

Envision an appliance, capable of providing electricity continuously 24/7 for the average home, small farm or even a third-world village; so clean, quiet and odorless it can be used indoors. That appliance is the Anywhere Energy system, utilizing fuel cell technology from TMI.

Power Anywhere, Anytime.

The Anywhere Energy power system was developed by Technology Management, Inc. (TMI), Ohio's oldest independent fuel cell systems developer, using a proprietary, low-cost, solid oxide fuel cell (SOFC) technology developed in Cleveland at the world R&D laboratories of SOHIO and acquired from BP America.

At its core, the Anywhere Energy system combines a versatile fuel processor with a solid oxide fuel cell to generate clean electricity and heat from multiple fossil-based and renewable gas and liquid fuel sources. Anywhere Energy is extremely user friendly, easy to maintain and safe. It is so compact, quiet, and odorless it can be put unnoticed in the corner of the home's utility area. It's also portable and is just about the only technology which can bring 24/7 uninterrupted power to remote areas, even battlefields to service critical requirements such as communications or emergency medical after natural disasters and power outages, where intermittent power and batteries are not sufficient.

Fuel cell-based power generator systems are different.

- **Continuous Power Availability.** Fuel cells are a primary power source unlike wind and solar or diesel and natural gas generators, which are intermittent and must be sited outdoors.
- **Safe, Clean & Quiet:** Compared to engine-driven generators which produce noise, odor and lethal carbon monoxide, fuel cell-based systems generate electricity using a clean, quiet, fuel-efficient electrochemical process, allowing indoor operation.
- **Cost Effective:** Fuel cell-based systems are at least double the efficiency of a comparable gas engine or generator. When the heat exhaust is used for cogeneration, combined heat and power (CHP) efficiencies can exceed 90-percent.
- **Modular Scalable & Redundant:** Fuel cell-based systems like the Anywhere Energy system are modular. This means all systems, regardless of size, have the same high efficiency. In contrast, wind turbines, solar panels and engines must be bigger to be more efficient. For more power, units can be added like "energy building blocks," with the extra benefit of redundancy and the ability to service individual units without total shutdown. The Anywhere Energy power system is evidence bigger isn't always better.

A New Industry: Distributed Generation & Shale Gas

Coupled with the "game changing" discoveries of massive reserves of hydrocarbons locked within the deep shales in key regions of North America, the Anywhere Energy system could be the "junction box" between a new fuel domestic source as it is extracted from the nation's shale deposits, a new distributed energy infrastructure and a new type of economic building block for rural communities and consumers.

Designed deliberately to be made by mature supply chain manufacturers and existing channels of distribution in the Midwest, the Anywhere Energy system could catalyze a new industry – and a host of applications based on distributed power – anchored in the Midwest. Using the same ingredients that anchored the automotive and appliance cluster – deep regional R&D, a network of assembly and parts manufacturing, a skilled workforce accustomed to the discipline of low cost, high volume production, and geographical location – small, residential-scale fuel cell systems from TMI would take advantage of the same regional strengths. A major incentive for systems integrators like TMI without in house capability is to "write the specifications" for regional OEM parts suppliers so that TMI can leverage their in place plant and equipment, management experience serving the high volume, low cost automobile industry and familiarity with proven distribution pathways to global markets.

In addition to connecting Midwest manufacturing with the "game changing" Marcellus, Utica and Point Pleasant shale formations in the upper Midwest, fuel cell systems providing power when and where it is needed can also catalyze economic development and jobs. The certainty of having a low-cost, stable domestic fuel source for decades, a low-cost, less grid-dependent source of energy for consumers, and new local wealth is the perfect setting for new enterprises and entrepreneurial activity.

TMI Facts & Firsts

Compact, 1 kW distributed power generation system

Indoor siting for high security and point-of-use cogeneration.

Appliance-like simplicity with no precious materials for low-cost manufacturing.

"On the fly" fuel changeover from liquid-to-liquid, gas-to-gas and liquid-to-gas.

