ETV and Energy

Greenhouse Gas Technology Center

The U.S. EPA Environmental Technology Verification (ETV) Program's Greenhouse Gas Technology (GHG) Center, in cooperation with Southern Research Institute, verifies advanced energy technologies that improve efficiency or otherwise reduce greenhouse gas emissions[1]. These may include:

- Technologies that produce or use sustainable or renewable energy sources
- Technologies that offer improved efficiencies for environmental performance of fossil fuels
- Hydrogen infrastructure technologies
- Technologies associated with distributed electrical generation, including combined heating/cooling and power applications.

The GHG Center has verified a total of 13 technologies for distributed energy production and energy efficiency: six microturbine/combined heat and power (CHP) technologies and two fuel cells that generate energy at the point of use; two gas processing systems designed to make biogas amenable for use by distributed generation energy systems; two internal combustion engines with heat recovery for distributed electrical power and heat production; and one ground-source heat pump for onsite water heating (see **Table 1**).

The complete verification reports for these technologies are available on the ETV Web Site at **http://www.epa.gov/etv/verifications/verification-index.html**. These reports provide full descriptions of the verification tests and results. The GHG Center has collaborated with a number of organizations on these verifications, including the State of Colorado, the New York State Energy Research and Development Authority (NYSERDA), New York City, and the EPA CHP Partnership.

Distributed Power Generation at a Glance

EPA estimates that, in 2002, the United States emitted almost 6.4 billion tons of carbon dioxide (CO_2) and nearly 22 million tons of nitrogen oxide (NO_X). Electricity generation accounted for 39% of the total CO_2 emissions and 21% of the total NO_X emissions. Other pollutants emitted during electricity generation include carbon monoxide (CO) and total hydrocarbons (THCs). Each of these emissions can have significant environmental and health effects. CO_2 is a greenhouse gas linked to global climate change. CO, THCs, and the various compounds in the NO_X family cause a wide variety of impacts (U.S. EPA, 2006).

GHG has focused on the use of fuel cells, microtubines, and engines as distributed generation sources. Distributed generation (DG) refers to power-generation equipment that provides electric power at a site much closer to end-use customers than central station generation. In addition to the efficiencies passed on by the technologies themselves, power transmission losses can be avoided and reliance on electricity from large electric utility plants can be reduced. When well-matched to a facility's needs in a properly designed CHP application, net fuel consumption and overall emissions can also be reduced. An added environmental benefit of some DG technologies is the ability to fuel these systems with renewable energy sources such as anaerobic digester gas or landfill gas, which reduces natural resource consumption. Further, these gases, if released to the atmosphere, contribute millions of tons of methane emissions annually in the United States (U.S. EPA, 2006; Southern Research Institute, 2004).

The GHG Center recently initiated a strategic program to identify and develop verification opportunities relating to the conversion of synthesis gas (syn-gas) to liquids. A number of gasifiers generate syn-gas (CO and H_2 blended with other gases) from coal, biomass, and waste streams (municipal solid waste, tires, etc.). There is increasing interest in the commercial production of ethanol, methanol and Fischer-Tropsch liquids from syn-gas. In some cases, these processes are being scaled down for in-situ production of liquids only. In other cases, larger installations could co-produce excess heat and power in addition to the liquids. Ultimately, the result may be cleaner burning fuels, reduced greenhouse gas and hazardous air pollutant emissions, improved energy security, and improved sustainability.

ETV Greenhouse Gas Technology Center

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Water Centers

Verifications conducted by the ETV Water Quality Protection (WQP) Center and Drinking Water Systems (DWS) Center, both operated in cooperation with NSF International, often report, as an operation and maintenance requirement, the electrical power consumption or fuel usage of the system during ETV testing. This information can help technology end-users or purchasers gauge the potential energy consumption of a technology for their intended purposes.

[1]The ETV Program operates largely as a public-private partnership through competitive cooperative agreements with non-profit research institutes. The program provides objective quality-assured data on the performance of commercial-ready technologies. ETV does not endorse the purchase or sale of any products and services mentioned in this document.

