

Benefits of Mesaba Energy Project

Clean Coal Power Initiative - Round 2 -

Next-generation full-scale
Integrated Gasification
Combined Cycle (IGCC)
using ConocoPhillips'
E-Gas™ technology



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Outline

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- Estimated Benefits
- Conclusion



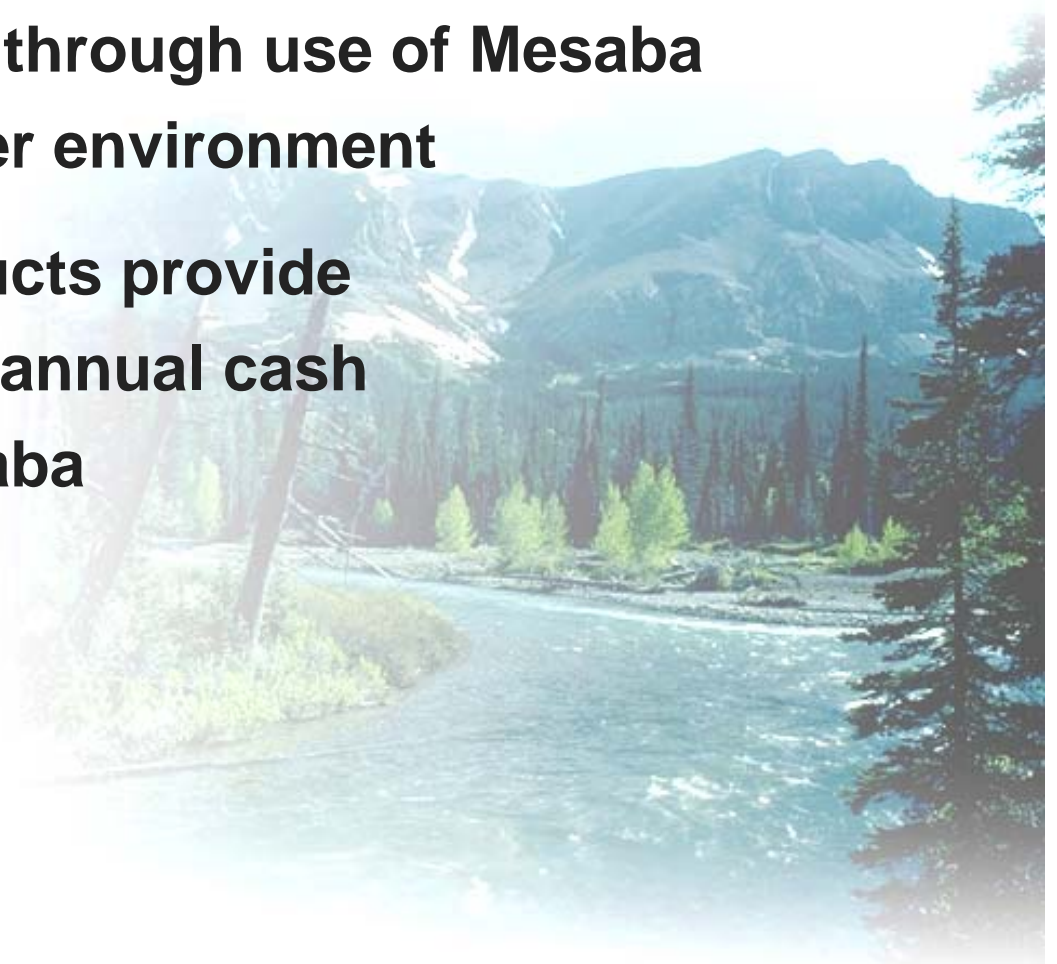
Executive Summary

- **Full Scale Demonstration Project is the next step in successful commercialization of this technology developed under the DOE Fossil Energy Program**
- **Facility will utilize Integrated Gasification Combined Cycle (IGCC) technology to achieve higher plant efficiencies and availability, lower emissions (including mercury), and lower operating costs (fuel flexibility and by-product marketability)**



Executive Summary (continued)

- **Avoided emissions through use of Mesaba contribute to cleaner environment**
- **Marketable byproducts provide a potential positive annual cash flow stream at Mesaba**