Proven operation on commercial grade (untreated) gas and liquid fuels including:

- Natural Gas, (Shale Gas) and Propane
- Diesel, Kerosene and JP-8* (military logistics fuel)
- Ethanol, Biodiesel, Vegetable oil (Soybean Oil*), Used Cooking Oil, Digester Biogas (simulated), Ammonia and Jatropa*

1996

1st sulfur tolerant cell & fuel reformer*

2004

1st full systems operation on JP-8*

2005

1st multi-kW system operation on natural gas & propane

2006

1st system operation on vegetable oil*

1st system operation on untreated truck diesel*

2009

1st on-farm 30-day system demo on soybean oil*

1st system operation on Jatropa*

1st public demonstration of fuel cell running on JP-8*

2010-2011

1,000+ hour demonstration run on JP-8*#

* 1st known in the world

On-site at Lockheed Martin

Federal and Industry Funders



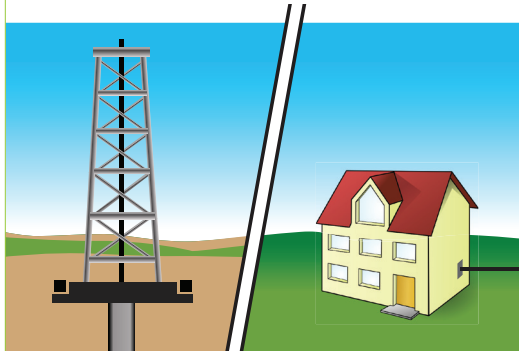
Battlefield Power



Supported by Ohio's Third Frontier Program and the US Department of Defense, TMI has partnered with Lockheed Martin MS2 Defense and Surveillance Systems (Akron, Ohio), and Stark State College of Technology, to develop next generation military gensets using TMI's solid oxide fuel cell technology. A Defense Science Board report, quoted the former top US commander in western Iraq: "By reducing the need for [petroleum] at our outlying bases, we can decrease the frequency of logistics convoys on the road, thereby reducing the danger to our marines, soldiers, and sailors." Reducing fuel needs saves lives! The fuel cell genset being jointly developed by TMI and Lockheed Martin could reduce fuel usage by third to a half.

As one Lockheed Martin executive said; "We believe the high fuel efficiency of TMI's fuel cell system and its ability to operate directly on untreated military logistic fuel will solve some of the most urgent and important power generation problems faced by the Department of Defense, Lockheed Martin's major customer."

Home Power from Domestic Shale Gas



The TMI Anywhere Energy system, running on pipeline natural gas delivered to the home or farm produces base load electricity and heat for cogeneration. In areas prone to prolonged interruptions in grid service after adverse weather, the Anywhere Energy system can augment or fortify the grid with 24/7 availability. Backup generators are costly, noisy, smelly, and pollute and are not designed to run for extended periods of time. They generate no ROI. The Anywhere Energy system is designed for 1000s of hours of continuous performance with power always available when and where it is needed most. Combined with low-cost natural gas from shale gas, fuel cells offer a cost-effective alternative for consumers in rural areas seeking energy independence.



Remote & Farm Power



By far, the largest underserved energy markets in the world are in the agricultural sector. Funded by the Ohio Soybean Council, TMI conducted a first-in-the-world 30-day demo of a fuel cell system generating clean electricity indoors from raw soybean oil. Near the birthplace of Thomas Edison, Ohio's first name in electricity innovation, a TMI fuel cell generated power inside a barn on a 7th generation family soybean farm adding another first to Ohio's list of energy innovations. A 2011 contract with the DOE is helping TMI to expand this unique ability of the system to switch between biofuels and fossil fuels.

Previously, under a Third Frontier Biomass to Energy Program, TMI partnered with The Ohio State University Ohio Agricultural Research & Development Center to show how anaerobic digester biogas (farm and food processing wastes) could be a fuel for the Anywhere Energy system. This project showcased the relationship between Ohio's two largest industries, manufacturing and agriculture. The small scale waste-to energy program was intended to illustrate the potential for farmers and small businesses in the agricultural sector to impact both the supply and demand sides of the energy solution, as a supplier of fuels and as a consumer of clean, renewable energy.

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Ohio Collaborators and Funders

