

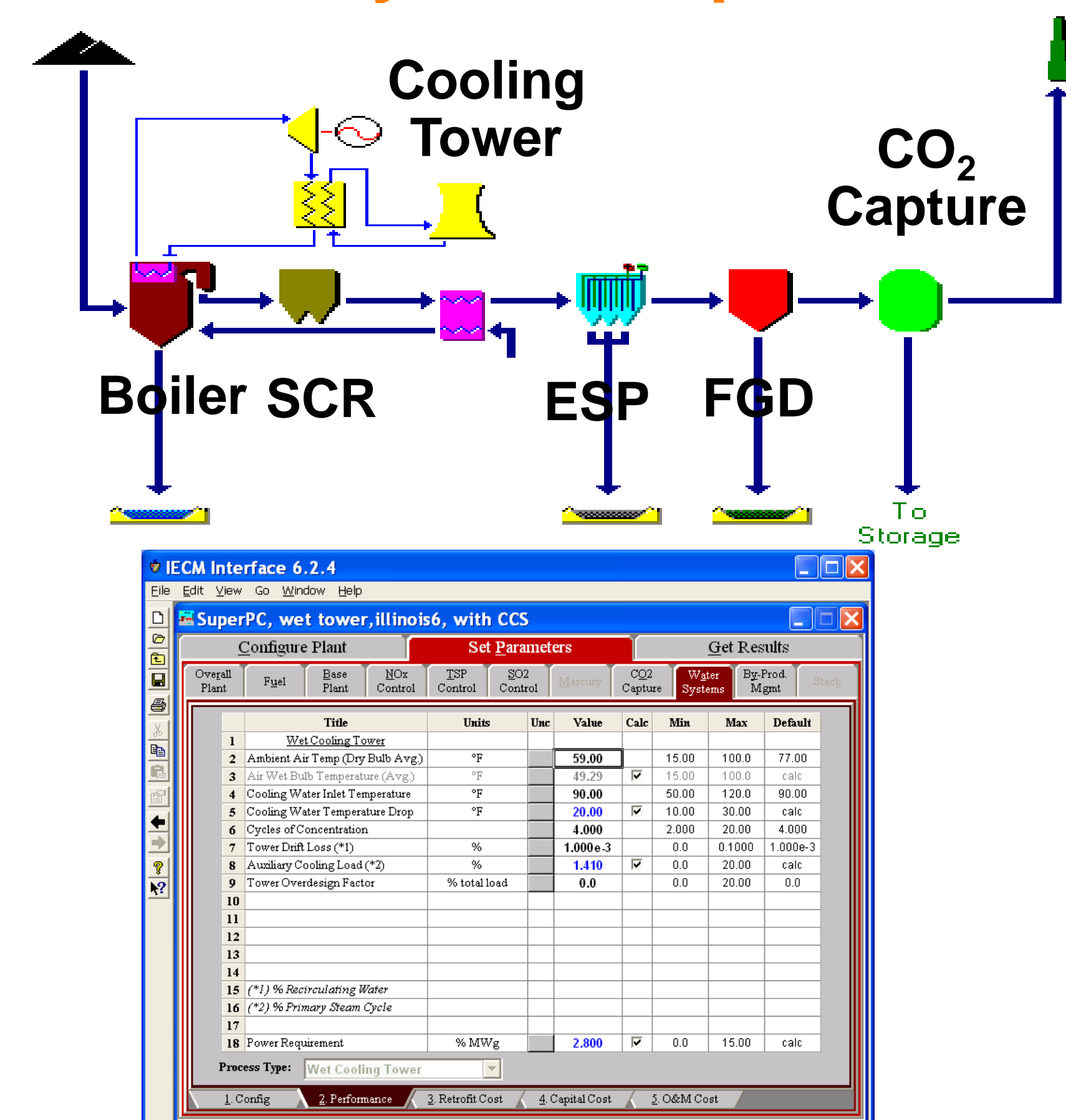
Background

- Water used by carbon capture and storage (CCS) systems is becoming an increasingly important factor for application of post-combustion CCS at coal-fired power plants.
- The objective of this paper is to quantify the consumptive water use of representative pulverized coal (PC) power plants equipped with traditional air pollution controls (SCR, ESP and wet FGD), as well as amine-based CO₂ capture systems.

