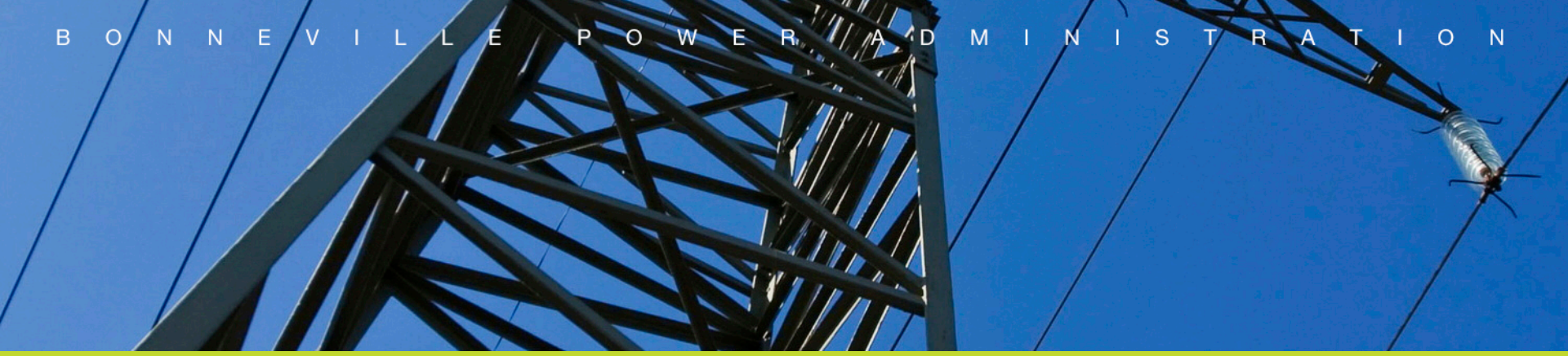

{Heat Pump Field Study

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Santiago Rodriguez – SBW Consulting

IEPEC

Why do this study?

- Understand regional installation practices of air source heat pumps, last baseline study conducted in 2005
- Bonneville Power Administration has a quality installation program – Performance Tested Comfort Systems
  - Informs program savings with updated current practice baseline
  - Informs progress region has made since interventions starting in early 2000's
  - Informs program on what to focus on, what is effective and not effective
  - Informs future regional savings potential

How did we do this study?

- Goal - Random sample of recent air source heat pump installs in single family homes
- Recruited homes that filed electric and mechanical permits data in last 3 years, data purchased from Buildfax
- Sent letters with an invite to an online survey
- If survey indicates home is eligible, call down list until geographical strata targets are met
- Visited 95 sites, half east of cascades, half west of cascades

