

DOCKETED

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Impacts of 2022 Metrics on Nonresidential and High Rise Residential Building Performance Compliance

October 17, 2019

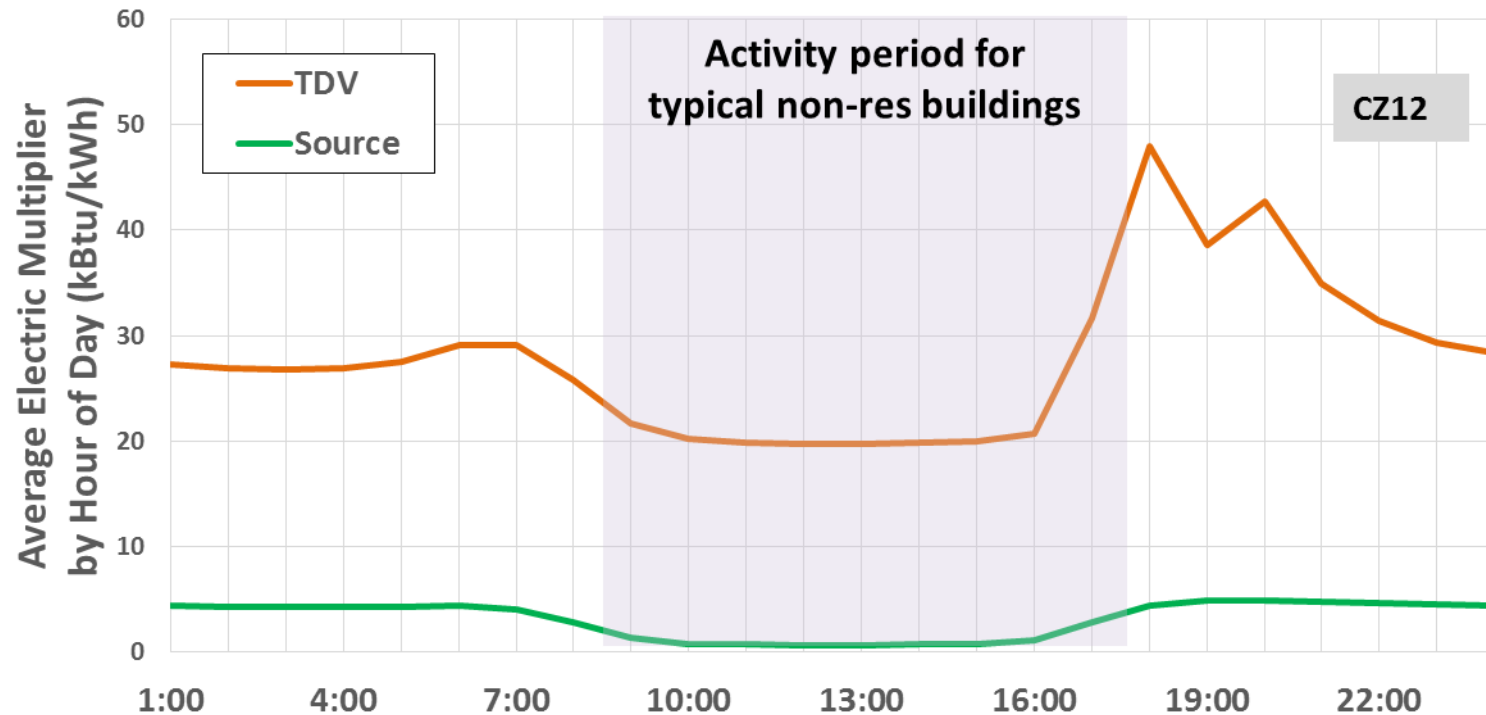
Roger Hedrick

APPROACH

- ▶ **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
- ▶ **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

