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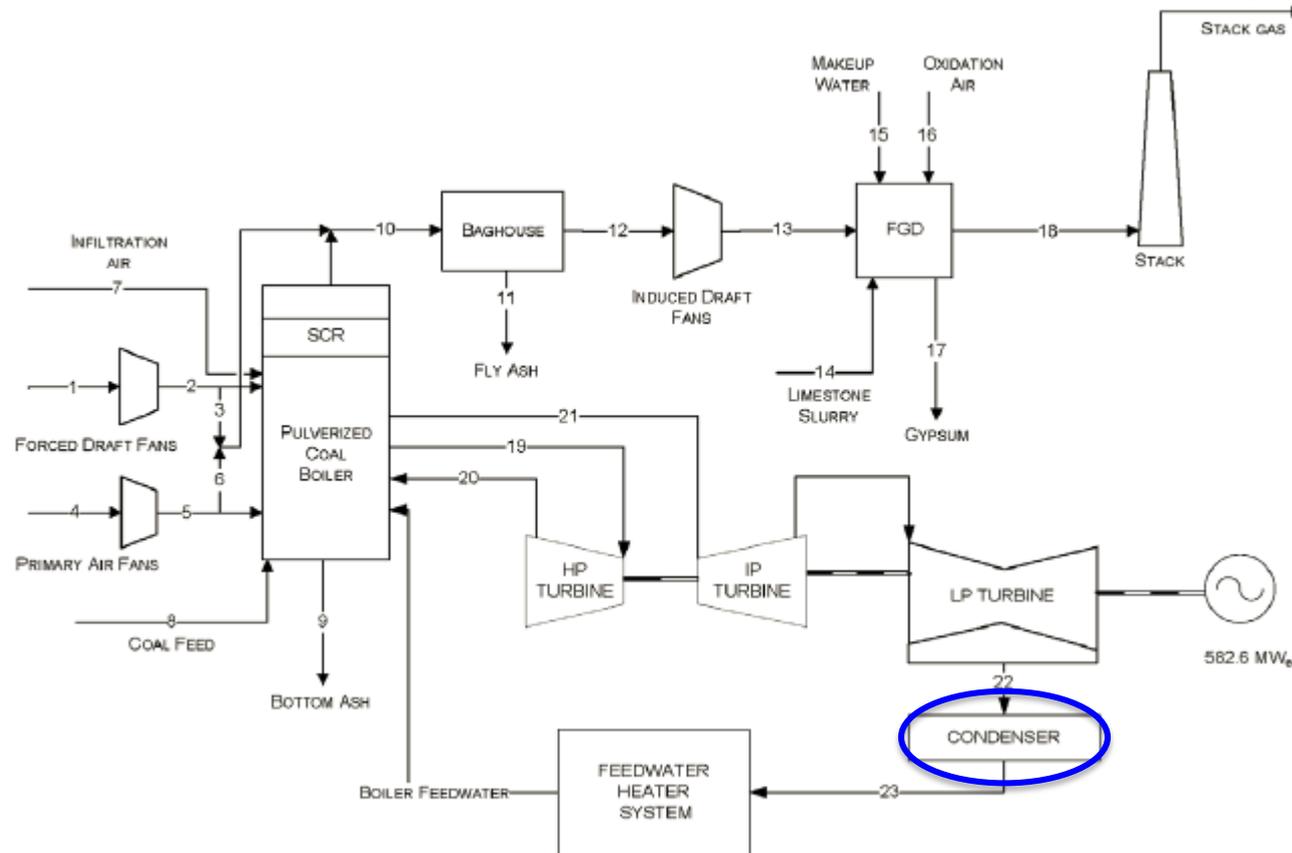
TECHNO-ECONOMIC APPROACH FOR ALTERNATIVE COOLING IN POWER PLANTS

The objectives of the TEA include

- ▶ Determining how LCOE depends on
 - Performance of key equipment
 - Cost of key equipment
 - Process configuration

