the Energy to Lead

Emerging Technology Program (ETP)

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GTI Overview

- Not-for-profit RD&D organization with 70 year history
- Facilities
  - 18 acre campus near Chicago
  - 200,000 ft^2, 28 specialized labs
  - Other sites in Alabama, D.C, Texas Massachusetts, California
- Staff of 250
  - 170 engineers, scientists covering all fields

Flex-Fuel Test Facility

Offices & Labs

Energy & Environmental Technology Center

Positioned to help utilities and their end use customers

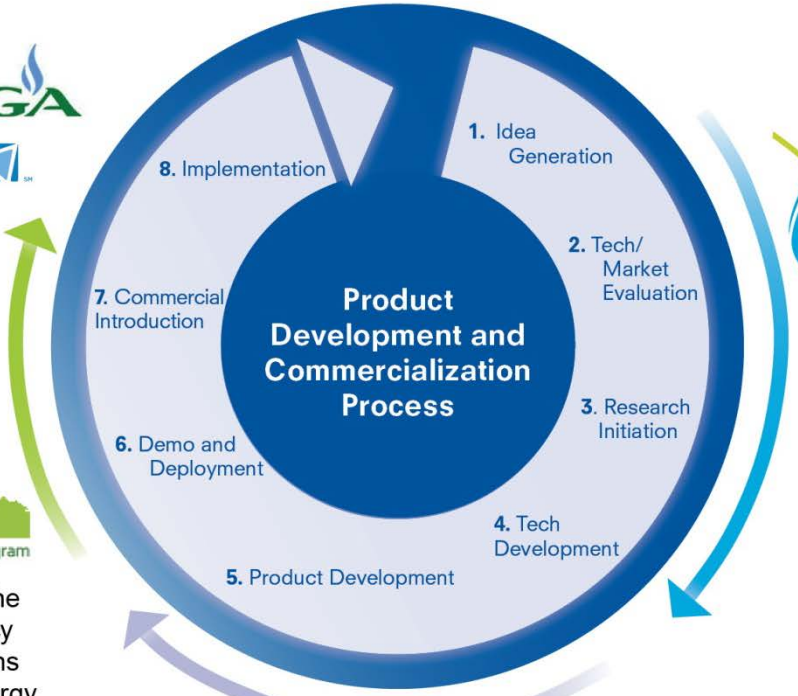
ETP
Emerging Technology Program

Utility Energy Efficiency (EE) Programs

AGA

CEE

ESC



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Established in 1985

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ETP encompasses a variety of new manufacturer technology/product offerings

UTD
Utilization Technology Development

UTD and its 16 members serve over 20 million gas consumers in 25 states and Canada. These companies work together on technology developments that meet their end-use customer energy efficiency and environmental needs

Established in 2004

ETP efforts will work with a range of manufacturers and end use customers, including major national accounts.

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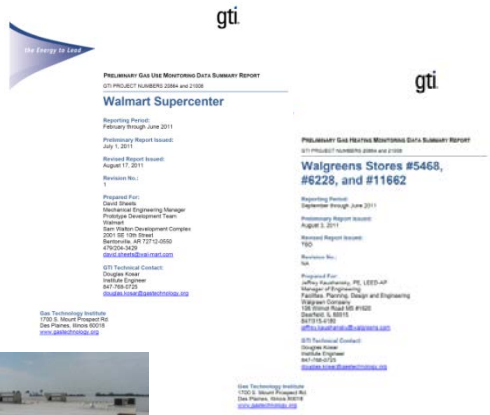
Emerging Technologies

- GTI has been active in the “emerging technology space” for many years
  - Not a new concept
  - Typically $1-5 million annually from gas industry and government partners
  - Expanding industry interest, driven in part by energy efficiency programs
    - For example, new three-year, $4 million ETP effort being launched with Nicor Gas
  - Opportunity for industry collaboration to leverage resources and increase market impact



ETP Scope

Emerging Technologies

Emerging technologies are new, energy efficient technologies, systems or practices that have significant energy savings potential but have not yet achieved sufficient market share to be considered self-sustaining or commercially validated within a given region or state.

- GTI is working with industry partners to develop a **national collaborative** (U.S. and Canada)
- Targeting **residential, commercial and industrial** solutions
- ETP is designed to **create value for member companies**, their ratepayers and related stakeholders
- ETP's principle goal is to **accelerate** the **market acceptance** of emerging technologies for inclusion in the utility's mainstream **energy efficiency programs**

National Collaborative

- **Significant scale** makes the **program attractive to commercial partners** as a vehicle to expedite the market introduction and acceptance of new efficient products
- **Funders drive agenda** and influence product/process deployments and evaluations to address the needs of their company, rate payers and the industry
- **Leverages collective funding, intelligence and experience** of program members to efficiently resolve technical and market barriers
- Provides **opportunity for field demonstrations within your service territory**, enabling a better understanding by utility personnel, customers, channel partners, trade allies and regulators
- Accelerates measure availability and **energy efficiency program savings**
- Positions companies to **drive new technologies into the market**