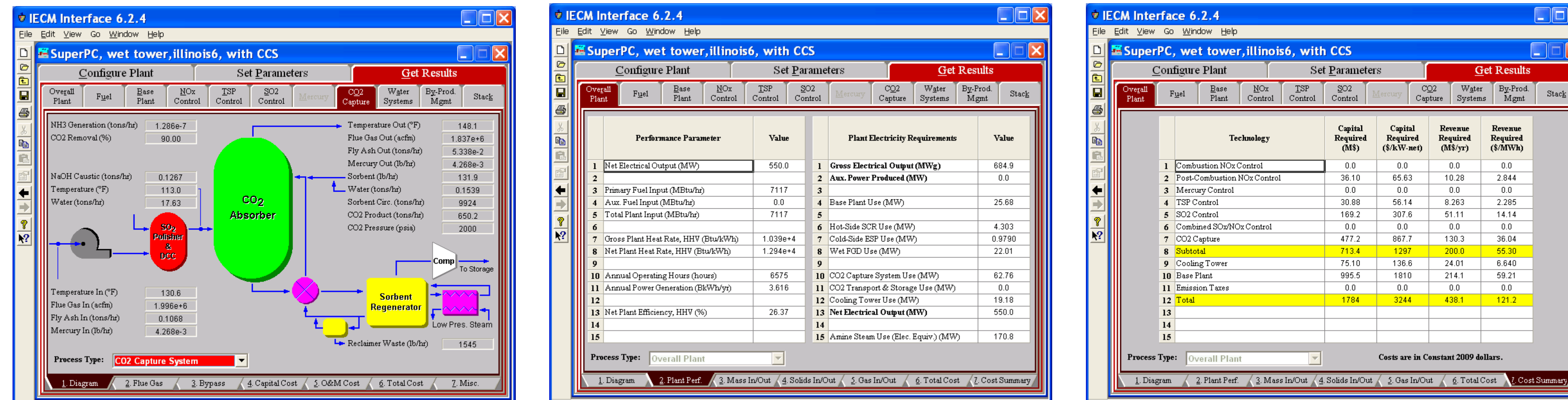
Methodology and Tool

- A water systems module that was developed based on mass and energy balances has been embedded in the Integrated Environmental Control Model (IECM) developed by CMU for USDOE/NETL.
- The IECM is publicly available at <http://www.cmu.edu/epp/iecm/>
- The IECM provides systematic estimates of performance, emissions, costs and uncertainties for preliminary design of fossil-fueled power plants with and without CCS.

