

MONTANA MEANS BUSINESS



**Governor's Office
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MONTANA MEANS BUSINESS



ALTERNATIVE ENERGY FROM MONTANA COAL



Montana's Clean and Abundant Alternative
to Conventional Power and Liquid Fuels

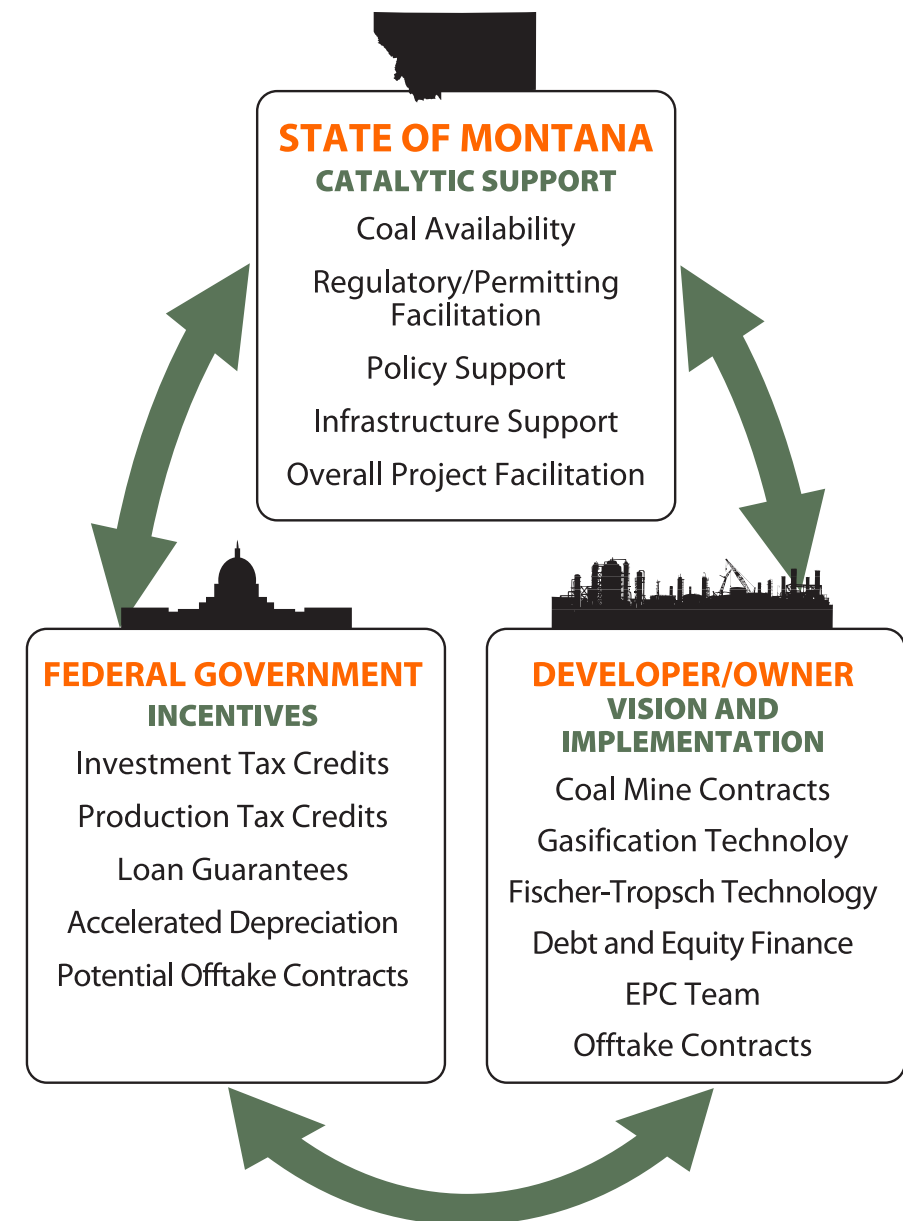
Montana's New Energy Source for America

Montana intends to take advantage of its status as holder of the nation's greatest coal reserves to:

- Break America's addiction to foreign oil and move to energy independence
- Utilize coal gasification to produce clean-burning transportation fuels and low-emissions power
- Create a domestic energy production economy in America's heartland
- Advance CO₂ sequestration technology
- Produce sulfur-free and particulate-free liquid fuels while reducing environmental contaminants

Montana's Catalytic Approach to Coal-To-Liquids

The State of Montana is taking on a catalytic role to bring together developers, industry representatives and the federal government, while providing permitting facilitation and coal feedstock for technology development, financing, engineering, infrastructure and product offtake.



