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Impacts of 2022 Metrics on Nonresidential and High Rise Residential Building Performance Compliance - Updated with 20 Year Metrics

May 7, 2020

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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
  - 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

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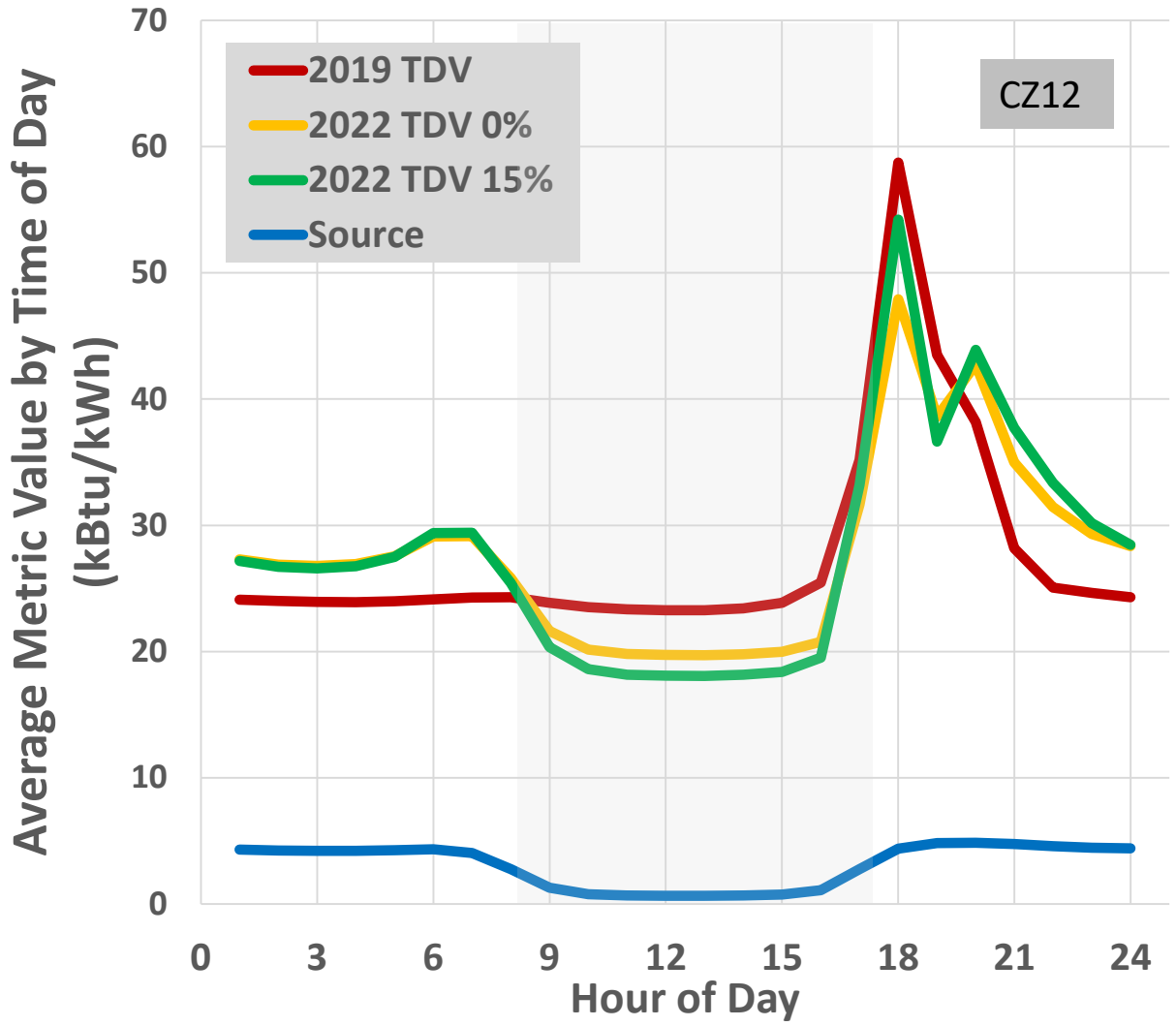
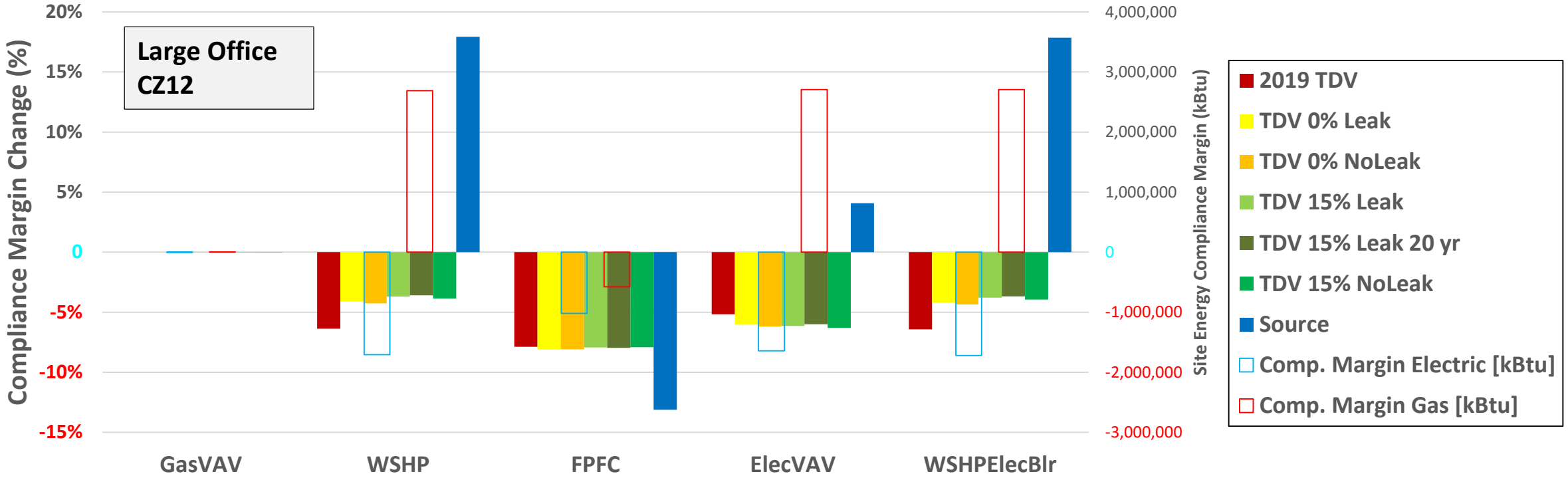
APPROACH

