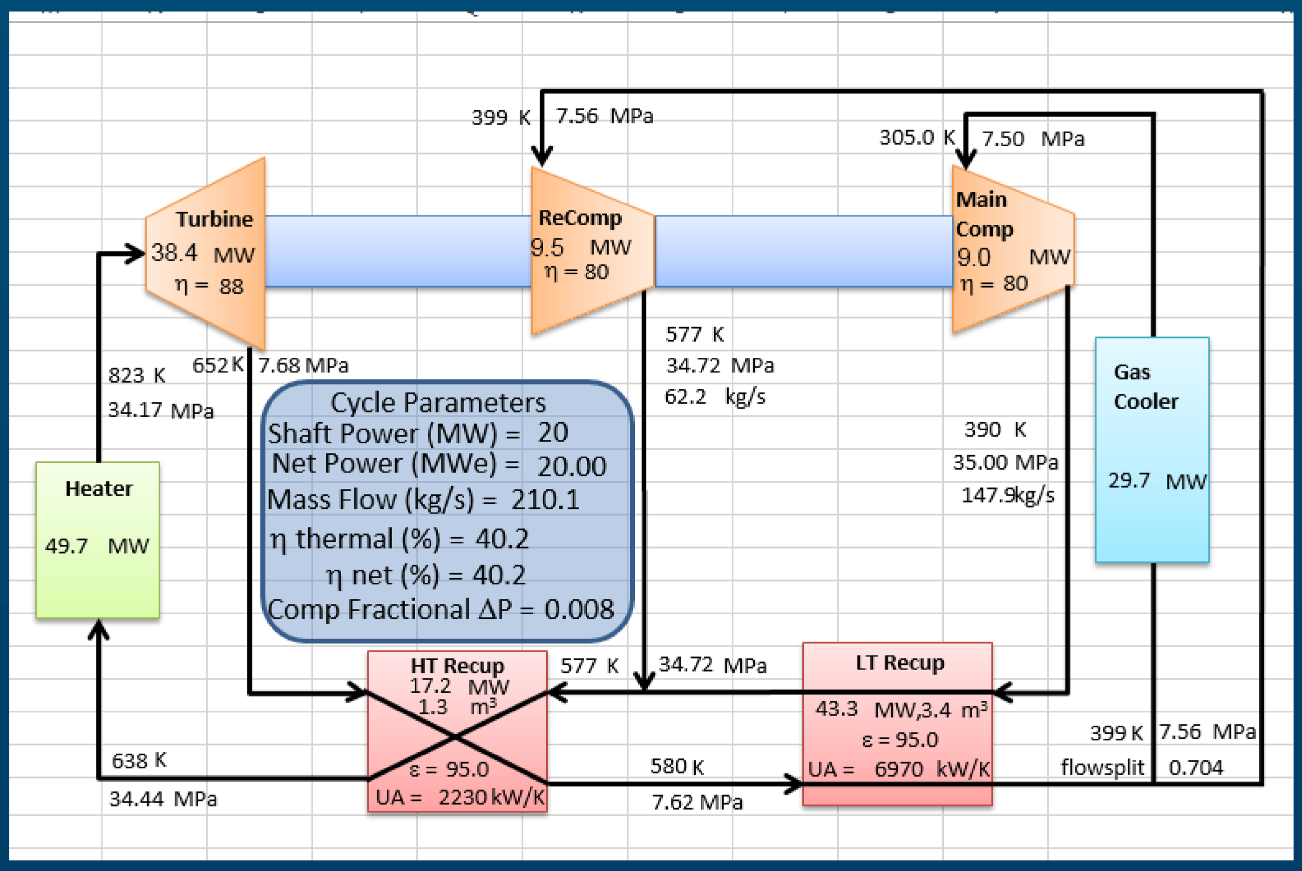
SAND2017-12269C

Brayton Cycle Economic Tool

Thomas Drennen, Hobart and William Smith Colleges
Blake Lance, Sandia National Labs

Model Overview

- Integration of Economic Tool with Sandia's RETS, the RCBC Evaluation and Trade Studies model.
- RETS is a supercritical CO2 (SCO2) recompression closed cycle (RCBC) modeling tool that calculates key system performance characteristics based on user-defined input on key variables such as: system size, recuperator effectiveness, turbine inlet temperatures, etc.