Program Activities

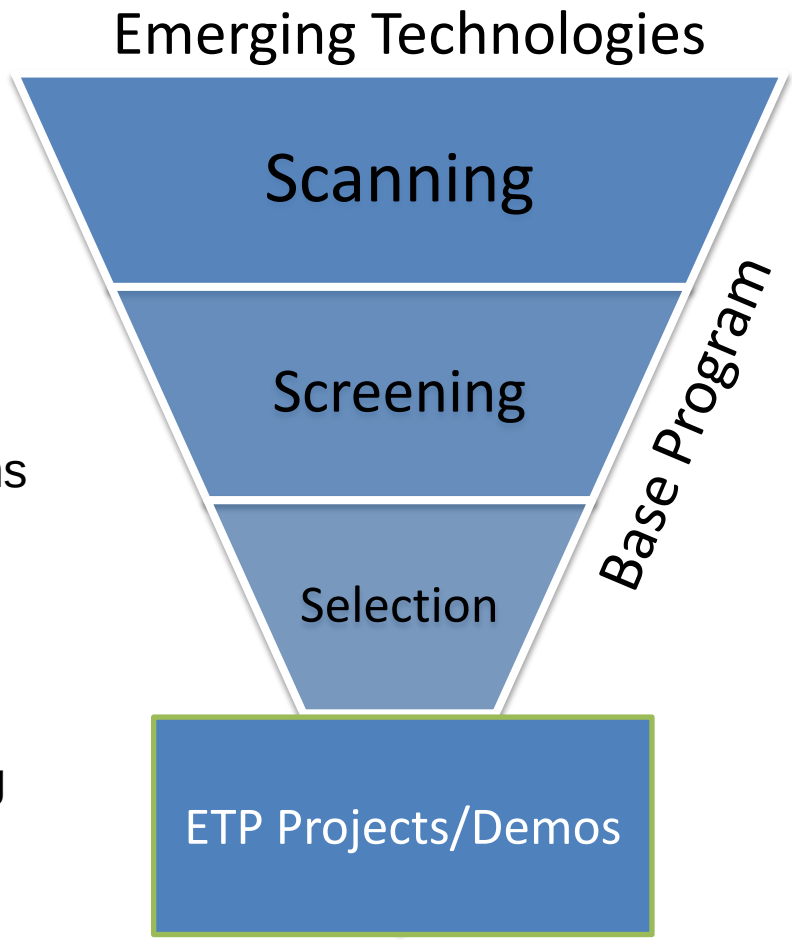
- Key activities may include:
  - **Product/process assessments**
    - Characterizing energy use, costs, benefits, market opportunities, energy savings potential and barriers
  - **Demonstrations**
    - Validate performance, efficiency, reliability
    - Enabling market development
    - Target unknowns, build program data
  - **Training, education and outreach**
  - **Develop robust work/white papers**

What Does ETP Do?

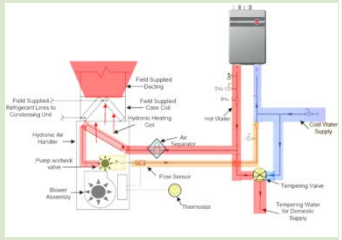
ETP is designed to help members identify and evaluate the most promising products and integrated solutions, assess their suitability for future use in utility energy efficiency programs, and deliver comprehensive program guidelines for successful full scale deployment.

ETP Projects/Demos

- GTI and its partners develop project proposals including scope, timeline and budget
- Collaborative project initiatives are expected to include:
  - In territory and/or regional demonstrations
  - Detailed technical and human data collection for full-scale program design and implementation guidelines
  - Market development including increasing contractor capacity and customer awareness



2012 ETP Projects

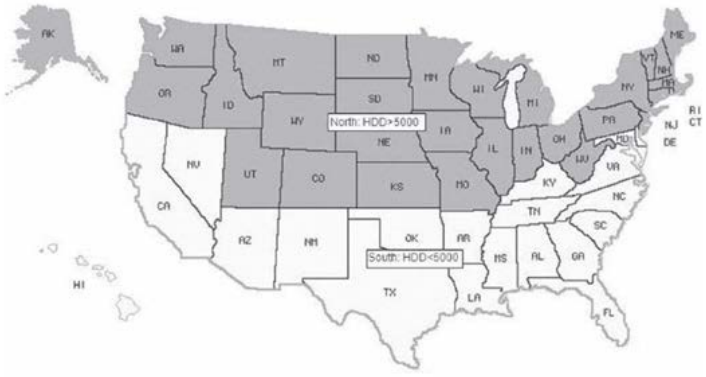
Energy Efficiency Opportunity		Market Sector
Combination Space/ Water Heater Systems	 	Residential/ Commercial
High-Efficiency Gas Heating Rooftop Package		Commercial
High-Efficiency Boilers, Ultramizer Deployment		Commercial/ Industrial