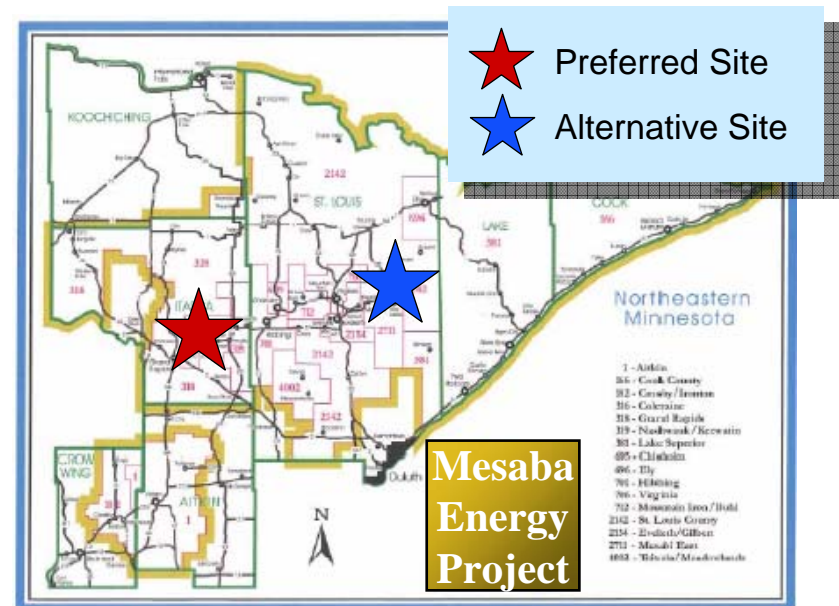
Mesaba Energy Project Basics

- **A new utility scale IGCC power plant using ConocoPhillips' E-Gas™ technology for coal gasification at the Mesaba Energy Project (“Mesaba”)**
- **Nominal Plant generation capacity 606 MWe (net)**
- **Preferred project location is West Range Plant Site**
 - Greenfield, but land designated for auxiliary mining purposes
 - Iron Range near Taconite and Bovey, about 70 miles northwest of Duluth
 - Remote location, but near natural gas pipelines, high voltage transmission line corridors and viable rail service



Mesaba Energy Project Basics (continued)

- **Alternate project location is the East Range Plant Site**
 - Iron Range near Hoyt Lakes, about 50 miles north of Duluth
 - Greenfield, but former taconite mining operations nearby
 - Access to water and feed-stock transportation options
- **Total Project Costs: \$1.97 Billion (DOE Share: \$36 Million)**
- **Schedule**
 - 2006 Project Start
 - 2006 to 2011 Construction
 - 2011 to 2012 Operations



Regional map showing locations of preferred and alternative sites.

