



UTD IMPACT

September 2017

UTD is a non-profit collaboration of utilities that creates and advances new technologies and products to reduce costs, address regulatory challenges, enable efficient fuel choices, lessen environmental impacts, and further integrate natural gas with renewable energy resources.

The commercialized products and major technology development advancements shown here illustrate some of UTD's impacts and benefits for ratepayers, utilities, other stakeholders, and our planet.

UTD highly values input from all stakeholders. Please call us if you have any questions regarding these exciting impacts!

Ron Snedic (1.847.768.0572)

Rich Kooy (1.847.768.0512)



UTD's 18 member companies serve more than 40 million natural gas customers in the Americas and Europe.

The UTD collaboration helps utilities build technology portfolios and expand energy efficiency programs.

Together we are shaping the energy future with clean, efficient end-use technologies.

Visit www.uta-co.org for more information.

COMMERCIALIZED PRODUCTS



Dedicated Outside Air System/Rooftop Unit

Condensing heating versions of Munters Dedicated Outside Air System and other packaged rooftop unit (RTU) products increase heating efficiency from 80%-81% to 90%-93%. It has a market potential of 3+ million BTU replacements. A number of field demonstrations by multiple RTU OEMs with major retailers and other end users are being considered in 2017, benefitting from UTD's prior research and heating module development.

Munters Corporation

Larry Klekar
210-249-3883
larry.klekar@munters.com
www.munters.com



NextAire™ Gas Heat Pump

NextAire's 8-ton and 15-ton gas heat pumps (GHP) for commercial use include variable refrigerant flow and multizone capabilities. They can efficiently heat (up to 1.5 COP) and cool commercial building space and reduce building peak electric demand. More than 400 units have been sold in the U.S. UTD's analysis is supporting best practices for siting.

IntelliChoice Energy

Tom Young
623-879-4664
tyoung@iceghp.com
www.iceghp.com

COMMERCIALIZED PRODUCTS (continued)



Cannon Boiler Works Ultramizer®

The Ultramizer is an advanced heat-and-water recovery system for larger commercial and industrial boilers (over 140,000-unit market in U.S.). It increases boiler efficiency from 80% to 93%—saving customers 15% in energy while also reducing water demand.

Cannon Boiler Works, Inc.
Chris Giron
724-335-8541 x414
sales@cannonboilerworks.com
www.cannonboilerworks.com



Heat Sponge Economizer for Industrial/Commercial Boilers

In either condensing or non-condensing configurations, this heat recovery system for commercial and industrial boilers (over 140,000 unit market in U.S.) increases boiler efficiency from 80% to a range of 85%-93% (validated by UTD lab testing). It also saves customers 5%-15% in annual energy costs. In 2017 UTD is completing a field test in Utah to further validate energy savings.

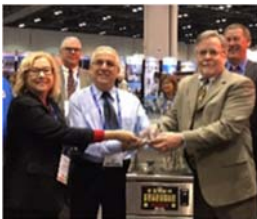
Boilerroom Equipment, Inc.
866-666-8977
www.heatsponge.com



S.U.N. Equinox Solar-Assisted Heating System

The Equinox system is a combination solar/natural gas water heating system using an efficient evacuated tube design. It can be used in residential, commercial, or industrial locations and is capable of meeting 100% of domestic hot-water and space heating needs. UTD validated its energy performance in a field demonstration.

Solar Usage Now, LLC
Tom Rieker
614-759-7242
service@netwalk.com
www.solarusagenow.com



ENERGY STAR® Fryer

In 2017 Royal Range's new high-efficiency fryer was awarded the National Restaurant Association's Kitchen Innovation Award and GFEN's Blue Flame Product of the Year Award. Independent testing has shown 63% heavy-load cooking energy efficiency, greatly exceeding the ENERGY STAR 50% threshold requirement.

Royal Range of California
Robert Lutz
951-360-1600
robert@royalranges.com
www.royalranges.com



Low-Oil-Volume Fryers

Marketed by Frymaster as Protector® fryers, this equipment increases energy efficiency while also extending cooking-oil quality and life to provide significant customer savings. Field demonstrations completed by UTD have shown an average savings of \$4,800 per year per fryer.

