Energy Sustainability Unit

Preparing for Energy Smart Office Awards- Experience from the 8 Energy Smart Offices

Seminar on EAEF Project 64 & 68
Energy Performance Contracting & Benchmarking
13 January 2006
National University of Singapore

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Outline

- Introduction
- The Process
- Performance Standards
- Benchmarking
- Systems' performance
- Indoor Environmental quality
- Future work

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Introduction

ENERGY SMART OFFICE is a Building Energy Efficiency Labelling System.

This is the first product of the NUS-NEA joint project entitled "Development of Building Energy Efficiency Labelling System".

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The Process Towards Energy Smart Office

1. Preliminary Benchmarking
2. Appoint an accredited ESCO
3. Review by ESU
4. Set Target & Track Progress

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Performance standards

1. EUI in top 25 percentile
2. Systems' performance
3. Indoor Environmental quality
4. Occupants' survey

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Benchmarking- Energy Performance

- Top 25% < 177 kWh/m^2/yr
- Should include the total (landlord + tenant) energy consumption
- Even though all the buildings reviewed were office buildings, the type of office usage had a significant effect on the EUI
- Banks, especially international ones consume a lot of energy for
  - data centers/server rooms in terms of high usage intensity
  - trading services in terms of long operating hours

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Calculation of EUI

Normalised EUI=(TBEC-DCEC-CPEC)/(GFA-CPA-DCA)

Where,

- **TBEC = Total building annual energy consumption**
- **DCEC = Data centre energy consumption = 3016 * DCA**
- **CPEC = Car park energy consumption**
- ***GFA = Gross floor area including car park**
- **CPA = car park area (above ground + under ground)**
- **DCA = data centre area**

*** GFA shall be enlarged in the case of long operating hour tenants/ areas where the Enlarged area = actual area of long operation x actual operating hours/**normal operating hours**

**** Normal operating hours = 55 hrs/week**

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Problems faced

- Data collection very difficult
- Building information not always available
- Problems with GFA
- Lower EUI does not always imply that the building is very energy efficient.
- The lower EUI can be as a result of the low intensity office activities.