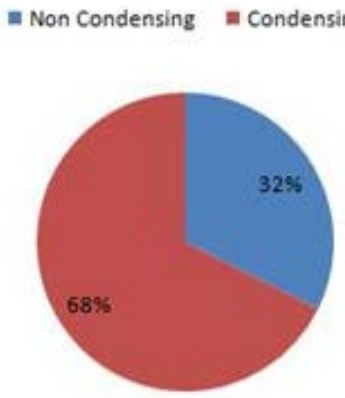
Residential Integrated HVAC and Water Heat: The Basics

- High efficiency tank or tankless water heater (90 EF+), combined with hydronic air handler
- Technology ‘concept’ has been around for years, but only recently have major manufacturers begun manufacturing truly integrated systems at cost-competitive prices
- For purpose components, DHW prioritization
- Currently available in marketplace, few takers
- New systems offer better capacity for larger homes

Residential Integrated HVAC and Water Heat: EE Programs

- DOE Direct Final Rule to require Northern Regions to raise the AFUE for non-weatherized gas furnaces from 80% to 90%
  - Full effect in 2013
- Condensing furnaces represent 68% of Northern Climate furnace shipments
- Decreasing opportunity for gas savings
- High efficiency water heating programs face challenging economics (e.g. TRC), especially with low gas prices
  - Improves utility/customer value proposition for water heating by piggy-backing on larger space heating load





Residential Integrated HVAC and Water Heat: The Customer

- Opportunity for significant energy savings (> 200 Therms annually)
- Improved payback, using one high efficiency device for two end use loads
- Direct vent, eliminating cost to reline chimney when customers ‘orphan’ water heater by upgrading to condensing furnace while retaining atmospherically-vented storage water heater (common in colder climates).
- New, pre-engineered systems supported by major manufacturers offer improved reliability and cost-effectiveness while reducing system design and installation errors

EXAMPLE:

Tankless:	$1,550
AHU:	$ 750
	$2,300

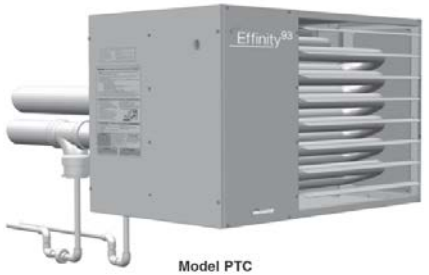
EXAMPLE:

Furnace:	$1,500
Heater:	$ 700
	$2,200

High-Efficiency Rooftop Packages & Unit Heaters for Comm/Ind Buildings

ETP Emerging Technology Program

- GTI is working with public-private partners to expand the availability and adoption of high-efficiency:
  - Rooftop space conditioning units
    - Packaged space heating and air conditioning units (Gas PACs)
    - Dedicated outdoor air systems (DOAS)
  - Unit space heaters
  - Achieving greater than 90% efficiency
    - Compared to conventional ~80% efficient products



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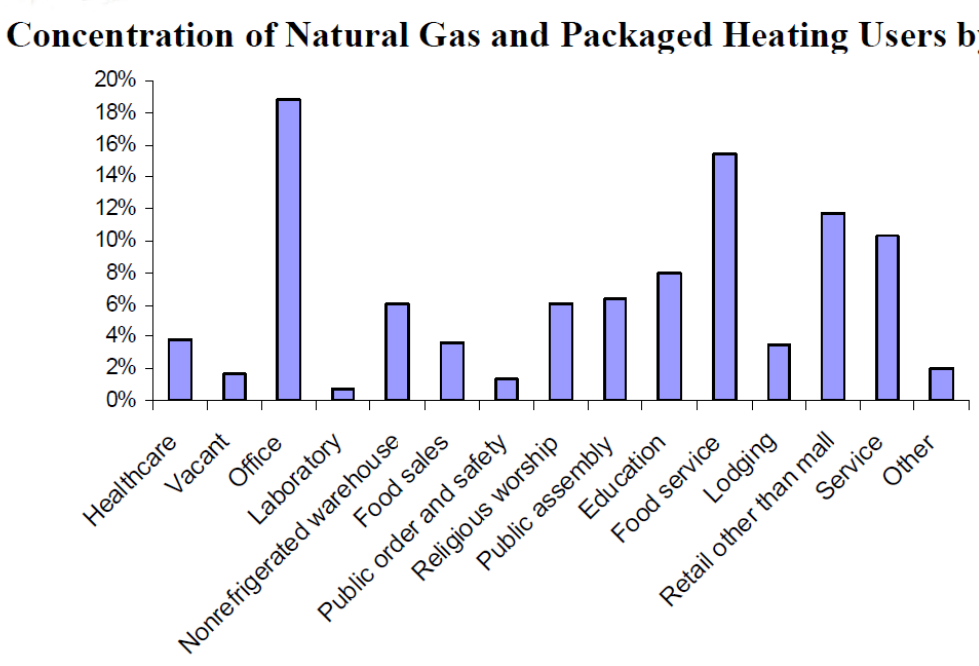
Gas PAC Market Attributes