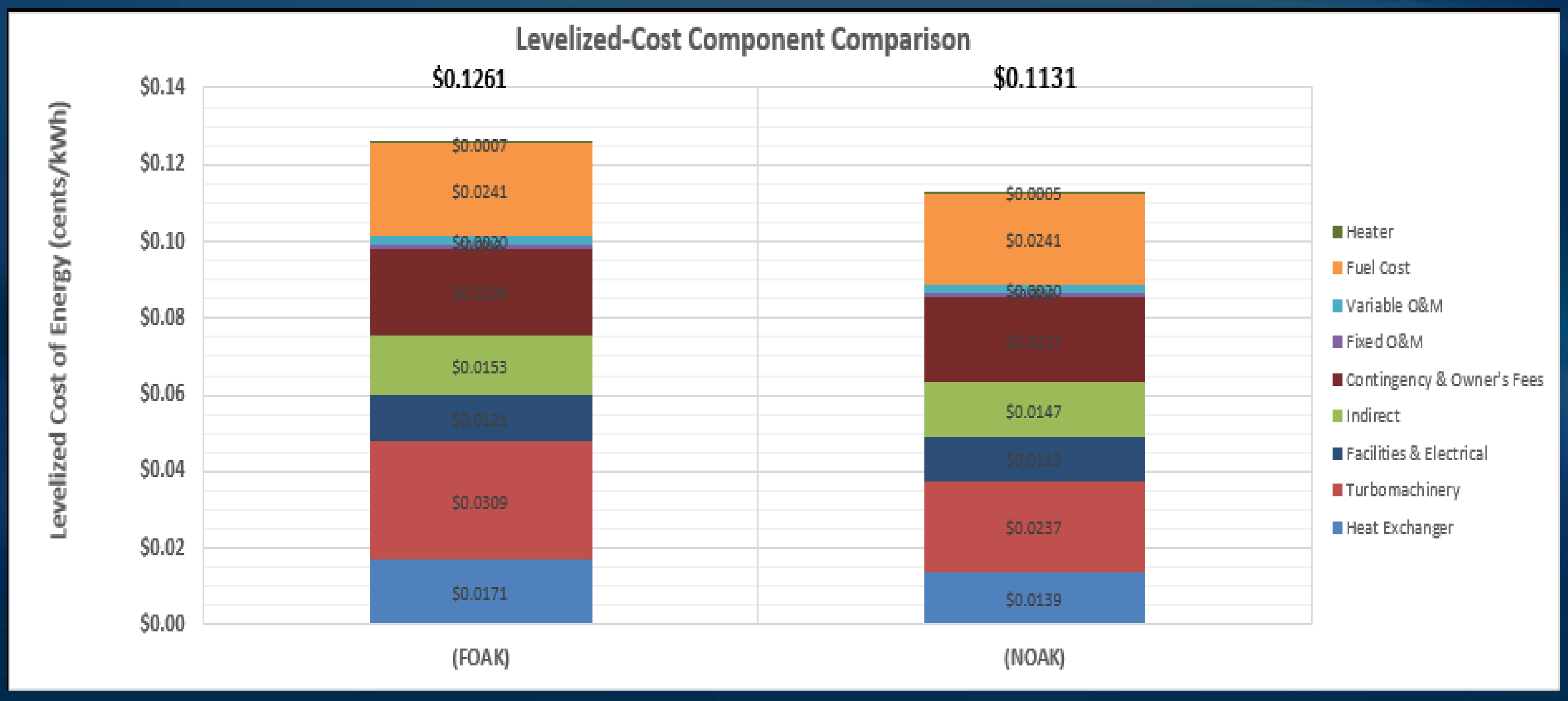


- In addition to technical input from the RETS, integrated tool requires assumptions about:
  - Fuel Costs
  - Fixed and Variable O&M
  - Scaling and costing relationships for plant components
  - Detailed financial assumptions (financing costs, depreciation, taxes, economic plant life)
- Costing information for various components from a variety of sources, including the internal Sandia estimates, vendor estimates, and other published estimates.