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Systems' Performance

- Air Conditioning
- Lighting
- Mechanical ventilation

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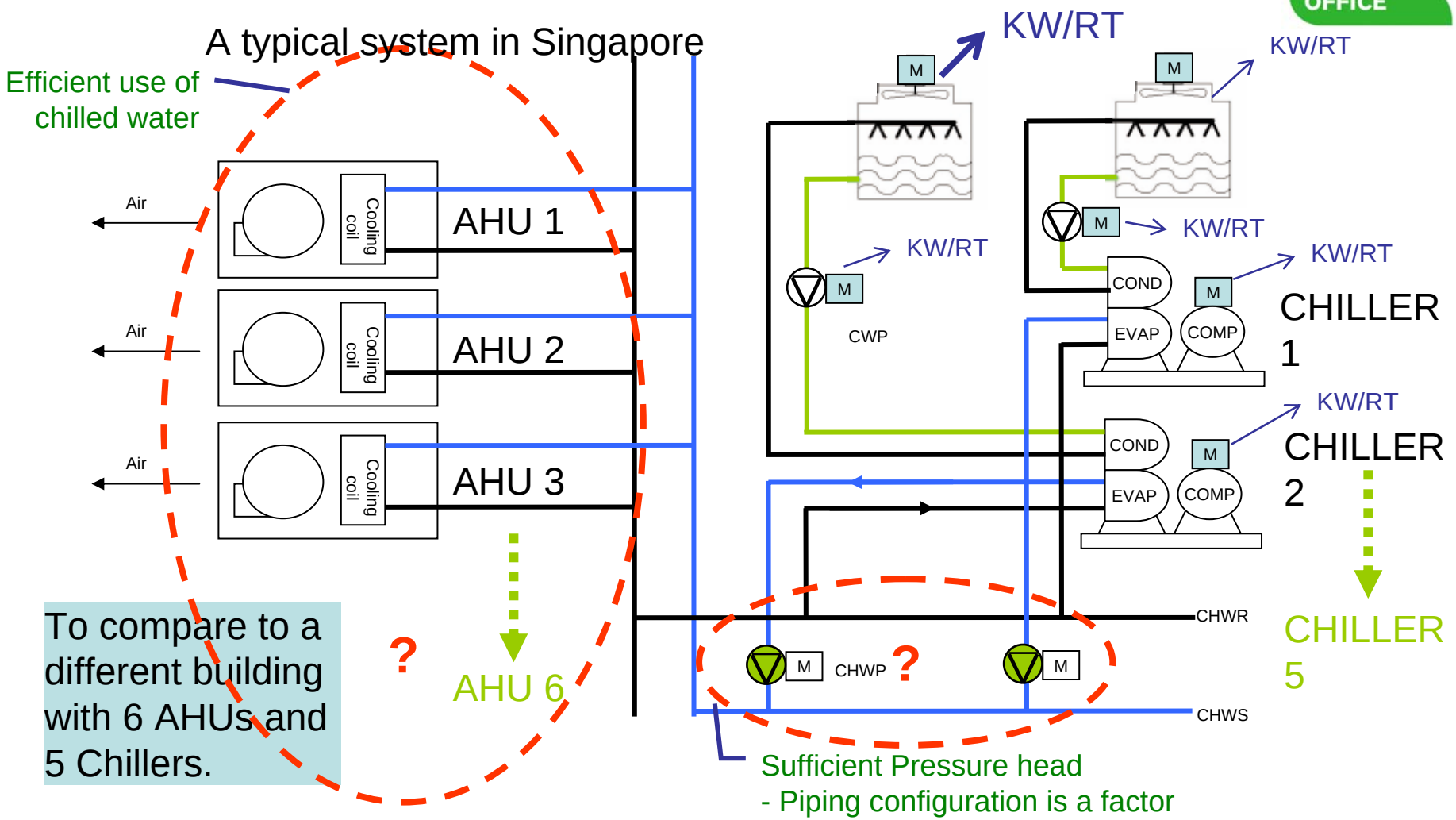
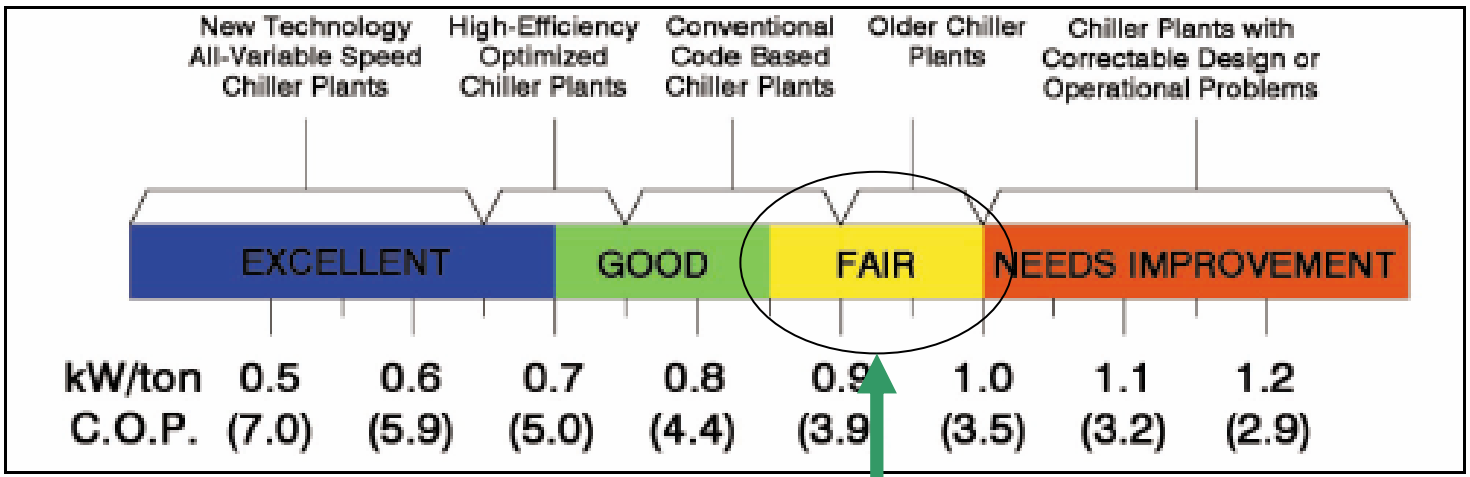
Air conditioning Systems' Performance



Air conditioning Systems' Performance



Plant room efficiency < 1.0 kW/RT

- **Does not consider primary and secondary chilled water pumps for the calculations of air conditioning system performance**

Source: ASHRAE Journal, September 2001

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Air conditioning System's Performance

- The audit of the chiller plant should be planned and conducted with utmost care.
- The power consumption of each of the sub systems like chillers, pumps and cooling towers should be separately measured.
- The measurement time should represent the most typical days with full load conditions and continuous logging should be done for a minimum of 1 week.

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Lighting System's Performance

- **Use W/m^2 as an indicator for efficient use of energy in lighting need.**
- **Various methods of optimizing lighting's energy use such as timer controls, use of dimmers, integration with day lighting, Building Automation System (BAS) etc.**

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Lighting System's Performance

- Record the total number of fittings;
- Identify the type of fixture including wattage and ballast lost;
- Estimate energy consumption from the rated power;
- Estimate the lighted areas from drawing plans;
- Calculate the lighting power density;
- Verify the calculated value by measuring the DB.

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Indoor Environmental Quality

- Thermal comfort
- Illumination
- IAQ
- Ventilation

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Indoor Environmental Quality

- Out of the 4 parameters, thermal comfort and illumination level were easily met by most of the buildings.
- However, Ventilation (fresh air) and Indoor Air Quality which is dependent on the ventilation were out of the specified range in many cases.
- High CO_2 level and high bacterial count were the most commonly observed problems.

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Ventilation measurement methodology

- Measure the air velocity at 9 different cross sections (m/s);
- Find the average air velocity (m/s);
- Measure the cross sectional area (m^2);
- Calculate the air volume (L/s) ;
- Measure the floor area served by that particular AHU (m^2);
- Calculate the ventilation rate in $L/s/m^2$;
- Repeat the same for other AHUs and find the average ventilation rate.

The Achievements of an Energy Smart Office

1. It is energy efficient, and among the top 25% of cohort.
2. Its systems are fine.
3. Its indoor environment is healthy.
4. Its users are satisfied.
5. It is independently checked, measured and verified.

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Future Works

- Hotels
- Hospitals
- Shopping Centres
- Schools

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