UTD IMPACT

March 2018

UTD is a non-profit collaboration of utilities that creates and advances new technologies and products to save consumers money, enable efficient fuel choices, minimize environmental impacts, further integrate natural gas with renewable energy, and address regulatory developments.

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 tackles compelling, key energy and environmental issues by working closely with leading researchers, governmental agencies, and others.

Please call us if you have any questions regarding these exciting impacts!

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COMMERCIALIZED PRODUCTS

NextAire™ Gas Heat Pump

NextAire’s 8-ton and 15-ton gas heat pumps (GHPs) 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

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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 2018, benefitting from UTD’s prior research and heating module development.

Munters Corporation

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UTD’s 19 member companies serve more than 45 million natural gas customers in the Americas and Europe.

UTD helps utilities create exciting new products for their customers, and maximize the impact of their energy-efficiency programs.

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

Visit www.utd-co.org for more information.
COMMERCIALIZED PRODUCTS (continued)

**Cannon Boiler Works Ultramizer<sup>®</sup>**
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.

**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 2018 UTD is completing a field test in Utah to further validate energy savings.

**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.

**ENERGY STAR<sup>®</sup> 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.

**Low-Oil-Volume Fryers**
Marketed by Frymaster as Protector<sup>®</sup> 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.

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

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.

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.

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.

Cummins Westport 6.7L Medium-Duty NGV Engine
On Dec. 8, 2016 Cummins Westport Inc. began full commercial production of the ISB6.7G (renamed B6.7N in 2018), 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 NOx standard of 0.1 g/bhp-hr.

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+ engines sold for transit, refuse-collection, and regional hauling applications since 2007. In 2016 it was advanced to become the first engine certified in North America to meet the 0.02 g/bhp-hr optional Near Zero (NZ) NOx emissions standard (i.e. 90% lower than the current EPA NOx limit of 0.2 g/bhp-hr). In 2018 it was renamed the L9N.

Cummins Westport 11.9L Near Zero Emission NGV Engine
This 11.9L 400-HP NGV engine (ISX12N) 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 MY18 it became CWI’s second engine certified to meet NZ NOx emissions standard of 0.02 g/bhp-hr.
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.

Ultimate CNG FuelMule™
The patented FuelMule™ mobile fueling solution can dispense 8 diesel gallon equivalent per minute and fuel 35-50 medium-duty vehicles per delivery. It is used as a temporary starter station, as station back-up, or for mobile onsite fueling. It has logged 250,000+ miles and almost 6,000 compressor hours delivering natural gas fuel to vehicles across the U.S. in 5 years of operation.

Momentum Fuel Technologies
844-264-8265
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Ultimate CNG, LLC
Dennis Pick
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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 2017-18 include a “road show” of a 53’ trailer to 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 2018.
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

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 improvements are underway in 2018.
Available online at http://cfscalc.gastechnology.org. For more information, contact Frank Johnson; frank.johnson@gastechnology.org
CSA NGV4.3 Storage and Delivery Standard Technical Committee Support
CSA NGV4.3 issued in 2018 and specifies the performance requirements for temperature compensation control used to prevent compressed natural gas (CNG) dispensing systems from exceeding a safe fill level of vehicle fuel storage container(s). It contains safety performance guidelines and field evaluation methods for existing dispensing systems. UTD supported participation to lead the Technical Task Force that created the Standard.
Available online at www.csagroup.org. For more information, contact Tony Lindsay; tony.lindsay@gastechnology.org

CSA NGV6.1 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@gastechnology.org

CSA NGV5.1 and NGV5.2 Fueling Appliance Standard Technical Committees 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 vehicle fueling appliances (VFAs) in non-residential locations, has been developed and was published in late 2017. UTD supported participation on both of the Technical Committees.
Available online at www.csagroup.org. For more information, contact Tony Lindsay; tony.lindsay@gastechnology.org