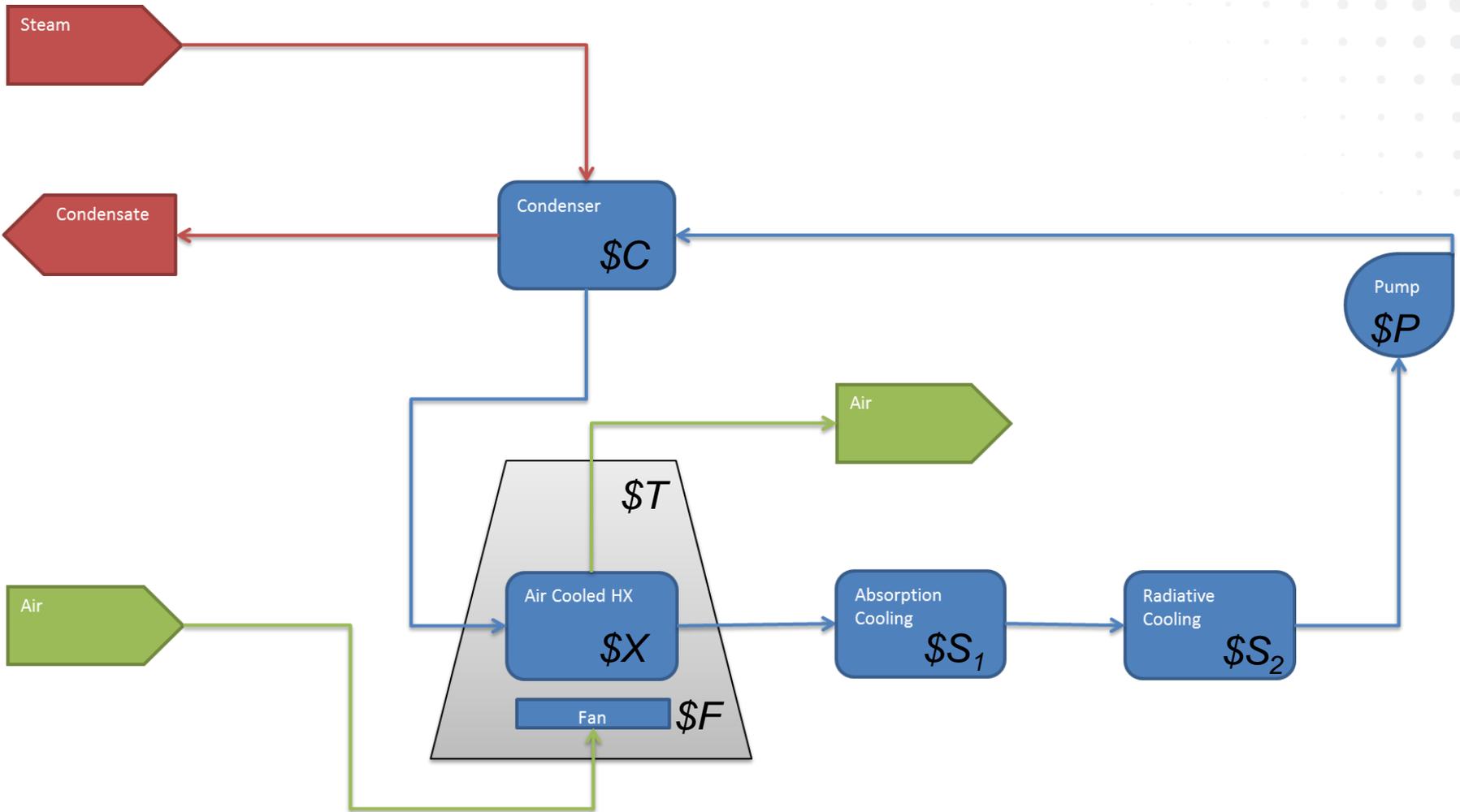
- ▶ Understanding the cost tolerance for key equipment that may still be in development, such that
 - LCOE does not increase
 - LCOE does not change by more than X%

A reference plant was chosen to compute percent changes in LCOE: NETL Case 9 Subcritical Coal