550 MW-net Plant Configuration and Water Systems Inputs



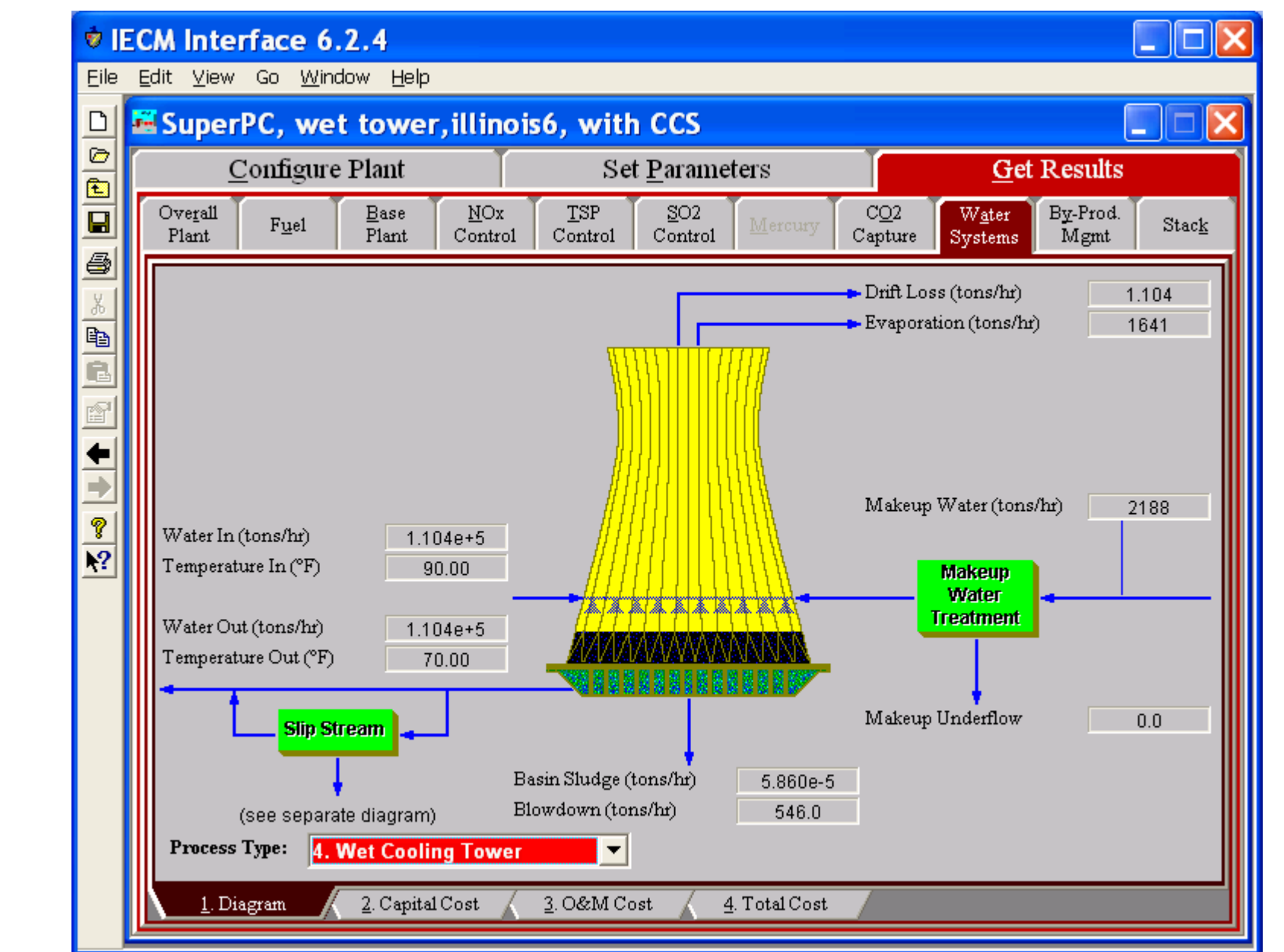
Carbon Capture System & Plant Performance and Cost



