AIRAH – NSW

FAN ENERGY & WATER USAGE ESTIMATOR
for
ADIABATIC 3C FLUID COOLERS

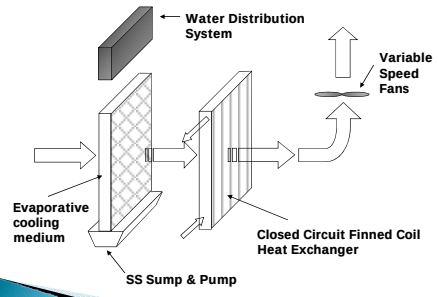
Main Topics

- Adiabatic 3C fluid cooler – working principle
- 3C-FEWUE Model – main elements
- Life Cycle Cost Comparison
- Demonstrate Model

Why develop FEWUE Model?

- Estimate precisely 3C fan energy consumed for different locations (climates) & cooling load profiles
- Estimate accurately annual water usage and usage patterns
  - to assist in sizing of rain water harvesting tanks
- Provide accurate data for life cycle cost calcs

3C Main Components



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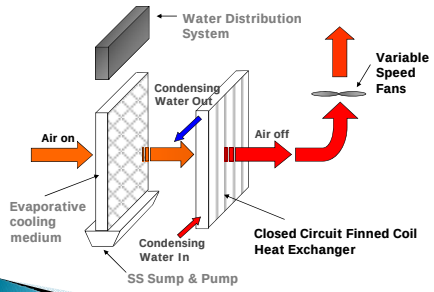
3C Working Principle – Dry Mode



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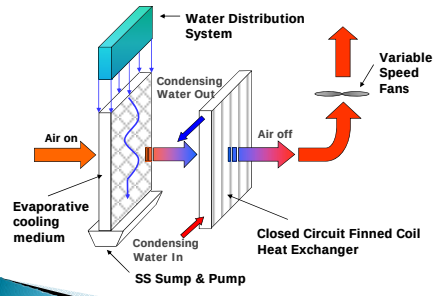
3C Working Principle – Precool Mode



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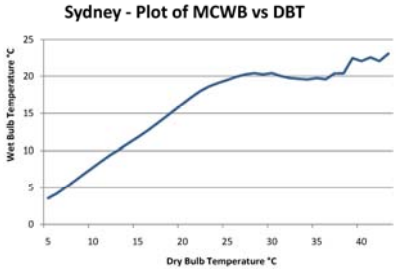
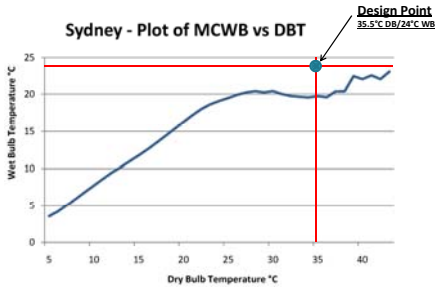
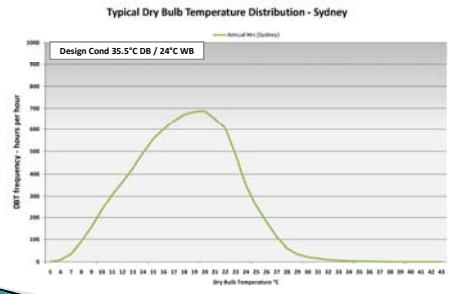
Climate Data for Sydney