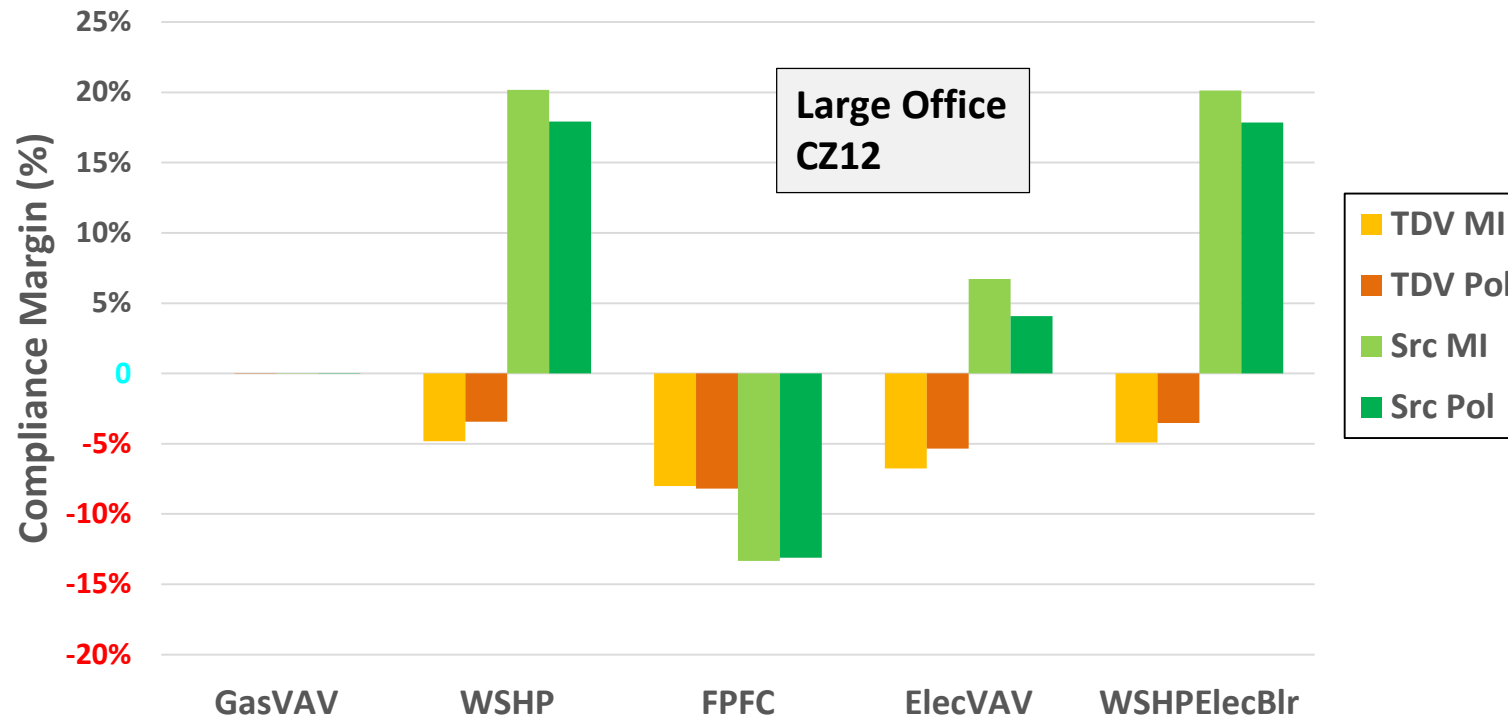
APPROACH

- ▶ Four metrics
 - TDV MI (Mid-IEPR)
 - TDV Pol (Policy)
 - Src MI (Source Mid-IEPR)
 - Src Pol (Source Policy)
- ▶ Look at Electrification, Efficiency Measures, Envelope Tradeoffs, and Grid



