

*the Energy to Lead*

# Natural Gas Energy Efficiency and Emerging Technologies



# GTI Overview

- > Non-profit research, development, demonstration organization with 70 year history
- > Facilities
  - 18 acre campus
  - 200,000 ft<sup>2</sup>
  - 28 specialized labs
- > Staff of 250



Offices &  
Labs



Flex-Fuel  
Test Facility



Energy & Environmental Technology Center

# Commercial & Industrial Boilers

- > Large number of commercial and industrial boilers
- > Estimated 75% of these boilers are over 30 years old
- > Prime opportunity for large energy efficiency improvements

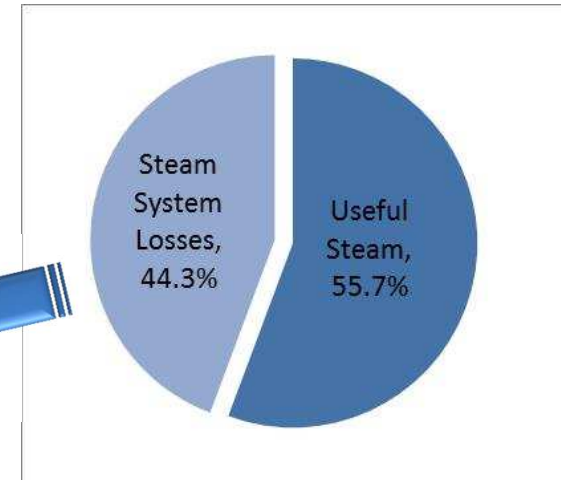
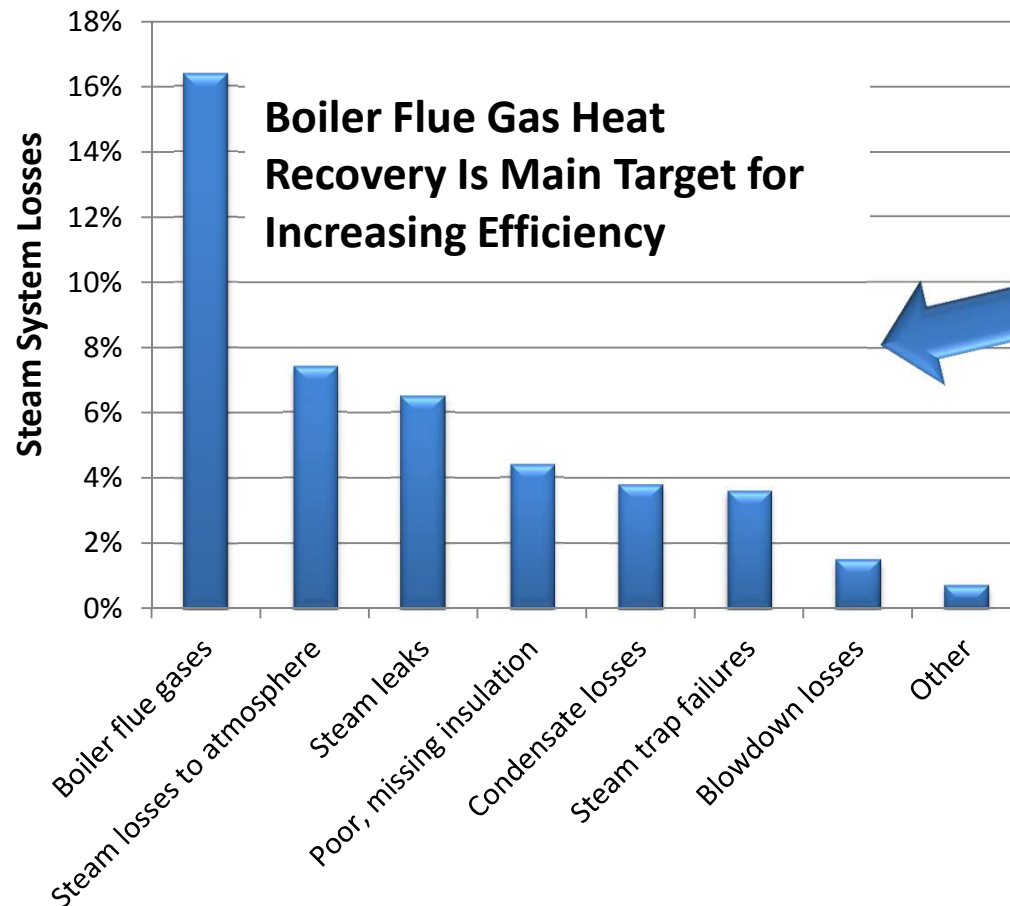
Commercial Building Type	Number of Boilers	
Education	35,895	30%
Office	28,030	23%
Health	15,190	13%
Other	11,900	10%
Lodging	10,545	9%
Public Assembly	7,280	6%
Retail	5,585	5%
Warehouse	5,365	4%
<b>Total</b>	<b>119,790</b>	