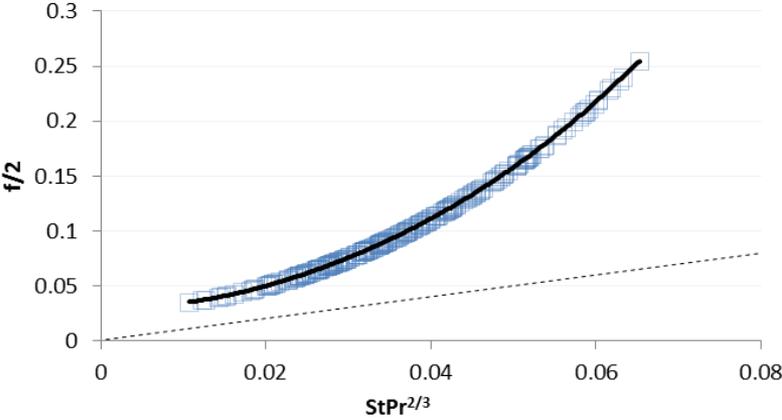
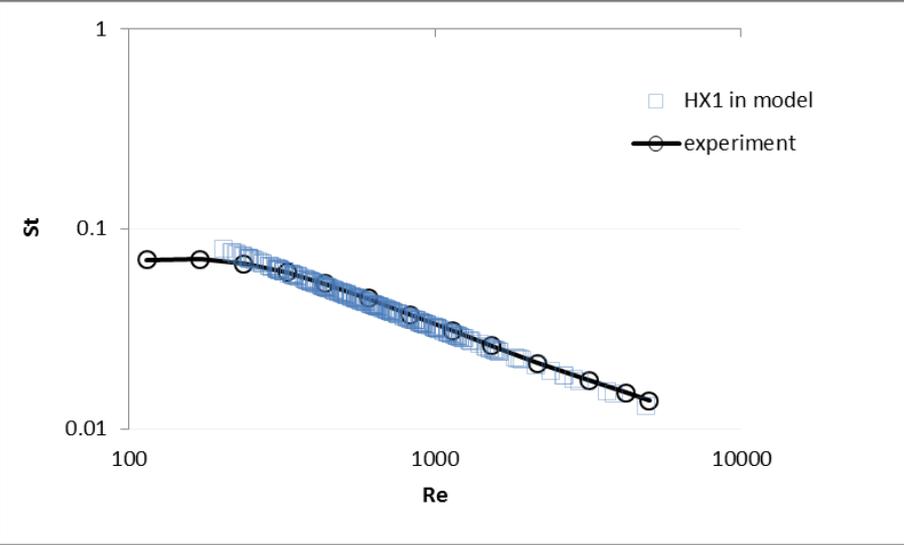
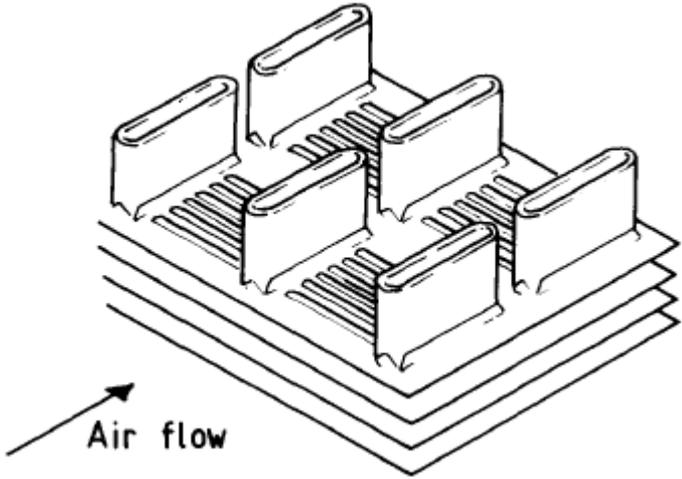
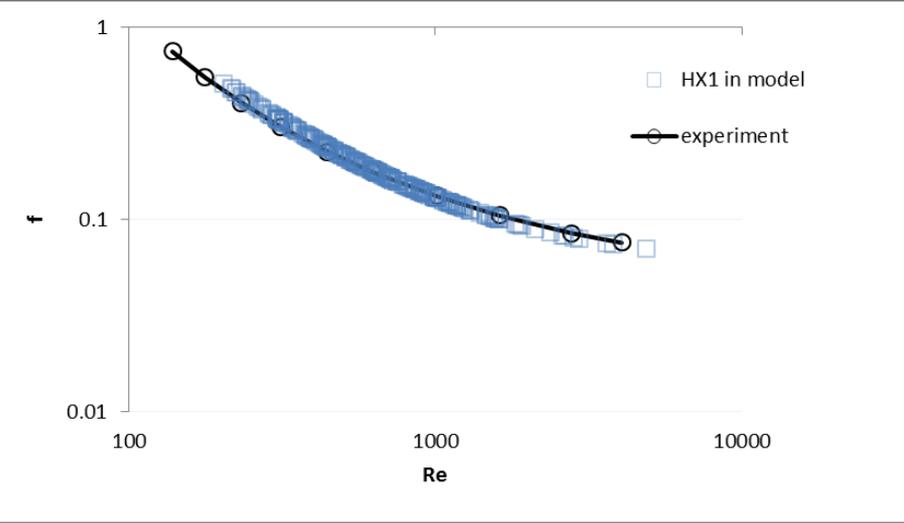


- ▶ We modified how the condenser provided cooling, without changing the operation of steam cycle.

Evaporative cooling was substituted, while keeping a closed-loop circulating water system.

