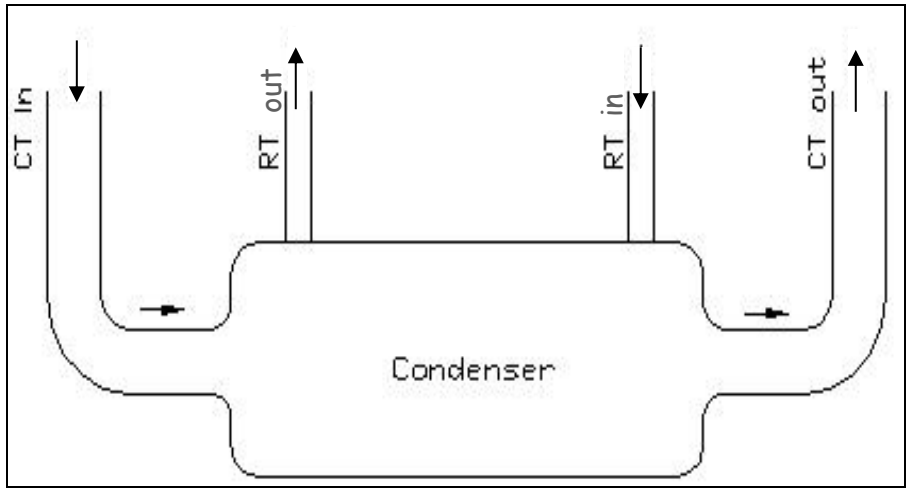
# Determining ATC Performance:

# Condenser Approach Temperature (CAT)

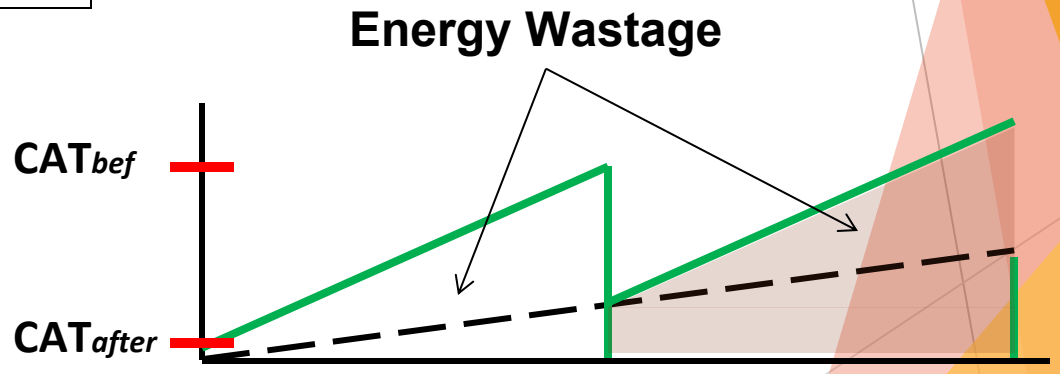
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# Quantifying Energy Savings: CAT Measurement




CT = Condenser water temperature
RT = Refrigerant temperature
> **Condenser Approach Temperature** (CAT)
= $RT_{out}$ - $CT_{out}$

**** According to all chiller manufacturers, 1º C reduction in the Condenser Approach Temperature (CAT) results in 5% reduction in chiller energy consumption for the same amount of cooling.***