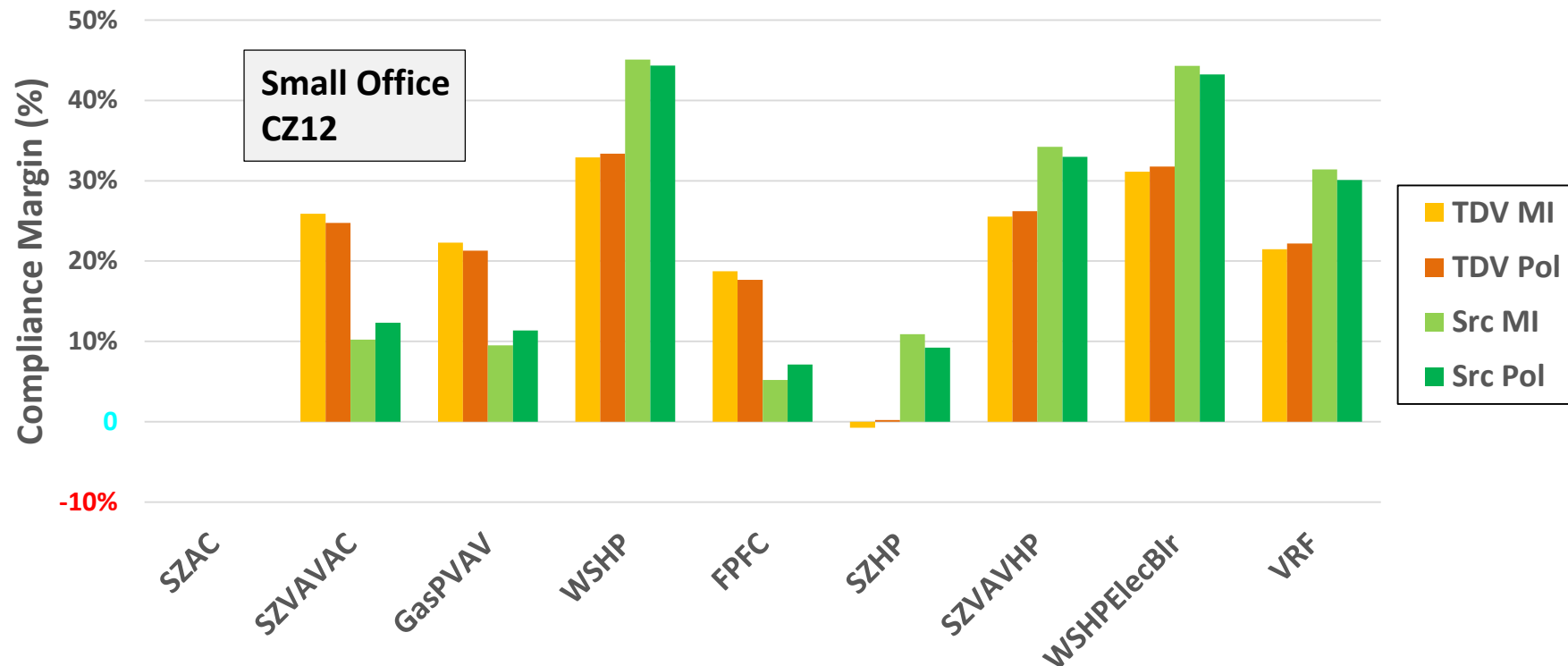
SYSTEM SWITCHING (INCL. ALL ELECTRIC)

- ▶ Large Office - Gas VAV (VAV with chillers and gas boilers) is used in the baseline
- ▶ For electric heat systems (WSHP and Elec VAV), TDV compliance is limiting criterion
- ▶ For gas heat system (four-pipe fan-coil), Source is limiting criterion