Industrial Sector	Total	
Food	10,610	25%
Paper	3,460	8%
Chemicals	11,980	28%
Refining	1,200	3%
Metals	3,330	8%
Other	12,435	29%
<b>Total</b>	<b>43,015</b>	



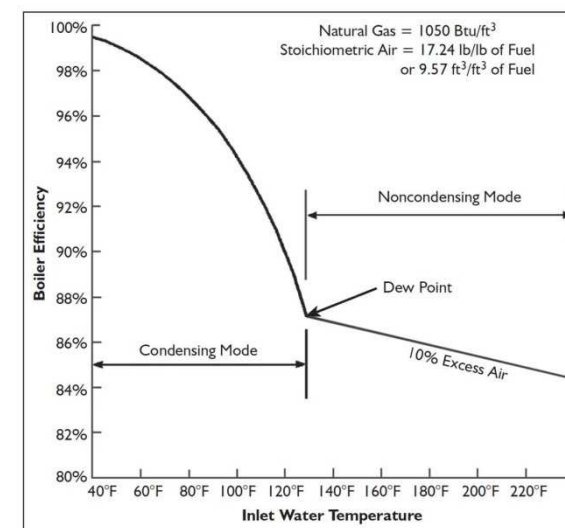
# Steam Systems and Energy Efficiency Improvement Opportunities



