x1931-7: PSD HDD/CDD Update Study

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Agenda

- ❑ Study Background
- ❑ Study Objectives
- ❑ Methodology
- ❑ Results
- ❑ Conclusions and Recommendations

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Study Background

DD – Degree Days
HDD – Heating Degree Days
CDD – Cooling Degree Days
NOAA – National Oceanic and Atmospheric Administration
TRM – Technical Reference Manual
TMY – Typical Meteorological Year

- The CT PSD uses single state-wide HDD and CDD values.
  - Current PSD HDD/CDD values are based on Hartford (inland) weather data.
  - Preliminary analysis of TMY data showed inland HDDs are 12% greater than coastal; inland CDDs are 9% greater than coastal.
  - Program participation data show about one-third of residential participants can be classified as coastal.
- Current PSD HDD/CDD values reflect 1978-2008 NOAA weather data.
  - Other jurisdictions are updating weather data to reflect recent climate trends.
- R91 impact evaluation best practices study recommended inclusion of coastal weather data in DD calculations.

Study Background

- Measures in the PSD that use HDD/CDD values.

Measures Affected	Equation in the PSD
Insulate Attic Openings, Residential	$ABTU_{Conductive} = A \times \left(\frac{1}{R_e} - \frac{1}{R_i} \right) \times HDD \times 24 \frac{hrs}{day} \times F_{adj}$
Wall Insulation, Residential	$ABTU_{Conductive} = A \times \left(\frac{1}{R_e} - \frac{1}{R_i} \right) \times HDD \times 24 \frac{hrs}{day} \times F_{adj}$
Ceiling Insulation, Residential	$ABTU_H = \left(\frac{1}{R_{existing}} - \frac{1}{R_{new}} \right) \times HDD \times 24 \times F_{Adj} \times A$
Floor Insulation, Residential	$ABTU_H = \left(\frac{1}{R_{existing}} - \frac{1}{R_{new}} \right) \times HDD \times 24 \times F_{Adj} \times A \times GF$
Kitchen Hood Controls, Commercial	HDD and CDD values are used as inputs in the savings calculation spreadsheet

Study Outcomes

- The outcomes of this study are:
  - Utility-specific HDD and CDD values based on recent climate data and population-based weighting.
  - A single state-wide set of weighted HDD and CDD values.
  - Separate HDD and CDD values for inland and coastal regions.

Methodology – Weather Data

Station ID	Location
WBAN:00169	Chester Airport
WBAN:54734	Danbury Municipal
WBAN:14707	Groton New London Airport
WBAN:14740	Hartford Bradley Intl Airport
WBAN:14752	Hartford Brainard Field
WBAN:94702	Igor I Sikorsky Memorial
WBAN:54788	Meriden Markham
WBAN:14758	New Haven Tweed
WBAN:64707	Oxford Waterbury
WBAN:54767	Willimantic Windham

- NOAA collects data among 10 weather stations in CT.
- We gathered 2005-2020 (16 years) of historical weather data for all 10 stations.
- The 16-year hourly temperature data were averaged to calculate average annual hourly temperature data for each station.
- Annual average HDD and CDD values were calculated for each station using the average annual hourly temperature data.
  - Degree-day values reflect a base temperature of 65°F.
  - HDD/CDD values for other base temperature scenarios were calculated for comparison.
  - The PSD uses the DD values for annual energy calculation, not peak demand estimation.

Note: NOAA reports weather data for 2006-2020 only for Meriden Markham, Oxford Waterbury, and Willimantic Windham; For Chester Airport, NOAA reports weather data for 2009-2020 only.

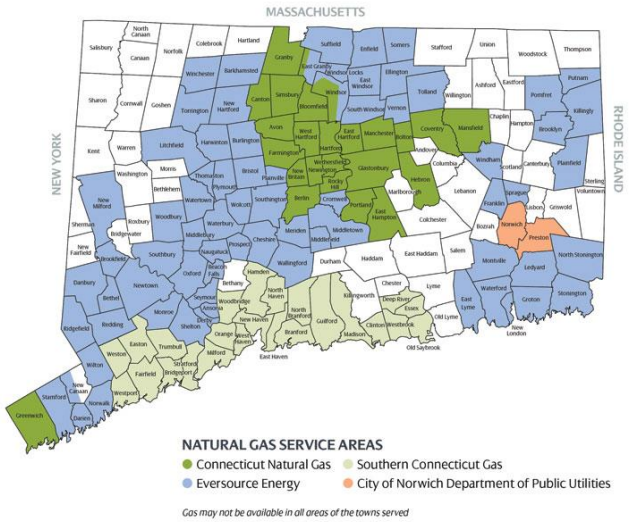
Methodology – Statewide Values

Weighting among different weather stations:

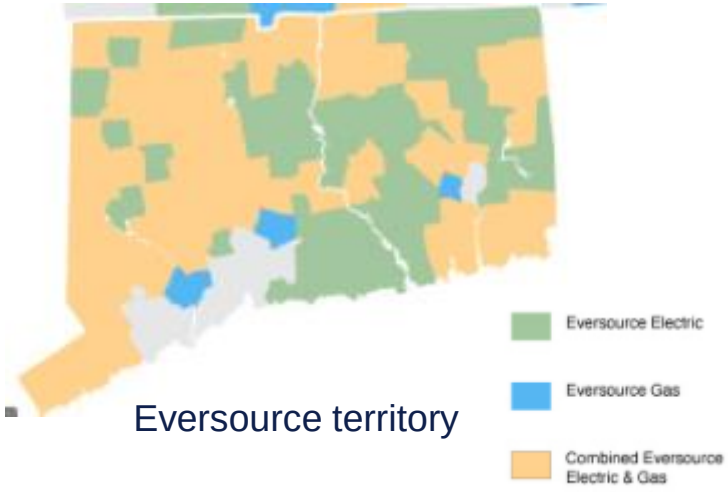
- We initially tested HES/IE 2019 program participation data (installations by zip code, reported energy savings, and incentive values) as weighting variables.
  - However, 2019 data was “noisy” due to variation in program activity by region.
- As such, census-based population data was used as the weighting variable.
  - Zip codes were assigned to the most proximate of the 10 weather stations via latitude/longitude mapping.
- For statewide HDD/CDD calculations:
  - Percentage weights for each weather station were calculated based on population data.
  - The weights were multiplied with the corresponding HDD/CDD values for each station. The values were then added to calculate the statewide HDD/CDD values.

Methodology – Utility-Specific Values

Based on municipal data cross-checked with utility coverage maps, each zip code in CT was associated with an electric and gas utility.



UI electric territory



Eversource territory

Source: utility territory map, utility by town data from ct.gov
https://www.energizect.com/events-resources/energy-basics/natural-gas-conversion
https://business.ct.gov/-/media/DOT/documents/dutilities/UTILITY-BY-TOWN.pdf

Methodology – Utility-Specific, Inland vs. Coastal

- Utility-specific HDD/CDD calculations:
  - Utility-specific HDD weights were calculated using population data of zip codes with Eversource or UI gas service.
  - Utility-specific CDD weights were calculated using population data of zip codes with Eversource or UI electric service.
- For inland/coastal HDD/CDD calculations:
  - Each weather station (and its corresponding statewide population-based weight) was labelled as either “inland” or “coastal” based on proximity to ocean.
  - The inland and coastal weights were then scaled to 100% equivalent.

Results by Utility

- Utility-specific HDD/CDD (65°F base) Values
  - HDD values

Description	Current PSD Values	Updated Values	% Difference
Eversource HDD	5,885	5,473	-7.0%
UI HDD	5,885	5,165	-12.2%

  - CDD Values

Description	Current PSD Values	Updated Values	% Difference
Eversource CDD	603	757	25.5%
UI CDD	603	864	43.3%

Statewide and Inland/Coastal Results

- State-wide HDD/CDD (65°F base) values

Description	Current PSD Values	Updated Values	% Difference
Statewide HDD	5,885	5,362	-8.9%
Statewide CDD	603	772	28.0%

- Inland and coastal HDD/CDD (65°F base) values

Description	Current PSD Values	Updated Values	% Difference
Inland HDD	5,885	5,578	-5.2%
Coastal HDD	5,885	5,019	-14.7%
Inland CDD	603	740	22.7%
Coastal CDD	603	823	36.5%

Conclusions and Recommendations

- ❑ We developed utility-specific, state-wide and inland/coastal DD values based on 2005-2020 weather data of 10 different weather stations in CT.
- ❑ We recommend adopting inland/coastal (regional) DD values in the PSD.
  - Alternatively, utility-specific DD values should be adopted if regional DD values cannot be used due to tracking database limitations.
  - The DD values should be updated in the following sections of the PSD.

Description	PSD Reference
Insulate Attic Openings, Residential	Page 242, Table 4-WWW
Wall Insulation, Residential	Page 251, Table 4-IIII
Ceiling Insulation, Residential	Page 258, Table 4-LLLL
Floor Insulation, Residential	Page 264, Table 4-OOOO
Kitchen Hood Controls, Commercial	Custom spreadsheet
Appendix Seven	Page 332-333, Table A7-1: Abbreviations and Acronyms

- ❑ Updating DD values in the PSD will avoid overestimation of heating savings by 9% and underestimation of cooling savings by 28%.
  - Differences between the current PSD DD values and the developed DD values come from inclusion of coastal weather data as well as recent changes in climate.

Conclusions and Recommendations (cont'd)

- Revision to HDD and CDD values may cause a "domino effect" to RRs.
  - The CT PSD's Appendix 3 RRs for residential weatherization measures are based on billing analysis from 2018 HES/IE evaluation. The RRs therefore reflect historical weather from the mid-2010s.
  - If unaddressed, changes in HDD and CDD could double-count the impact of milder weather.
  - The RRs need to be adjusted using the HES-IE evaluation data to ensure no double-counting.
  - We are working with the EA Team to quantify RR adjustments, which will require data requests of prior evaluation studies. Aiming to complete this added research in time for 2022 PSD.
  - Worst case alternative: ad-hoc adjustment of RRs in utilities' tracking systems after PSD is posted.

Thank You

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