

## THE NATIVE AMERICAN MOHEGAN TRIBE OF CONNECTICUT

### *Learning by Doing: A Fuel Cell and Offset Program*

#### PROJECT SNAPSHOT

##### PROJECTS

Mohegan Fuel Cell Education Program

##### TECHNOLOGY

Hybrid energy system consisting of two 200-kilowatt PC25 IFC/ONSI phosphoric acid fuel cells

##### CO<sub>2</sub> EMISSION REDUCTIONS

Preliminary estimate: 1,281 tons

##### INVESTMENT

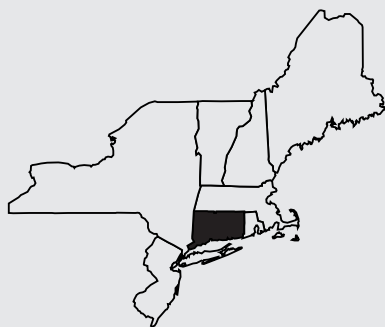
\$2.6 million

##### LESSONS LEARNED

The success of the Fuel Cell Team has reinforced the benefits of a team approach to management of issues on the reservation. Such a huge undertaking requires excellent communication, openness, timely discussion of issues, and efficient team meetings with clear roles and responsibilities.

##### FUNDING SOURCES

The Mohegan Tribe



#### INTRODUCTION

Self-sufficiency is a concept that has long held special meaning for many Native American people. The Mohegan Nation, a Native American tribe based in Uncasville, CT, is exploring ways to become more self-sufficient and environmentally responsible. One way is to develop an innovative hybrid energy system at its Mohegan Sun Resort, five miles north of New London. The system will consist of fuel cells and state-of-the-art natural gas boilers. Over the short term, the Nation hopes to reduce reliance on its backup diesel generators by replacing them with much cleaner fuel cells. Over the longer haul, the Mohegans seek to maintain enough capacity on their reservation to cut themselves loose from the regional electricity grid, at least during times of ordinary demand.

Members of the Native American Mohegan Tribe of Connecticut also are exemplary in another way – their process. The Tribe hosts a number of multi-disciplinary Pollution Prevention Teams that focus on the huge Mohegan Sun Resort. The teams apply a “systems approach” to pollution prevention and environmental sustainability. As part of Phase II of the ongoing expansion of the reservation and the casino, the Mohegan Nation assembled a *cross-cutting* Fuel Cell Team to plan for, purchase and operate a fuel cell array as part of the Mohegan Fuel Cell Education Program – and as a centerpiece of its long-term environmental strategy. At this point, much of the planning has been completed and implementation is beginning. Although energy savings projections right now are only estimates, measured data will be collected as the project gets underway.

#### THE PROJECT

More than six years in the making, the Mohegan Fuel Cell Education Program is now in the implementation phase under the direction of the multi-disciplinary Fuel Cell Team. The program has three components:

1. Installation and operation of at least two 200-kilowatt PC 25 fuel cells manufactured by International Fuel Cells Corporation of South Windsor, CT. They will be components of a hybrid energy system that also includes natural gas-fired boilers.
2. Purchase of carbon offsets to mitigate, for a period of 25 years, the CO<sub>2</sub> emissions associated with the operation of the fuel cells. The offsets will be created by planting trees in Costa Rica.
3. Development of an educational program to share the lessons of this new technology with members of the Mohegan Tribe, other tribes and the general public.

The two fuel cells are scheduled for delivery in August 2001. They will employ natural gas to generate about four percent of the reservation’s electricity needs. In addition, they will preheat water to be used by adjacent natural gas boilers-also new-that will generate steam for heating and cooling.