IEPEC

Field Study Team

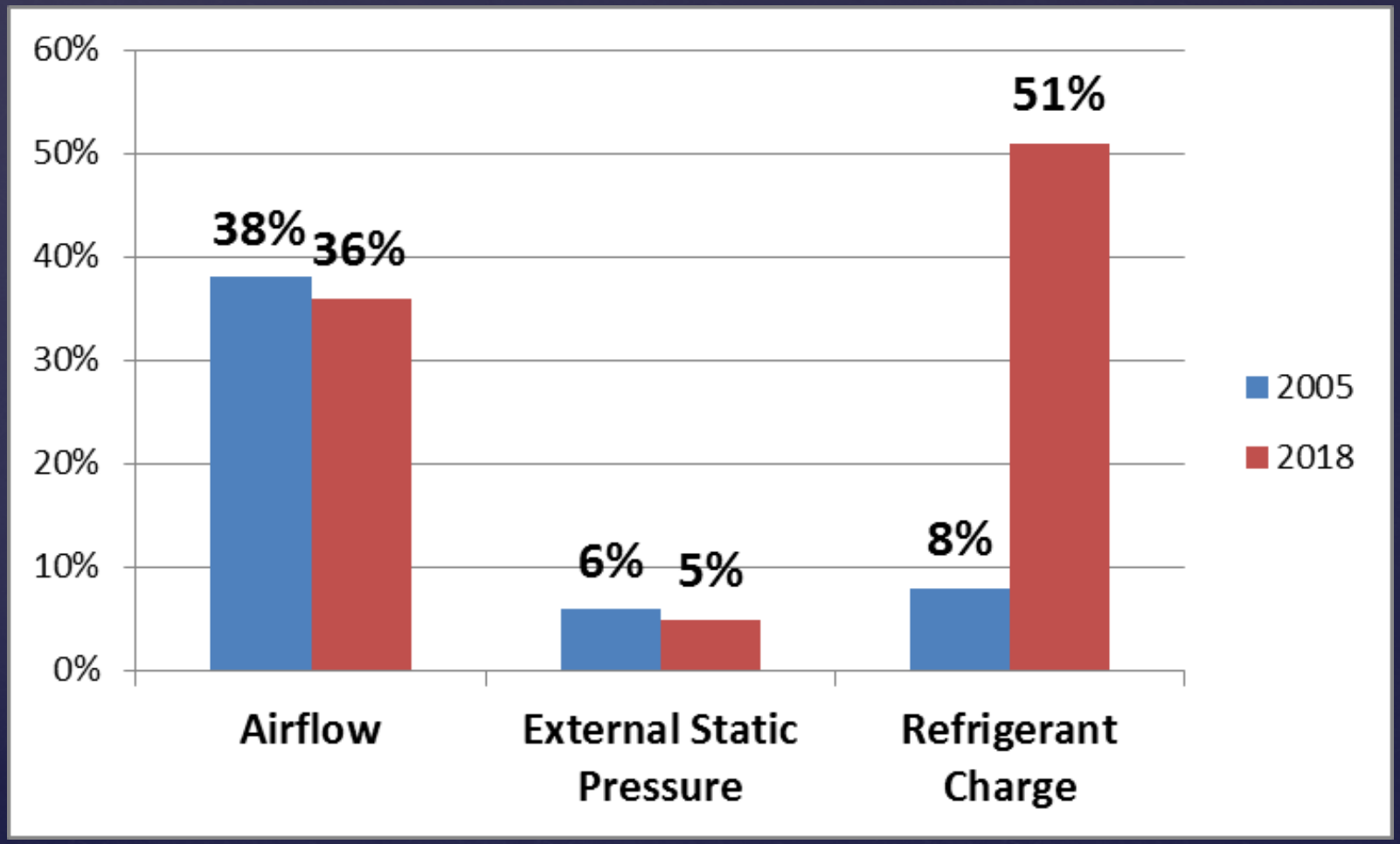
Data Collection

- Participant Interview and Survey
- Heat Pump nameplate information and thermostat settings
- Heat pump performance tests: Airflow, external static pressure, temperature split
- Duct blaster (leakage) test
- Blower door whole house air leakage test
- Home envelope and external duct audit