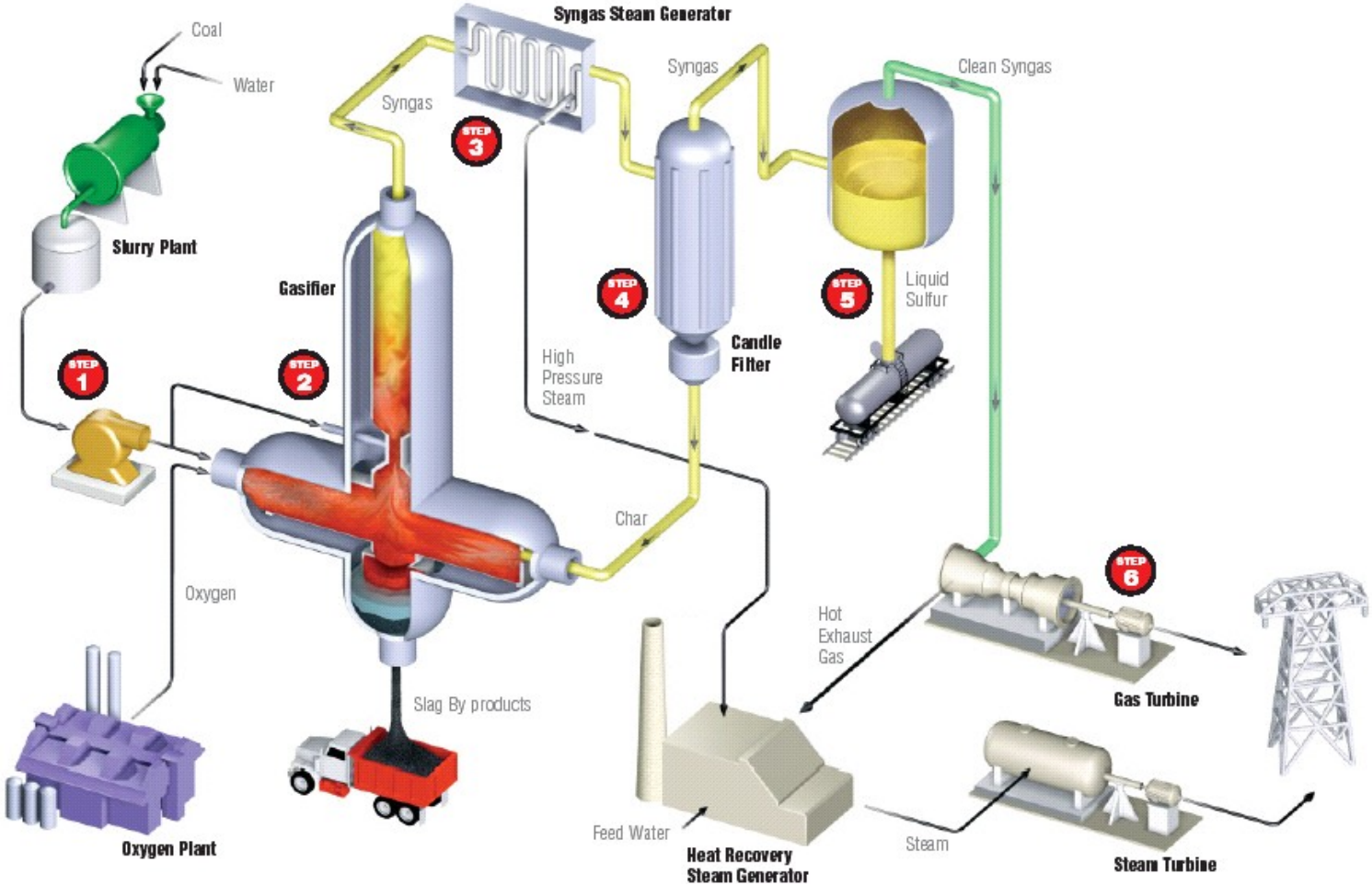


Fuel/Coal Supply

- **Plant designed to be fuel flexible**
 - Base Case Fuel-Bituminous Coal (Illinois Basin No. 6)
 - Predominant Case, Fuel Blend-Sub-Bituminous Coal (Powder River Basin) and Petroleum Coke



Mesaba Process Configuration



Team Composition

- **Partner: Excelsior Energy (Minnetonka, MN)**
- **Engineering, Procurement and Construction (EPC): Fluor Enterprises (Aliso Viejo, CA)**
- **Technology Rights Holder: ConocoPhillips (Houston, TX)**



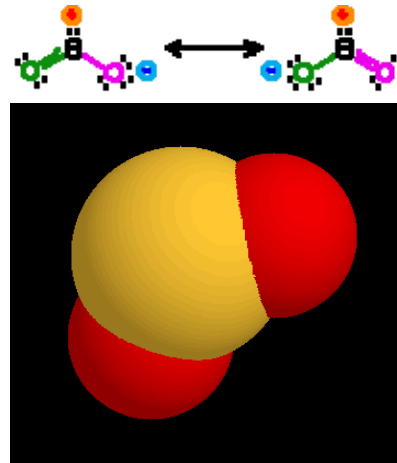
IGCC and ConocoPhillips E-Gas™ Process

- **The Mesaba project will improve commercial scale IGCC performance as a result of:**
 - DOE funded investigations of potential performance and technological upgrades
 - 1600 operational lessons learned from the Clean Coal Technology (CCT) Wabash River Coal Gasification Repowering Project in Terre Haute, IN (Wabash River)
 - Research and development efforts of DOE and the ConocoPhillips gasification teams



Air Emissions

- Greater than 90% Hg removal from coal input
- Better than 99% sulfur removal for bituminous coal, slightly less for sub-bituminous coal
- NO_x emissions reduced to 15 ppmvd @ 15% oxygen
- Very low particulate matter emissions, i.e., on order of natural gas
- CO₂ emissions reduced by 15%
- CO₂ capture adaptable