> Gas PAC equipment used extensively in commercial and industrial building segments



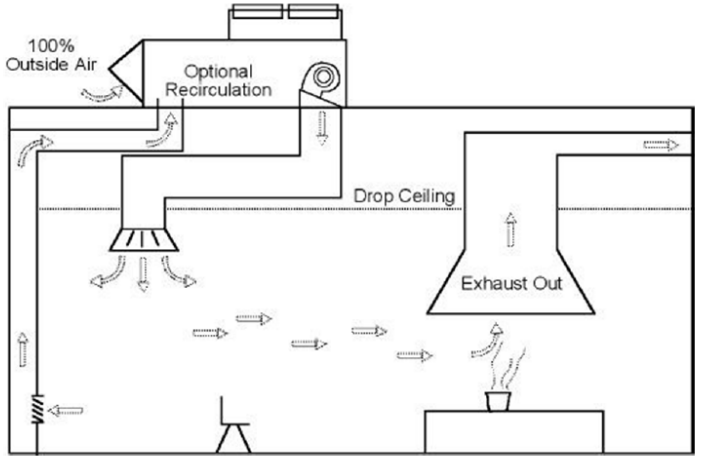
343 Trillion Btu of energy

465,000 commercial buildings

- Office
- Foodservice

Dedicated Outdoor Air Systems (DOAS)

- ASHRAE requirements point to need for fresh air supply to commercial buildings
- Dedicated outdoor air systems, or DOAS, provide a “neutral” source of fresh air



Commercial Heating Feedback
GTI National Account (NA) Interviews

ETP Emerging Technology Program

- One-on-one discussions with several major NA's
  - None specifying condensing heating equipment (no gas PACs available but high efficiency unit heaters in market)
  - Many use a combination of gas rooftop and unit heater equipment in the same retail building (e.g., SuperCenter)
  - DOAS coupled w/no outside air (OA) gas PACs have most promising net operating cost savings
  - Large numbers of HVAC retrofits peaking in next few years yields opportunity for cost effective, high efficiency heating entry

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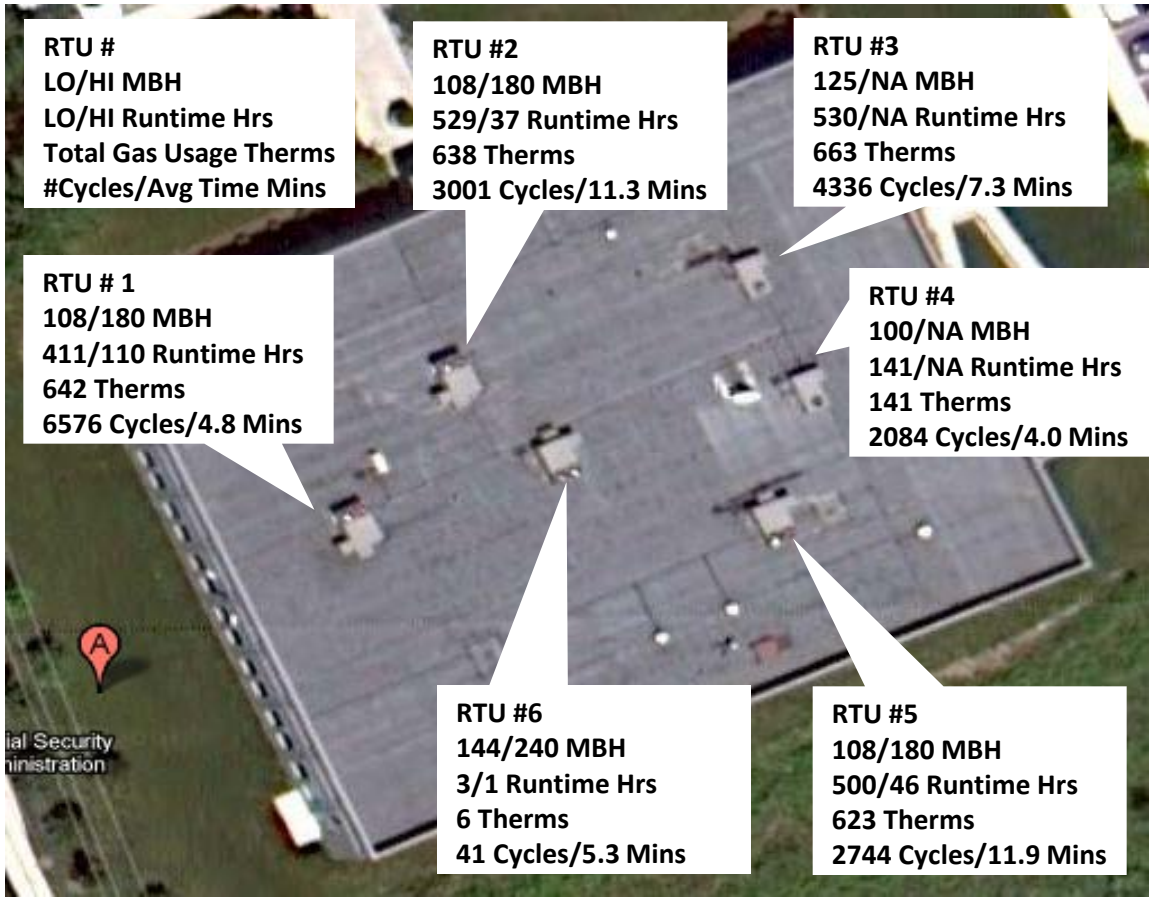
Gas PAC Field Monitoring