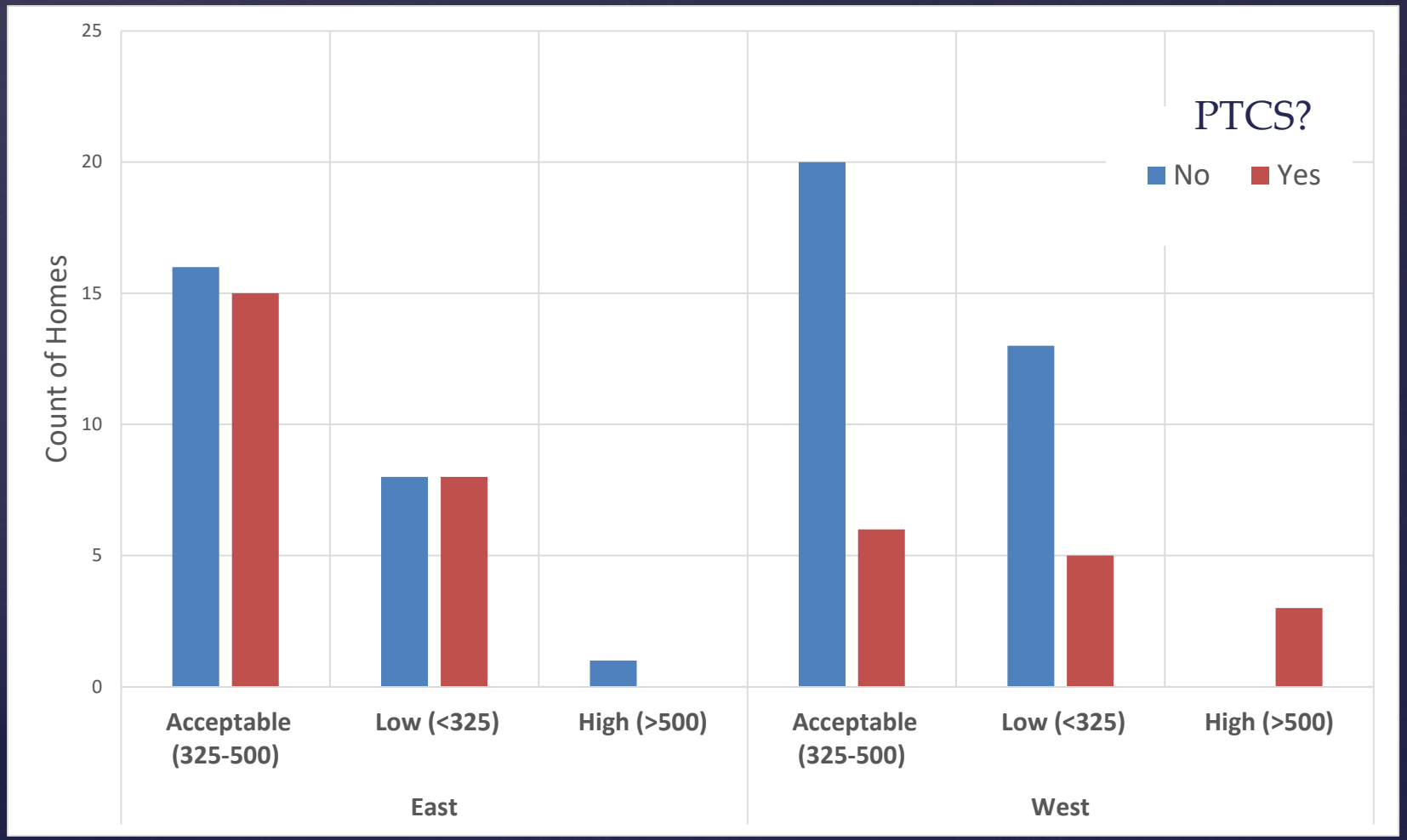
Use of Data

- Heat pump performance data informs how well the system was installed and commissioned
- Data from the air leakage tests (duct and whole home) along with the shell audit will be entered into two different sizing calculators
  - Regional Technical Forum developed calculator used by PTCS
  - Ecotope developed calculator developed for Idaho Power
- Regional Technical Forum will use the results to update regional Unit Energy Savings estimates

