

CT 1931-1 Industry Standard Practice: Boilers and Furnaces

Findings and Recommendations

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6/28/21

Agenda

- Study Background and Objectives
- ISP and Baselines
- Study Approach
- Findings (Furnaces and Boilers)
- Recommendations (Furnaces and Boilers)



Empowering you to make
smart energy choices



Project Objectives

For commercial furnaces and boilers:

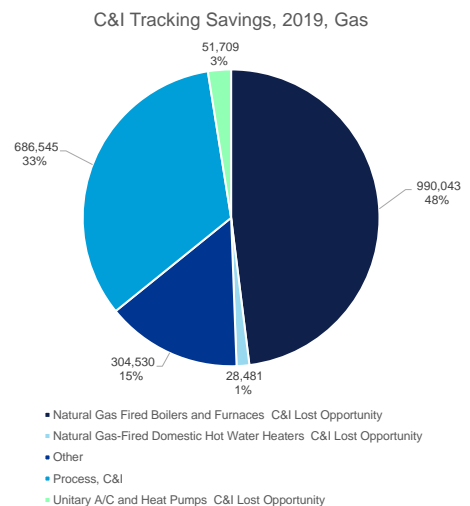
- Determine Industry Standard Practice based on primary and secondary research
- Provide recommended efficiency values for use in the PSD



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ISP and Baselines

- Industry Standard Practice (ISP) is a method for identifying appropriate baselines for measures that have no applicable code, or for measures for which there is evidence of practices above or below code
- Industry-leading jurisdictions (CA, MA, WA, RI) are using non-code ISP more often, even when code applies.
- CT has started to use ISP baselines in some cases
 - Residential natural gas furnaces & boilers uses 2018 evaluation findings
 - Residential GSHP uses ENERGY STAR Tier 1
 - Findings from this study are recommended as baselines for commercial furnaces and boilers
- C&I lost opportunity boilers and furnaces accounted for nearly half of 2019 CT gas savings



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Existing Baselines in PSD

Furnaces

Federal Minimum Standard

1994-2023 Standard	80%	Et
Standard Starting 2023	81%	Et

International Energy Conservation Code

IECC-2015	80%	AFUE
IECC-2018	80%	Et

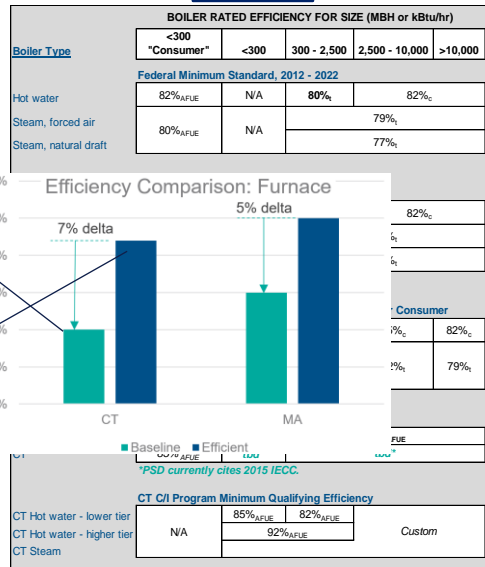
Industry Standard Practice

CT Residential ISP	85%	AFUE
MA Residential and Commercial ISP	85%	AFUE

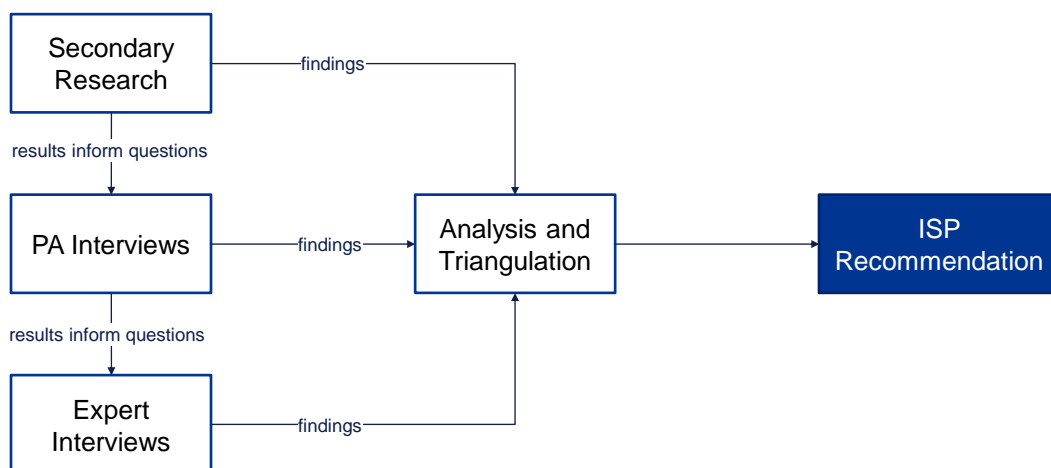
High Efficiency Systems

EnergizeCT program minimum, commercial	92%	AFUE or Ec
MA program minimum, up to 150 kBtu/hr, requires ECM. Bonus for 97%	95%	AFUE
DOE "maximum technologically feasible" as of 2016	92%	Et
Maximum available efficiency on the market	98%	AFUE