- GTI Conventional Gas PAC Field Monitoring
  - Over 105 gas PAC units in 11 Chicago area commercial buildings
  - Ranging in size from 2,000 to 200,000 sq ft
  - 1 small office
  - 3 quick service restaurants
  - 3 drug/convenience stores
  - 3 clothing/home goods stores
  - 1 retail “super” store

Sample Rooftop Monitoring Results

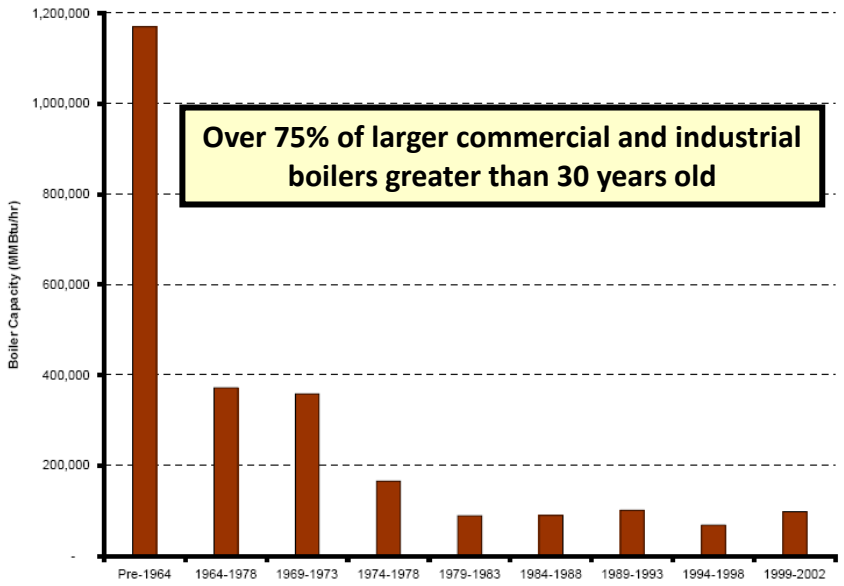


- Social Security Admin 12,500 sq ft bldg with 6 RTUs
- Preliminary results 10/29/10 - **2/23/11**
  - Great diversity in total RTU runtime: perimeter **>>** core
  - Average heating cycle times range from 4-12 minutes

Commercial & Industrial Boilers

ETP Emerging Technology Program

- Large population of outdated commercial/industrial boilers
  - New options for improved efficiency



Commercial

Building Type	Number of Boilers	Total Boiler Capacity (MMBtu/Hr)	Average Capacity per Facility (MMBtu/hr)
Education	35,895	128,790	3.6
Office	28,030	297,090	10.6
Health	15,190	317,110	20.9
Other	11,900	88,970	7.5
Lodging	10,545	140,830	13.4
Public Assembly	7,280	55,205	7.6
Retail	5,585	47,230	8.5
Warehouse	5,365	72,385	13.5
Total	**119,790**	**1,147,610**	**9.6**

Industrial

	Food	Paper	Chemicals	Refining	Metals	Other Industrial	Total
< 10 MMBtu/hr	6,570	820	6,720	260	1,850	7,275	23,495
10-50 MMBtu/hr	3,070	1,080	3,370	260	920	3,680	12,380
50-100 MMBtu/hr	570	530	950	260	330	930	3,570
100-250 MBtu/hr	330	540	590	200	110	440	2,210
>250 MMBtu/hr	70	490	350	220	120	110	1,360
Total Units	**10,610**	**3,460**	**11,980**	**1,200**	**3,330**	**12,435**	**43,015**

Source: EEA/ORNL (2005)