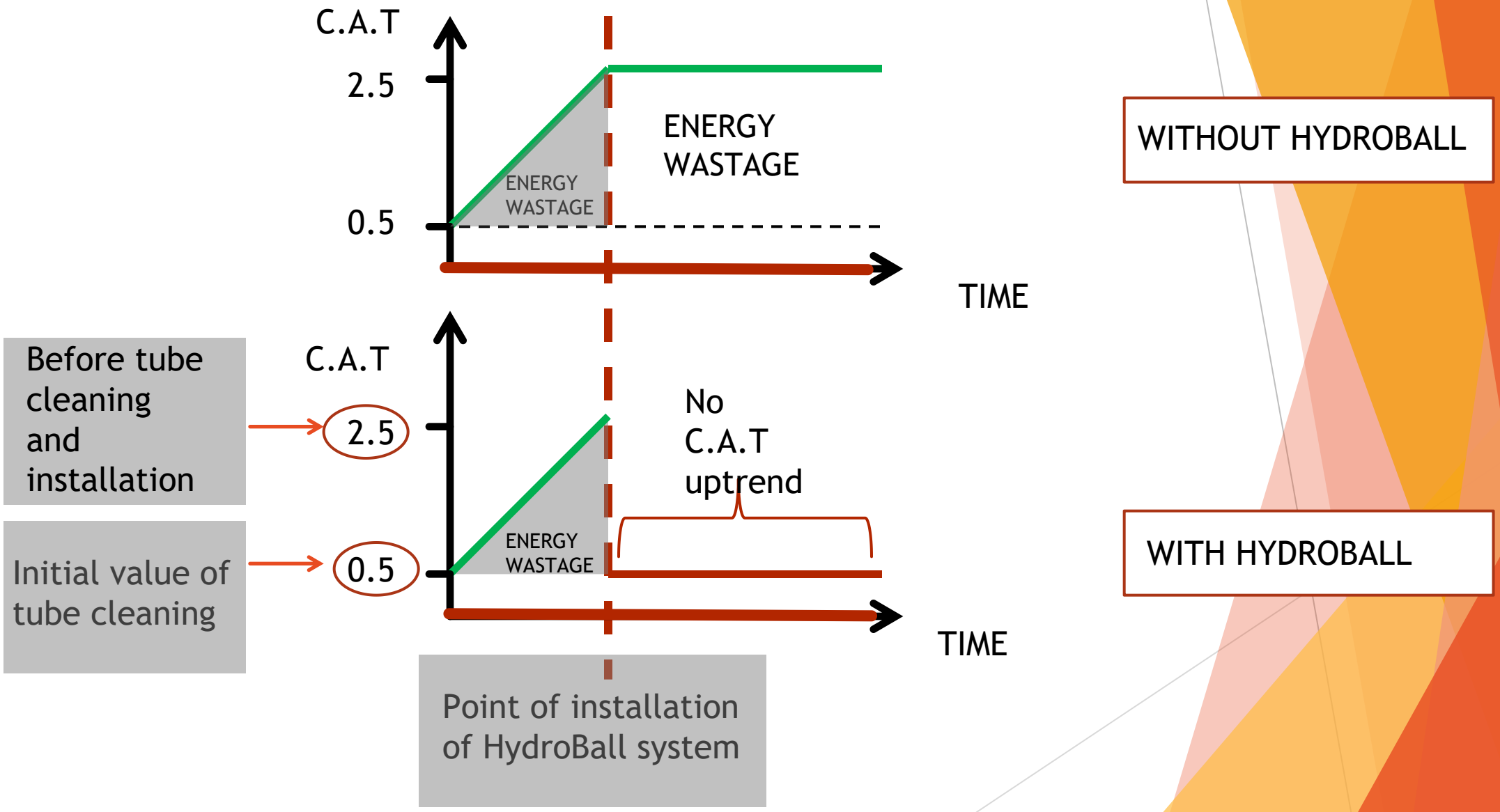



**Energy Savings (%)** = ($CAT_{bef}$ – $CAT_{after}$ ) x 5%
= (2.5 ˚C – 0.5 ˚C) x 5%
= 10%



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# No Uptrend of Condenser Approach Temperature




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# HydroBall ATC: Improves Overall Chiller Efficiency

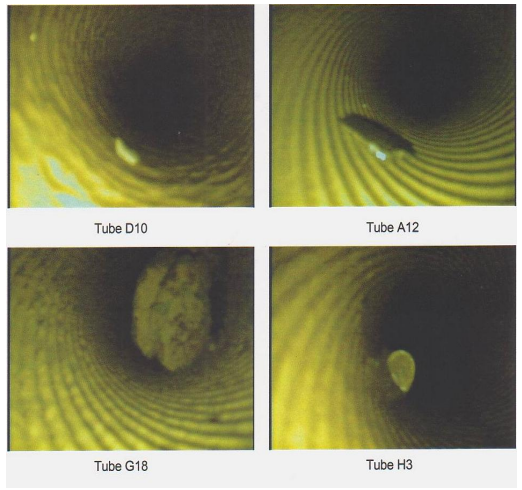
| Averaged values | CHILLER 2 (without HydroBall System) | | | | CHILLER 3 (with HydroBall System) | | | | % Reduction in Specific Electricity Consumption |
|---|---|---|---|---|---|---|---|---|---|
| | Chiller 2 Efficiency kW/RT | Chiller Consume kW | Condenser Pressure* (bar) | Chiller Tonnage RT | Chiller 3 Efficiency kW/RT | Chiller Consume kW | Condenser Pressure* (bar) | Chiller Tonnage RT | |
| **PRE-COMMISSIONING PERFORMANCE AUDIT** | | | | | | | | | |
| **Pre-audit May/Jun 05** | 0.77 | 126.24 | 0.48 | 170.70 | 0.78 | 115.12 | 0.65 | 148.19 | -1.3% |
| **POST-COMMISSIONING PERFORMANCE AUDIT** | | | | | | | | | |
| **Post-audit Jul/Aug 05** | 0.92 | 126.99 | 1.34 | 138.56 | 0.7 | | .74 | 157.90 | **16.30%** |
| **Post-audit Aug/Sep 05** | 0.93 | 127.64 | 1.63 | 138 .86 | | | | 171.22 | **19.35%** |
| **Post-audit Sep/Oct 05** | 0.95 | 134.41 | 0.49 | 142.78 | | | | 152.38 | **18.95%** |
| **Post-audit Oct/Nov 05** | 0.95 | 126.83 | 0.78 | 135.04 | 0.78 | | 0.59 | 157.03 | **17.89%** |
| **Post-audit Nov/Dec 05** | 0.92 | 108.89 | 0.83 | 119.94 | 0.74 | 95.28 | 0.58 | 129.89 | **19.57%** |
| | | | | | | | | **Average** | **18.4%** |