- In addition to component costs, costs include estimates for :
  - Site preparation, including facility construction
  - Project indirect costs (engineering, labor, management fees, and contingency fees)
  - Development costs (engineering studies, permitting, legal fees, insurance fees, property taxes during construction)
  - Electrical Interconnection costs

Levelized Cost of Energy

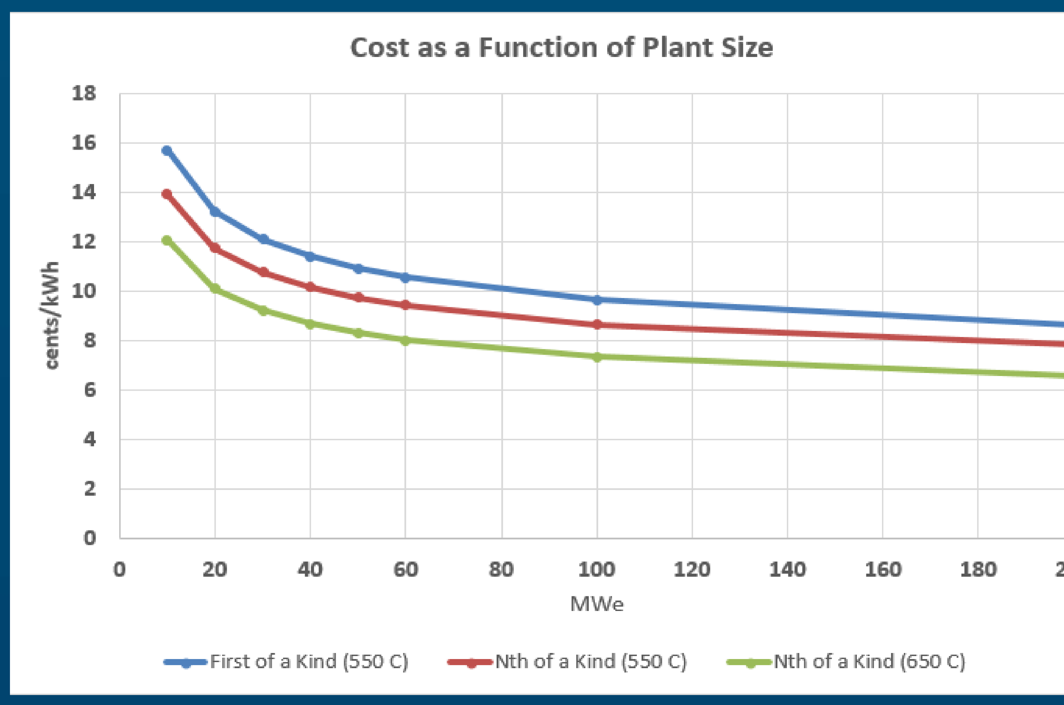
LCOE ($/kWh) for first of a kind (FOAK) and n^th^ of a kind (NOAK)