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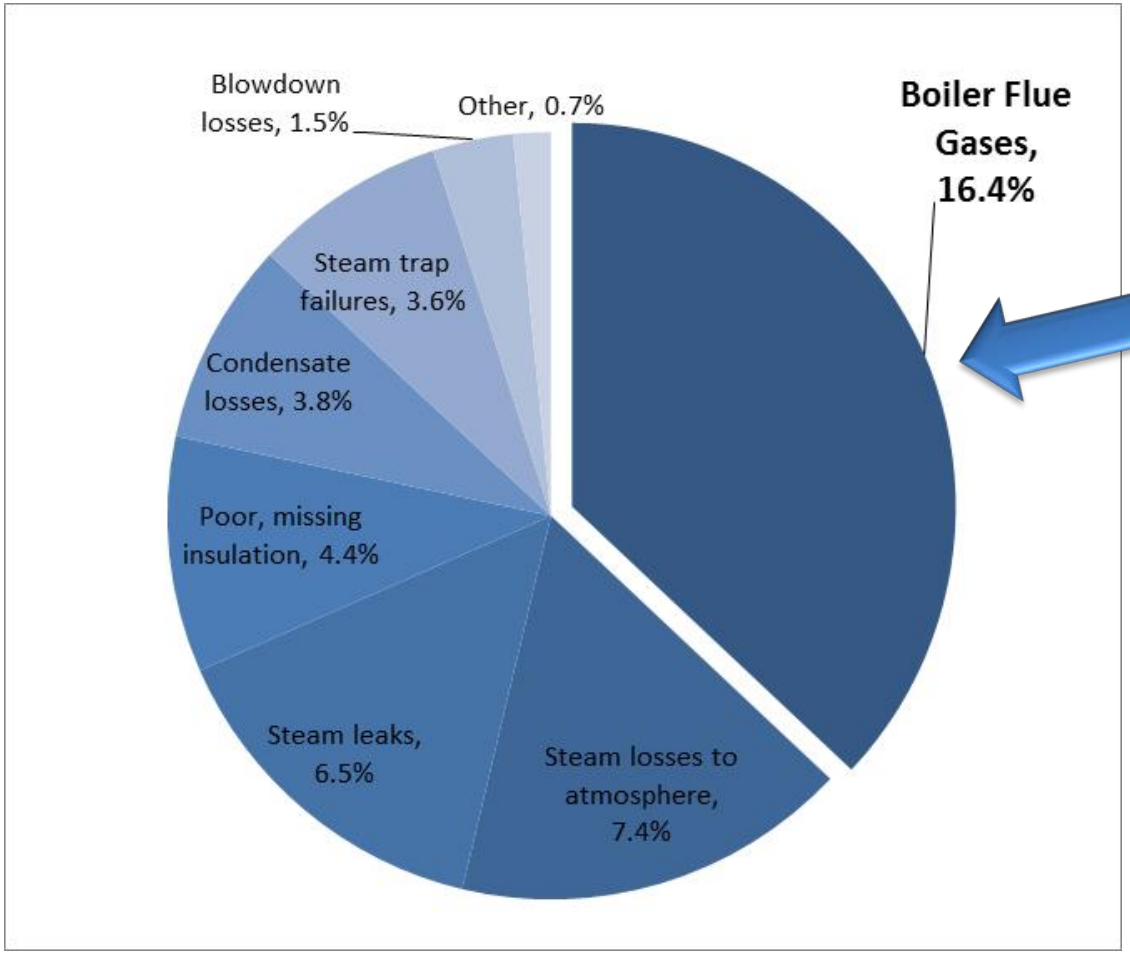
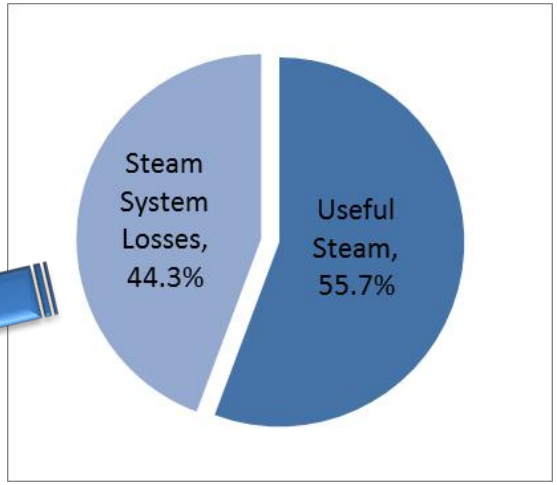
