Sound

- Acoustics considered part of a sustainable environment
- Many options for sound control for heat rejection equipment

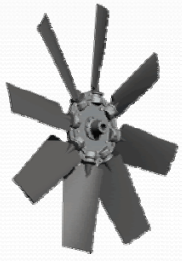
First option to consider:

Oversize and slow down

Saves energy too!

Sound

- Variable speed drive on fans
  - Smooth starts and stops
  - No abrupt speed changes
  - Other benefits:
    - Saves energy
    - Closer temperature control
    - Reduced maintenance



Sound

- Unit design
  - Centrifugal
  - Axial
- Note that axial designs are about 50% of the fan kW as compared to an equivalent tonnage centrifugal model

Sound

- Layout
  - Face quiet sides towards noise sensitive areas where possible

Counterflow design with four sided air inlet

Crossflow design with double sided air inlet

Sound

- Watch out for water noise, especially on counterflow
  - Becomes predominate sound when tower equipped with VFD

Counterflow design

Water Silencers for Basin

Sound

- Use higher solidity axial fans
  - More blades
  - Wider chord blades
  - Slower speed to move the same air
- Often can achieve sound levels of centrifugal designs

Sound

- Consider attenuation
  - Lowers sound levels but comes with a performance penalty ranging from 2% to 5% or more

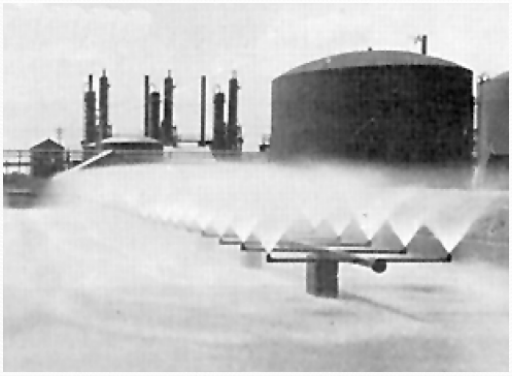
Water Use

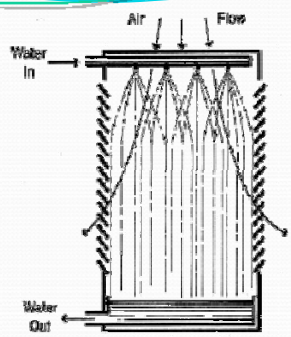
Water Use

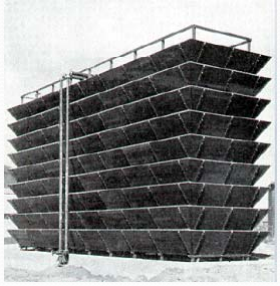
- Once through systems were once the norm
- Cooling towers were developed as the first water saving devices to recycle water

Water Use

- Early tower designs mimicked nature





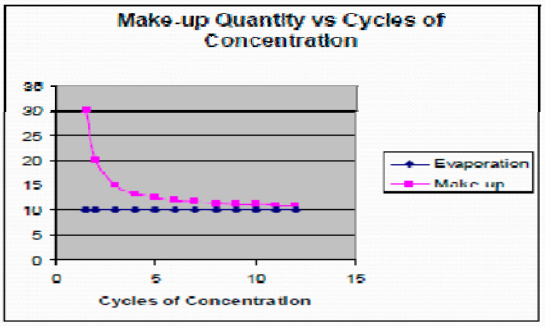


Water Use

- Water required by the cooling tower
  - Evaporation
  - Bleed to maintain water quality
  - Drift
    - Actually not a loss, but part of the bleed
- Total water use is typically about 5% of the water flow rate

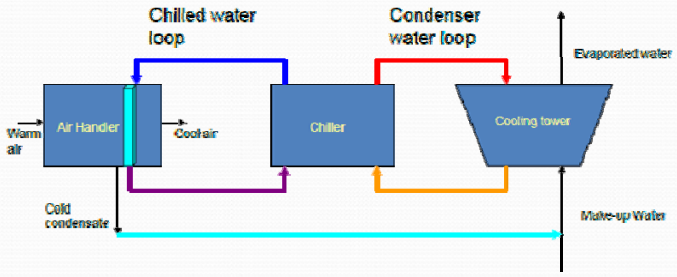
Water Use

- Operate tower at proper cycles of concentration (COC)
  - Diminishing water savings beyond 4 or 5 cycles
  - The higher the COC, the greater the risk in terms of scaling and corrosion