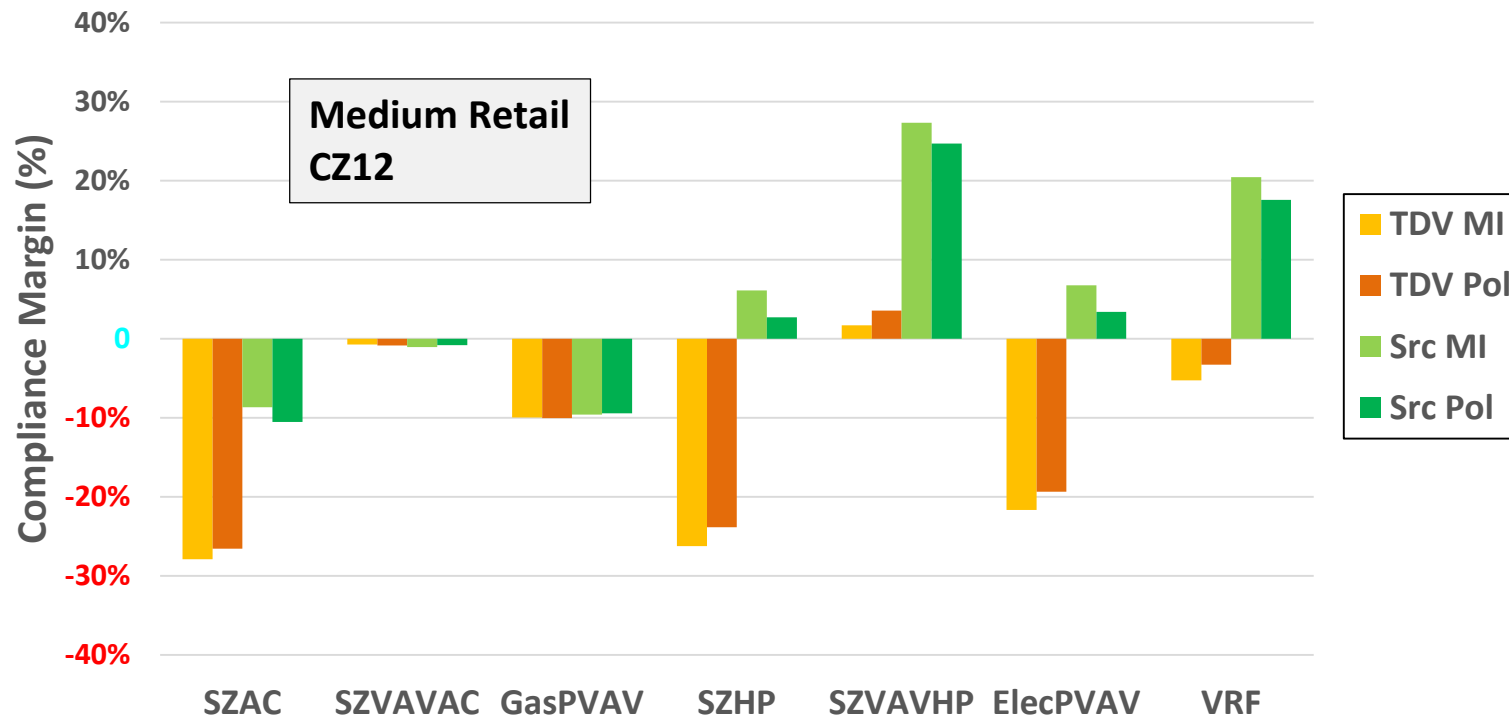
SYSTEM SWITCHING (INCL. ALL ELECTRIC)

- ▶ 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 compliance is limiting criterion,
 - for gas heat systems (SZVAVAC, GasPVAV, FPFC), Source is limiting.