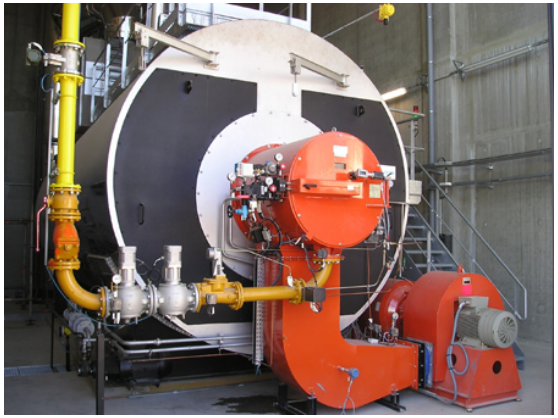
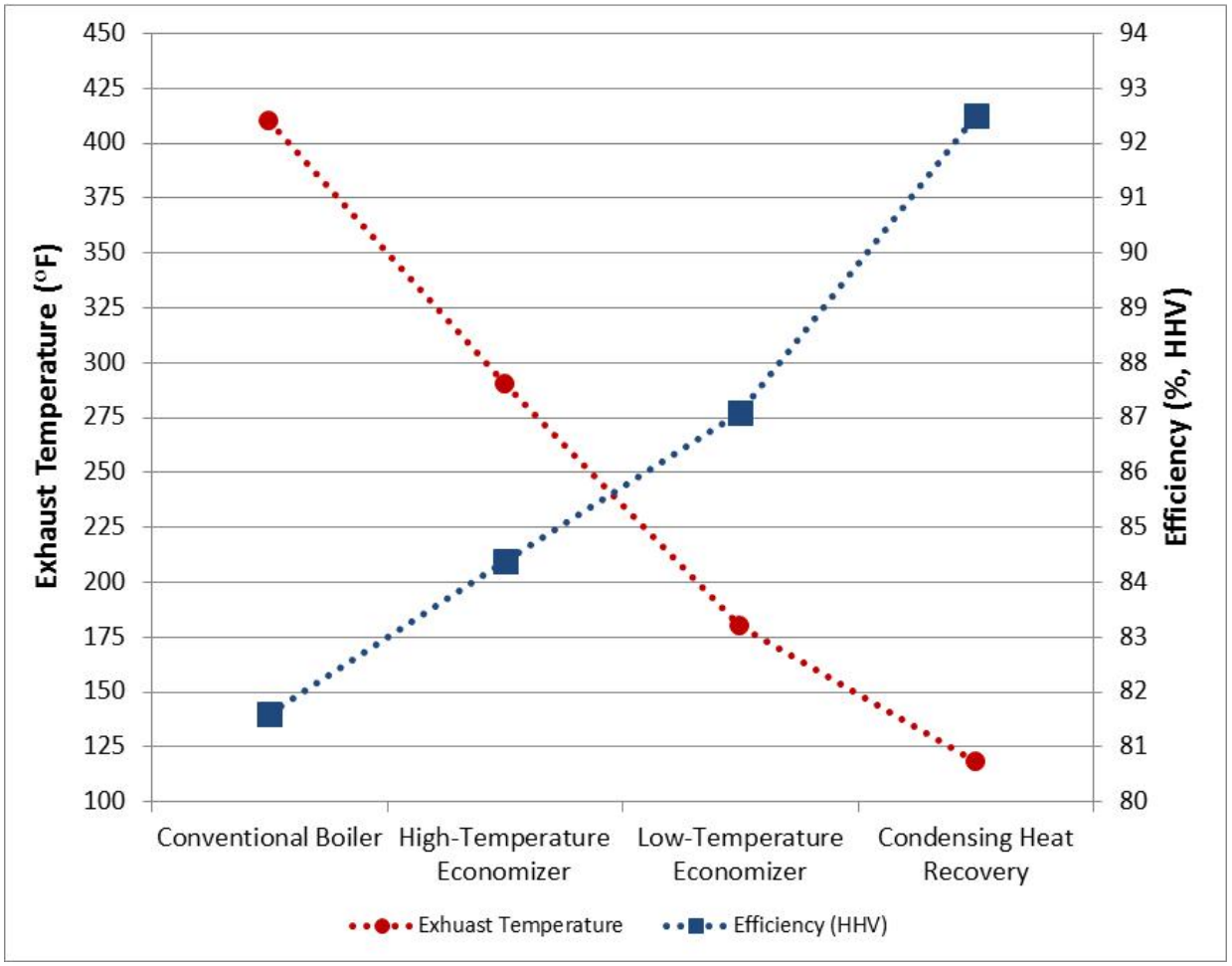
Steam Systems and EE Improvement Opportunities