20 MWe, 550 ℃, 3.00 $/MMBtu natural gas, 85% capacity factor

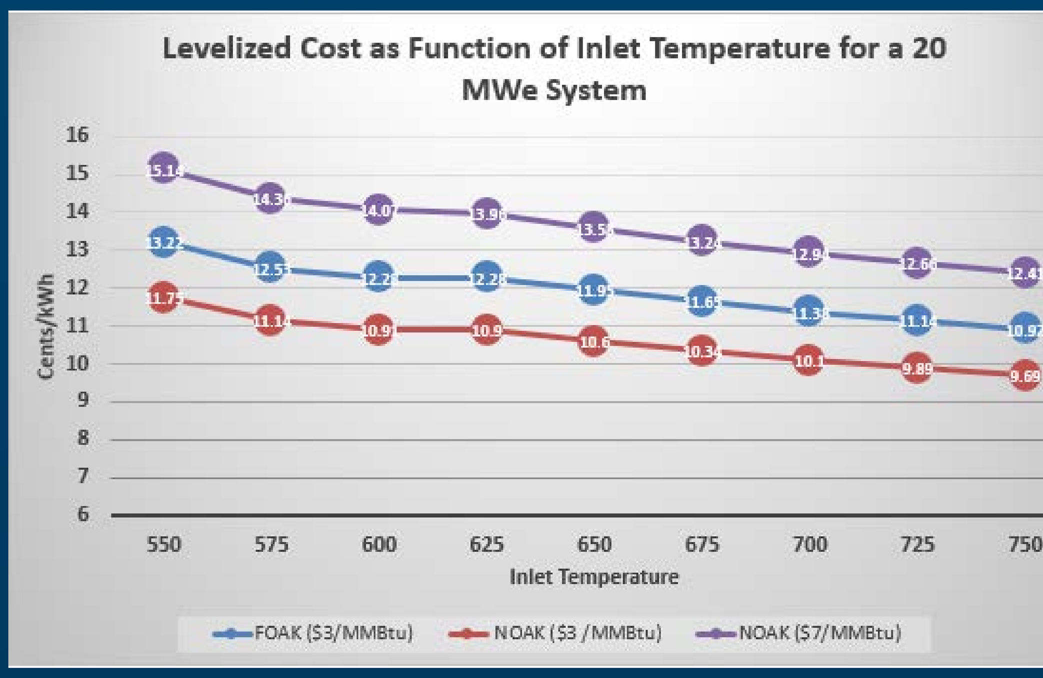


Sensitivity Analysis

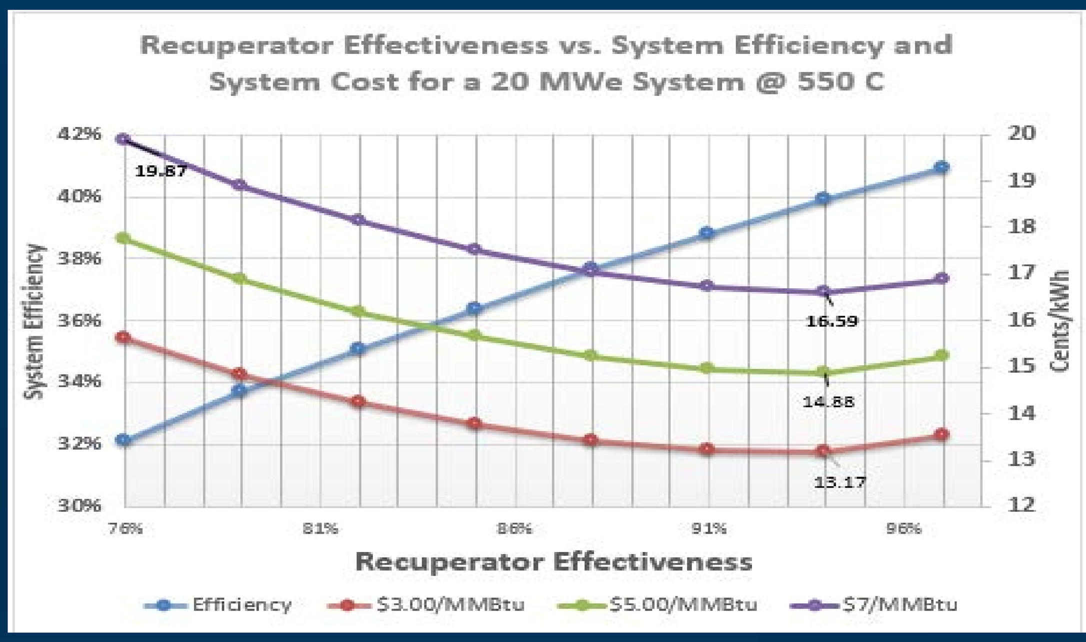
LCOE costs decrease as system size increases. Estimated costs decrease significantly for increased turbine inlet temperatures and for nth-of-a-Kind (NOAK) plants.