- Six metrics
  - TDV Policy, 0% Retail Adder, CH_4 Leaks
  - TDV Policy, 0% Retail Adder, No CH_4 Leaks
  - TDV Policy, 15% Retail Adder, CH_4 Leaks
  - TDV Policy, 15% Retail Adder, No CH_4 Leaks
  - Source Energy, CH_4 Leaks
  - Source Energy, No CH_4 Leaks
- Source metrics identical
- No difference between electric TDV with and without CH_4 leaks
- Look at Electrification, Efficiency Measures, Envelope Tradeoffs, and Grid Harmonization



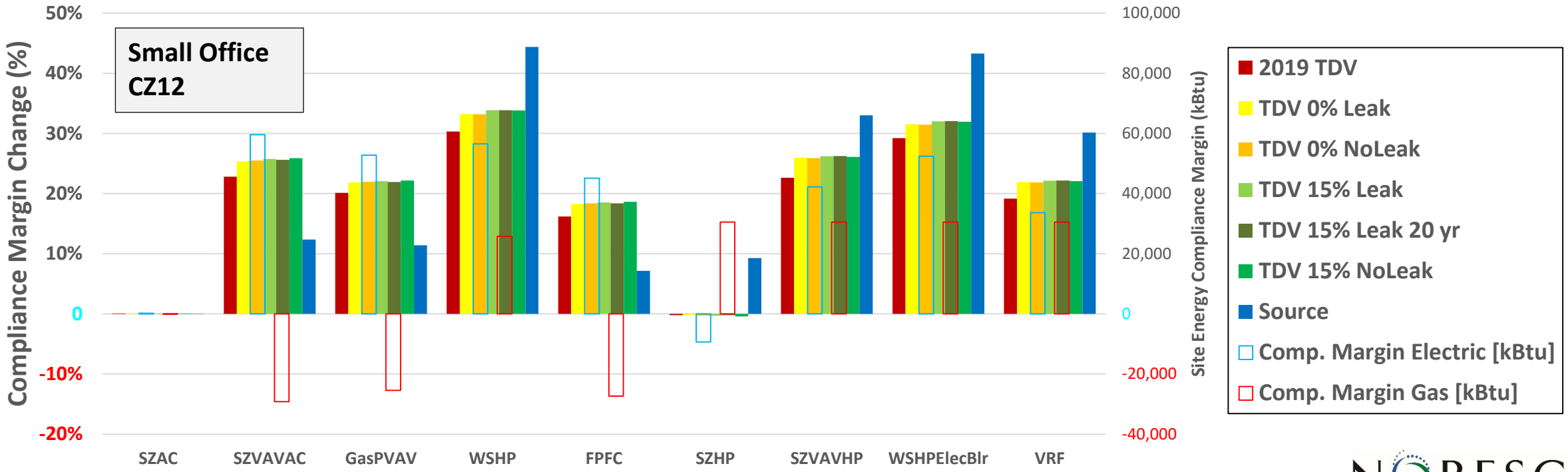
SYSTEM SWITCHING (INCL. ALL ELECTRIC)

- Large Office – Gas VAV (VAV with chillers and gas boilers) is used in the baseline
- For electric heat systems (WSHP and Elec VAV), improvements needed to reduce TDV deficit
- For gas heat system (four-pipe fan-coil), improvements must be enough to get source to 0



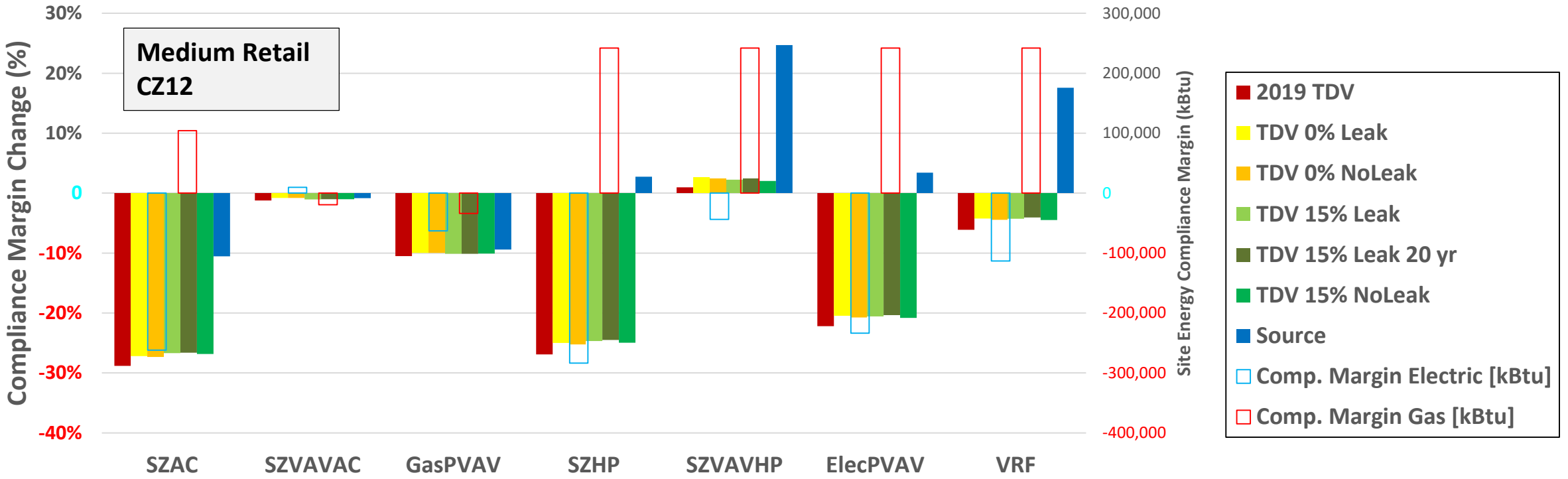
SYSTEM SWITCHING (INCL. ALL ELECTRIC)

- 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 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.