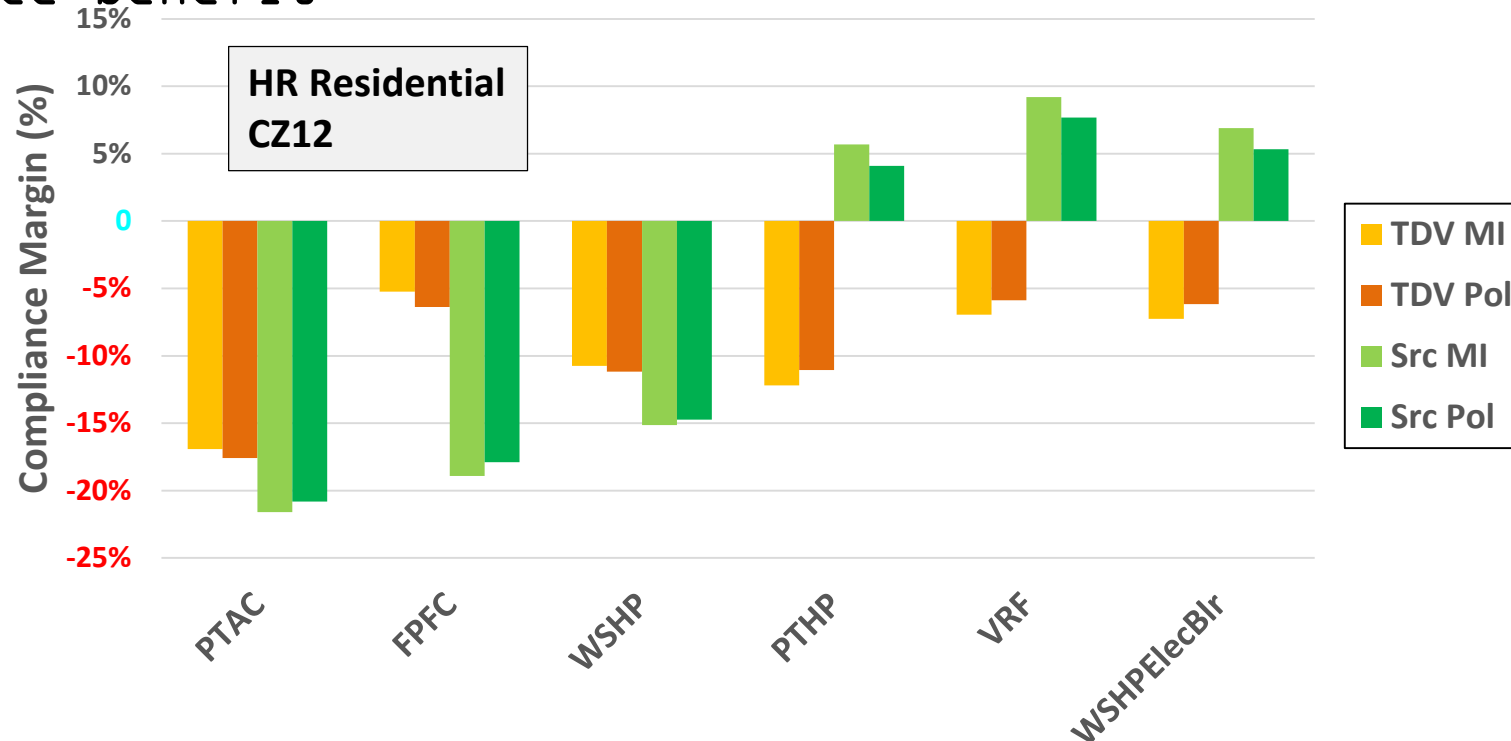
SYSTEM SWITCHING (INCL. ALL ELECTRIC)

- ▶ 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



SYSTEM SWITCHING (INCL. ALL ELECTRIC)