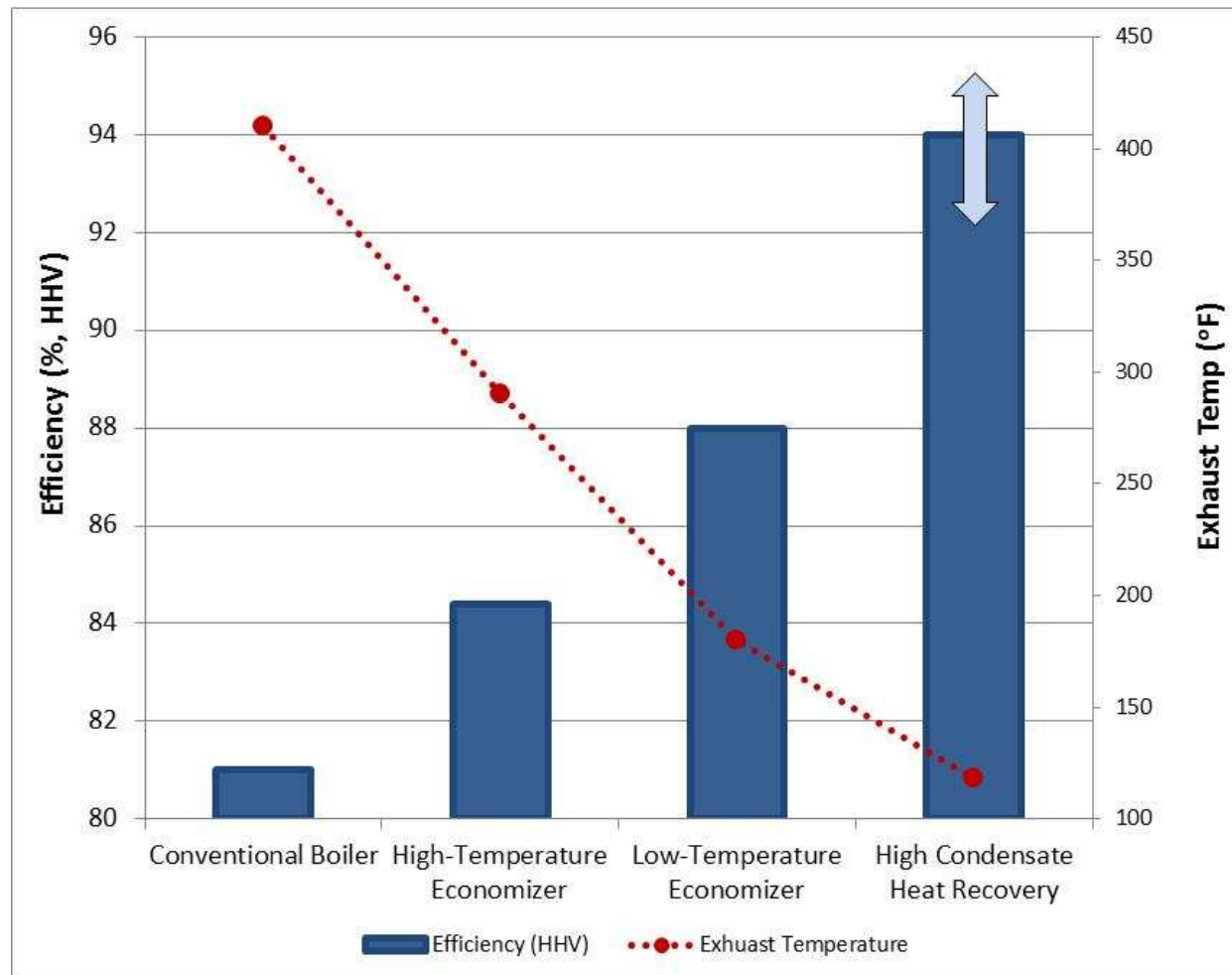


# Natural Gas Boiler Exhaust Heat Recovery

- > Natural gas combustion produces ~18% water volume in exhaust ~ 10% of fuel energy input
- > Steps to higher energy efficiency → sensible & latent heat recovery
  - **Sensible**=reduce exhaust temperature by preheating water (or other use) → up to 88% efficiency
  - **Latent**=condensing exhaust water vapor to liquid releases energy that can be recovered → over 88% efficiency
  - Caution: Exhaust condensate is usually corrosive (pH 3-5)

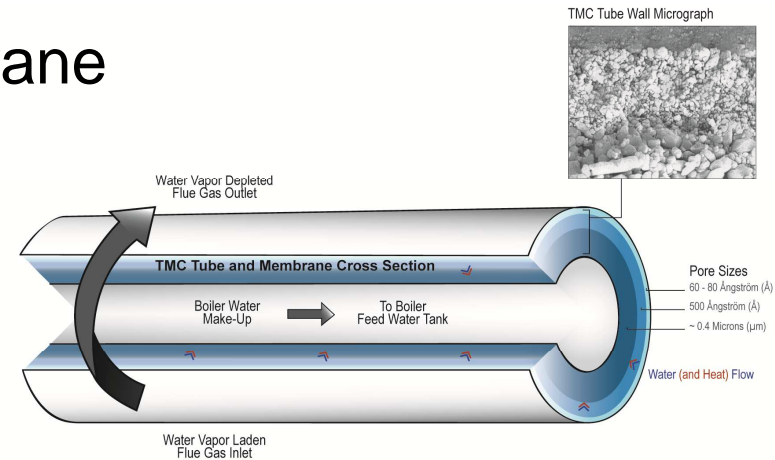


# Example Boiler Efficiency Improvement Options



# Simultaneous Sensible & Latent Heat Recovery & Water Separation

- > GTI-developed Transport Membrane Condenser (TMC) technology
- > TMC uses a robust nanoporous membrane to selectively remove pure water from natural gas combustion byproducts
  - Recovers energy, saves water, avoids corrosive condensate
- > Successfully developed for C&I boilers
  - Retrofit or new units



TMC tubes in a bundle assembly

# TMC Tube, Module, and Integrated Heat/Water Recovery System



TMC bundles integrated into a 3 by 3 array to capture heat and pure exhaust water

Boiler feedwater is pre-heated

Fresh feedwater requirements partially offset by exhaust water recovery



# Ultra-High Efficiency Boiler at Richardson Brands



- > GTI deployed TMC-based heat recovery at Richardson Brands
- > Key support from NYSERDA, National Grid, USDOE
- > Over 15% savings in steam production costs
- > Up to 20% less make-up water



RBC Plant – Canajoharie, NY

# Cannon Boiler Works Ultramizer®

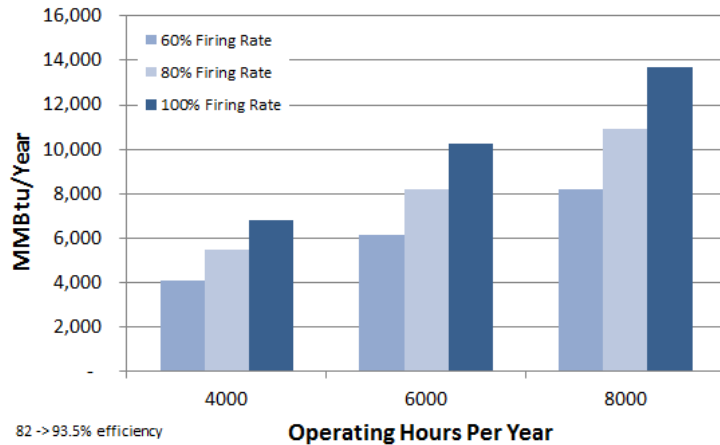
- > Advanced TMC-based heat recovery systems for industrial, large commercial, and institutional boilers commercially available from Cannon Boiler Works
  - Current sizes around 10-20 MMBtu/hr
  - 92-95% efficiency
- > Ongoing development to scale-up to larger sizes
  - Over 20 MMBtu/hr