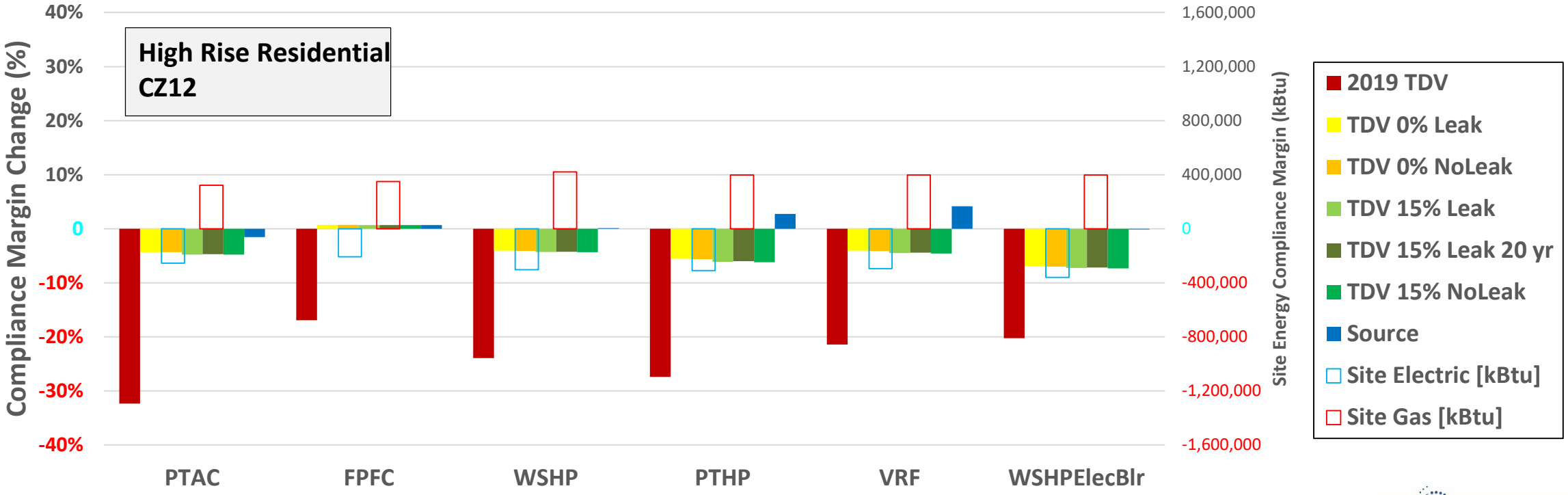
SYSTEM SWITCHING (INCL. ALL ELECTRIC)

- 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



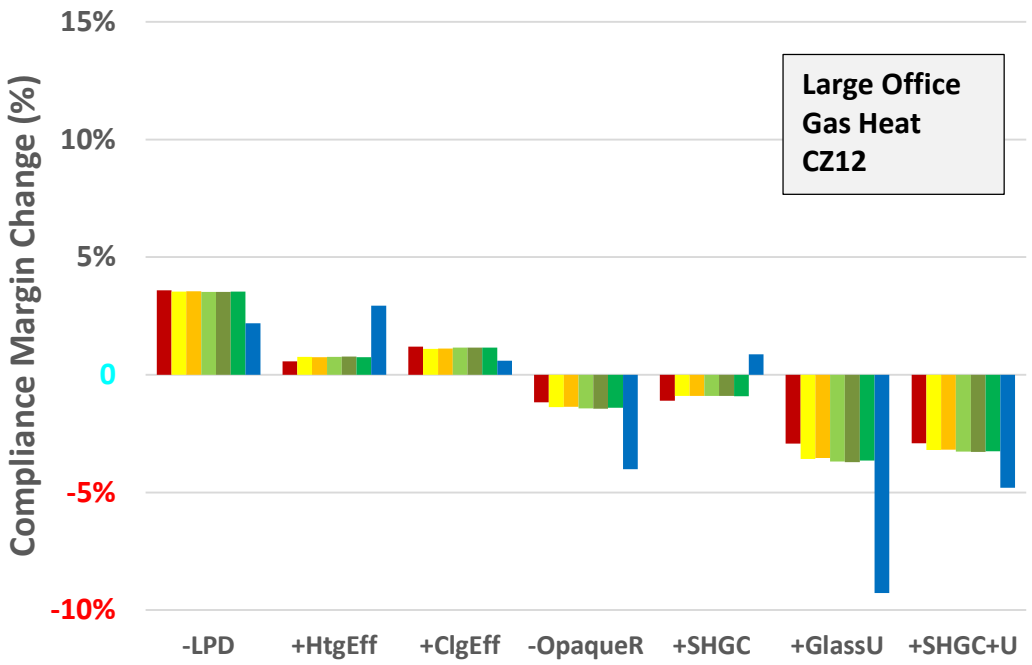
SYSTEM SWITCHING (INCL. ALL ELECTRIC)