Frymaster
Linda Brugler
318-866-2488
lbrugler@frymaster.com
www.frymaster.com



ENERGY STAR Conveyor Oven

ENERGY-STAR-rated conveyor ovens from Lincoln include an advanced energy-management system to reduce energy consumption up to 38%.

Lincoln, a division of Maniowoc Foodservice
260-459-8200
www.lincolnfp.com

COMMERCIALIZED PRODUCTS (continued)



ENERGY STAR Convection Oven

This unit showed improved efficiency and 40% energy savings compared to a standard oven during field testing and achieved an ENERGY STAR rating.

Garland

905-624-0260
www.garland-group.com



High-Efficiency Broiler

This broiler features infrared burners and an energy-saving hood that showed an average of 23% energy savings during field testing. It offers more efficient cooking as well as reducing heat gain to the kitchen.

Royal Range of California

800-769-2414
www.royalranges.com



High-Efficiency Broiler

The Montague Company commercialized a version of the advanced broiler technology using thermostatic broiler-temperature control and an energy-saving hood. It was recognized with a Kitchen Innovations Award in 2013.

Montague

800-345-1830
www.montaguecompany.com



ENERGY STAR Countertop Steamer

A compact gas-fired countertop steamer for commercial foodservice offers enhanced cooking rates while providing energy savings and reduced water consumption. It was the first gas-fired boilerless steamer on the market and received an ENERGY STAR rating.

Market Forge Industries Inc.

617-387-4100
866-698-3188
custserv@mfi
www.mfi.com



ISB6.7G

Cummins Westport 6.7L Medium-Duty NGV Engine

On Dec. 8, 2016 Cummins Westport Inc. began full commercial production of the ISB6.7G, a 6.7-liter, 240-HP, medium-duty, factory-built dedicated natural gas vehicle (NGV) engine for school bus, shuttle bus, medium-duty truck, and vocational uses. It meets U.S. 2017 EPA GHG requirements and CARB's optional more stringent low NO_x standard of 0.1 g/bhp-hr.

Cummins Westport Inc.

Stephen Ptucha
604-718-2024
sptucha@westport.com
www.cumminswestport.com



Cummins Westport 8.9L Near Zero Emission NGV Engine

This 8.9L 320-HP NGV engine is widely used in the U.S. and Canada, with 50,000+ ISL G engines sold for transit, refuse-collection, and regional hauling applications since 2007. In 2016 it was advanced to become the ISL G-NZ, the first engine certified in North America to meet the 0.02 g/bhp-hr optional Near Zero (NZ) NO_x emissions standard, i.e. 90% lower than the current EPA NO_x limit of 0.2 g/bhp-hr.

Cummins Westport Inc.

Stephen Ptucha
604-718-2024
sptucha@westport.com
www.cumminswestport.com



Cummins Westport 11.9L High-Horsepower NGV Engine

This 11.9L 400-HP NGV engine (ISX12G) is used in large trucks, buses, and refuse vehicles. Engine sales since 2013 are approaching 10,000 units and 25,000+ engines will likely be sold in North America by 2020, using ~40 bcf of natural gas and yielding \$600+ million in annual NGV fuel sales and substantial emissions reductions. In 2018 it will be certified to meet Near Zero NO_x emissions standard of 0.02 g/bhp-hr.

Cummins Westport Inc.

Stephen Ptucha
604-718-2024
sptucha@westport.com
www.cumminswestport.com

COMMERCIALIZED PRODUCTS (continued)



HyperComp/3M NGV Cylinders

These lightweight Type IV NGV cylinders are manufactured using advanced 3M nanoparticle-enhanced matrix resin technology for high strength and durability. Three tank sizes of 30, 40, and 45 DGE are now offered in nine unique CNG Fuel System Solutions from Momentum Fuel Technologies, including roof mount, saddle mount, and back-of-cab designs.

Momentum Fuel Technologies

844-264-8265
www.momentumfueltechnologies.com



Ultimate CNG FuelMule™

The patented FuelMule™ mobile fueling solution can dispense eight diesel gallon equivalent per minute and fuel 35 to 50 medium-duty vehicles per delivery. It is used as a temporary starter station, for station back-up, or for mobile onsite fueling. The first unit logged 250,000+ miles and almost 4,000 compressor hours to deliver natural gas fuel to about 13,500 vehicle fills across 11 states in its first 4 years of operation.