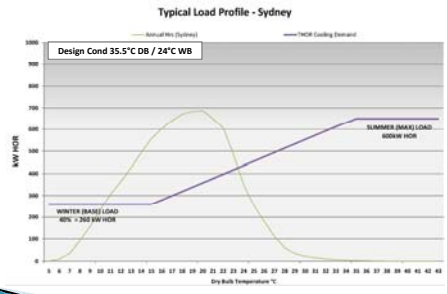
Typical Design Cond– Sydney



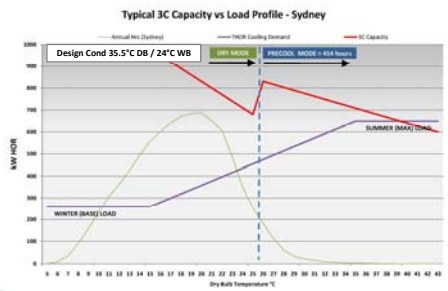
Dry Bulb Temp Frequency– Sydney



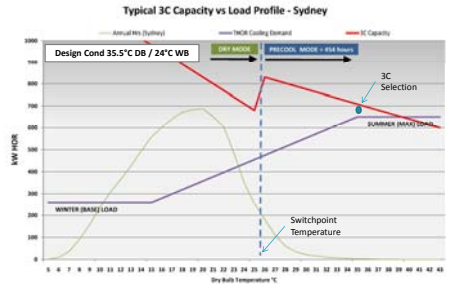
Simple Load Profile– Sydney



Typical 3C Capacity vs DBT



3C Selection based on Max Conds



3C-FEWUE Model

- Match the 3C capacity to cooling load – vary the fan speed
- Fan power α fan speed^3
- At higher DBTs – initiate precooling + fan speed control
- Water usage is dependent on: –
  - DB & WB conditions
  - Air flow rate through pads
  - No. of hours of precooling

3C-FEWUE Model

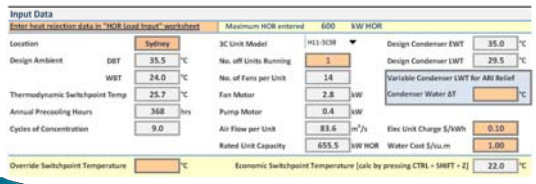
- Excel 2007 Spreadsheet – Macro-enabled
- Version 1.2 – Australia only (uses CSIRO ACADS-BSG reference year climate data)
- Version 2.0 – International (uses ASHRAE Climatic Data for Design & Standards)

3C-FEWUE Main Interface

- Three (3) sections
  - Input section
  - Output section
  - Charts

Input section

- **Divided into three (3) parts**
  - **Location selection**
  - **3C Model selection**
  - **Water temperature control / unit cost for utilities**



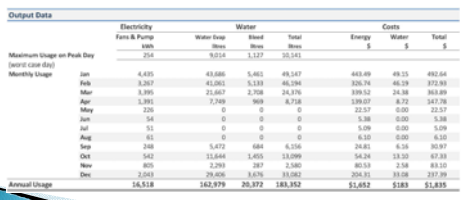
HOR Load Input sheet

Variables

- Number of days per week
- Number of weeks per year – between 48 & 52 to cater for summer shutdown
- Allowance for variable loads between summer/ winter and trans-seasonal
- Monthly daytime heat rejection loads
- Monthly night-time loads

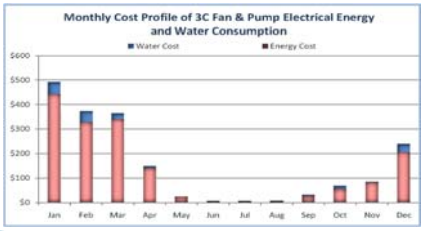
Output Section

- **Divided into three parts**
  - **Fan & pump electricity usage in kWhr**
  - **Water usage in litres**
  - **Fan energy and water usage costs**



Charts – first chart

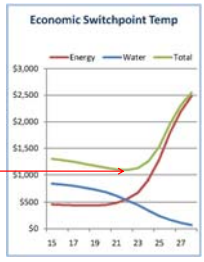
- Bar chart displaying visually the costs
- Red bars – monthly fan energy cost
- Blue bars – monthly water usage costs



Charts – second chart

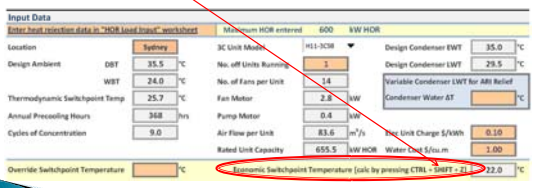
Line chart displays Economic Switchpoint Temperature (ESPT) by calculating cost of energy and water at various SPTs

- **Red line – energy cost at various SPT**
- **Blue line – water cost at various SPTs**
- **Green line – Total costs (sum of the red & blue)**
- **Lowest operating cost = ESPT**



ESPT Calculation

- Once Location and Unit Selection data inputted, then press CTRL+SHIFT+Z to activate the Macro
- ESPT will appear when macro completes calcs



ESPT Calculator Tab

Tabular display of fan energy consumption & water usage and associated costs at various SPTs to identify lowest operating cost