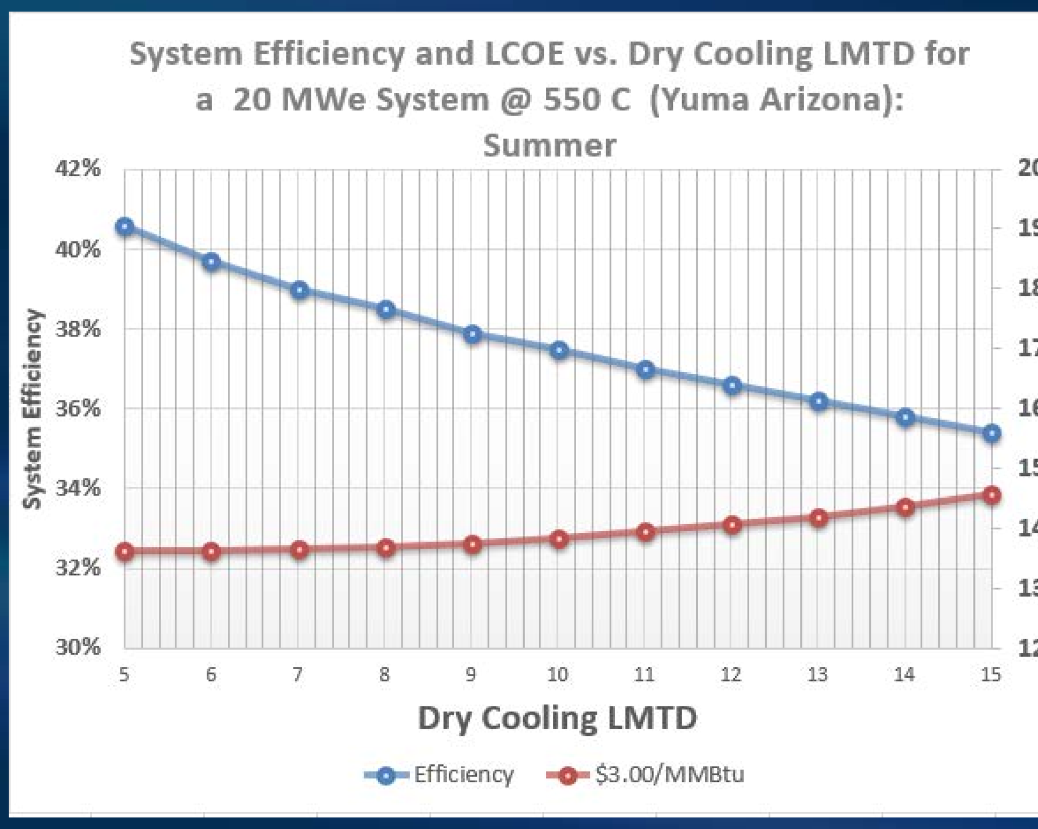
As inlet temperature increases, system efficiency increases, but so do system costs. These additional systems cost is offset by increased system efficiencies which lead to lower LCOE estimates



System efficiency increases as recuperator effectiveness increases, resulting in lower LCOE. Optimal recuperator effectiveness is 94%. Beyond that, LCOE costs increase.



System efficiency – and hence LCOE – are highly sensitive to assumptions about cooling systems and physical location.



U.S. DEPARTMENT OF ENERGY · NNSA National Nuclear Security Administration · Sandia National Laboratories

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia LLC, a wholly owned subsidiary of Honeywell International Inc. for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.