Table 1. Verified GHG Energy Technologies	
Technology Name	Technology Description/Application
Microturbines and CHP Systems	
Capstone Turbine Corporation, Capstone 60 kW Microturbine CHP System	Natural-gas-fired microturbine with heat recovery system for distributed electrical power and heat generation
Capstone Turbine Corporation, Capstone 30 kW Microturbine System	Biogas-fired microturbine combined with heat recovery system for distributed electrical power and heat generation
Honeywell Power Systems, Inc., Parallon® 75 kW Turbogenerator	Natural-gas-fired microturbine for distributed electrical power generation
Honeywell Power Systems, Inc., Parallon® 75 kW Turbogenerator with CO Emissions Control	Natural-gas-fired microturbine for distributed electrical power generation
Ingersoll-Rand Energy Systems, IR Power Works™ 70 kW Microturbine System	Natural-gas-fired microturbine with heat recovery system for distributed electrical power and heat generation
Mariah Energy Corporation, Heat PlusPower™ System	Natural-gas-fired microturbine with heat recovery system for distributed electrical power and heat generation
Fuel Cells	
Plug Power, SU1 Fuel Cell System	Proton exchange membrane fuel cell for distributed electrical power generation
UTC Fuel Cells, LLC, PC25™ Fuel Cell[A]	Landfill gas clean-up and phosphoric acid fuel cell combined with heat recovery system for distributed electrical power and heat generation
Gas Processing Systems	
NATCO Group, Inc., Paques THIOPAQ	Sour gas processing system for biogas purification
US Filter/Westates Carbon, Gas Processing Unit (GPU) (verified with the PC25C Fuel Cell Power Plant)	Carbon-based digester or sour gas processing system for anaerobic digester gas
Internal Combustion Engines	
Aisin Seiki Co., LTD., 6.0 kW Natural Gas-Fired Cogeneration Unit	Gas-fired internal combustion engine combined with heat recovery system for distributed electrical power and heat generation
Martin Machinery, Inc., Martin Machinery Internal Combustion Engine	Biogas-fired internal combustion engine combined with heat recovery system for distributed electrical power and heat generation
Ground-Source Heat Pump Water Heating System	
ECR Technologies, Inc., EarthLinked® Water Heating System	Ground-source heat pump water heating system

[A] This technology was verified twice: first at municipal solid waste landfills and including a gas processing unit to operate using landfill gas (1998), and second at a wastewater treatment facility and including a gas processing unit to operate using anaerobic digester gas (2004). UTC Fuel Cells, LLC was known as International Fuel Cells Corporation when it was verified in 1998. This technology has since been renamed as the PureCell™ 200.
kW = kilowatts

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Environmental and Sustainable Technology Evaluations (ESTE)

In 2005, ETV began a new program element, Environmental and Sustainable Technology Evaluations (ESTE) (see **http://www.epa.gov/etv/este.html**). ESTE expands the program's ability to respond directly to EPA's need for credible performance data on innovative and commercial-ready technologies to address high-risk environmental problems. Funding for projects under ESTE is awarded through a competitive process and projects are required to have support from EPA program and/or regional offices. In 2005, ESTE funding was awarded for two projects related to waste-to-energy generation. The projects are: verification of fuel characteristics and emissions from biomass co-fired boilers, and anaerobic digestion of animal manure. Both of these projects are currently developing test/quality-assurance plans in preparation for verification testing. ETV has already signed agreements with two host sites for verification of different approaches to coal/biomass co-firing.

References

Southern Research Institute, 2004. *ETV Verification Statement: PC25C Fuel Cell Power Plant—Model C*. September.

U.S. EPA, 2006. *ETV Case Studies: Demonstrating Program Outcomes, Volume II*. EPA/600/R-06/082. September.

U.S. EPA ETV, http://www.epa.gov/etv.

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