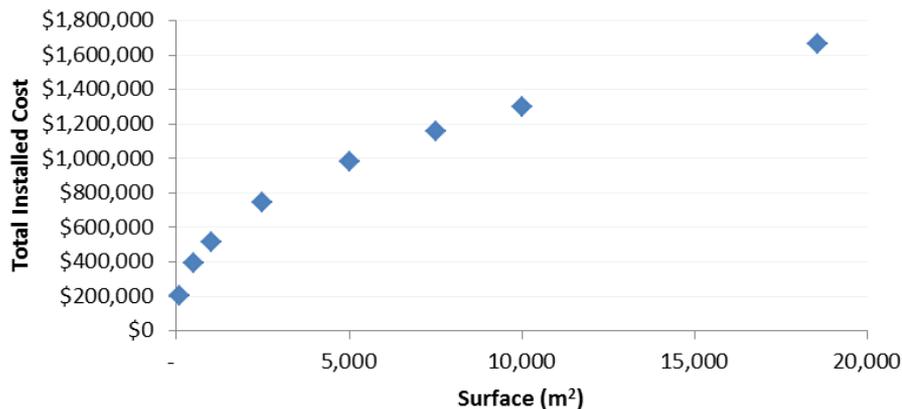


Exemplary Air Cooled HXer Characteristics

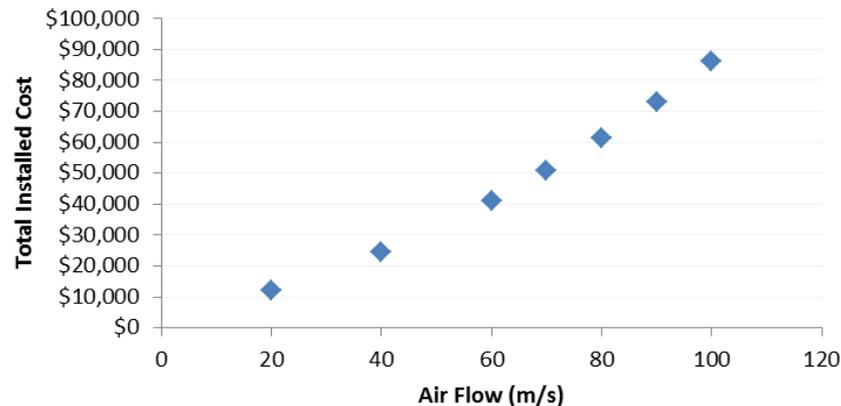


Equipment Installed Cost, Economies of Scale

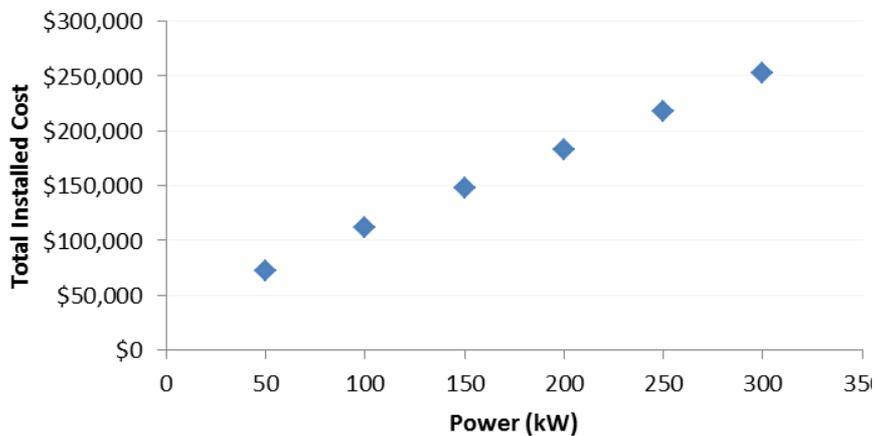
Air Cooled Heat Exchanger



