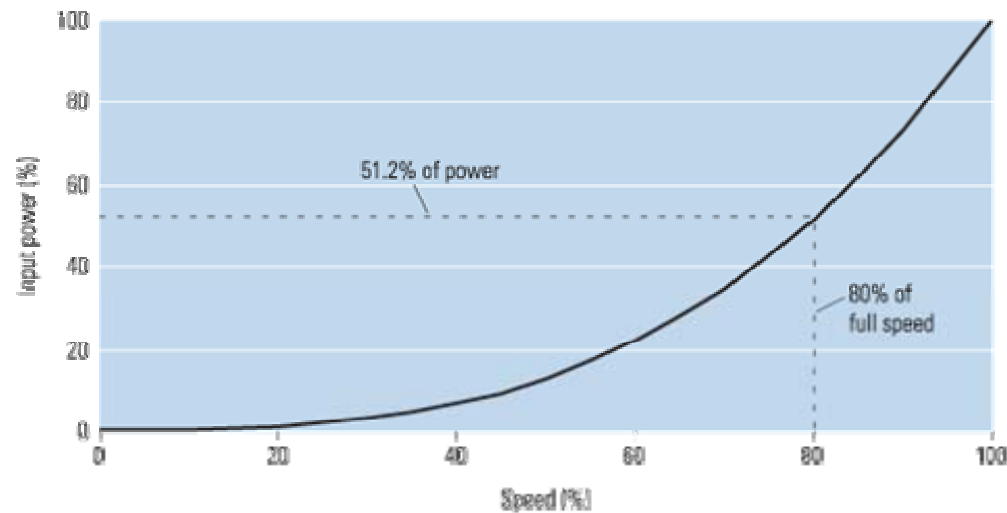
ECM -2 Fan Power



ECM -2 Fan Power



- Fan power accounts for an estimated 30% of the total air conditioning load for Block 7.
- The power consumed by the air conditioning unit fans is reduced by using a variable speed drive (VSD) to control the supply duct pressure.
- This occurs when the cooling demand on the system reduces, and more air bypasses the cooling coil, the fan speed (and power) will naturally reduce due to the reduction in static losses.

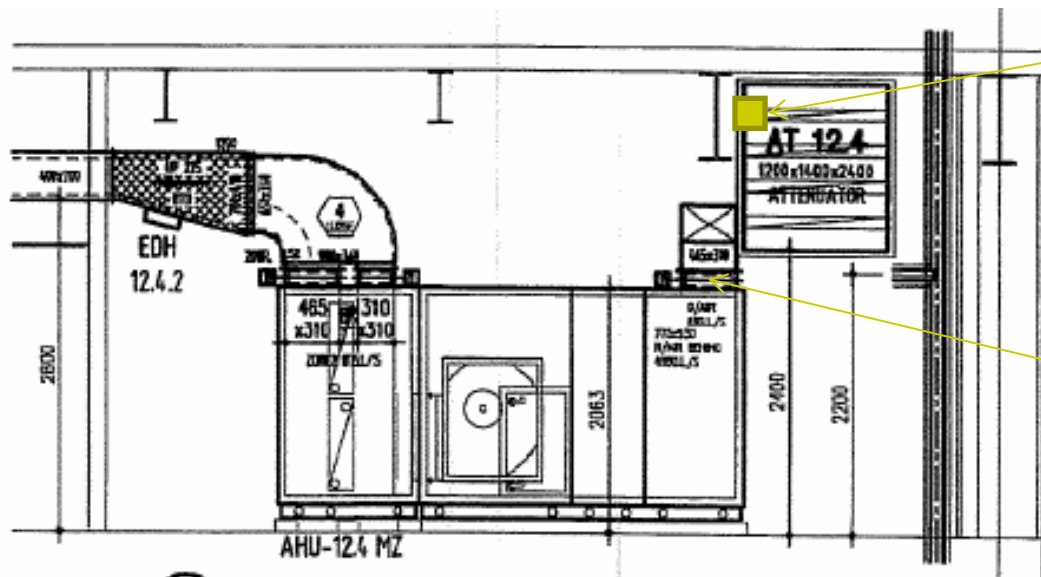


Courtesy: E source

ECM-3 CO2 Control



Limits the amount of fresh air introduced into the building based on space CO2 levels to reduce cooling and heating demand



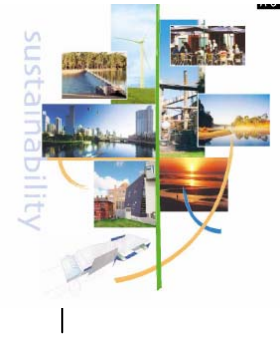
CO2 is measured at the return air discharge to the plantroom

Minimum OA damper is set closed,
Opens when CO2 > 770ppm, (closes again at 730ppm)

Queensland Health

Post evaluation of EPCs

- The process with upfront financial selection (return on investment) at 12.75 in some EPC circumstances resulted in over capitalisation and ESCO profits
- The EPC concept could be a mechanism to obtain or upgrade capital assets where there is old plant technology improvements and efficiency gains
- Selection and procedure that warrants the upgrade, in some circumstances plant was replaced with little direct benefit when combined with high return on investment ECMs.
- Proactively initiating energy and water saving measures through its Eco-Efficiency Unit (EEU) meet or exceeded the ROI and KPIs through M&V measurements
- Our contestable energy purchasing practices and energy and water conservation measures in Queensland Health facilities will save more than 300,000 Kls water, 41,000,000 kWh of electricity, and 36,000 tonnes of CO2 annually
- Investment in energy efficiency is also central to this transformation. Improving the efficiency with which we use energy will deliver benefits to every corner of the country
- Energy Performance Contracting (EPC) is enabling the department to save money, water and energy, reduce CO2 emissions, support the Queensland Government's priorities, and the Government Energy Management Strategy
- These actions also enable us to actively support and contribute to the community that we serve, and protect the environment for future generations.





Reference Web Pages

- **Relevant links**
- <http://www.energy.qld.gov.au> - Queensland's Department of Energy deals with complex energy issues relating to the state's communities and industry.
- <http://greenhouse.gov.au> - The Australian Greenhouse Office is responsible for managing the delivery of major new and existing Commonwealth energy efficiency initiatives.
- <http://www.energyrating.gov.au> - The website which details current and future items covered under the energy rating label and minimum energy performance standards.
- <http://energystar.gov.au> - The national ENERGY STAR program encourages the use of energy efficient equipment at home and in business.
- http://www.qgm.qld.gov.au/po_whatsnew_greenproc.htm - Queensland Purchasing has kicked off a new project to help 'green-up' procurement across Queensland Government agencies.
- <http://www.seav.vic.gov.au> – Victoria sustainability energy authority agencies. Energy management and GHG emission toolkits.
- <http://www.aepca.asn.au/> - AEPCA is the Australasian Energy Performance Contracting Association. Its members are formed from ESCO's, State Government departments and private companies interested in the Performance Contracting process.

QUESTIONS ??

