

# Co-firing Coal and Municipal Solid Waste in Integrated Gasification Combined Cycle

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## Introduction:

Integrated Gasification Combined Cycle (IGCC) is a clean coal technology:

- Low CO<sub>2</sub> emissions due to capture
- Waste to energy benefits when using Municipal Solid Waste (MSW).
- Co-firing with bio-based fuel from MSW reduces life-cycle emissions.
- Expensive, demonstration-stage technology

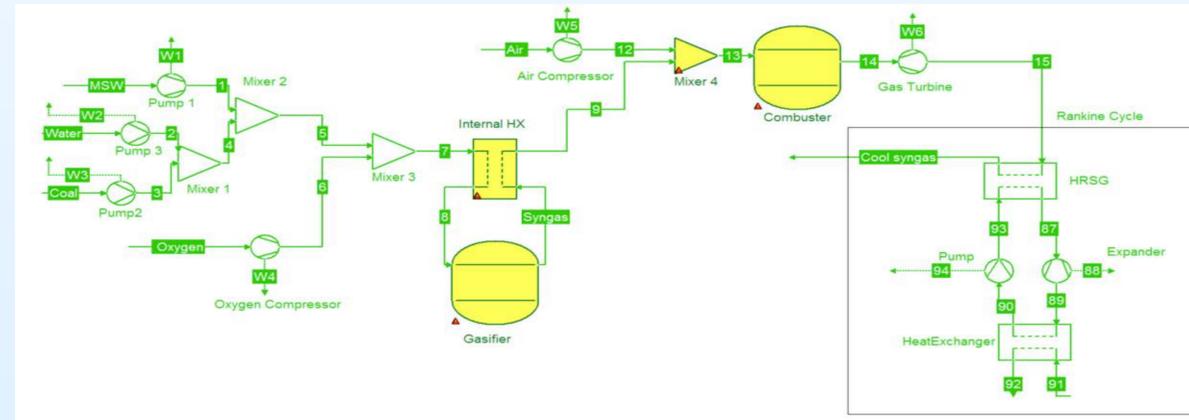
## Assumptions:

- Proxy compounds:
  - Bi-phenyl (C<sub>10</sub>H<sub>12</sub>) as Coal
  - Formaldehyde (CH<sub>2</sub>O) as MSW
- Equipment efficiency is 80%
- Temperature difference in Heat Exchangers is greater than 20°C
- The tipping fee is \$76/tonne and electricity sale price is \$52/MWh

## Methodology and Results:

### Thermodynamic

- Two Scenarios : Coal-fired vs Coal-MSW co-fired.
- COCO simulator is used to simulate the PFD of the IGCC process to conduct thermodynamic analysis.
- Sensitivity analysis over Coal-MSW ratio is to meet target net power and CO<sub>2</sub> emission limit.



Model of the IGCC used in Cape – Open simulator

### Results of Thermodynamic Analysis

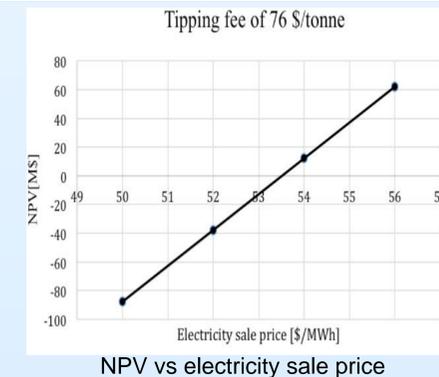
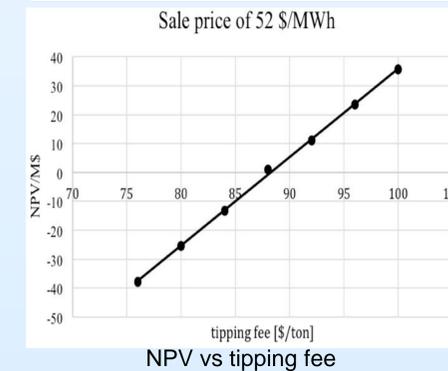
Scenario [wt.%]	Coal flow [kg/s]	Oxygen flow [kg/s]	Net Power [MW]	CO <sub>2</sub> Emission [kg/MWh]
Coal (100)	22.9	22.9	313	905
Coal-MSW (60-40)	13.74	21	261	648
Coal-MSW (60-40)	16.48	25.2	322	630

### Economic

- With parametric analysis, tipping fee or electricity sale price when the project is profitable will be found.

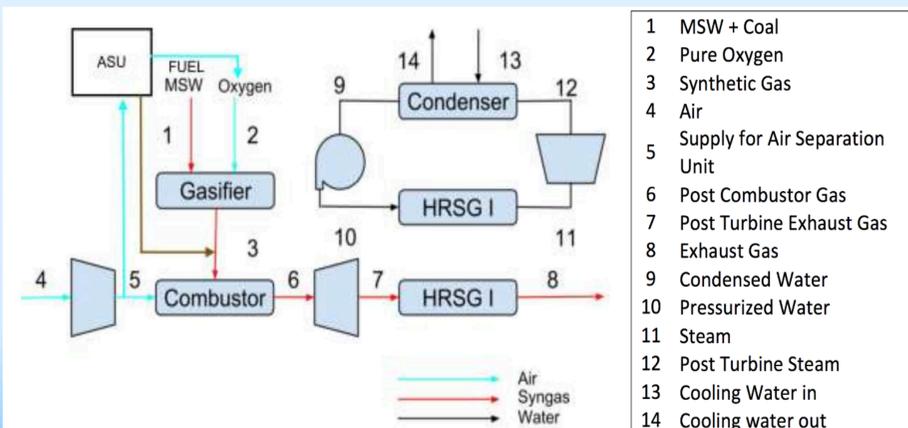
### Results of Economic Analysis

Case	IGCC-Coal	IGCC : Coal-MSW	NGCC
NPV [M\$]	-2.7	-2.9	722
IRR [%/yr]	6	5.1	19.3
LCOE [\$/MWh]	76.3	54	23



## Conclusion:

- At Coal-MSW ratio of 60-40, and 20% higher flowrate, EPA limit is met and target power requirements are met.
- Breakeven point is at tipping fee of \$88/tonne and electricity price of \$53.5/MWh for each parametric analysis.
- CO<sub>2</sub> emissions are reduced without carbon capture but at higher price.



Simplified model of an Integrated Gasification power plant operated with Coal and Municipal Solid Waste (MSW)

[1] "The Regulatory Impact Analysis for the Final Standards of Performance for Greenhouse Gas Emissions from New, Modified, and Reconstructed Stationary Sources: Electric Utility Generating Units" (August 2015). Publication No. EPA-452/R-15-005. Executive Summary, pp.4, Table 1.

[2] Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012, pp 8, Table 2.

[3] US Energy Information Administration. Independent Statistics and Analysis. June 2012