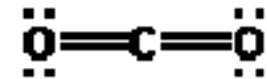


Sulfur Dioxide

Nitrogen
Oxide (NO)

+

Nitrogen
Dioxide (NO₂)



Carbon Dioxide

Nitrogen
Oxides (NO_x)



Estimated Benefits *Approach*

- Quantify emissions and those avoided on an annual basis for Mesaba
- Compare emissions against those for other conventional coal-burning technologies



Estimated Benefits

Annual Emissions Reductions

Air Emissions Avoided	100% Sub-Bituminous Coal	100% Bituminous Coal
Sulfur Dioxide (SO₂), TPY	19,400	108,000
Nitrogen Oxides (NO_x), TPY	2,400	3,300
Carbon Dioxide (CO₂), TPY	850,000	750,000
Mercury, Pounds/Year	240	320



Estimated Benefits

Coal-Fired Power Plant Emissions Comparison: 606 MWe (net) Basis, 90% Availability

Tons per year	Supercritical Pulverized Coal	Pulverized Coal with ESP & FGD	Circulating Fluidized Bed	Mesaba IGCC
SO₂	3,370	4,140	3,500	560
NO_x	1,470	1,820	1,860	1,300
Hg	0.4	0.1	0.1	0.013



Estimated Benefits

*Coal-Fired Power Plant Emissions Comparison:
606 MWe (net) Basis, 90% Availability (continued)*

Tons per year	Supercritical Pulverized Coal	Pulverized Coal with ESP & FGD	Circulating Fluidized Bed	Mesaba IGCC
PM/PM10	380	410	350	250
VOC	80	N/A	90	70
CO	2,530	2,270	2,560	760



Estimated Benefits

Combustion Utilization By-products

Marketable Combustion By-Products	100% Sub-Bituminous Coal	100% Bituminous Coal
Elemental Sulfur, TPY	9,700	54,000
Gasifier Slag, TPY	133,000	205,000

- A ready market exists for both byproducts
- Existing transportation options provide cost effective access to these markets



Estimated Benefits

Regional

- **Reduced land disturbance**
 - Minimizes land and resource requirements
 - Recovered elemental sulfur and slag combustion utilization byproducts offset both mining and landfill capacity for these materials
- **Reduced impact on local water sources**
 - Plant make-up water is readily available from existing abandoned mine pits
 - Zero liquid discharge system eliminates waste waters associated with contact cooling process



Regional Benefits (continued)

- Remote location is not near major population center
- Both project locations zoned for industrial usage
- Construction employment could bring as many as 1000 temporary jobs
- Plant operation is anticipated to result in the addition of 300 to 400 permanent and support operations jobs to the area



Estimated Benefits

National

- **Will implement further refinements in IGCC, advancing the technology into mainstream national generation mix**
 - Largely eliminates the uncertainty of emerging regulatory programs associated with Greenhouse Gas Emissions, Mercury, and fine particulate matter that would otherwise complicate the permitting of a conventional coal fired power plant
 - Availability increases to 90%, up from 77% at Wabash River, resulting in a smaller construction footprint
 - Integrated Air Separation Unit-Gas Turbine (first in U.S.) increases technology efficiency and reduces auxiliary electrical load
 - Standard replicable design configuration with sound basis for installed costs provides pathway for similar installations
 - Flexibility to process both high- and low-rank coals into a clean synthesis gas that contains hydrogen and includes petroleum coke, which may have a negative economic value



National Benefits (continued)

- Reduced overall emissions, including CO₂
- Carbon capture adaptable
- Will utilize the Nation's abundant coal resources and increase energy security as a result
- Further the President's environmental initiatives for America:
 - Clear Skies
 - Global Climate Change
 - FutureGen
 - Hydrogen



Conclusions

- **Significant emissions and energy security benefits will result from the successful demonstration and commercialization of the Mesaba Energy Project and other technologies developed under the Clean Coal Power Initiative**



**Visit the NETL web site for information on all
Power Plant Improvement Initiatives and
Clean Coal Power Initiative projects**

www.netl.doe.gov/coal/CCPI