Ultimate CNG, LLC

Dennis Pick
703-209-4086
dpick@ultimatecng.com
www.ultimatecng.com

KEY INFORMATION & ANALYTICAL TOOLS



Reliability, Cost and Environmental Impacts of Standby Generation Systems

In 2017 Generac launched a website supported by UTD research that provides technical information on costs, emissions, and reliability for natural gas generators, including a white paper on natural gas reliability and a Total Cost of Ownership calculator that compares costs and emissions of natural gas vs. diesel-fueled standby generators. Other efforts by Generac in 2017 include a “road show” of a 53’ trailer to more than 3,500 power generation experts.

Available on-line at <https://www.generac.com/Industrial/all-about/natural-gas-fuel>. For more information, contact Pat Rowley; patricia.rowley@gastechnology.org



CHP Interconnection Equipment Review Assessment

In 2016 the results of Phase 1 of UTD research project 2.15.M were made publicly available in order to build public understanding of the opportunities for wider standardization and harmonization of CHP interconnection practices. Discussions about UTD’s research results are being held with key decision-makers during 2017.

Available on-line at http://www.gastechnology.org/reports_software/Documents/CHP-Interconnection-Equipment-Analysis.pdf. For more information, contact Tim Kingston; tim.kingston@gastechnology.org



Micro-CHP Techno-Economic Assessment

UTD funded a comprehensive technical and economic assessment on a range of micro-CHP systems applied to seven possible residential and light-commercial applications in five regional U.S. markets. Results provide target first cost and overall annual system efficiencies needed to achieve desirable payback periods.

For more information or a copy of the UTD Project 1.11.O report, contact Tim Kingston; tim.kingston@gastechnology.org

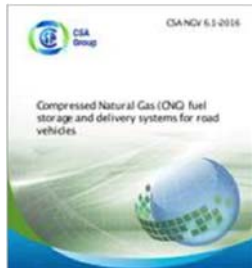
KEY INFORMATION & ANALYTICAL TOOLS (continued)



Commercial Foodservice (CFS) Equipment Calculator

Introduced in 2016 with UTD support, this website hosts CFS information and tools for the restaurant industry and others to determine the economic and environmental benefits of using new, more advanced commercial foodservice equipment. The website was showcased at several restaurant trade shows during 2017, and further improvements are underway.

Available online at <http://cfscalculator.gastechtechnology.org>. For more information, contact Frank Johnson; frank.johnson@gastechtechnology.org



CSA NGV Storage and Delivery Standard Technical Committee Support

CSA NGV6.1 was introduced in 2016 and defines the requirements for the balance of systems and equipment onboard a NGV which is not otherwise defined by NGV1 for the receptacle or NGV2 for the storage containers. UTD supported GTI's participation on the Technical Committee.

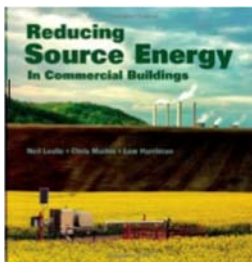
Available online at www.csagroup.org. For more information, contact Tony Lindsay; tony.lindsay@gastechtechnology.org



CSA NGV Fueling Appliance Standard Technical Committee Support

CSA NGV5.1 was introduced in 2015 and updated in 2016, and provides mechanical, physical, and electrical requirements for residential fueling appliances (RFAs) that dispense natural gas for NGVs, including indoor and outdoor fueling appliances that connect to residential gas piping. A complimentary standard, NGV5.2 for fueling appliances in non-residential locations, has been developed and is undergoing industry review in anticipation of publication in 2018. UTD supported GTI's participation on the Technical Committee.

Available online at www.csagroup.org. For more information, contact Tony Lindsay; tony.lindsay@gastechtechnology.org



Source Energy Technical Data

Researchers are providing clear, credible, and unbiased technical data regarding the benefits of source energy in reducing energy consumption and carbon emissions, to support analysis of equitable treatment of fuels in codes, standards, and regulations. Source energy is now included in the International Green Construction Code (IgCC) that applies to the construction and renovation of new high-performance commercial buildings, structures, and systems, and included in various American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) standards.