Source Energy Technical Data
Researchers are providing unbiased technical data on the benefits of source energy in reducing energy consumption and carbon emissions in buildings and transportation. Source energy is now included in the International Green Construction Code (IgCC) for high-performance commercial buildings, and in various American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) standards (e.g., Standard 100 for existing buildings, Standard 105 method for comparing building energy performance, Standard 189 for high-efficiency green buildings, and Standard 214 for building energy performance rating).
For more information, contact Neil Leslie; neil.leslie@gastechnology.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. SEEAT data is also used in the GTI-developed Energy Planning Analysis Tool (EPAT).
Available online at www.cmictools.com and www.epat.gastechnology.org. For more information, contact Neil Leslie; neil.leslie@gastechnology.org
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 is underway in 2018. 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 NOₓ Burner

This innovative technology for firetube boilers is in operation in 2018 at a Mission Linen Supply facility in California. It improves efficiency and achieves NOₓ 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 NOₓ emission regulations without sacrificing energy efficiency.

Project Manager: David Cygan

Low NOₓ Ribbon Burner System

A new low NOₓ combustion system reduces NOₓ emissions by 50% in food processing, thermoforming and other industrial applications. The system was evaluated in bench-scale, pilot scale, and full-scale production settings and has demonstrated transparent operation at an industrial bakery in California. Post-demo monitoring will occur in Q1 2018 along with commercialization activities with 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 NOₓ emission levels without a SCR system and across the full range of firing rates — achieving NOₓ levels 50% below CARB limits. A 2014 installation in California operates with 84+% system efficiency and system emissions well below 9 ppm NOₓ. UTD efforts during 2017 helped align the technology for broader application sizes (e.g. to 400 kW / 400 BHP).

Project Manager: David Cygan

Low NOₓ 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 robust, high efficiency (3-6% increase), ultra-low emissions burner (50%-75% reduction in NOₓ emissions compared to current burners, with < 5 ppm NOₓ achievable), and >10:1 turndown.

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 biomethane 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 supplementing the funding from U.S. DOE ARPA-E and other funders in a current UTD project.

*Project Manager: David Cygan*

**CARB-Compliant Engine-Based Micro-CHP System**
UTD researchers are working in collaboration with the California Energy Commission and SoCalGas to advance and commercialize the first-ever engine-based micro-CHP system that complies with California Air Resource Board requirements. A system offered by a major manufacturer in an influential market like California could spark the US micro-CHP market.

*Project Manager: Tim Kingston*

**Low-NOx Furnace**
Low NOx 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*
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

Residential Furnace Retrofit for High-Efficiency Heating and Humidification
In December 2017 the results of a year-long field study in four Minnesota homes of novel
Transport Membrane Humidifier (TMH) technology were publicly released – The steady state
furnace efficiency increased from 79% to 93%, and the output increased by 10,500 Btu/hour
on average without experiencing any excess humidification issues.

Project Manager: Dexin Wang

WORKING WITH PARTNERS TO CO-FUND UTD INITIATIVES
In 2017, each $1.00 in new UTD funding was leveraged by $3.92 of direct funding from government and industry partners
for related end-use R&D. GTI secured $13.4 million from federal and state government partners and $4.0 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) funding of $5 million to develop an alternative fuel vehicle corridor spanning from
Michigan to Montana, and demonstrate NGV fueling stations and vehicles.
> U.S. Department of Defense (DOD) funding of $4+ million to demonstrate new natural gas energy efficiency and
resiliency technology at military facilities.
> California Energy Commission (CEC) funding of four new projects totaling $3.2 million. These efforts include testing
two new natural gas heat pumps technologies, high-efficiency low-capacity heating systems, and an energy
recovery system for commercial users.
> Funding from other state agencies such as three new projects that total $0.7+ million from NYSERDA and IL
DCEO, to advance low-capacity heating systems and other emerging technologies.
> More than $3 million in other gas industry funding for a range of emerging technology efforts aiming to support the
evaluation of commercial readiness of new higher-efficiency natural gas technologies.