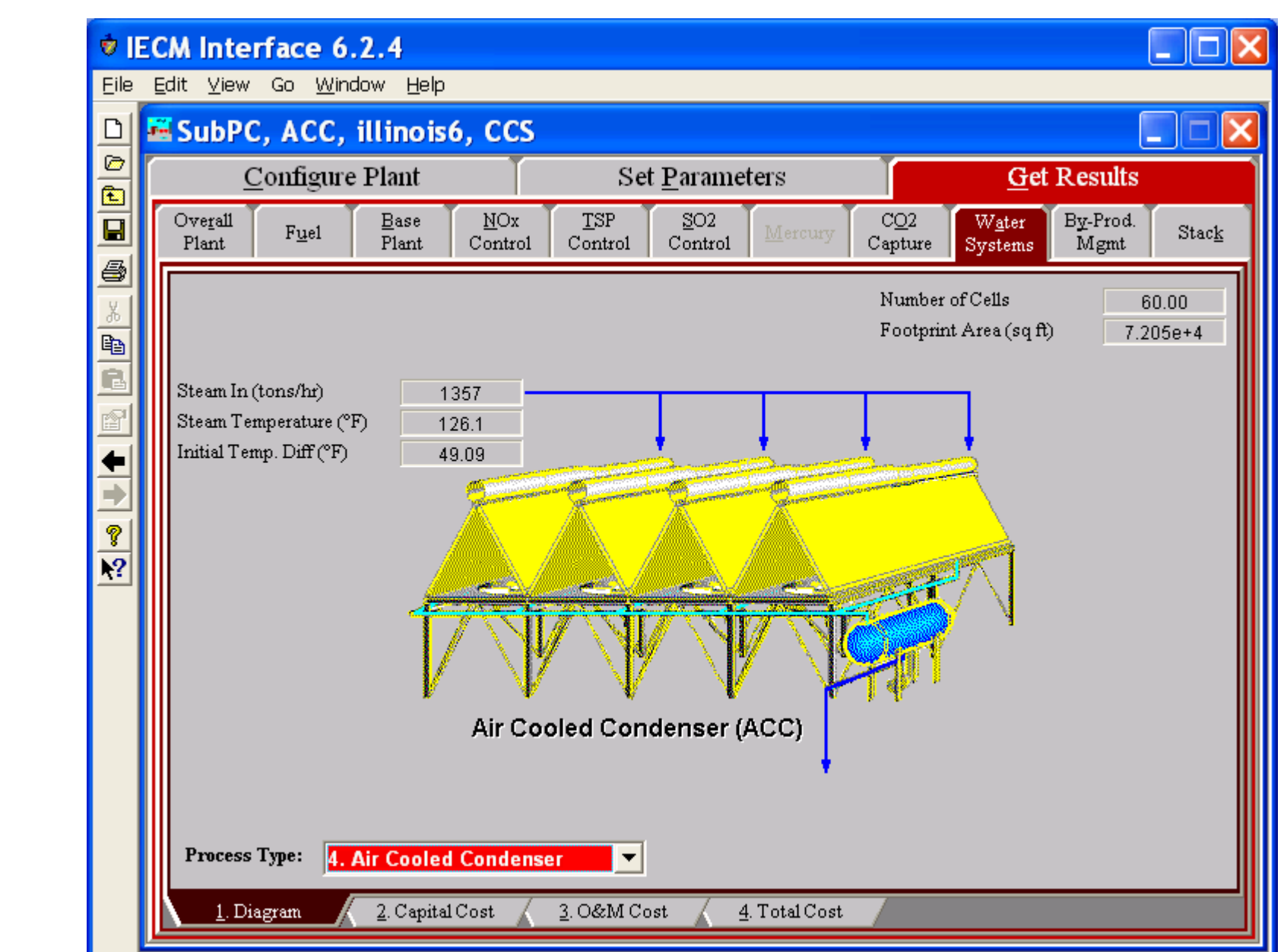
CO2 Capture System

Plant Performance & Cost

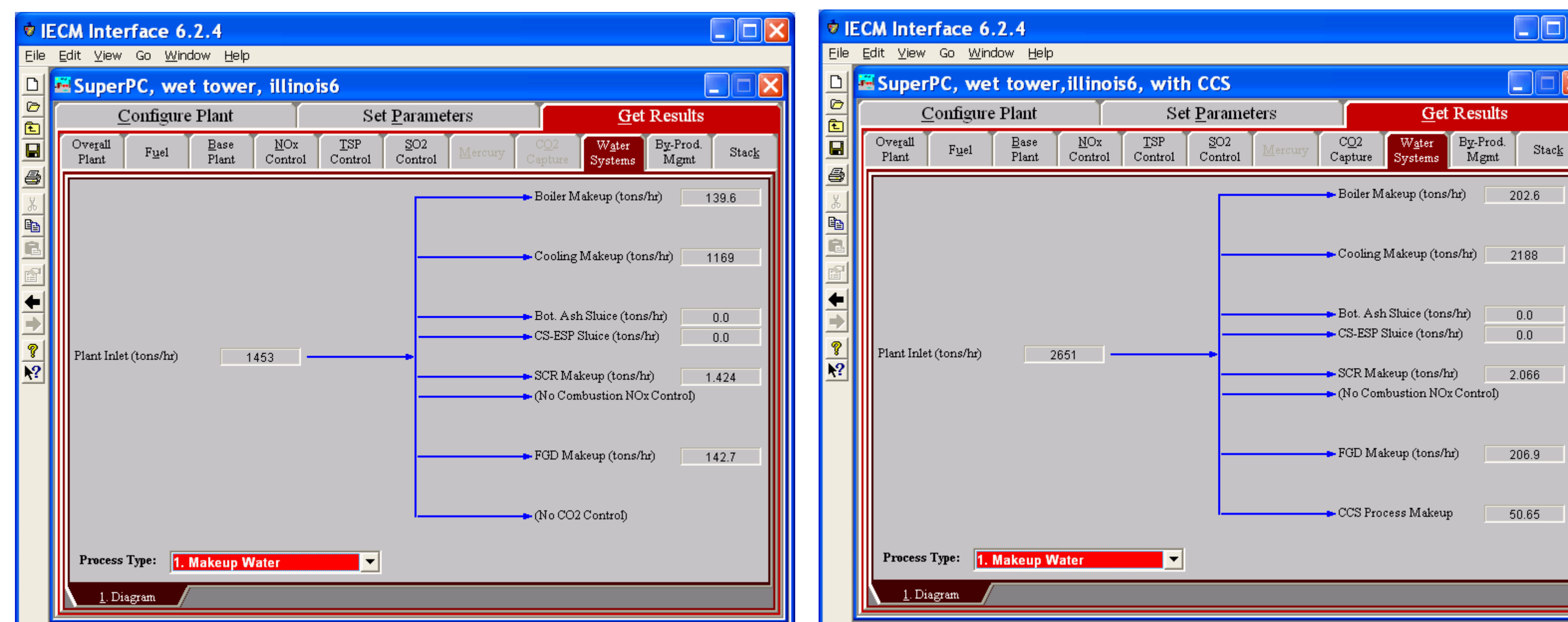
