Bio-Energy with Carbon Capture and Storage (BECCS)

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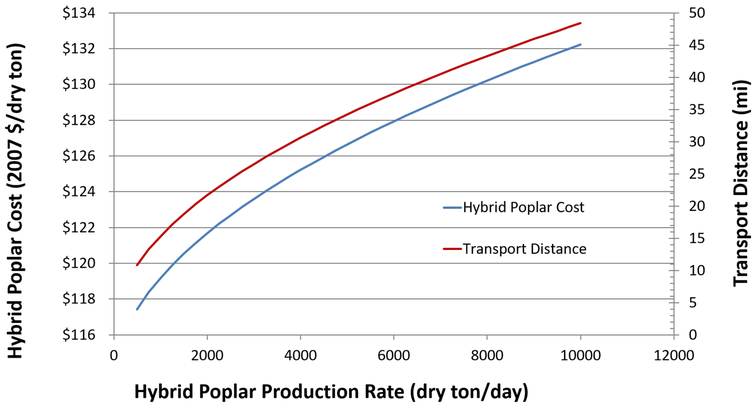
Motivation

- Examine the performance, life cycle environmental response, and economics of co-firing biomass at various feed rates with coal in pulverized coal (PC) power plants
- Establish a series of reference BECCS cases to aid in assessing future coal-based greenhouse gas (GHG) reduction initiatives

Evaluation Basis

- Prior study [1] compared 17 cases of PC boilers with and without carbon capture at various levels of biomass co-firing
  - 550 MW net baseload electricity generating greenfield facilities based in the Midwest United States
  - Coal basis: Illinois No. 6
  - Biomass basis: Hybrid Poplar
  - Carbon capture systems: Amine-based post combustion capture and oxy-combustion with capture
- Comparison based on levelized cost of electricity (LCOE) and limited life cycle GHG reductions

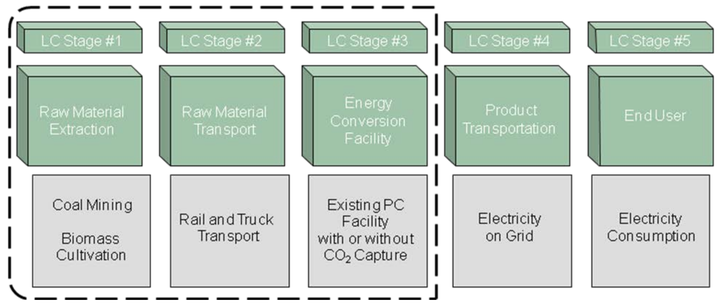


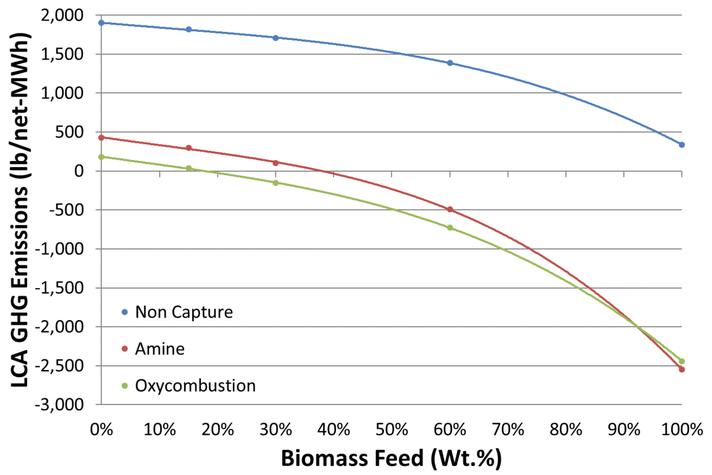
Coal Cost		
	$/AR ton	$/MMBtu
Illinois No. 6 Cost	38.26	1.64
Hybrid Poplar Cost		
Minimum Feed	58.73	6.96
Maximum Feed	67.42	7.99

- Coal price based on Annual Energy Outlook 2008 and scaled to 2007 dollars
- Biomass cost based on a function of amount and distance required to travel to the site in 2007 dollars

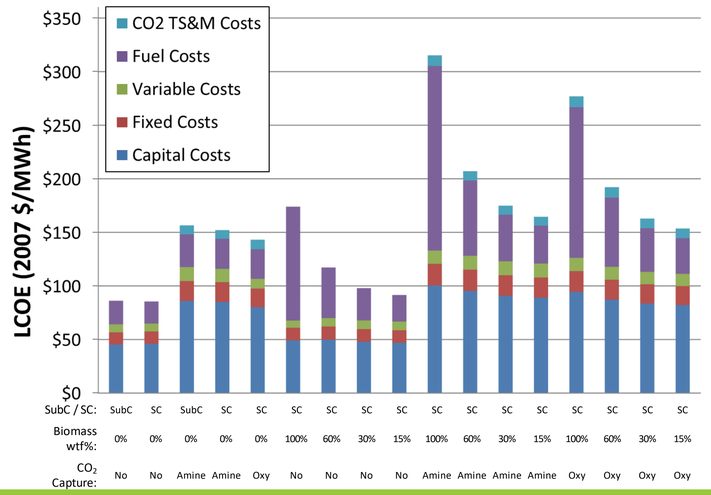
Limited Life Cycle Analysis

- Analysis performed as “Cradle to Gate” approach considering life cycle stages 1 through 3





Economic Comparison



Key Conclusions

- Co-firing biomass with coal reduces net GHG emissions over the plant life cycle due to biomass absorbing CO_2 during its growth phase
- Zero life cycle CO_2 emissions are unobtainable without capture
- Amine-based capture (90% efficiency) achieves net zero LCA emissions from co-firing ~38% hybrid poplar, with negative emissions resulting from higher percentages
- Economics are negatively impacted by the logistical costs associated with increased hybrid poplar feed rates
- Technical and logistical biomass supply chain hurdles exist in the supply chain that significantly impact hybrid poplar costs
  - Biomass growth potential and land availability in proximity to the plant location
  - Supply chain model (distributed versus central)
  - Harvest timetables and fuel storage availability

Future Work

- NETL is currently updating select amine and baseline cases from the prior study [1] to conform to the methodology in the upcoming Revision 4 of the NETL Cost and Performance Baseline for Fossil Energy Plants
- Updated cost and performance parameters will be considered
- Conduct a full inventory LCA of BECCS systems

References

[1] NETL. Greenhouse Gas Reductions in the Power Industry Using Domestic Coal and Biomass Volume 2: Pulverized Coal Plants, 2012

Disclaimer

Acknowledgement

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