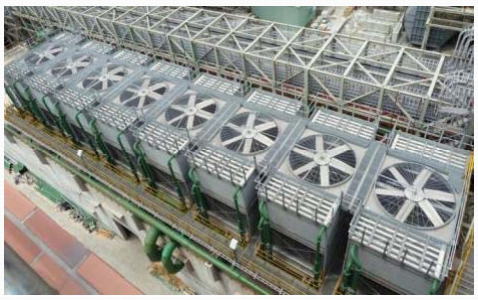
Water Use

- Consider alternative water sources such as:
  - Reclaimed water
  - Condensate collection
  - Recycled blowdown (RO)
- Critical to provide proper treatment and monitoring



Water Use

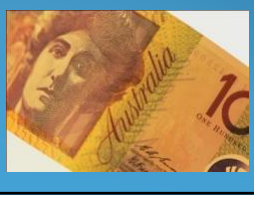
- Wide range of material of construction options available to handle higher COC as well as alternate water sources



Water Use

- Water saving heat rejection designs
  - Combine wet and dry heat transfer

Total Cost of Ownership



Purchasing Considerations

Lowest Total Cost of Ownership
=
Lowest Environmental Impact

TCO

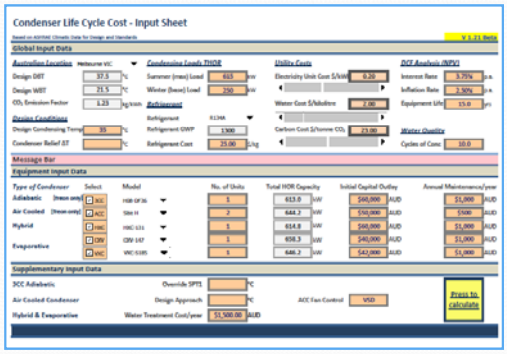
- Sum of all costs over the life of a system
  - Acquisition
  - Operating
  - Replacement
  - Upgrades
  - Decommissioning
  - Environmental

TCO

- TCO is useful to compare alternatives
  - One cooling system versus another
  - Choice between equipment types
- Many costs are the same between two alternatives so these drop out of the analysis
- TCO tools are available to assist in this analysis

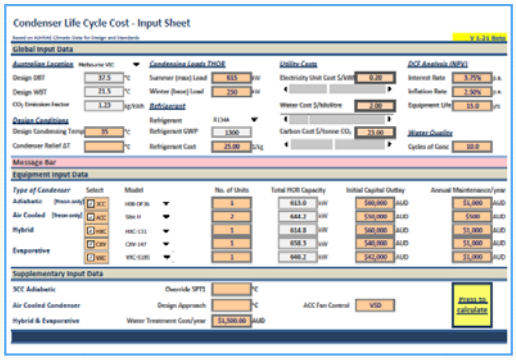
TCO

- Purchase price
- Electricity
- Water & water treatment
- Maintenance
- Replacement
- Carbon Tax
- Refrigerant GWP



TCO

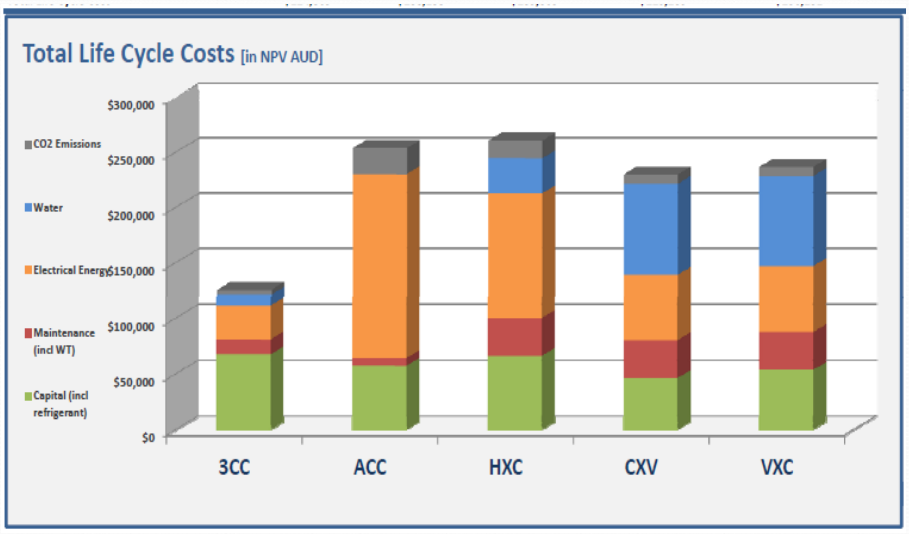
- Other factors to consider:
  - Cycles of concentration
  - Inflation rate
  - Equipment lifetimes
  - Load profile



TCO

- Example:
  - Compare TCO of a air cooled condenser, adiabatic condenser, evaporative condenser, and hybrid wet / dry condenser

TCO



Sustainability in Heat Rejection

Thank You!