Wet Cooling System



Dry Cooling System



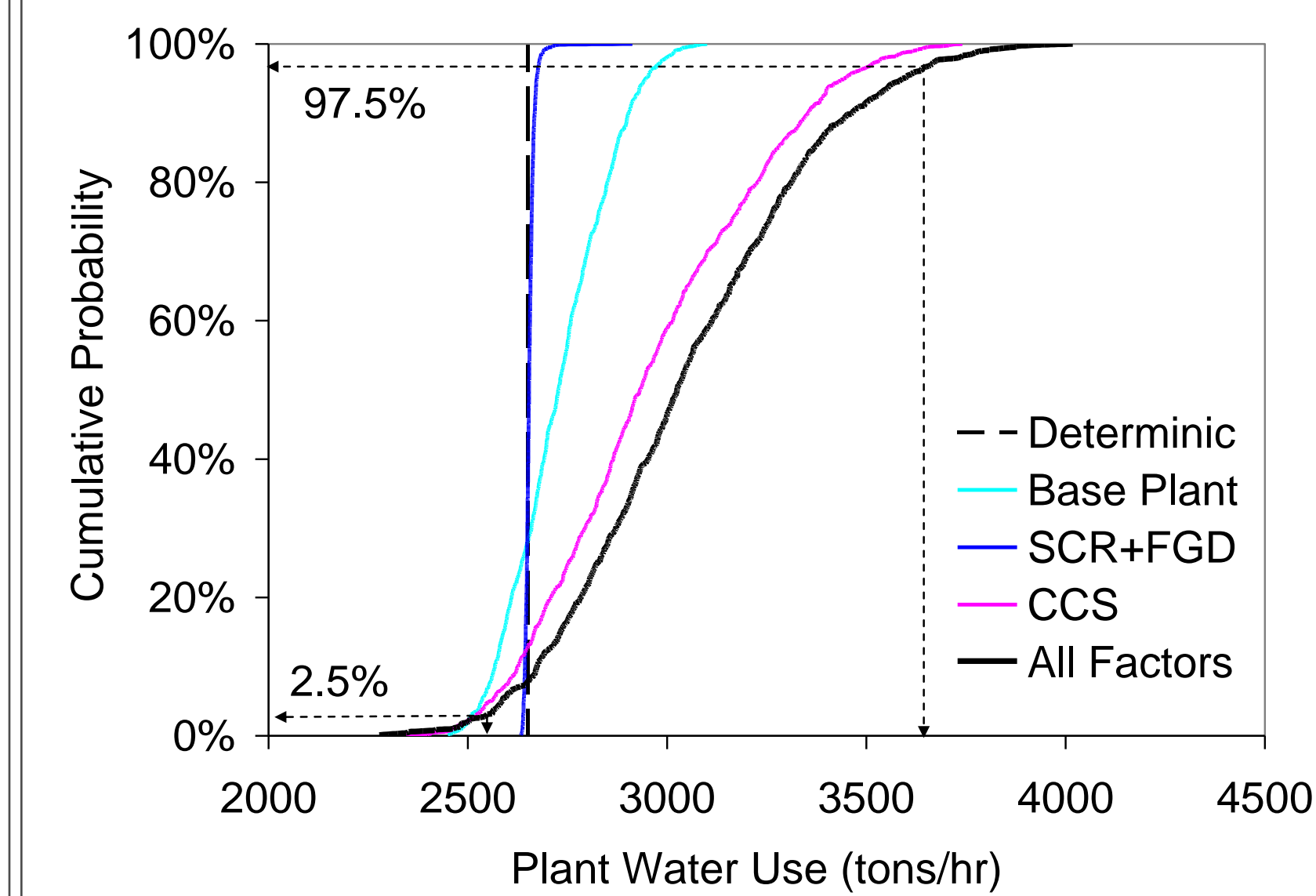
Water Use at PC Plants with and without CCS