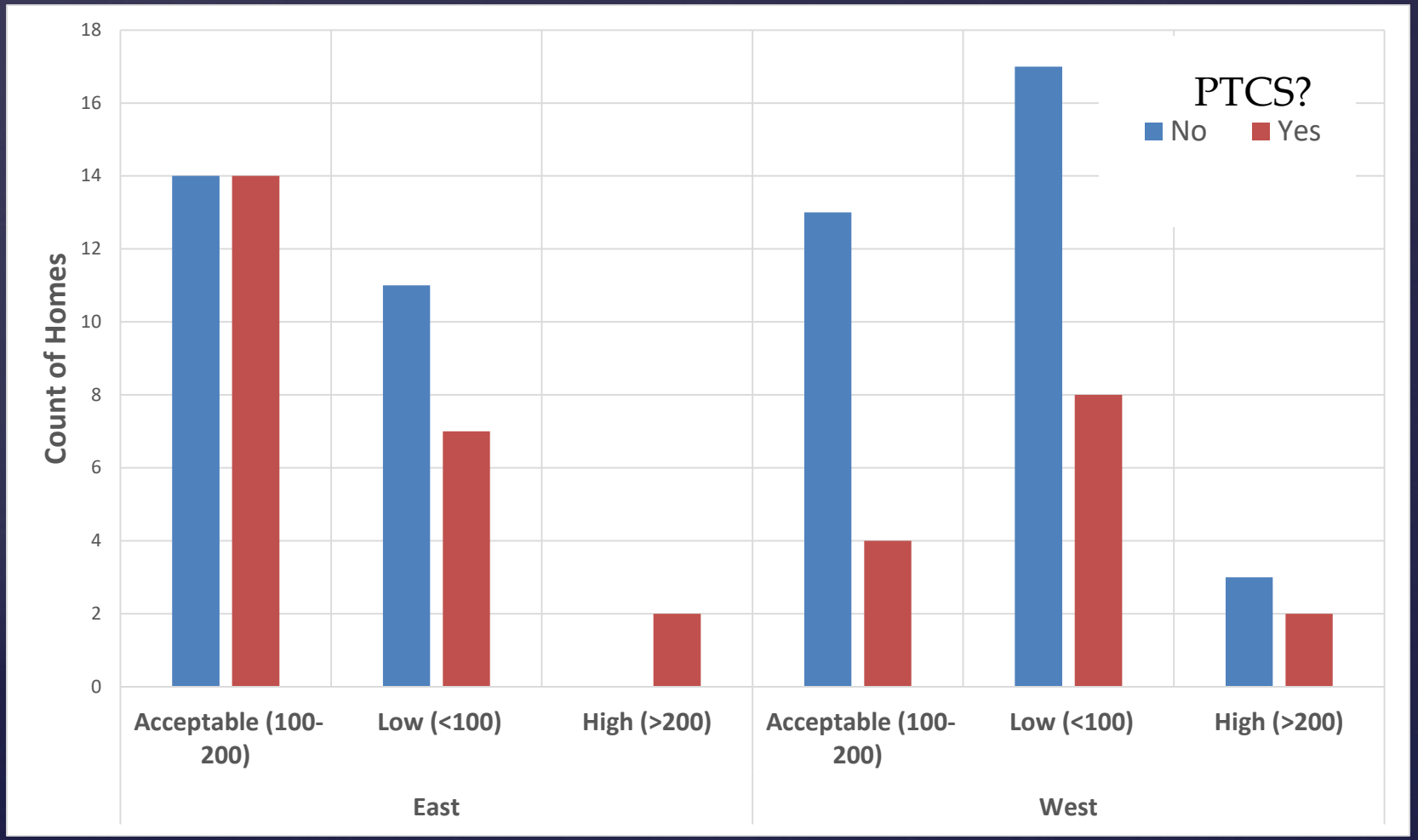
Baseline in 2005 vs 2018



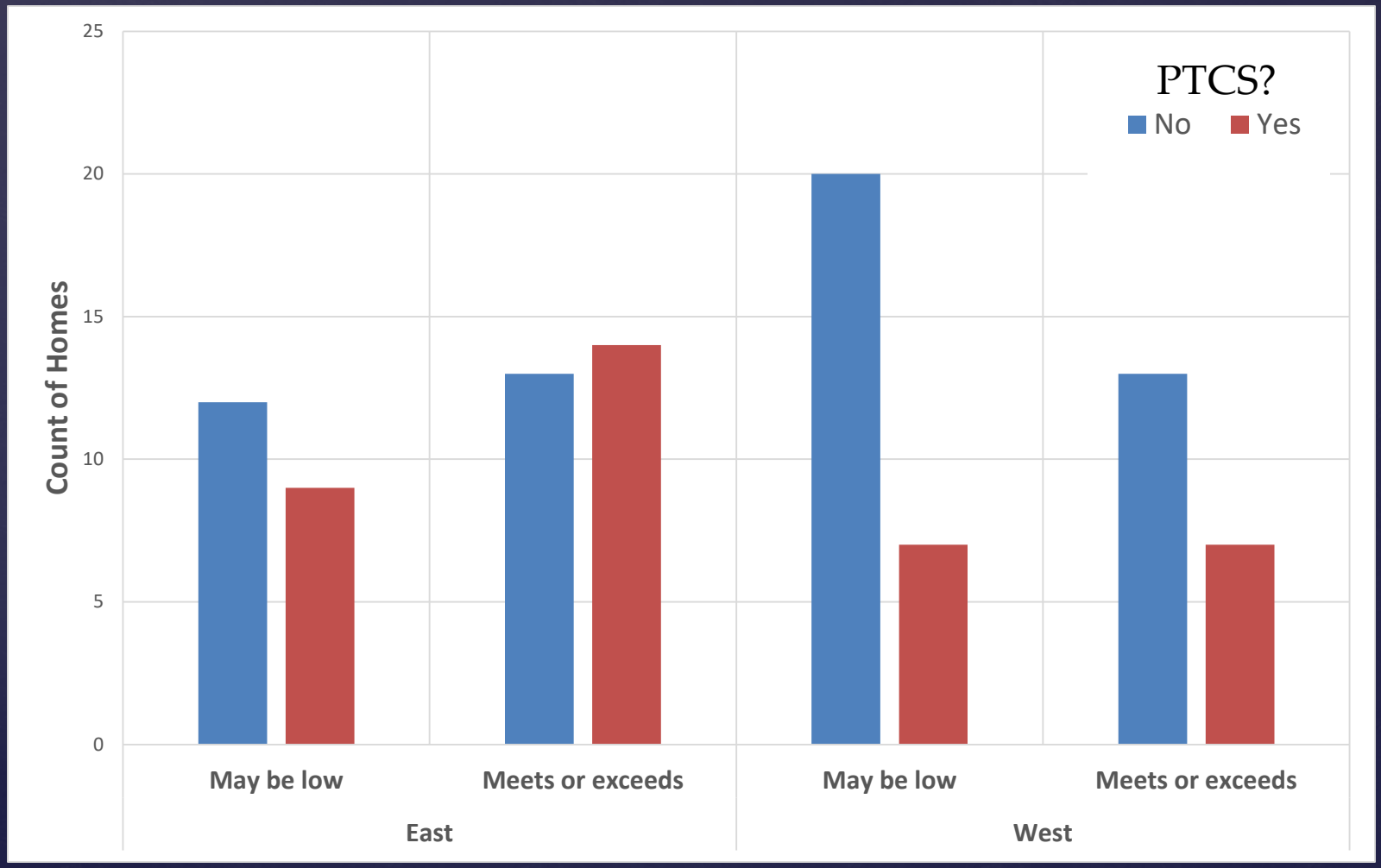
Airflow


PTCS?
No
Yes
Count of Homes
25
20
15
10
5
0
Acceptable (325-500)
Low (<325)
High (>500)
Acceptable (325-500)
Low (<325)
High (>500)
East
West