◀ Governor Brian Schweitzer tours the Great Plains Synfuels Plant in central North Dakota.

Gasification and Fischer-Tropsch (F-T) Technologies

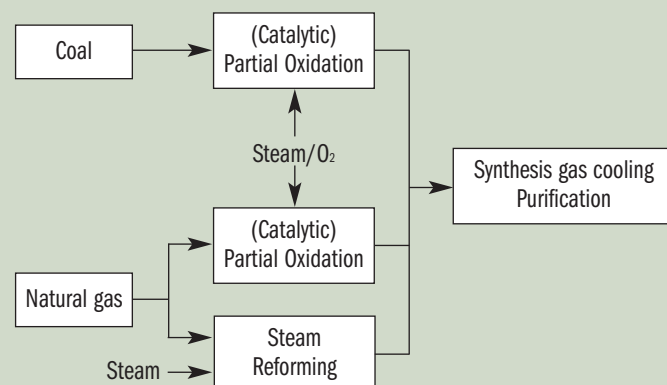
F-T motor fuel is made from syn-gas (hydrogen and carbon monoxide) produced by coal gasification.

- In the 1800s, lamplighters once made their rounds down the streets of many of America's largest cities lighting street lights fueled by "town gas," the product of early and relatively crude forms of coal gasification. Town gas was replaced when large natural gas reserves were developed. *Source: Department of Energy*
- In the 1970s, interest in coal gasification revived, due largely to concerns that the U.S.'s supply of natural gas was waning. When government price controls on natural gas were subsequently lifted, large quantities of natural gas became available and development of coal gasification in American stalled. *Source: Department of Energy*
- Recently, prices of natural gas have risen sharply while America obtains 60% of its oil from foreign supplies. *Source: Department of Energy*
- Because F-T diesel can be made for about \$40/bbl (about \$1/gal.), the time is right to revive coal gasification and make our fuels in America. *Source: Rentech*



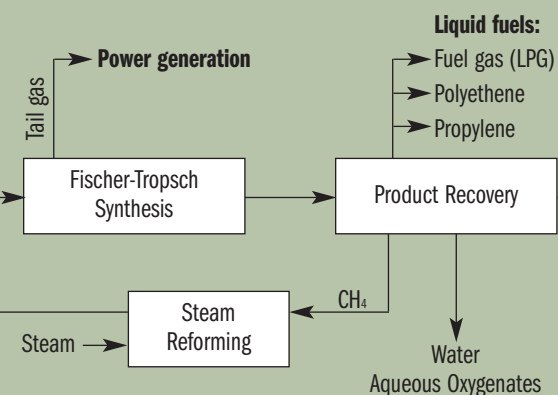
▲ Aerial view of the Great Plains Synfuels Plant. This plant represents an example of engineers using innovative technologies to produce energy resources.

SYN GAS PRODUCTION



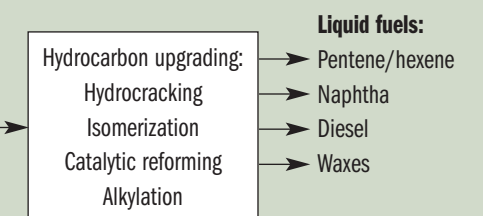
ALTERNATIVE ENERGY FROM MONTANA COAL

FISCHER-TROPSCH SYNTHESIS



GOVERNOR'S OFFICE OF ECONOMIC DEVELOPMENT

PRODUCT OFF-TAKE



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A Brief History of the Fischer-Tropsch Process

- **America, 1910s:** U.S. Bureau of Mines experimentation turns coal into liquid fuels.

- **Germany, 1920s:** Fischer Tropsch (F-T) process first creates “syngas” for liquid fuel production.

- **Germany, 1940s:** Germany makes 90% of its aviation fuel and the majority of its petroleum from coal during World War II.