For more information, contact Neil Leslie; neil.leslie@gastechtechnology.org



Source Energy and Emissions Analysis Tool

The Source Energy and Emissions Analysis Tool (SEEAT) allows calculation of the source energy and greenhouse-gas emissions related to point-of-use (site) energy consumption by fuel type for each energy-consuming device. The source-energy and carbon-emission calculation methodology used accounts for primary energy consumption and related emissions for the full fuel cycle for residential and commercial buildings, industrial applications, and light-duty vehicles.

Available online at www.cmictools.com. For more information, contact Neil Leslie; neil.leslie@gastechtechnology.org

TECHNOLOGY ADVANCEMENTS



Gas-fired Absorption Heat Pump Residential Water Heater

This efficient residential Gas-Fired Heat Pump Water Heater (GHPWH) continues to advance to market. Field testing of five latest-generation units will start in 2017. The projected Uniform Energy Factor (UEF) of 1.3 is considerably greater than standard gas water heaters and better than an electric heat pump water heater on a source-energy basis. When commercially available, it will be the only residential water-heating technology with a source-energy-based EF ≥ 1.0 .

Project Manager: Paul Glanville



Gas-fired Absorption Heat Pump for Space Heating or Commercial Water Heating

This Gas Absorption Heat Pump (GAHP) technology is targeted for residential space heating and commercial water heating. Through laboratory testing and modeling, the GAHP demonstrated an Annual Fuel Utilization Efficiency of 140% and a financial payback period of as low as three years. In 2017 UTD launched a new field demonstration of the latest prototype with several commercializing partners.

Project Manager: Paul Glanville



Ultra-Low NO_x Burner

This innovative technology for firetube boilers is in operation in 2017 at a Mission Linen Supply facility in California. It improves efficiency and achieves NO_x emissions below 9 vppm, while avoiding the significant efficiency, capital cost, and/or operating cost penalties to use conventional Selective Catalytic Reduction or burner enhancements such as external Flue Gas Recirculation and/or High Excess Air firing. UTD's partner Power Flame Inc. is focused on helping businesses meet current and future NO_x emission regulations without sacrificing energy efficiency.

Project Manager: David Cygan



Low NO_x Ribbon Burner System

A new low NO_x combustion system reduces NO_x emissions by 50% in food processing, thermoforming and other industrial applications. A prototype unit is in on-going commercial operation at an industrial bakery in California, and additional monitoring and performance testing is being performed in 2017 in cooperation with the host site management and Flynn Burner Corp.

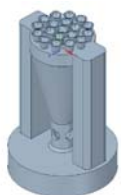
Project Manager: Yaroslav Chudnovsky



FlexCHP High-Efficiency Ultra-Clean Power and Steam Package

This innovative CHP package allows flexible steam production while meeting stringent California NO_x emission levels without a SCR system and across the full range of firing rates — achieving NO_x levels 50% below CARB limits. A 2014 installation in California operates with 82+% system efficiency and system emissions well below 9 ppm NO_x. Additional applications are pending, and UTD efforts underway in 2017 will increase the technology application size to 400 kW / 400 BHP.

Project Manager: David Cygan

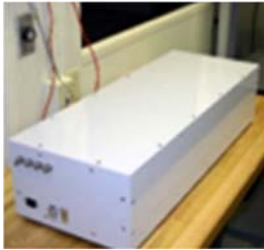


Low NO_x Advanced Retention Nozzle Burner

A novel design for next-generation retention nozzles leverages new additive manufacturing capabilities and equipment. Potential applications include industrial and commercial boilers and water heaters. Laboratory tests to date have demonstrated excellent burner performance and low NO_x and CO emissions, and additional testing will occur during 2017.

Project Manager: Sandeep Alavandi

TECHNOLOGY ADVANCEMENTS (continued)



Gas Quality Sensor

The Gas Quality Sensor (GQS) uses solid-state infrared light absorption spectroscopy to measure Btu content and gas composition. Pre-commercial units are undergoing testing in collaboration with the licensing partner, CMR Group, for use with natural gas and bio-methane fuels. When commercialized, the GQS is expected to be priced competitively to a gas chromatograph, while providing much faster response and lower maintenance costs.

