POWER SYSTEMS LIFE CYCLE ANALYSIS TOOL (POWER LCAT)

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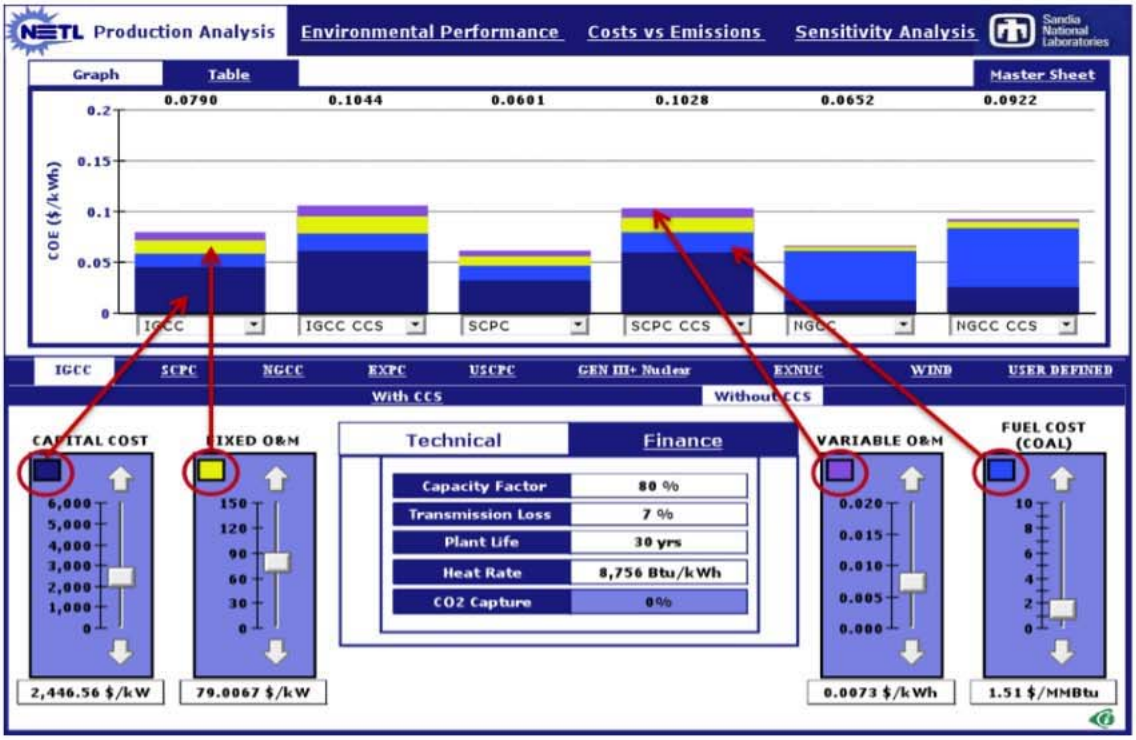
Overview

Power LCAT is a high-level dynamic model that calculates production costs and tracks environmental performance for a range of electricity generation technologies: natural gas combined cycle (NGCC), integrated gasification combined cycle (IGCC), supercritical pulverized coal (SCPC), existing pulverized coal (EXPC), nuclear, and wind (with and without backup power). All of the fossil fuel technologies also include the option of carbon capture and sequestration technologies (CCS). The model allows for quick sensitivity analysis on key technical and financial assumptions, such as: capital, O&M, and fuel costs; interest rates; construction time; heat rates; taxes; depreciation; and capacity factors. Power LCAT is targeted at helping policy makers, students, and interested stakeholders understand the economic and environmental tradeoffs associated with various electricity production options.



Methodology

Power LCAT has four main sections: "Production Analysis", "Environmental Performance", "Costs vs. Emissions", and "Sensitivity Analysis." The "Production Analysis" section calculates the cost of electricity (COE) ($/kWh) for each option and allows users to explore key sensitivities. The "Environmental Performance" section estimates aggregate greenhouse gas and non-greenhouse gas emissions, as well as water usage at each stage of the life cycle analysis. The "Costs vs. Emissions" section explores the tradeoffs between costs ($/kWh) and greenhouse gas emissions (kg CO_2e/MWh). The "Sensitivity Analysis" section allows one to vary several assumptions simultaneously (capital costs, O&M costs, tax rates, capacity factors, and fuel prices) and view the results graphically. The

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The technology options are based on detailed life cycle analysis (LCA) reports conducted by the NETL. For each of these technologies, NETL's detailed LCAs include consideration of five stages associated with energy production: raw material acquisition (RMA), raw material transport (RMT), energy conversion facility (ECF), product transportation (PT), and end user electricity consumption.

Results

For the default model assumptions, the results show that for the fossil fuel technology options the supercritical pulverized coal plant is the lowest cost option at 6.01 cents/kWh. The next lowest cost fossil fuel option is the natural gas combined cycle plant (6.52 cents/kWh) and then the integrated gasification combined cycle plant (7.90 cents/kWh). Of the nuclear options, the EXNUC plant is the lowest cost option at 1.74 cents /kWh followed by a Gen III+ plant at 10.78 cents/kWh. Power LCAT currently includes one renewable technology option – a 200 MW wind turbine (with or without backup). For the default assumptions, the COE for the standalone option is 4.91 cents/kWh and 8.11 cents/kWh with a gas turbine simple cycle backup.

Conclusions

This paper will: explain the basic methodology used to calculate production costs and to estimate environmental performance; provide a general overview of the model operation and initial results; and demonstrate the wide range of options for conducting sensitivity analysis.

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