- **America, 1940s:** Congress appropriates \$100 million in Synthetic Liquid Fuels Act for studying coal-to-liquids. By 1953, U.S. test plants are producing 5,000 BPD of unleaded gasoline using F-T process.

- **America, 1953:** U.S. research is abandoned.

- **South Africa, 1950s:** Heavy government investment in F-T infrastructure.

- **South Africa, Today:** 300,000 BPD production of gasoline and diesel from F-T process.

Source: Department of Energy



▲ Franz Fischer in his laboratory, 1918.

Fischer-Tropsch and Gasification Technology Today

- **Over 100 gasification plants exist worldwide**, mostly for chemical production. **Sasol, Ltd.** of South Africa currently produces 250,000 BPD of gasoline and 50,000 BPD of diesel, as well as numerous usable industrial chemicals utilizing gasification and F-T technology.

- The **Dakota Gasification Company** plant located in Beulah, North Dakota, was built in the 1980’s with federal DOE assistance and produces synthetic natural gas, CO₂ and other usable chemicals.

- The **Polk Power Station** near Mulberry, Florida, is the nation’s first “greenfield” (built as a brand new plant) commercial gasification combined cycle power station.

- The **Wabash River Coal Gasification Repowering Project** was the first full-size commercial gasification-combined cycle plant built in the United States. Located outside West Terre Haute, Indiana, the plant started full operations in November, 1995.



▲ Tampa Electric’s Polk Power Station

▲ Wabash River Coal Gasification Plant

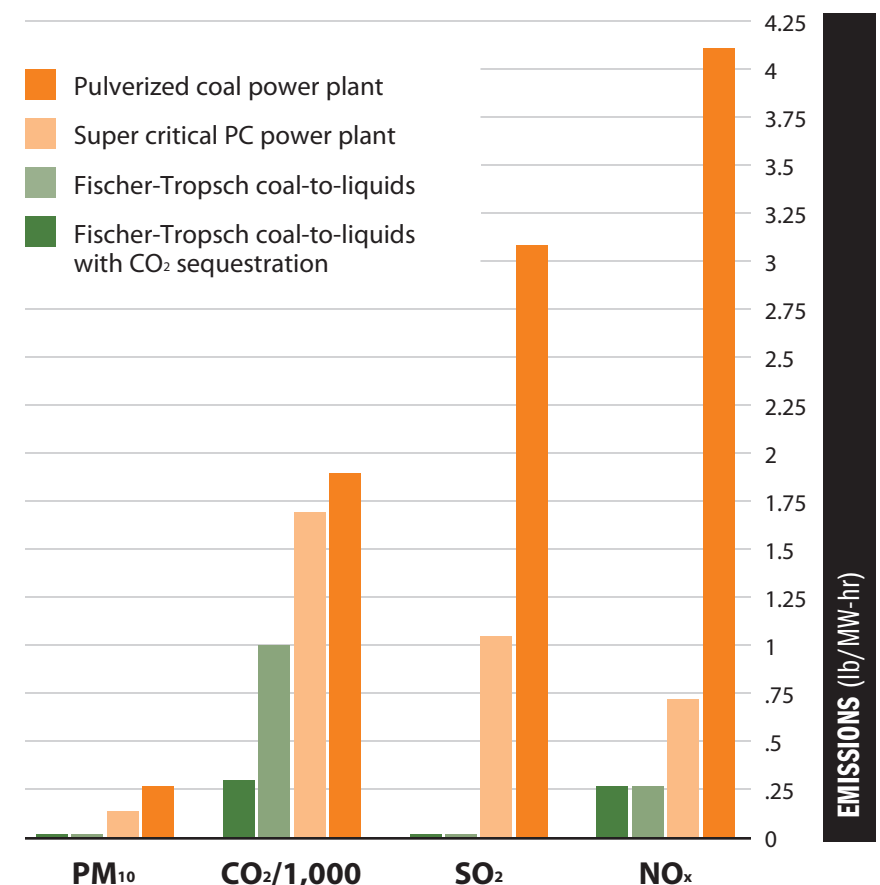
Products of Gasification/ F-T Process

- **High octane, clean-burning motor fuels** that run in existing engines
- A **base fuel (JP-8)** that the U.S. military is now testing as a single, universal battlefield fuel
- Marketable synthetic **natural gas**
- **CO₂** (a highly sought commodity for enhanced oil recovery - EOR)
- **Electric power** created by waste heat
- **Hydrogen** for various purposes
- **Sulfur, ammonia, phenols, naphtha** and numerous other usable industrial chemicals