Industrial boiler heat recovery with Ultramizer product at brewery

# Ultramizer Energy & User Savings

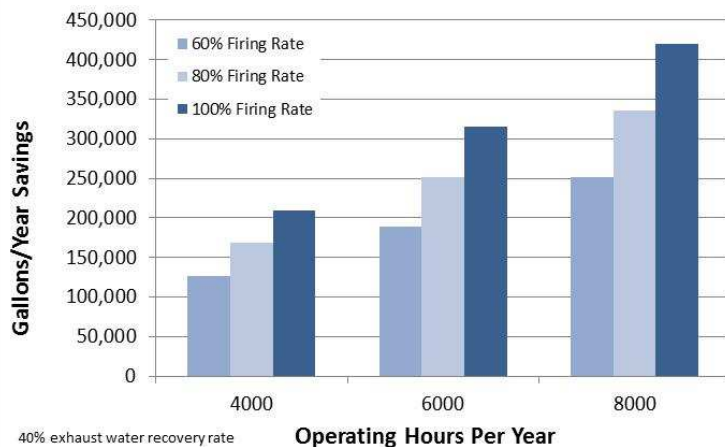
**300 Boiler Hp Ultramizer Energy Savings**



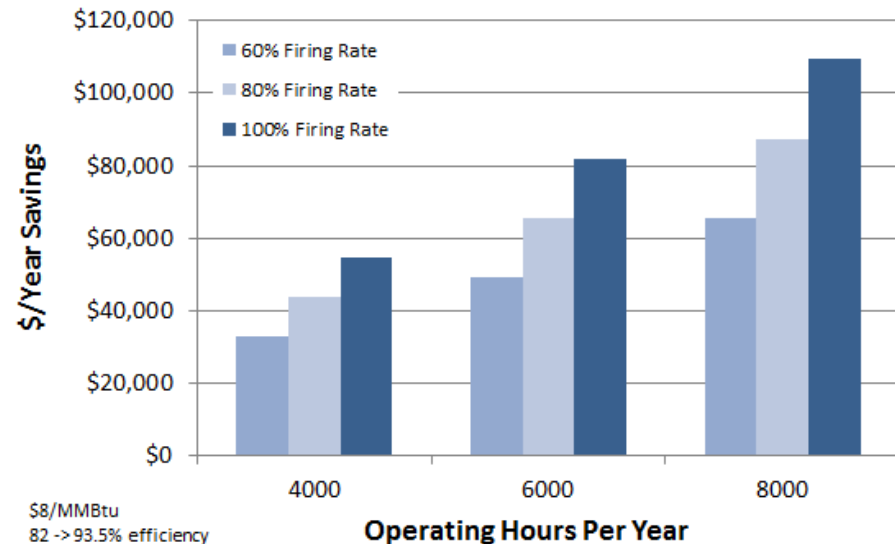
**300 hp Boiler @80% average firing rate**

	Energy Savings MMBtu/yr	Energy Cost Savings (\$/yr)	Water Savings (Gallons/yr)	Water Cost Savings*
6000 hours/year	8,200	\$65,590	251,900	\$2,519
8000 hours/year	10,930	\$87,450	335,900	\$3,359

**300 Boiler Hp Ultramizer Water Savings**



**300 Boiler Hp Ultramizer Energy Cost Savings**



\* Assuming \$10/1000 gallons for water purchase and clean-up

300 boiler hp equals ~ 10 MMBtu/hr

# State of New York Benefits:

## High-Efficiency Commercial/Industrial Boilers



Universities



Hospitals



Offices/Hotels,  
Multi-Family and  
Public Housing



Manufacturing

### State of New York Benefits

- Over 20 Trillion Btu annual savings
- \$200 million reduced energy costs for consumers
- 1.2 million tons of CO<sub>2</sub> emissions avoided
- 615 million gallons of water saved per year

Sector	Number of Boilers	Annual Gas Consumption (TBtu)
Commercial	13,080	32
Industrial	2,270	99
Total	15,350	131



# Summary

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- > Transport Membrane Condenser (TMC) is a highly innovative solution for high-efficiency boiler heat and water recovery
- > Ultramizer® product available from Cannon Boiler Works
- > Large potential energy efficiency savings in State of New York
  - Over 20 Trillion BTU
    - > Commercial boilers
    - > Institutional boilers
    - > Industrial boilers