Example Boiler Efficiency Improvement Options



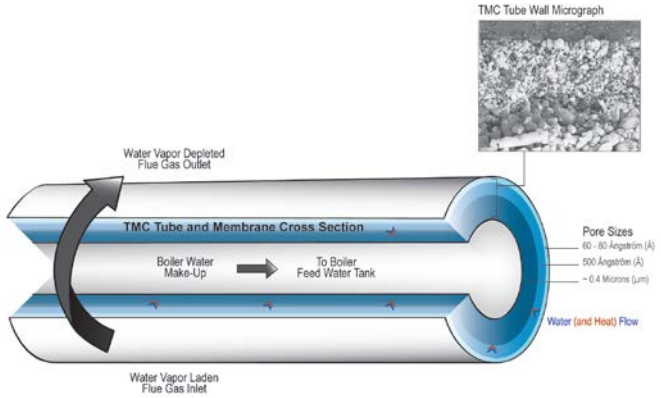
High and low temperature economizers may be made of carbon or stainless steel

Condensing economizers often use stainless steel to resist corrosion

Simultaneous Sensible & Latent Heat Recovery & Water Separation

ETP Emerging Technology Program

- GTI-developed Transport Membrane Condenser (TMC) technology
- TMC uses a robust nanoporous membrane to selectively remove <u>pure water</u> from natural gas combustion byproducts
  - Saves water and avoids corrosive condensation problem
- Successfully developed for C&I boilers with Cannon Boiler Works
  - Retrofit or new units



TMC tubes in a bundle assembly

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Ultra-High Efficiency Boiler

Advanced Heat Recovery at Baxter Healthcare

ETP Emerging Technology Program

- Field test of TMC-based heat recovery systems
- 13-15% energy and carbon savings
  - Total efficiency ~92.5%
- Over $40,000 annual savings at Baxter
  - Over $80,000 at higher hours & firing rates
- More than 250,000 gallons saved yearly

cbw Cannon Boiler Works, Inc.

Baxter

Southern California Gas Company
A Sempra Energy company

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ETP Summary: A Critical Role to Achieve Market Impact

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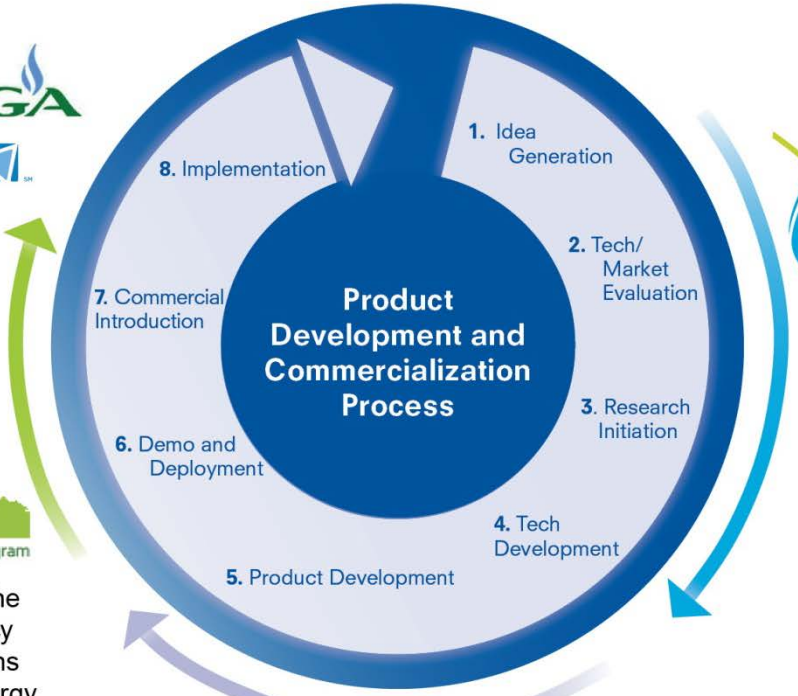

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Next Steps

- Program kick-off slated for Q2 2012
  - Base program activities including working group development
  - Discuss and select high priority ETP projects
- Continued program development activities
  - Grow membership
  - Support regulatory filings
  - Identify increased funding alternatives

Thanks, Questions?

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ETP Emerging Technology Program

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Emerging Technology Program (ETP)

Addressing implementation barriers and associated risks related to market acceptance and adoption of emerging technologies.

Improved energy efficiency is a shared policy goal around the world; it is often the most economic and readily available means of improving energy security and reducing carbon emissions. New technology is essential to further energy efficiency improvements and to move toward a cleaner, more sustainable energy future.

Emerging Technology Program (ETP) — A newly established collaborative program managed by Gas Technology Institute (GTI) — is focused on accelerating the commercialization and adoption of the latest energy efficient technologies. The program is designed to help companies identify and evaluate the most promising products and integrated solutions and assess their suitability for future use in utility energy efficiency programs.

GTI's industry-leading expertise provides the information and resources required to help advance market acceptance of emerging technologies for near- to mid-term implementation. ETP strives to create market pull by deployment of natural gas solutions at a desired scale, leading to self-sustaining commercial viability and impact.

Effective Industry Collaboration

Collaborative ETP initiatives provide an opportunity for companies to share insights, leverage energy efficiency funds and help increase the transfer of technology between upstream innovations and the marketplace.

ETP also offers access to GTI services and capabilities for energy efficiency program planning, implementation and assessment. GTI and its partners can work with your company to tailor or modify initiatives to address company or regionally specific needs and opportunities. We can also support a regulatory submission for ETP authorization. GTI has a long history of working collaboratively with utility companies, regulatory agencies, local state/federal government, non-government organizations, manufacturers, channel partners, trade allies and other stakeholders to reduce the time and cost of getting new technology to market.

ETP activities are "beyond development" stage: Field Testing, Demonstration, and Deployment — a focused effort to ensure market acceptance of next-generation emerging technologies

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