

PROJECT facts

Transportation Fuels
and Chemicals

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U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY



DEVELOPMENT OF OXYGEN TRANSPORT MEMBRANE (OTM) FOR PRODUCTION AND TESTING OF SYNTHESIS GAS-DERIVED ULTRA-CLEAN FUELS

Description

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Natural gas is an attractive feedstock for the production of ultra-clean fuels (UCF) because it is abundant and inexpensive, and can be converted into a number of sulfur free fuels including diesel, gasoline, dimethyl ether and derivatives, methanol and other oxygenates that can be used within the existing fuel distribution infrastructure. These fuels, when used neat, or when blended with petroleum based fuels, have the potential to dramatically reduce vehicle emissions from a number of propulsion systems including advanced IC (internal combustion) engines, fuel cells, and IC- fuel cell hybrids.

The processes for producing UCFs utilize a common first process step whereby natural gas is converted to synthesis gas, followed by a fuel-specific second process step to convert the synthesis gas into the desired fuel. Conversion of natural gas to synthesis gas is typically about 60% of the total fuel capital cost. Consequently, the economics of UCFs derived from natural gas, and hence their viability as transportation fuels, can be affected significantly by reducing the cost of converting natural gas to synthesis gas.



*Single Large Format
Tube Tester*



*Large Format
OTM Tubes*



*Multi-tube Pilot Plant
Reactor, P-1*

LEAD INDUSTRY PARTNER

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PARTICIPANTS

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Nuvera Fuel Cells
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COST SHARING

DOE \$15 million
Non-DOE \$22. million

The goals of the 7year project are to (1) develop advanced synthesis gas technology, based on Oxygen Transport Membranes (OTMs), that will provide a step change reduction in the cost of converting natural gas to a spectrum of liquid transportation fuels and hydrogen, thereby improving the prospects for meeting vehicle emissions targets with cost competitive UCFs; (2) evaluate the performance of, and emissions from selected synthesis gas-derived UCFs in advanced vehicle propulsion systems, including advanced diesel engines with post treatment and fuel cells; and 3) develop an optimized UCF/diesel engine/exhaust aftertreatment system.

The project team includes stakeholders in every aspect of the value chain from natural gas production through fuel combustion including (1) resource holders, (2) resource producers, (3) conversion technology providers, (4) fuel producers, (5) advanced propulsion system developers and (6) engine manufacturers. The project team is led by Praxair, the largest producer of industrial gases in North and South America and a leader in developing OTM technology. Other team members are: BP Amoco, the largest natural gas holder and gasoline marketer in North America and inventor of the OTM synthesis gas process; Statoil, a major energy company with large natural gas reserves and OTM technology capability; International Truck and Engine Corp., a world leader in engine development and manufacturing; Nuvera, a leader in development of fuel cells and on-board fuel processing technology; and Foster Wheeler an engineering and construction firm with expertise in high temperature processes and steam methane reforming.

The development team will employ a systems approach, in both developing the OTM synthesis gas technology and ultra-clean fuel blends and evaluating the impact of ultra-clean fuel properties on engine or fuel cell performance and exhaust treatment technologies. The team proposes to focus on the most cost sensitive step in the conversion of gas to ultra-clean fuels: the production of synthesis gas from natural gas. Praxair is the prime contractor with significant work subcontracted to Statoil, Foster Wheeler, International, and Nuvera. Nuvera has completed their task; BP is now only focusing on fuels development and testing. This superbly qualified team combines technical expertise, project management experience, and strong financial capabilities. In partnership with the DOE, this team is uniquely positioned to develop the technology considered crucial to the growth of economical ultra-clean fuel supplies.

