

US DOE Southeast Clean Energy Application Center

SHORT COURSE IN DESIGN AND ANALYSIS CONCEPTS FOR BIOMASS COMBINED HEAT AND POWER SYSTEMS

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# Evaluating the Life-Cycle Benefits of CHP

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# What is Life Cycle Costing

# Life Cycle Cost Definition

Life cycle cost is the total cost of ownership of machinery and equipment, including its cost of acquisition, operation, maintenance, conversion, and/or decommission. LCC are summations of cost estimates from inception to disposal for both equipment and projects as determined by an analytical study and estimate of total costs experienced in annual time increments during the project life with consideration for the time value of money. The objective of LCC analysis is to choose the most cost effective approach from a series of alternatives (note alternatives is a plural word) to achieve the lowest long-term cost of ownership. LCC is an economic model over the project life span. Usually the cost of operation, maintenance, and disposal costs exceed all other first costs many times over (supporting costs are often 2-20 times greater than the initial procurement costs). The best balance among cost elements is achieved when the total LCC is minimized. As with most engineering tools, LCC provides best results when both engineering art and science are merged with good judgment to build a sound business case for action. Businesses must summarize LCC results in net present value (NPV) format considering depreciation, taxes and the time value of money.

# Life Cycle Cost Definition

## Total cost of ownership

- Acquisition, including installation
- Operation
- Maintenance
- Decommissioning

## Considering

- The time value of money
- Net present value of money

# Short Definition

- Cradle-to-Grave Analysis
- Womb-to-Tomb Analysis
- Whole Life Cost
- Cost of ownership
- Eco-Balance

# New Power Plant Project

- 100,000 lbs/hr @ 300 psig steam
- Operating Hours = 8700 hrs/yr
- Natural Gas Cost = \$6.00/MMBtu
- Biomass Fuel Cost = \$3.00/MMBtu
- Electrical Cost = \$.06/kWh
- 20-Year Life Cycle
- Salvage Value = 10% Initial Cost

<b>Life Cycle Cost Comparison</b>	<b>Purchased Power w/ Natural Gas Heating</b>	<b>Nat. Gas CHP</b>	<b>BioMass CHP</b>
<b>Initial Investment, Including Installation Cost</b>	<b>\$1,000,000</b>	<b>\$3,000,000</b>	<b>\$10,000,000</b>
<b>Purchased Electrical Costs</b>	<b>\$859,000</b>		
<b>Purchased Fuel Costs</b>	<b>\$5,690,000</b>	<b>\$6,000,000</b>	<b>\$3,000,000</b>
<b>Annual Energy Costs</b>	<b>\$6,549,000</b>	<b>\$6,000,000</b>	<b>\$3,000,000</b>
<b>Annual Maintenance\Operation Costs</b>	<b>\$400,000</b>	<b>\$500,000</b>	<b>\$1,000,000</b>
<b>Salvage value</b>	<b>\$100,000</b>	<b>\$300,000</b>	<b>\$1,000,000</b>
<b>Net discount rate (percent)</b>	<b>6%</b>	<b>6%</b>	<b>6%</b>
<b>Years of operation for the equipment</b>	<b>20</b>	<b>20</b>	<b>20</b>
<b>Present worth of 20 Years Operating Costs</b>	<b>\$75,116,514</b>	<b>\$68,819,527</b>	<b>\$34,409,764</b>
<b>Present worth of 20-year Idling Losses</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>Present worth of 20-Year Maintenance Costs</b>	<b>\$4,587,968</b>	<b>\$5,734,961</b>	<b>\$11,469,921</b>
<b>Discounted Salvage Value Year 20</b>	<b>\$31,180</b>	<b>\$93,541</b>	<b>\$311,805</b>
<b>LCC Life Cycle Cost</b>	<b>\$80,673,302</b>	<b>\$77,460,947</b>	<b>\$55,567,880</b>

# Additional Assessments

- LCA – Life Cycle Assessment
- LCIA – Life Cycle Impact Assessment

Account for Environmental Impact!

# Environmental Cost Benefits

## Financial Benefits

- Biomass Fuels are Carbon Neutral - Credits?
- Possible Tax Incentives?
- Grants or Low Interest Loans

## Other Benefits

- Coal Fuel Displacement (14,300 metric tons/yr.)
- Community incentives – Public Perception
- Corporate incentives

# Conclusion/Summary

- Biomass CHP Projects are Both Economically and Environmentally Beneficial
- Overcome High Initial Costs for Long Term Benefits
  - Financial Benefits
  - Environmental Benefits
- A Sustainable Environment is Economically Viable

# Questions?

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*Technology for Energy and the Environment*