Carbon dioxide emissions from the two fuel cells will be offset by carbon dioxide reductions created through investment in the 100-acre Klinki Forestry Project. The project is operated in Costa Rica by Reforest the Tropics, a Connecticut non-profit group. The organization re-forests mixed tropical tree species in pastures and farms to offset CO<sub>2</sub> emissions, and thus mitigate the effects of climate change. The Klinki project is supported by the Costa Rican government and is part of the U.S. Initiative for Joint Implementation. Reforest the Tropics is working with the Mohegan Sun Casino, Connecticut College and St. Mark’s Church in New Canaan, and with Connecticut elementary, middle and high schools to establish carbon offsets in the form of thriving forests.

“In linking on-site fuel cells to investment in Central American rainforest reforestation as a strategy for mitigating climate change, we are seeking to estab-

lish a precedent,” stated Dr. Norman Richards, Administrator of the Mohegan Environmental Protection Department. “Our state-of-the-art fuel cell technology will be virtually pollution-free due to the offset investment – and it not only will sequester carbon but also will create new habitat.”

The fuel cell team is developing an educational program to share what it learns about fuel cell technology. Tours of the fuel cells will be offered and educational materials developed, including a prominent spot on the Tribe’s website. The project budget includes more than \$40,000 for education, with additional resources set aside for quarterly and final reports. The project also will be incorporated in the Mohegan Youth Education Program.

Total cost of the Mohegan Fuel Cell Education Program will be about \$2.6 million, of which \$140,000 will be applied to carbon emission offsets, some \$1.6 million will pay for the two new fuel cells, and the remaining \$850,000 will be spent on a variety of related activities, including fuel cell installation, monitoring and performance testing, integration of the waste heat from the fuel cells into the gas-fired boilers, and education. The Tribe will provide all of the funding, although it is pursuing a U.S. Department of Energy rebate to offset a portion of fuel cell cost. DOE’s Climate Change Fuel Cell Program provides rebates of \$1,000/kilowatt, and so far has awarded more than \$18.8 million nationwide to assist in the purchase of 94 fuel cell units. If the fuel cells perform as well as the team expects, it is likely to recommend that the Tribal Council consider purchasing additional fuel cells in the future. Indeed, space for a total of six 200 kW fuel cell units will be reserved at the power plant site, and more should be available elsewhere.

The Mohegan Tribal Council has unanimously approved funding for the Mohegan Fuel Cell Education Program. The fuel cell team includes a number of energy and engineering consulting firms (e.g., Energy Research Center, The Energy Network, Cristino Associates);

universities (e.g., Connecticut College); key suppliers (International Fuel Cells); agencies (Connecticut Department of Environmental Protection, U.S. EPA); Tribal government departments (Planning, Development, Financial and Legal, and the Utility Authority); and the Mohegan Sun Engineering Department. The team is similar to the five-year-old Mohegan Pollution Prevention Teams that have saved the Tribe over half a million dollars a year, while dramatically reducing pollutants. The latter focus on issues like solid waste management, pollution prevention monitoring, energy-efficiency on both the demand and supply sides, transportation, buildings and construction, and integrated pest management – to name a few.

## THE RESULTS

Although operational data will not be available for some time, the addition of fuel cells to the reservation’s infrastructure is expected to increase efficiency and reliability of its central power plant, and reduce air pollution from generators tied to the region’s electricity grid. In most existing fuel cell applications, a fuel processor chemically extracts hydrogen from natural gas or methanol, producing a small quantity of air emissions – far less than those associated with a conventional power plant. In addition to reduced air pollution, fuel cell generation offers other advantages, including higher efficiency and reliability, quieter operation, and modularity. Depending on its type, a fuel cell can convert 40 to 60 percent of the fuel’s chemically-stored energy into electricity. Overall efficiency can reach 85 to 90 percent when the heat released as a result of the chemical reaction is captured and used to preheat water for the natural gas boilers. As the following table illustrates, electricity generated by fuel cells is accompanied by far fewer air emissions than electricity produced by the New England Power Pool. Assuming that they fully operate 85 percent of the time, the fuel cells are expected to generate approximately 3,000 MWh annually, while emitting only 90 pounds

TABLE I

EMISSION COMPARISONS

POLLUTANT	EMISSIONS (LBS/MWH)	
	FUEL CELL (Natural Gas)	ISO New England Marginal Emission Rate
NO <sub>x</sub>	0.03	6.2
SO <sub>2</sub>	0 <sup>(a)</sup>	2.1
CO <sub>2</sub>	660 <sup>(b)</sup>	1,520

(a) Fuel cells generally emit SO<sub>2</sub> below detectable limits.