External Static Pressure



Refrigerant charge



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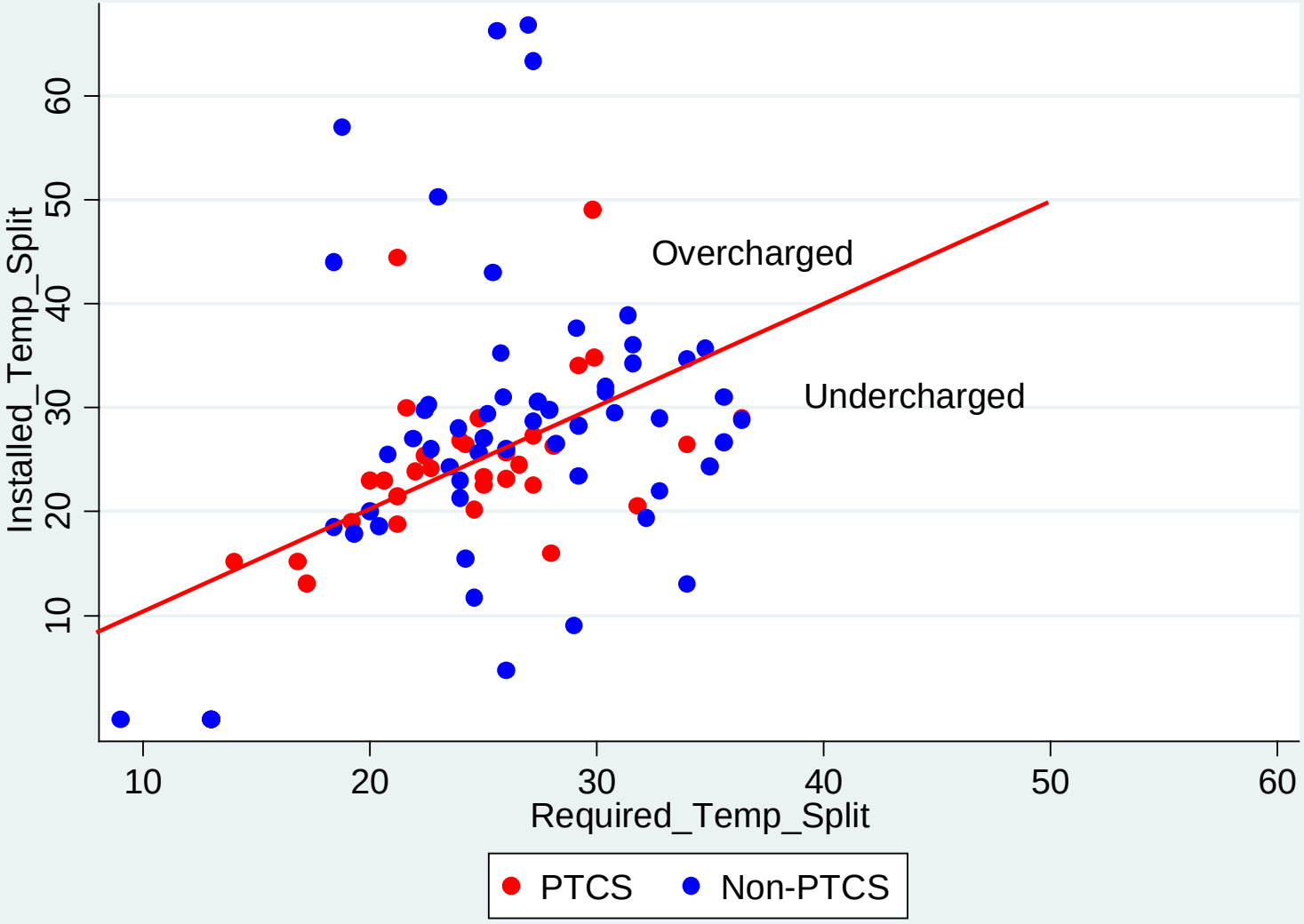
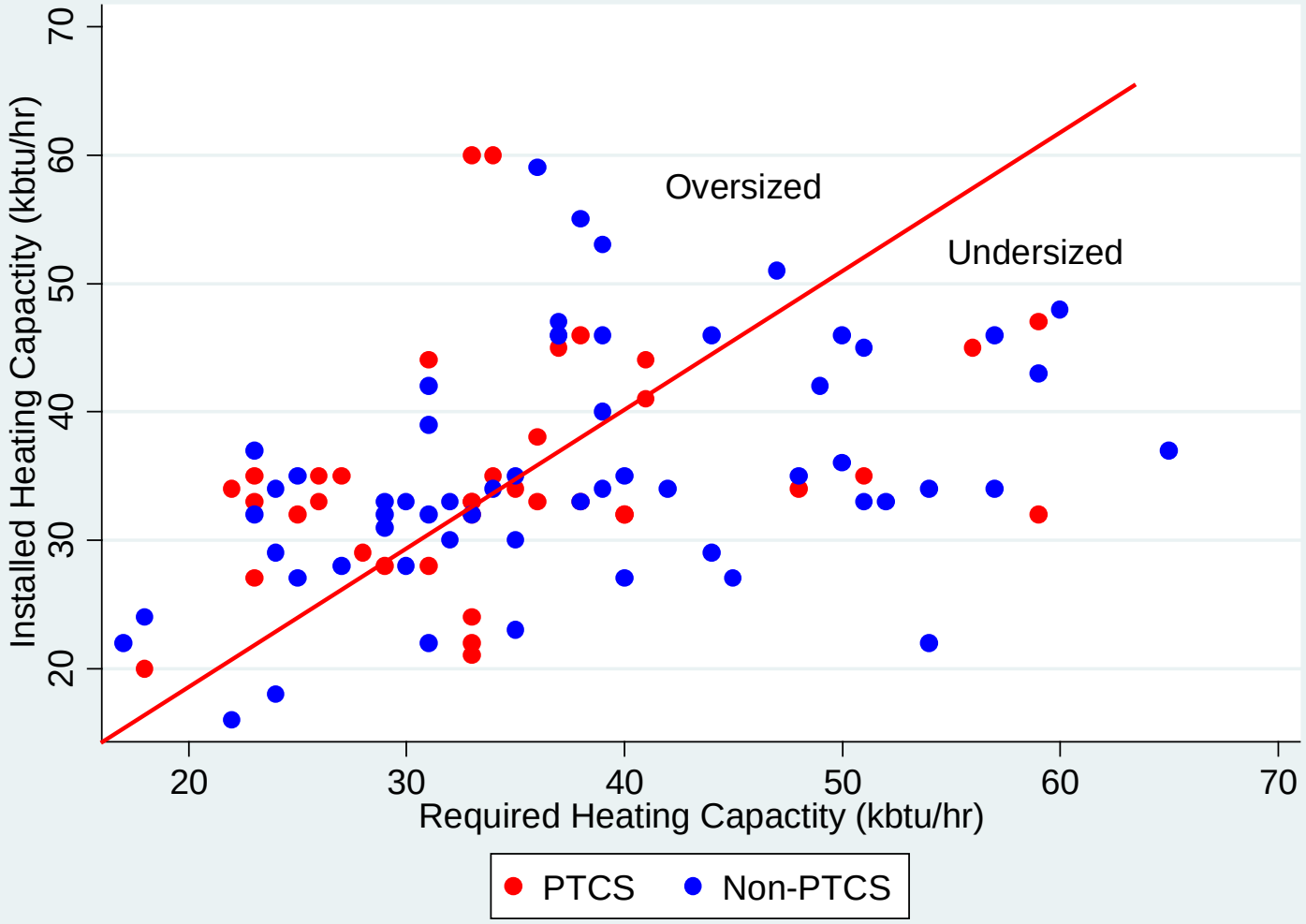
Temperature Split