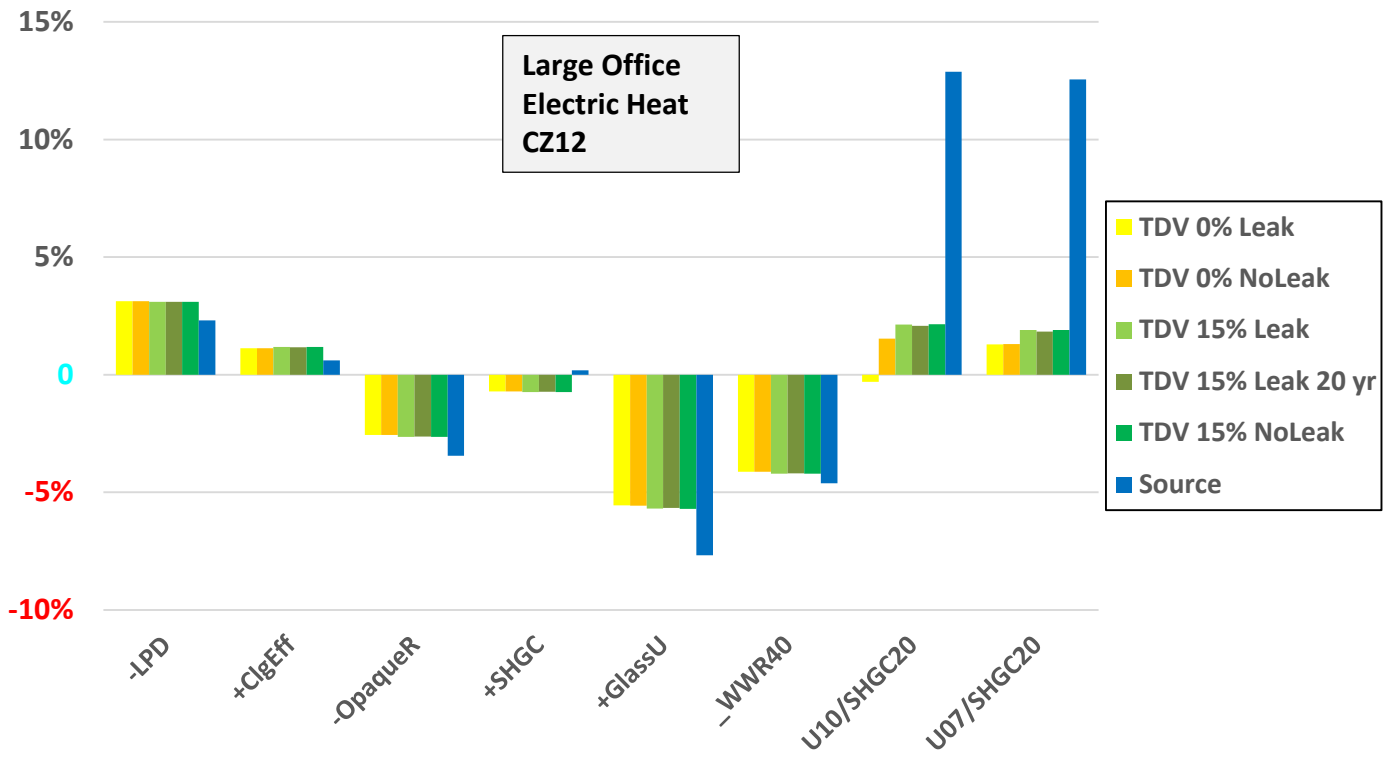
- High-Rise Residential - FPFC (Four-Pipe Fan Coil) in the dwelling units and VAV in the nonresidential spaces, both served by chillers and gas boiler, are used in the baseline. System changes below are only in residential dwelling units.
- Similar trend again
- Water heating is significant, so electric water heating gives large Source benefit