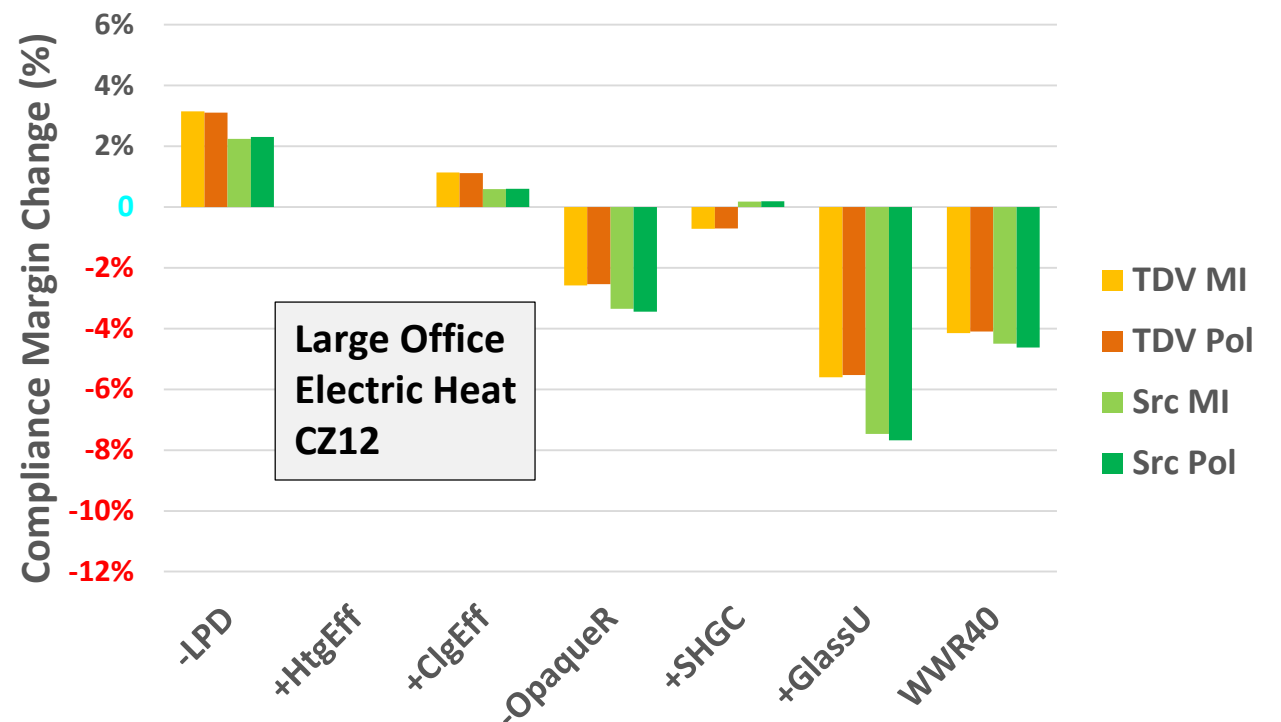
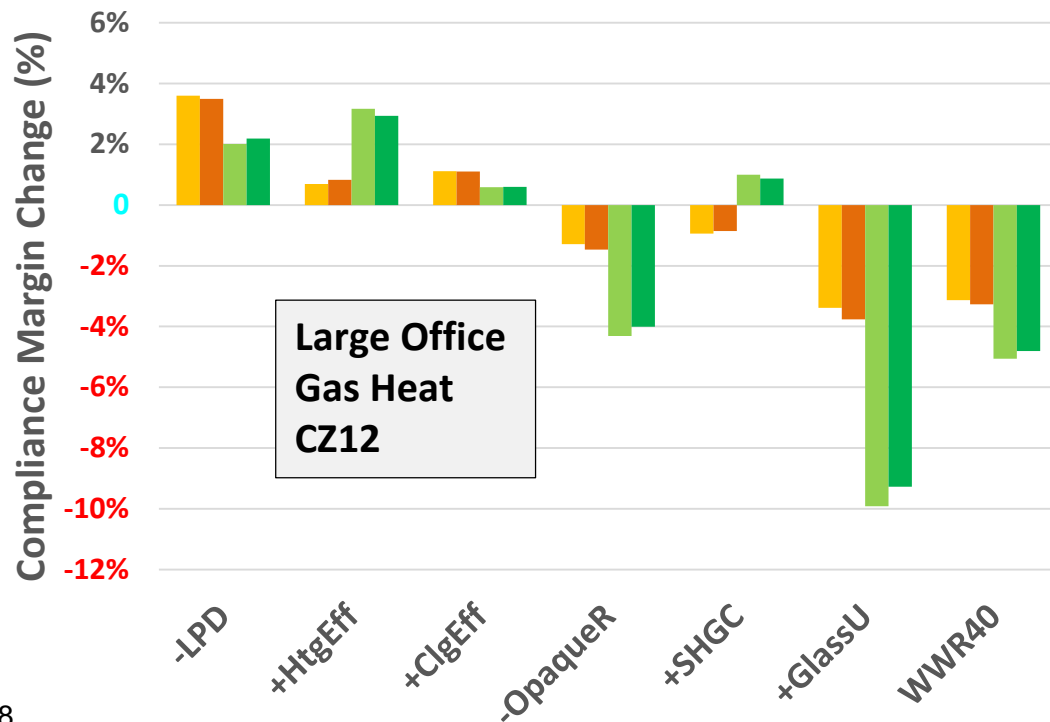
- ▶ High-Rise Residential - FPFC (Four-Pipe Fan Coil) is used in the baseline in the dwelling units
- ▶ Similar trend again
- ▶ Water heating is significant, so electric water heating gives large Source benefit