Difference in electrical kWh consumption between both chillers varies from low of **$1.4K** per mth to **>$4K** per mth! And that's just for ***one chiller!***

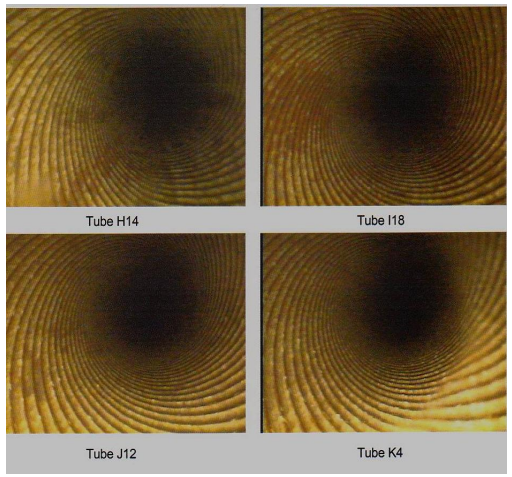
**Note:**
- Chiller Rating = 270 RT, Operating Load = 60%, Optimum Load: 80%
*Chiller 2 and 3 connected in parallel and subjected to identical pressure at both inlet and outlet headers

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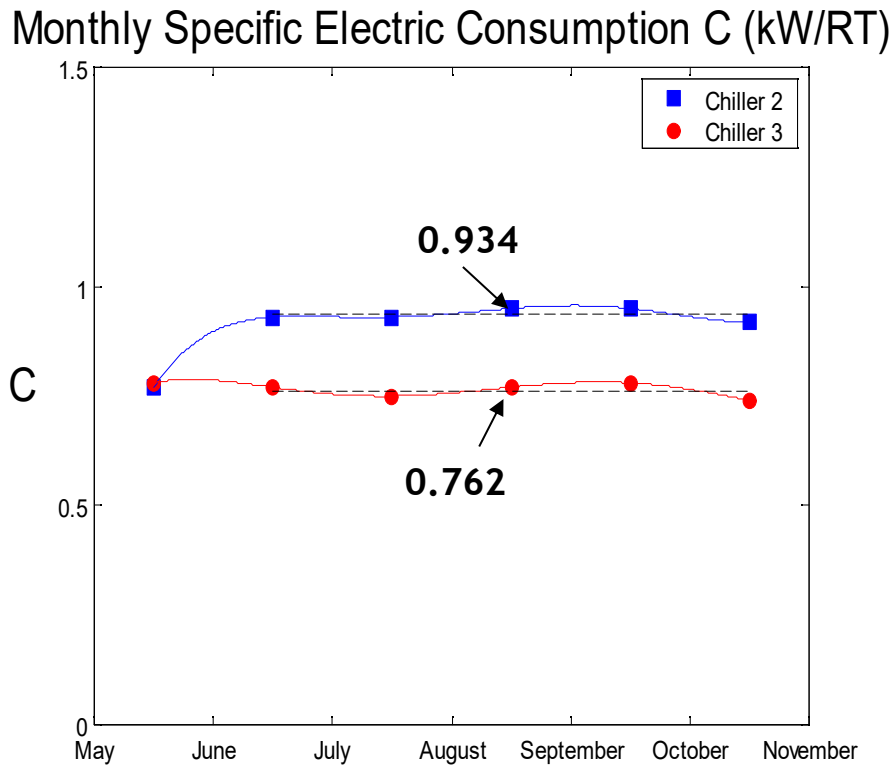
# Proven Technology




Without HydroBall System




With HydroBall System




$$\text{Savings} = \frac{(0.934 - 0.762)}{0.934} \times 100\% = 18.4\ \%$$

Source: Study Project Ref No : L00279/772
The Enterprise Challenge, Public Services Division, Prime Minister's Office

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# Basis for Estimating Product's Payback Period

Our assumptions are as follows:

- Average of **4** compressors per commercial building or semiconductor facility
- Typical monthly power bill for buildings amounts to **S$300,000**
- Air-conditioning bill takes up **60%**, i.e., **$180,000**
- Chiller power takes up **50%**, i.e., **$90,000**
- After installation of the HydroBall System, there will be estimated **10%** (based on the 18.4% energy saved in NTU case study) in average energy savings, i.e., **$9K**
- The average selling price is **S$28K** to cover a medium-size condenser

Thus, the payback period is computed as follows:

**Payback period = Cost of 4 automatic cleaning systems / Energy cost savings per month**

**= (S$28K*4) / S$9K**

**= 12.44 months**

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