EFFICIENCY MEASURES

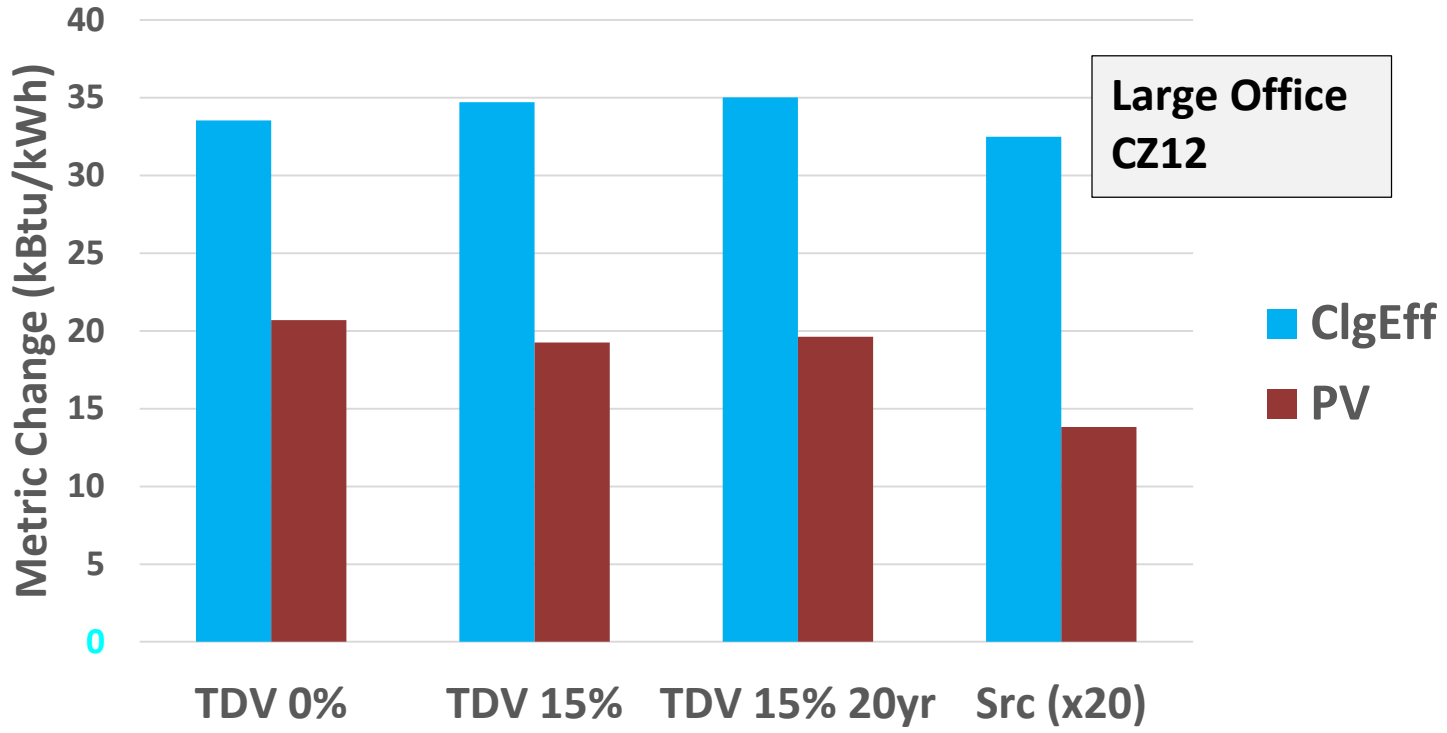
- Large Office – Change in compliance for different measures
  - Relative to VAV with hot water or electric resistance reheat
  - Don't compare magnitude of different measures – arbitrary changes used
  - Look at differences between TDV and Source for each measure
- Trading off envelope – Source provides larger penalty than TDV, except for SHGC increase