Boilers



Study Approach



Industry Experts Characteristics

- Interviewees:
 - 10 experts completed 15 interviews
 - 5 designer, 2 distributor, 6 installer, and 2 manufacturer
- Activity level over past 2 years:
 - 400 furnace, 1,100 boiler
- Application type:
 - RoF¹: 66% furnace, 53% boiler
 - ER²: 15% furnace, 29% boiler
 - NC³: 18% furnace, 19% boiler
- Incentives:
 - 11% furnace, 77% boiler

¹ Replace on failure is replacement of failed equipment or financially unviable to maintain

² Early replacement includes all projects where working equipment was replaced, regardless of age

³ New Construction projects include gut renovations and new building

Commercial Furnace ISP Major Findings

Parameter	ISP Recommendation
Furnace Type	Blend of condensing and non-condensing furnaces.
Furnace Efficiency	<p>85% efficiency for unknown conditions. Acknowledges that there is a significant market share of condensing equipment but still a high degree of standard efficiency equipment as well.</p> <p>90% E_c for known existing condensing stack.</p> <p>80% E_c code baseline for known no existing condensing stack.</p>
Variations	<120,000 Btu/hr: use residential baseline equipment baselines as evaluations and ISP studies are conducted.
NC/ROF Differences	No variation by NC or ROF

Commercial Furnace ISP Major Findings (cont.)

Parameter	ISP Recommendation
Existing Conditions that Change Baseline	Existing condensing stack: condensing equipment is baseline
Barriers to installing efficient equipment	Physical limitations in space for installing condensing venting: code efficiency is baseline
Equipment qualifies or partially qualifies for incentive, but does not receive	Some condensing equipment is sold outside the program.
Future market changes	Baseline conditions will continue to increase in efficiency over time.

Commercial Boiler ISP Major Findings

Parameter	ISP Recommendation
Boiler Type	Hot water distribution system: Condensing Hot Water Boiler Steam distribution system: Steam Boiler <i>Exception: for hot water systems where installing a condensing boiler is not physically possible due to space or venting constraints, a cast iron sectional boiler is the recommended baseline.</i>
Boiler Efficiency	Small boilers (<300,000 Btu/hr): 92% AFUE Medium boilers (300,000<n<2,500,000 Btu/hr/): 90% combustion efficiency Large boilers (>2,500,000 Btu/hr): 90% combustion efficiency Exception: cast iron sectional boiler: 82% combustion efficiency
Steam Boiler Efficiency	82% combustion efficiency

Commercial Boiler ISP Major Findings (cont.)

Parameter	ISP Recommendation
Supply and Return Water Setpoints	Standard supply water temperature based on distribution system. Design temperature for ROF applications is often 180F, somewhat lower for other distribution system types. 40F delta T standard assumption between supply and return.
Existing Conditions that Change Baseline	Existing condensing stack means a condensing boiler is always baseline.
Barriers to installing efficient equipment	If physical space limitations prevent a condensing stack from being installed, a sectional cast iron boiler is the baseline.
Equipment qualifies for incentive, but does not receive	Evidence of a high efficient market share
Future market changes	Condensing equipment supported as baseline

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Ancillary Findings



Most boiler projects received incentives.

Experts noted that the program has been very effective at changing the way equipment is designed, hinting at market transformation.



Incentives were cited as an important decision-making factor for customers.



Venting cited as a barrier to installing efficient equipment.

Additional incentive dollars to help projects with these barriers may be effective, especially given the recommended increase to the baseline efficiency.

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Baseline Efficiency Recommendations

Parameter		Current (IECC 2021)	Recommended
Furnace	All sizes	80% E_t	Unknown existing venting: 85% E_t Existing condensing stack: 90% E_t Existing non-condensing stack: 80% E_t
Boilers	Small (<300,000 Btu/hr)	82% AFUE	92% AFUE
	Medium (300,000 to 2,500,000 Btu/hr)	80% E_t	90% E_c
	Large (>2,500,000 Btu/hr)	82% E_c	90% E_c
	Steam	80% AFUE (<300,000 Btu/hr) 79% E_t (>300,000 Btu/hr)	82% E_c (all sizes)
	Cast Iron Sectional Hot Water	82% AFUE (<300,000 Btu/hr) 80% E_t (300,000 – 2,500,000 Btu/hr) 82% E_c (>2,500,000 Btu/hr)	82% E_c (all sizes)

AFUE = Annual Fuel Usage Economy

E_c = Combustion Efficiency

E_t = Thermal Efficiency

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14 DNV ©