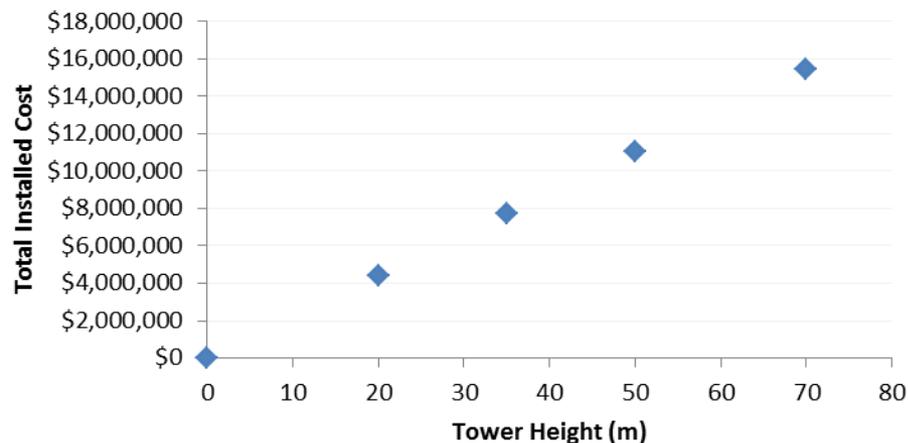
Axial Tube Fans



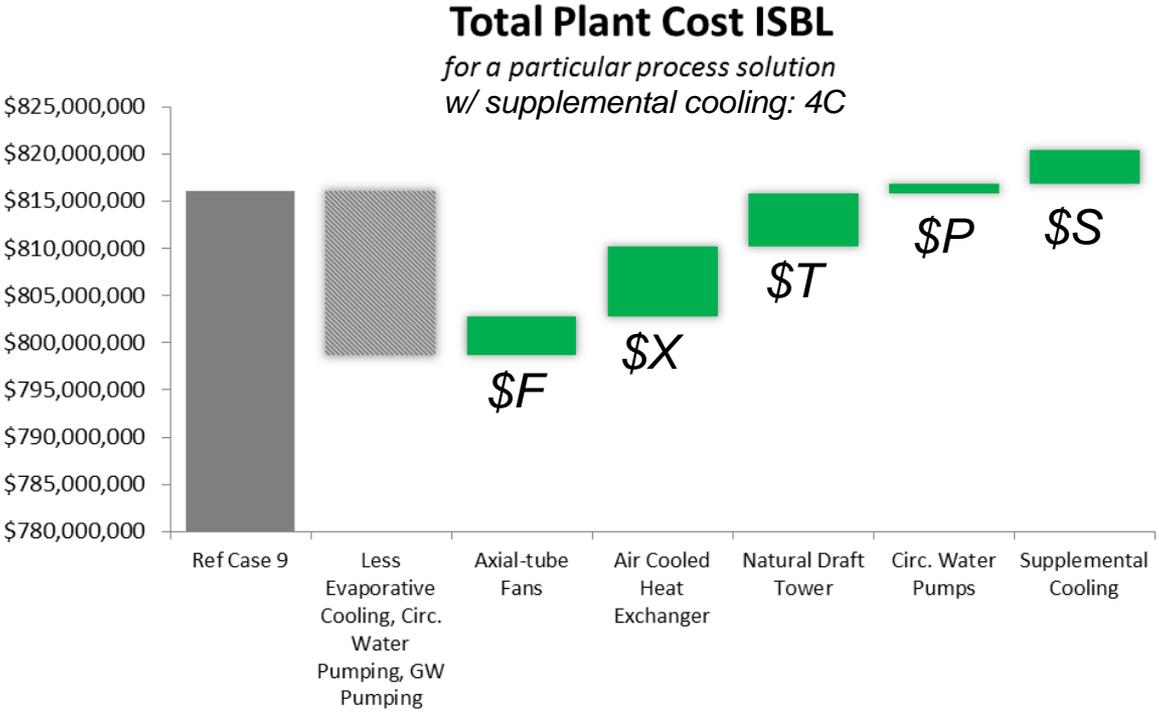
Centrifugal Pumps



Natural Draft Tower

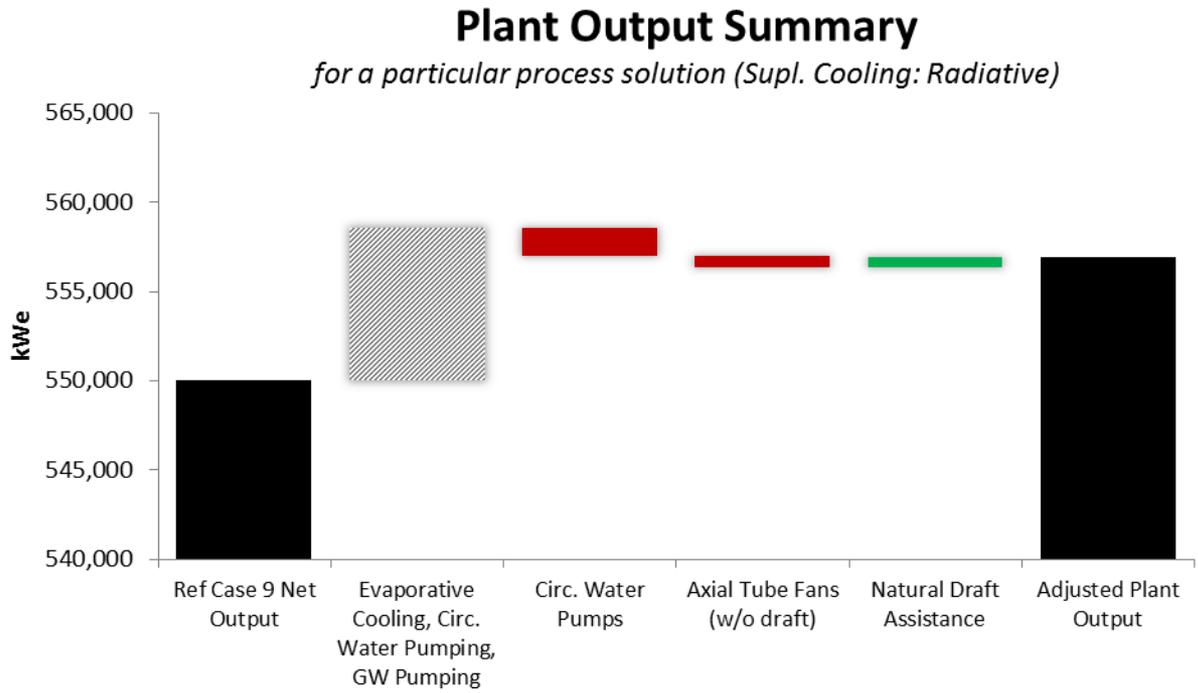


Adjustment to Total Plant Cost