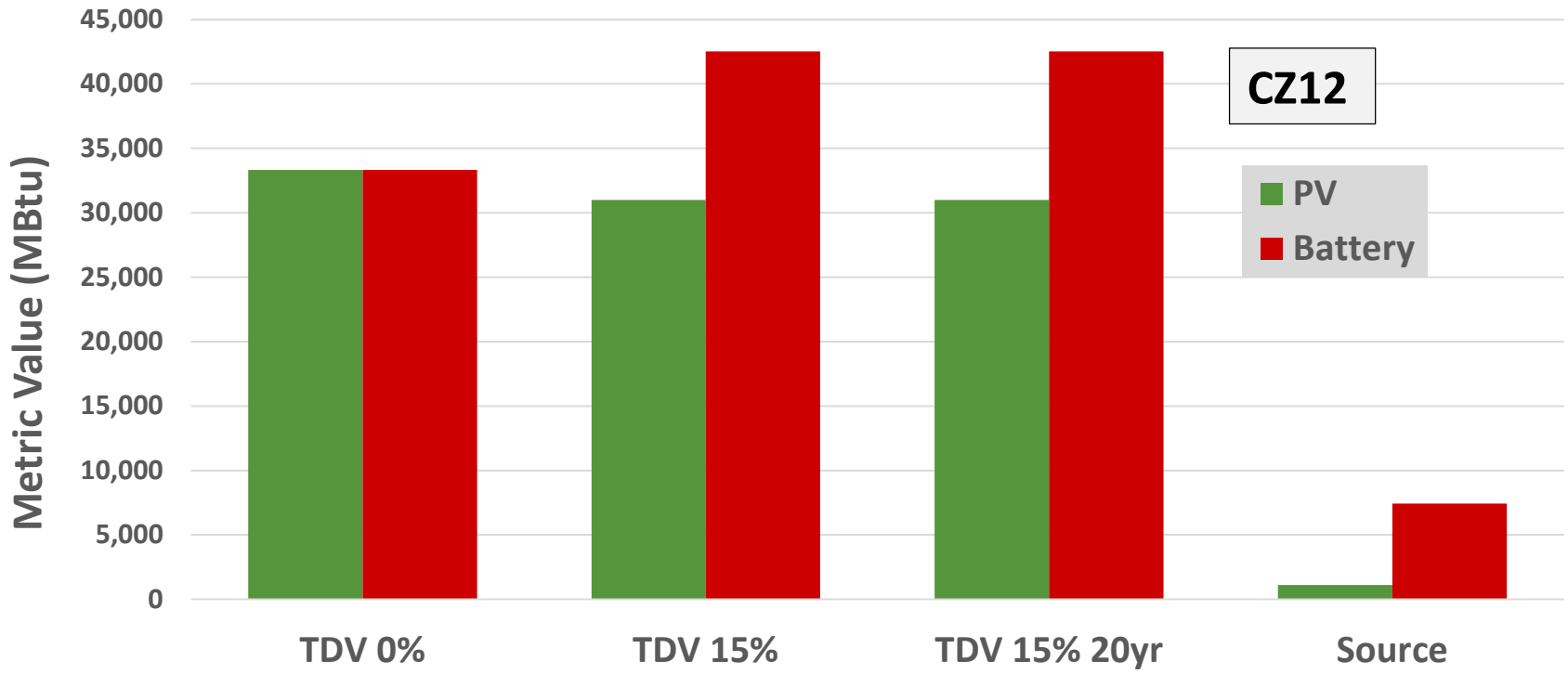
GRID INTEGRATION - PV

- 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%



GRID INTEGRATION – BATTERY STORAGE

- 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