EFFICIENCY MEASURES

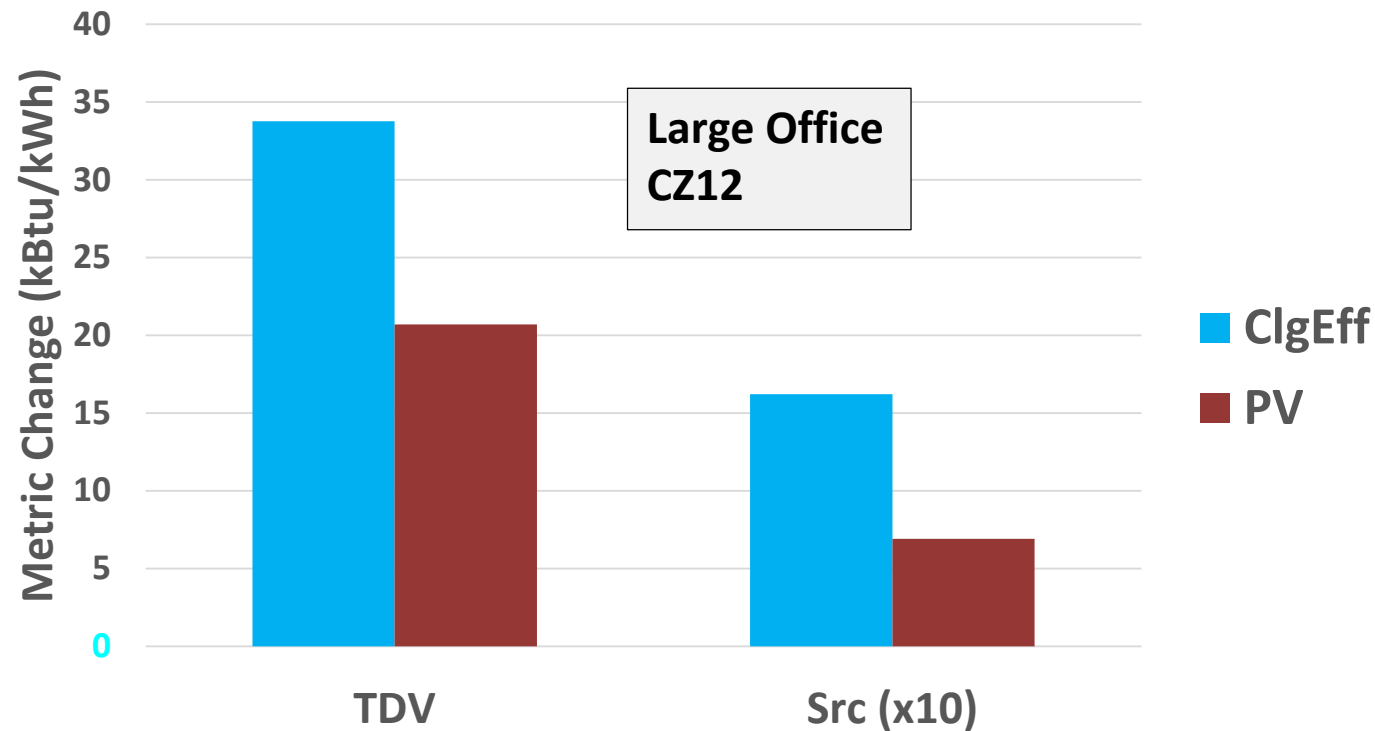
- ▶ Large Office - Change in compliance for different measures
 - Relative to VAV with hot water or electric resistance reheat
 - Don't compare magnitude of different measures - arbitrary changes used
 - Look are differences between TDV and Source for each measure

- ▶ Trading off envelope - Source provides larger penalty than TDV, except for SHGC increase