Environmental Profile of Gasification/F-T Process

- Fuels that meet the highest clean air standards in the world
- Removal of particulates, sulfur, mercury, and other pollutants
- Potential for electricity production with near-zero emissions
- Coal plants that are CO₂ capture-ready
- Exportation of advanced technology to coal-utilizing developing nations to address global environmental concerns

**Emissions Comparison of F-T Fuels Plants
with 535MW Power Plants** (national figures, Rentech)



Federal Government Market Opportunities

U.S. Military can drive offtake:

- Department of Defense (DOD) is the largest consumer of foreign oil in America
- Currently testing JP-8 as a single battlefield fuel for all vehicles and planes (fuel is 20% lighter than petroleum based fuel)
- National Security: Concentration of coastal refineries creates vulnerability to hurricanes and terrorism
- F-T fuels would enable DOD's European bases to meet 2012 European Union clean air requirements
- New DOD authority for long-term buying

Private Market Opportunities

- Major Railroads
- Trucking Companies
- Truckstop Chains
- Airlines
- Refineries



▲ JP-8 fuel is the DOD's desired fuel to power all military vehicles and planes. It has been estimated that approximately 60 billion gallons are used worldwide each year, with 4.5 billion used by the U.S. Air Force, the U.S. Army, and NATO. JP-8 is also used to fuel heaters, stoves, tanks, and other vehicles in military service; and used as coolant for engines and other aircraft components.



Federal Incentives

- Loan guarantees of up to 80% of project cost for coal liquefaction
- Fifty cents per gallon diesel production tax credits
- Accelerated refining expense deduction allows depreciation of 50% of liquefaction facility in first year
- Industrial gasification tax credits available
- Energy Bill grants Department of Defense authority to enter into long-term fuel off-take contracts

Industry Players

Gasification Technologies

- GE, Lurgi, Shell, KBR, Future Energy, Conoco-Phillips, Alchemix

Liquefaction Technologies

- Sasol, Lurgi, GE, Rentech, Syntroleum

Engineering, Procurement and Construction

- Bechtel, Halliburton, Black and Veatch, Fluor-Daniel, Uhde

Coal-to-Liquid Fuels Basics

(10,200 BPD plant estimate)

EPC Capital	\$0.75 billion <small>(based on 2004 cost data)</small>
Coal feed	7,650 TPD
Net Power	95MW
Total Fuel Production	10,200 BPD
F-T Diesel Production	8,560 BPD
F-T Diesel Production Cost	\$40 BBL
CO₂ Production	1,950 TPD
CO₂ Netback	\$7.50/ton

The source of the above information is Rentech Inc. These numbers will differ depending on the company involved and the technology applied, but all representations indicate the cost to produce diesel is approximately \$40 /BBL. The EPC costs will be driven by both the technology utilized and the size of the project.



Considerations for F-T Development

- Few full-scale commercial operations currently in existence
- \$40 per barrel oil price needed for F-T profitability
- High capital cost required—10,200 BPD plant costing at least \$750 million
- Long term offtake agreements required to protect against oil market fluctuations
- Government, business and technology team required



Montana's Assets for Gasification and F-T Development

- Governor Schweitzer is the leading national proponent of Coal-To-Liquid (CTL) technology
- Over one-fourth of America's coal reserves, totaling 120 billion tons of estimated demonstrated reserve base.
- One billion tons of **state-owned** coal in eastern plains, where low over-burden allows for highly economical (and safe) surface mining
- Strong refining infrastructure in Billings and available quality workforce throughout coal region
- One of the most productive and best-educated workforces in America
- Proximity to premium Mountain and West Coast markets seeking clean fuel and power



◀ Governor Brian Schweitzer tours the Syntroleum synfuel plant with Syntroleum CEO Ken Agee.