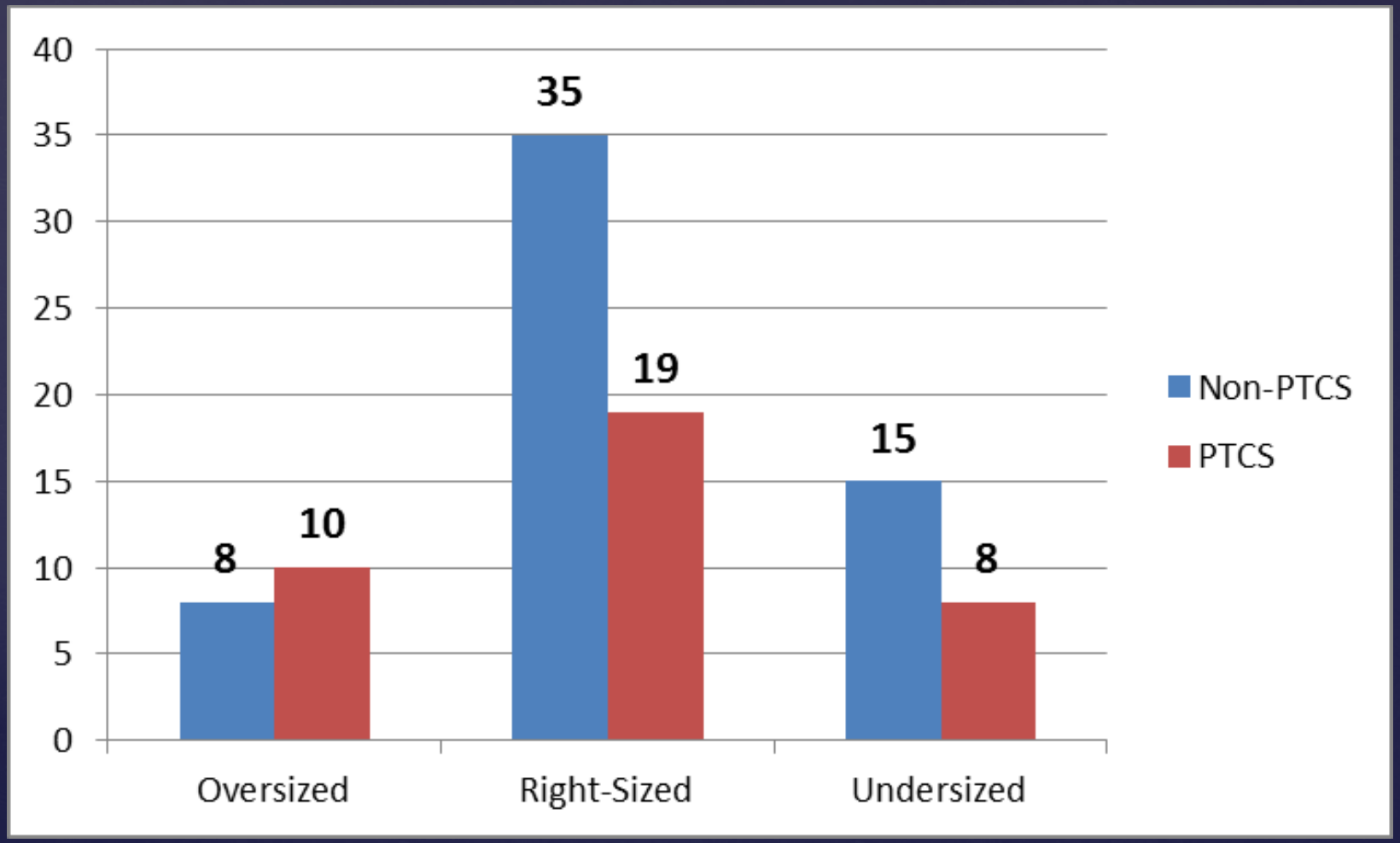
Sizing Baseline then and now

- 2005 – Units tended to be undersized by 30%
- 2019 – 39% of units were undersized by 10% or more when compared to Ecotope tool. West of cascades sites tended to be undersized at a greater rate.
- 54% of units were undersized by 10% or more when compared to PTCS tool