(b) Fuel cell emission rates typically are 1,000 lbs/MWh, but here excess heat will be captured and used to preheat the boiler feed water—thereby increasing efficiency.

of NO<sub>x</sub>, virtually zero SO<sub>2</sub> and 983 tons of CO<sub>2</sub>. In contrast, if the same amount of electricity had been purchased from the grid, the associated emissions would be 3 tons of NO<sub>x</sub>, 9 tons of SO<sub>2</sub> and 2,263 tons of CO<sub>2</sub>. The net result of using fuel cells to displace nearly 3,000 MWh hours of electricity from the grid is impressive: 1,281 fewer tons of CO<sub>2</sub> a year, nine fewer tons of SO<sub>2</sub> and three of NO<sub>x</sub>. This is equivalent to avoiding the use of six barrels of oil a day or removing 180 typical vehicles from the road each year.

## LESSONS LEARNED

Establishing a hybrid system that consists of fuel cells and natural gas boilers is an extremely ambitious and complex task. Some of the questions that must be addressed are: where to install the fuel cells; how to integrate them with the domestic hot water system and the boilers; how to determine what the backup for the fuel cells will be; how to monitor and evaluate the project, and keep records; and what the design of the related educational program ought to be like. As Dr. Richards stated: “I can’t perceive any other way to implement this or any other project on the reservation. The multi-disciplinary, team-based approach encourages excellent communication, openness, timely discussion of issues, creative strategic planning, and efficient team meetings with clear roles and

responsibilities. It is the only way to make these kinds of projects work.”

### **FUTURE COMMITMENTS**

The Mohegan Tribe intends to put a number of renewable energy resource applications on display as part of the education and outreach effort at its new visitors center. By the end of the summer of 2001, planning will begin for a ground source heat pump and photovoltaics system at the new center. The Tribe's Pollution Prevention Teams will continue to be the focal point of the effort to progress toward sustainability by applying a systems-based approach. Over the long term, the Tribe will strive to become an environmentally conscious resort and reservation by exploring the development of distributed energy resources and communicating the lessons it has learned to its visitors and to other tribes.

### **ORGANIZATIONAL PROFILE**

The Mohegan Tribe is a sovereign, federally-recognized Indian Nation with a reservation on the Thames River in Uncasville, CT. The Mohegan Nation leadership team includes Lifetime Chief G'tinamong Ralph W. Sturges, Medicine Woman Gladys Tantaquidgeon, a nine-member Tribal Council, and a seven-member Council of Elders. The Tribe's constitution confers membership on those who trace their ancestry to the 1861 tribal roll and who have remained involved in tribal activities. With a current enrollment of nearly 1,300, the Mohegan Tribe received federal recognition on March 7, 1994.

The Native American Mohegan Tribe of Connecticut is probably best known for the Mohegan Sun Resort in Uncasville, on the Thames River in southeastern Connecticut. Opened in 1996, the resort is the third-largest casino in the United States, drawing about ten million visitors a year. It has an annual budget of \$10 million, and employs more than 5,600 people in Connecticut.

### **CONTACTS**

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The Native American Mohegan web  
site: [www.mohegan.nsn.us/](http://www.mohegan.nsn.us/)

International Fuel Cells web site:  
[www.ifc.com/index\\_fl1.shtml](http://www.ifc.com/index_fl1.shtml)

Klinki Forestry Project web site:  
[www.unfccc.de/program/aij/aijact/  
crUSA07.html](http://www.unfccc.de/program/aij/aijact/crUSA07.html)