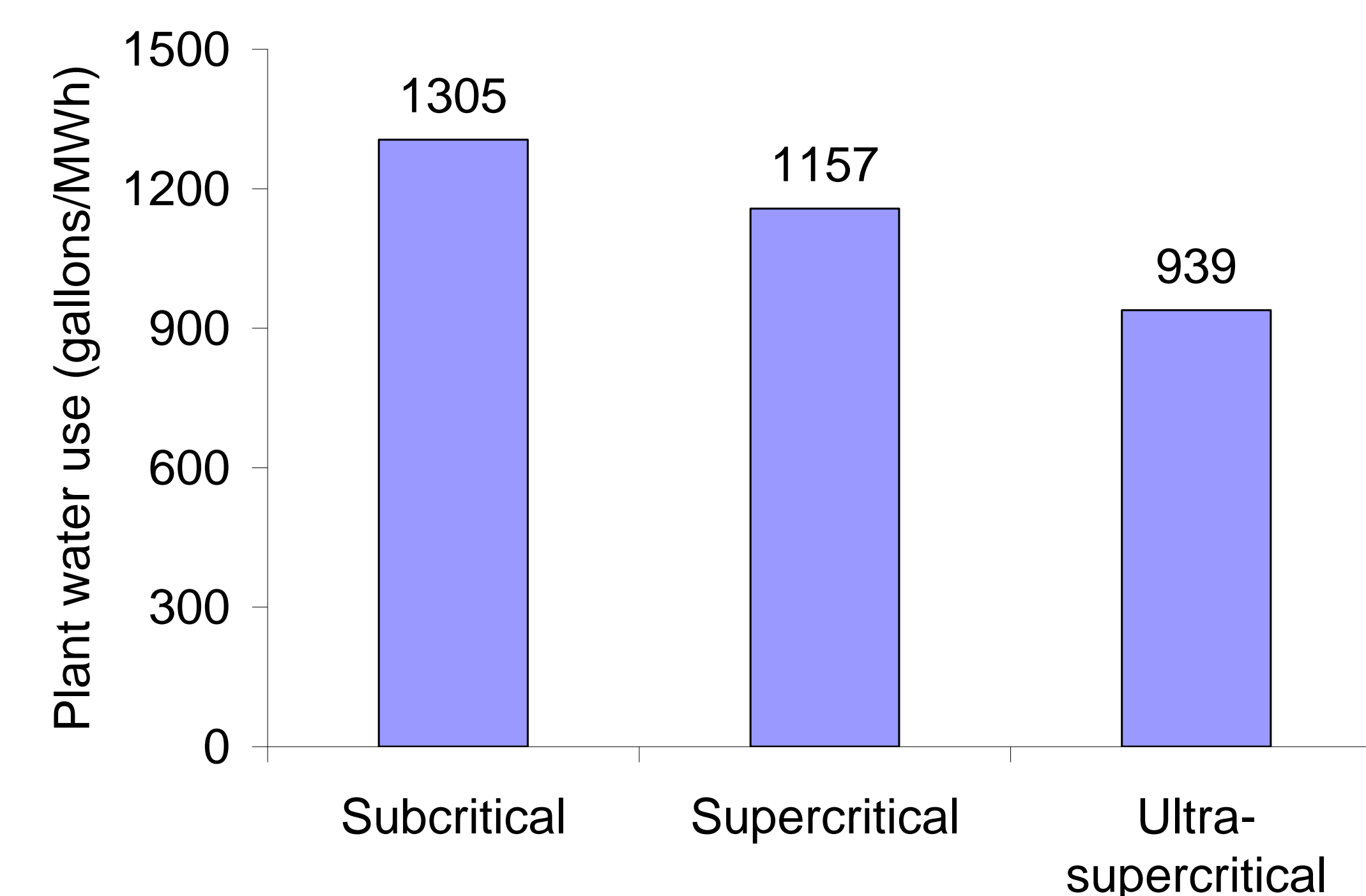
w/o CCS

w/ CCS

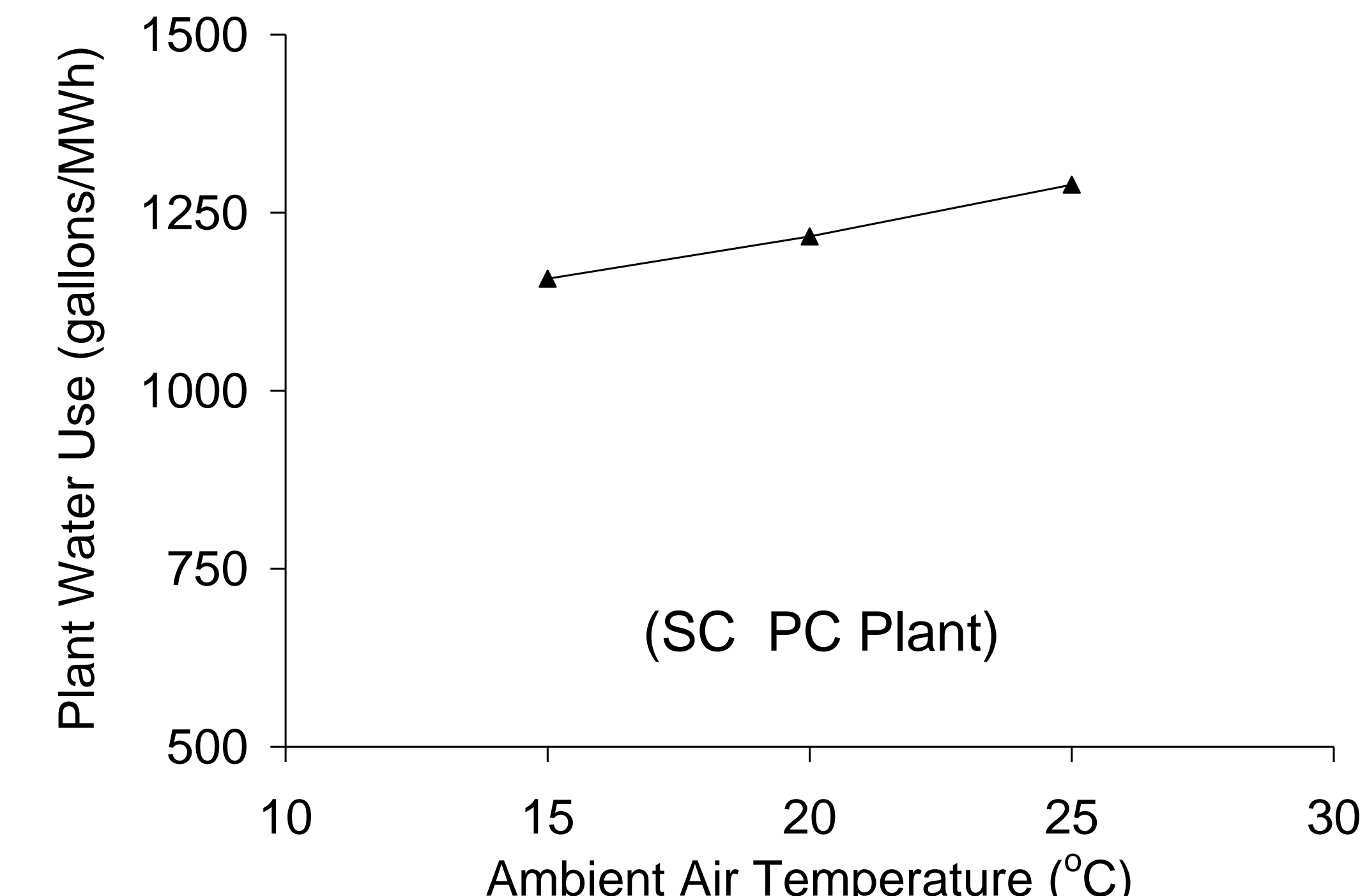
Uncertainty on Water Use at the PC Plant with CCS



Effects of Plant Type on Water Use



Effects of Air Temp. on Water Use



Conclusions

- The addition of a current amine-based carbon capture system to the plant would approximately double water use, especially for cooling systems;
- Improving plant energy efficiency decreases plant water use; Water losses vary by air temperature; Replacing wet cooling with dry cooling significantly reduces water use at a plant;
- There is a need for careful coordination of energy, climate change, and water resource policies.

Acknowledgments

This work was supported by the U.S. Department of Energy under Contract No. DE-AC26-04NT4187 from the National Energy Technology Laboratory. Any opinions, findings, conclusions or recommendations expressed in this paper are those of the authors alone and do not reflect the views of DOE or any other government agency.