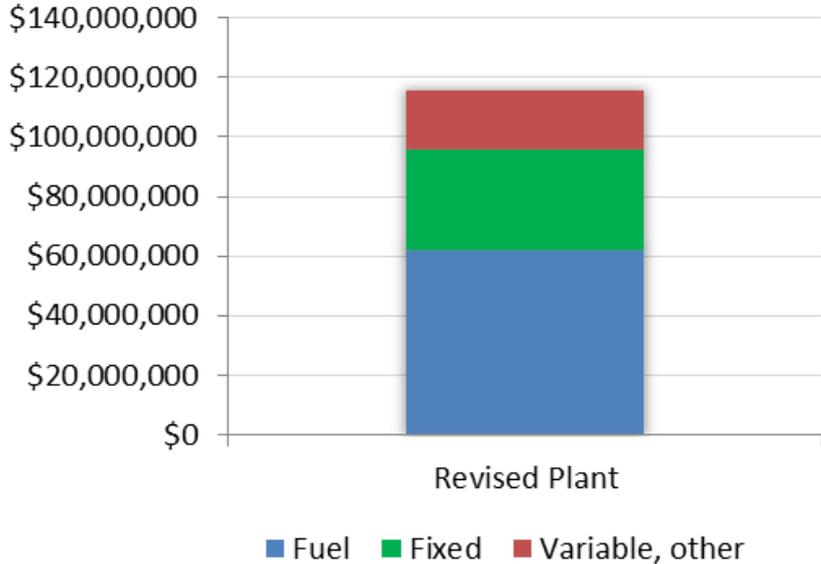
- ▶ Fans, Exchanger, Tower, Pumps are sized to the process solution that closes the mass and energy balances. Then supplemental cooling is adjusted until the change in LCOE is 0% (*in this case*).

