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<th><strong>Docket Number:</strong></th>
<th>19-BSTD-03</th>
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<tr>
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<td>2022 Energy Code Pre-Rulemaking</td>
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<tr>
<td><strong>Document Title:</strong></td>
<td>Presentation - Impacts of 2022 Metrics on Nonresidential and High Rise Residential Building Performance Compliance</td>
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<tr>
<td><strong>Description:</strong></td>
<td>Updated version of a presentation originally presented at the March 2020 Staff Workshop on Compliance Metrics.</td>
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<td><strong>Filer:</strong></td>
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Impacts of 2022 Metrics on Nonresidential and High Rise Residential Building Performance Compliance - Updated with 20 Year Metrics
Large Suite of Simulations
- Eight Building Types – Large, Medium and Small Office, Large and Medium Retail, Small School, Warehouse, High-Rise Residential
- 16 Climate Zones
- New 2022 Weather Files
- 2019 Weather Files

Effects of Switching to Electric Heat
- Multiple system types
- Mix of gas heat and electric heat

Effects on Selected Efficiency Measures
- Reduced LPD, Increased heating efficiency, Increased cooling efficiency, Increased residential water heating efficiency

Effects on Envelope Tradeoffs
- Reduced opaque Insulation, Reduced glazing SHGC, Increased glazing U-factor, Increased WWR (Office and Residential)

Grid Harmonization Signals
- Increased cooling efficiency vs. PV
Six metrics
- TDV Policy, 0% Retail Adder, CH₄ Leaks
- TDV Policy, 0% Retail Adder, No CH₄ Leaks
- TDV Policy, 15% Retail Adder, CH₄ Leaks
- TDV Policy, 15% Retail Adder, No CH₄ Leaks
- Source Energy, CH₄ Leaks
- Source Energy, No CH₄ Leaks

Source metrics identical

No difference between electric TDV with and without CH₄ leaks

Look at Electrification, Efficiency Measures, Envelope Tradeoffs, and Grid Harmonization
Large Office – Gas VAV (VAV with chillers and gas boilers) is used in the baseline

For electric heat systems (WSHP and Elec VAV), improvements needed to reduce TDV deficit

For gas heat system (four-pipe fan-coil), improvements must be enough to get source to 0
Small Office — SZAC (Single Zone A/C with gas furnace) is used in the baseline

Similar Trends –
for electric heat systems (WSHP, heat pumps and VRF), TDV will limit reduced efficiency for gas heat systems (SZVAVAC, GasPVAV, FPFC), Source will limit reduced efficiency, TDV for electric and gas single zone systems is similar, source very different.
Medium Retail - SZVAVAC (Single Zone VAV A/C with gas furnace) is used in the baseline

Similar Trends except for SZAC. SZAC is constant volume fan, so the reduced compliance margin is primarily due to increased fan energy, so TDV is the limiting criterion.
High-Rise Residential - FPFC (Four-Pipe Fan Coil) in the dwelling units and VAV in the nonresidential spaces, both served by chillers and gas boiler, are used in the baseline. System changes below are only in residential dwelling units.

Similar trend again

Water heating is significant, so electric water heating gives large Source benefit
EFFICIENCY MEASURES

Large Office – Change in compliance for different measures
- Relative to VAV with hot water or electric resistance reheat
- Don’t compare magnitude of different measures – arbitrary changes used
- Look at differences between TDV and Source for each measure

Trading off envelope – Source provides larger penalty than TDV, except for SHGC increase
Large Office – Cooling efficiency increase vs. adding PV - PV scaled to provide equal kWh savings

TDV and Source both show much larger impact from increased cooling efficiency than PV – Source more than double, TDV slightly less.

TDV with 15% adder gives more credit for efficiency, less for PV relative to 0%
Analysis in CSE, “Simple” control algorithm

Metric values for PV and battery systems that provide the same savings in TDV 0%

TDV 0% favors PV, Source strongly favors battery, TDV 15% in between
CONCLUSIONS

- Source energy is the driver for electrification
- TDV drives cost effective options
- Trading off envelope efficiency in a design will result in large Source energy penalty and a larger TDV penalty than in 2019
- Both metrics give similar signal when comparing PV to cooling efficiency, reducing value of PV – but particularly for Source energy
- Source energy magnifies value of battery storage compared to PV
- TDV variants show only small differences – except for batteries