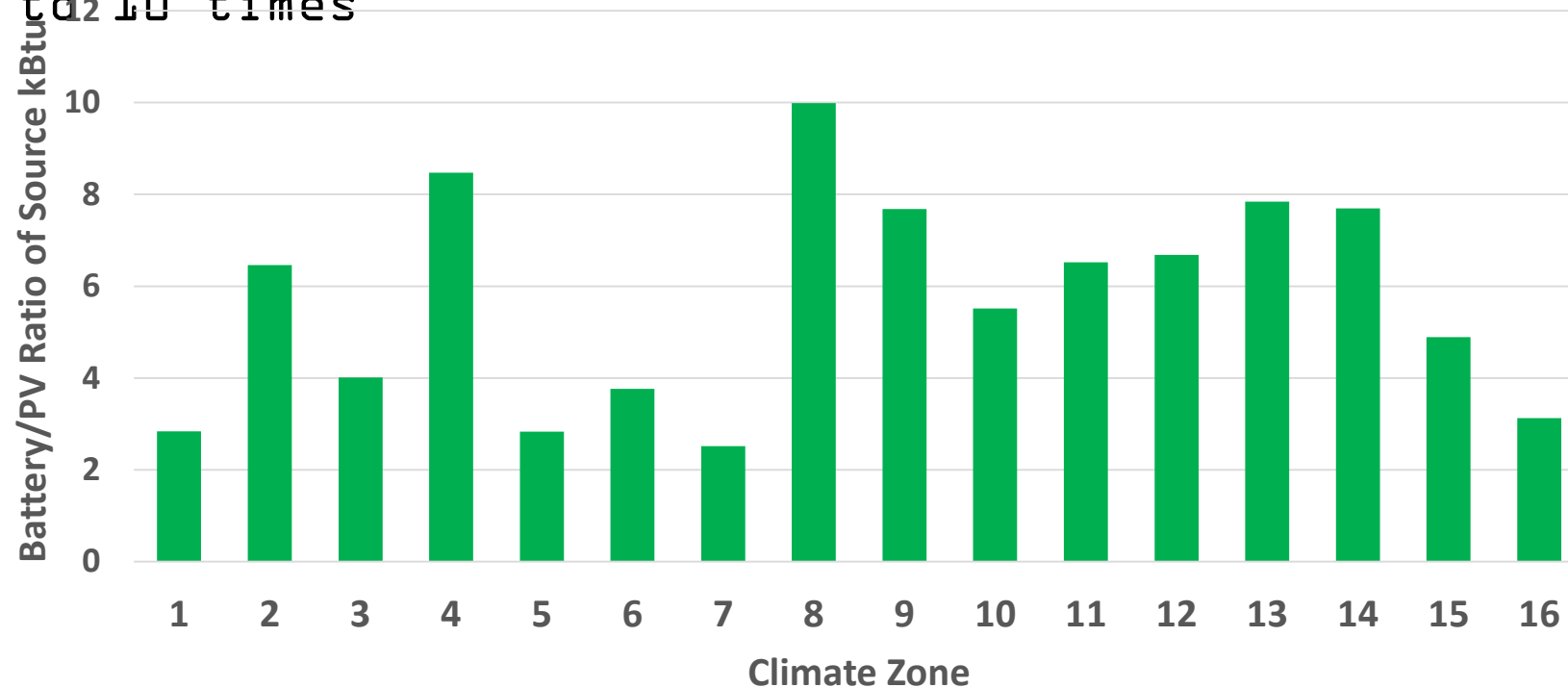
GRID INTEGRATION - PV

- ▶ Large Office - Cooling efficiency increase vs. adding PV
 - PV sized to provide equal kWh
- ▶ TDV and Source both show much larger impact from increased cooling efficiency than PV - Source more than double, TDV more than 1.5



GRID INTEGRATION - BATTERY STORAGE

- ▶ Analysis in CSE, "Simple" control algorithm
- ▶ Source impact for PV and battery systems that provide the same TDV savings
- ▶ Battery systems provide much larger Source savings than PV systems - 2.8 to 10 times



CONCLUSIONS

- ▶ TDV is limiting criterion for all-electric designs
- ▶ Adding Source energy imposes new limiting criterion for gas heating designs
- ▶ Trading off envelope efficiency in a design will result in large Source energy penalty
- ▶ 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