Adjustment to Plant Output

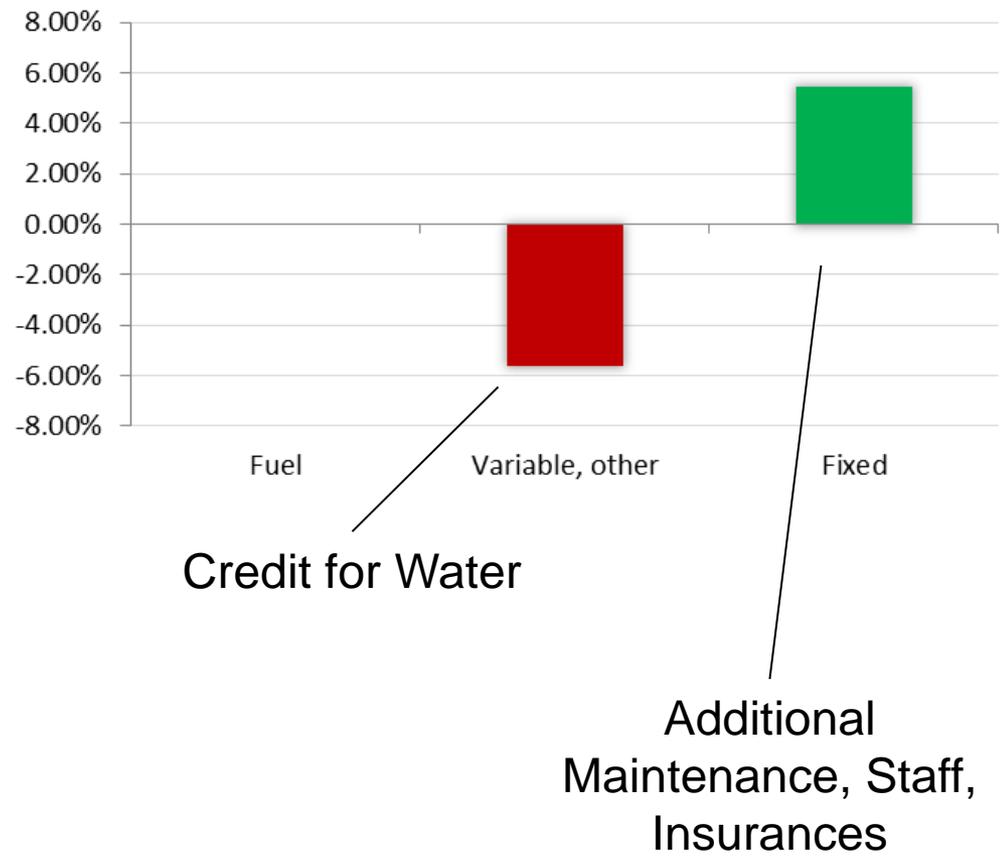


Adjustment to Operating Expenses

Annual Operating Expense

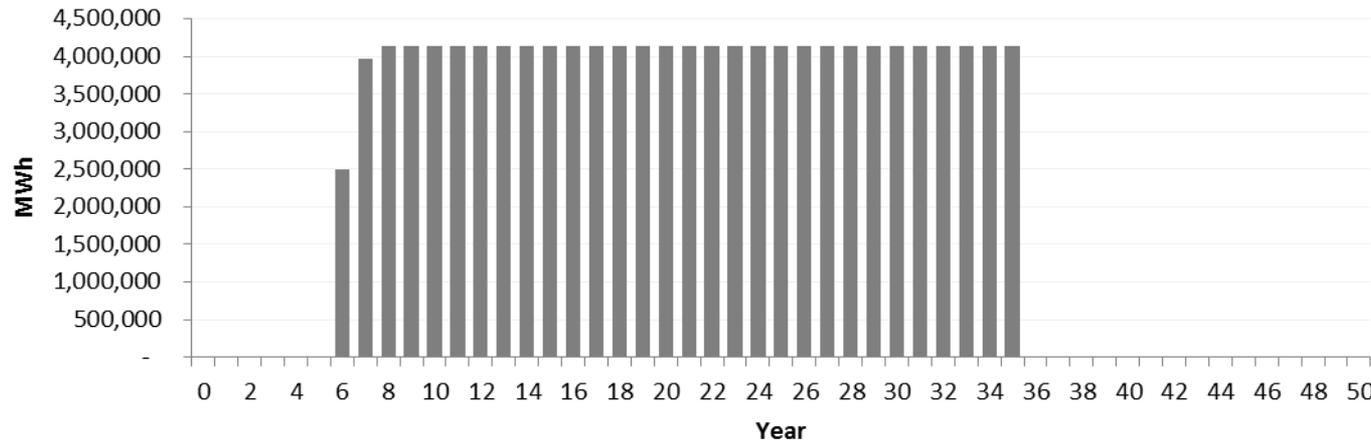


Percent Change in Operating Expenses relative to Reference Case 9

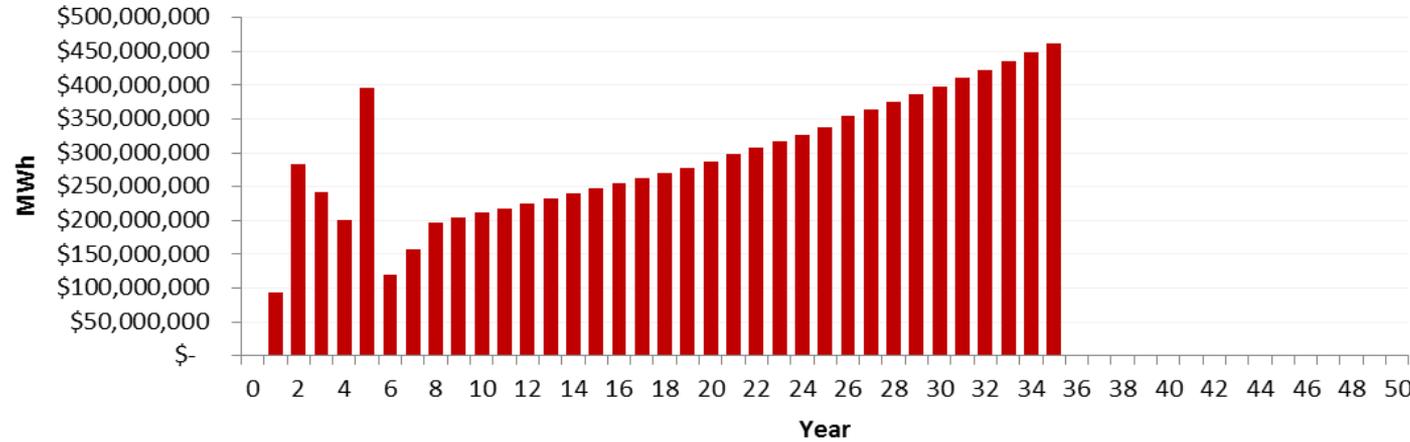


Plant lifecycle

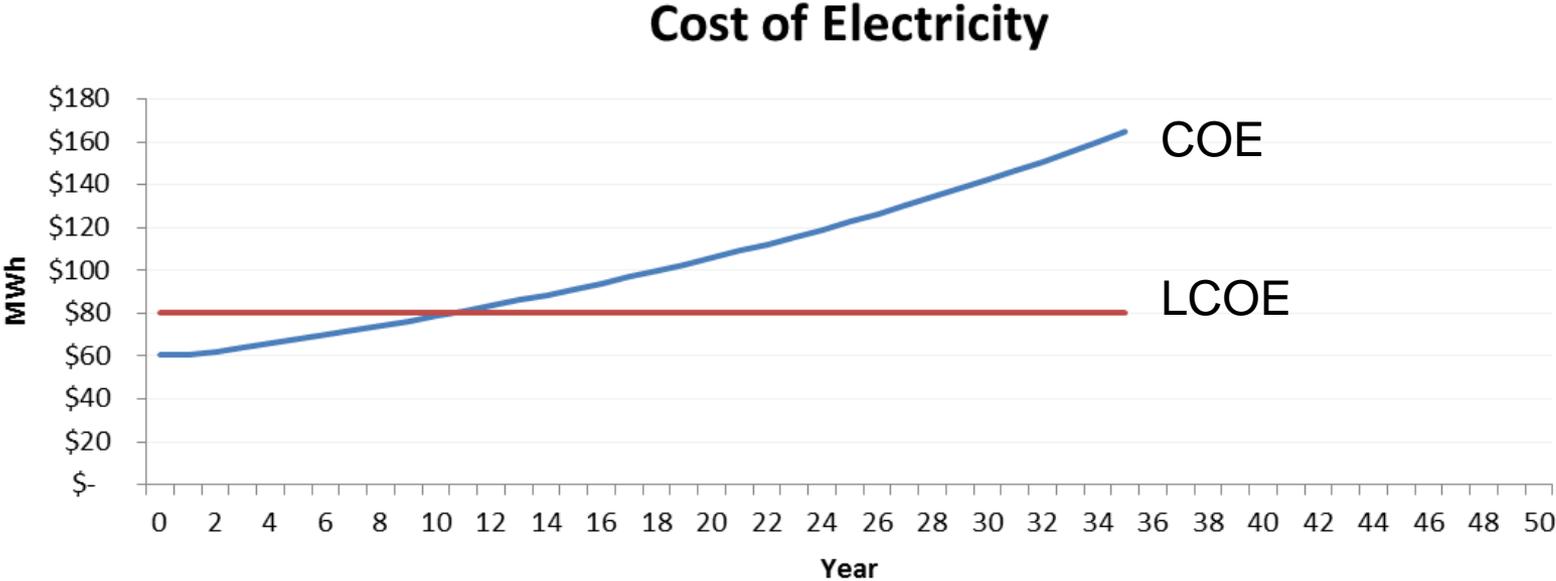
Net Electricity Production



Expenses



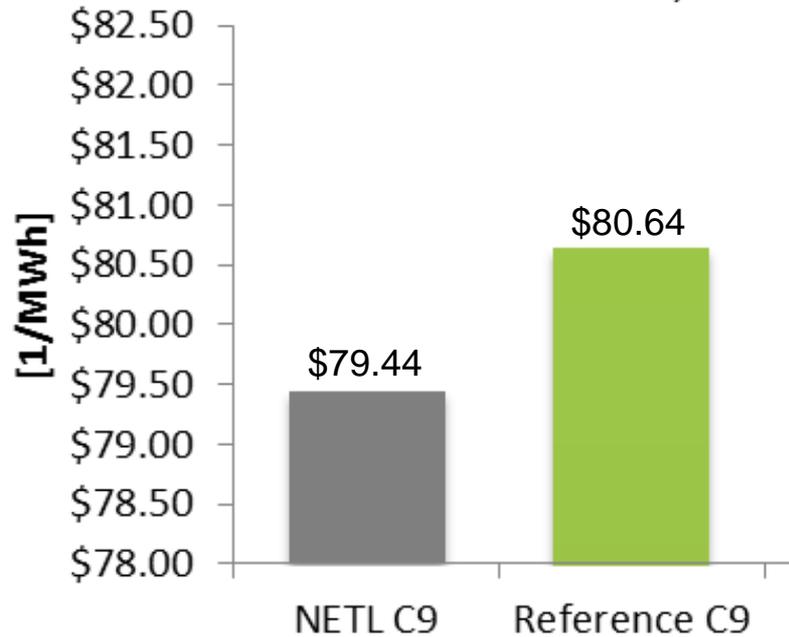
Required COE for meeting economic constraints



- ▶ COE in base year dollars: \$60.38 / MWh
- ▶ COE in first year of operation dollars: \$70.00 / MWh
- ▶ LCOE in base year dollars: \$80.54 / MWh

LCOE Comparison

Nominal, base year dollars (Y2007)



Lessons Learned include

- ▶ Natural draft towers reduce fan capex and loads (fans have unfavorable economies of scale). It is difficult to find economical solutions without natural draft towers.
- ▶ Reducing friction in the Air Cooled Heat Exchanger improves loads, but does not change the required mass flow rate. Fan capex is not affected.
- ▶ One can have a sizeable equipment allowance for Supplemental Cooling* while incurring a small LCOE penalty.



CHANGING WHAT'S POSSIBLE

Thanks

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