Project Manager: David Rue



Cost-effective Small-Scale Compressor for Natural Gas Vehicles (NGVs)

A cost-effective small-scale compressor could significantly change the NGV fueling market. With UTD cost share and U.S. DOE funding, GTI and the University of Texas, Austin (using specialty materials from Argonne National Laboratory) developed a novel approach using a linear motor and only one moving piston, and operated a prototype successfully in the lab. The technology is currently being scaled up to 50 SCFM capacity with UTD funding.

Project Manager: Jason Stair



On-Demand Heat and Power System

This unique new technology can capture and store renewable energy (or other energy, including waste heat), augment it with natural gas as needed, and deliver heat and power on-demand to commercial, industrial, and other users. UTD is advancing this technology by providing co-funding to U.S. DOE ARPA-E and other funders in a current UTD project.

Project Manager: David Cygan



Combination Space/Water Heating and Air Handling Unit System

This technology allows an integrated natural gas-fired combination space and water heating system to provide supplemental space heating with existing or new electric heat pumps and condensing gas water heating for single or multi-family homes. Field testing efforts are underway at five homes in New York to gather performance data.

Project Manager: Tim Kingston



Low-NO_x Furnace

Low NO_x combustion systems were developed in cooperation with SCAQMD and five residential furnace manufacturers to achieve emissions levels less than 14 ng/J. Innovative burner materials including metal mesh and metal foam were used to achieve even heat transfer and uniform flame temperatures. UTD completed durability testing in 2017.

Project Manager: Frank Johnson



ENERGY STAR Gas Dryer

UTD worked with a major manufacturer to develop one of the first commercially-available gas-fired ENERGY STAR clothes dryer (included at energystar.gov/products/appliances/clothes_dryers). UTD is currently investigating next-generation technologies and developing an early-stage prototype dryer to substantially further increase operating efficiency.

Project Manager: Shawn Scott

TECHNOLOGY ADVANCEMENTS (continued)



Self-Powered Gas Appliance Control Valve

A new approach for a self-powered natural gas control valve for use in water heaters and other gas appliances is in development. This device may allow ENERGY STAR-rated water heaters to operate without needing an electrical connection, helping reduce installation costs.

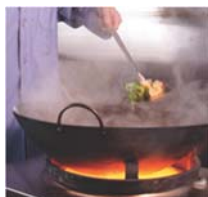
Project Manager: Dave Kalensky



Next Generation Infrared Burner

UTD-funded researchers are testing a variety of unique metal foam materials to evaluate their potential performance as next-generation, high-efficiency, low-emission infrared burners that are directly fired with natural gas.

Project Manager: Sandeep Alavandi



High-Efficiency Wok

A high-efficiency wok has undergone extensive laboratory testing. Tests showed up to a 63% efficiency improvement over conventional woks.

Project Manager: Frank Johnson

WORKING WITH PARTNERS TO CO-FUND UTD INITIATIVES

In 2016, each \$1.00 in new UTD funding was leveraged by \$4.71 of direct funding from government and industry partners for related end-use R&D. GTI secured \$12.25 million from federal and state government partners and \$3.91 million in funding from manufacturing partners and other gas industry resources (outside of UTD). Manufacturing partners provided significant, additional in-kind co-funding.

Examples include:

- > U.S. Department of Energy (DOE) Advanced Research Project Agency – Energy (ARPA-E) Program: \$3.71 million to develop several different innovative end-use technology concepts.
- > California Energy Commission: \$5.18 million for technology development projects related to NGV engines, Zero Net Energy (ZNE) homes, energy- and water-saving industrial processes, and other advances.
- > U.S. Army Corps of Engineers Construction Engineering Research Laboratory (CERL): \$1.85 million to demonstrate efficient natural gas equipment at military bases.
- > DOE National Energy Technology Laboratory (NETL): \$0.75 million to provide training for cost-effective, code-complaint maintenance facilities for alternative fuel vehicles.
- > NYSERDA: \$0.27 million to demonstrate and document the performance of a novel new factory-packaged micro combined heat and power (CHP) system.