Economic Switchpoint Temperature Calculator

				ESPT	22
Swpt Temp °C	Energy kWhr	Water litres	Energy $0.10	Water $1.00	Total
15	4,557	847,656	$455.72	$847.66	$1,303.37
16	4,483	828,585	$448.28	$828.58	$1,276.86
17	4,421	806,522	$442.15	$806.52	$1,248.67
18	4,376	772,172	$437.56	$772.17	$1,209.73
19	4,371	734,727	$437.06	$734.73	$1,171.79
20	4,471	688,456	$447.09	$688.46	$1,135.55
21	4,832	618,519	$483.25	$618.52	$1,101.77
22	5,596	532,958	$559.62	$532.96	$1,092.58
23	6,788	447,887	$678.79	$447.89	$1,126.68
24	9,216	338,716	$921.64	$338.72	$1,260.36
25	12,926	240,317	$1,292.58	$240.32	$1,532.90
26	17,988	164,985	$1,798.79	$164.98	$1,963.78
27	21,974	111,414	$2,197.36	$111.41	$2,308.77
28	24,802	68,077	$2,480.25	$68.08	$2,548.33
					$1,092.58

Version 1.2 Constraints

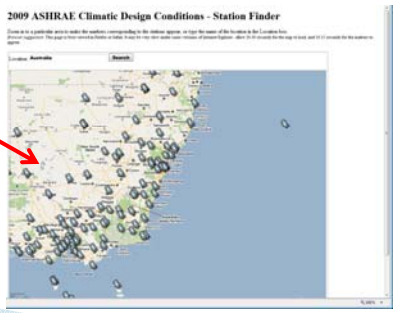
- CSIRO ACADS-BSG reference year climate data is very dated (over 30 years old)
- Only relevant to 10 locations in Australia – main centres only
- ACADS-BSG newsletter continues to highlight frustration with DCCEE (51 months) to release up-to-date corrected climate data

FEWUE – Version 2.0

- ASHRAE Climatic Data for Design & Standards
- Access to climate data from 5,564 weather stations around the world
- Climate data is relatively up-to-date (ranging from 1991 to 2006)

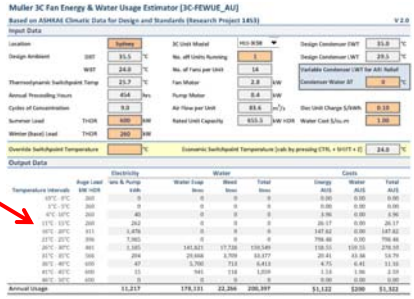
268 Weather Stations in Australia

Weather station locations in SE Australia

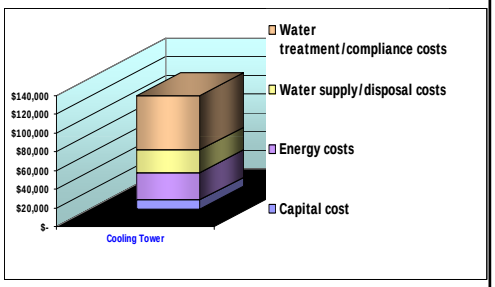


FEWUE Output changes

Replace months of the year – with temperature intervals



Typical Cooling Tower – 15 year LCC



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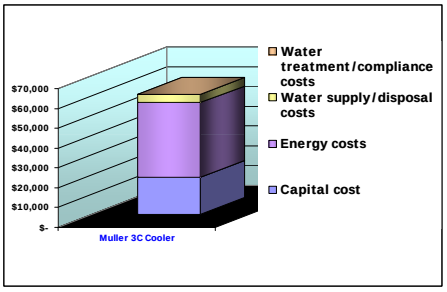
Muller 3C – 15 year LCC



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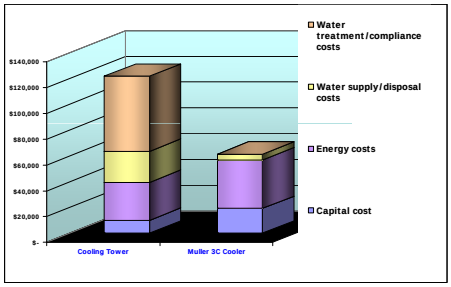
Compare Cooling Tower with 3C



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Demonstration

3C_FEWUE_Model