Heat Pump Sizing



Heat Pump Sizing

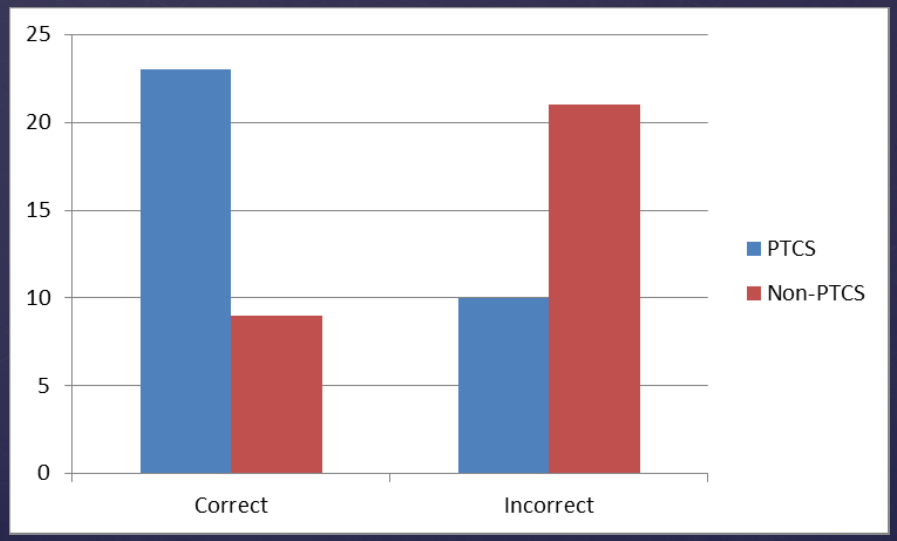


Controls – Auxiliary Lock Out

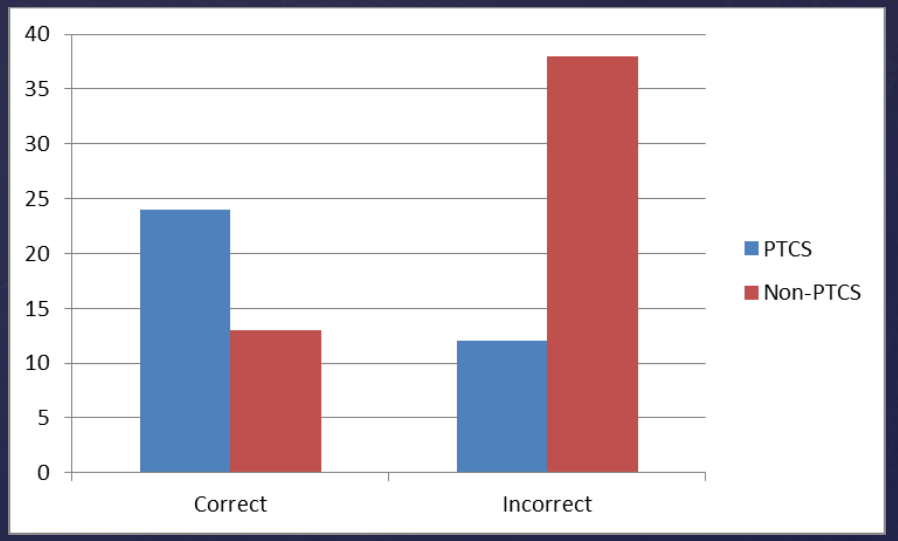
- 57% of all sites did not have the auxiliary lockout set at 35 F or below
- Excluding duel fuel sites (28%) 49% of sites did not have the auxiliary lockout set at 35 F or below
- Inefficient lockout settings tended to be set at 40F – 55F degrees
- Efficient settings tended to be set at 35F

Auxiliary Lock Out - PTCS

Excluding Dual Fuel



Including Dual Fuel

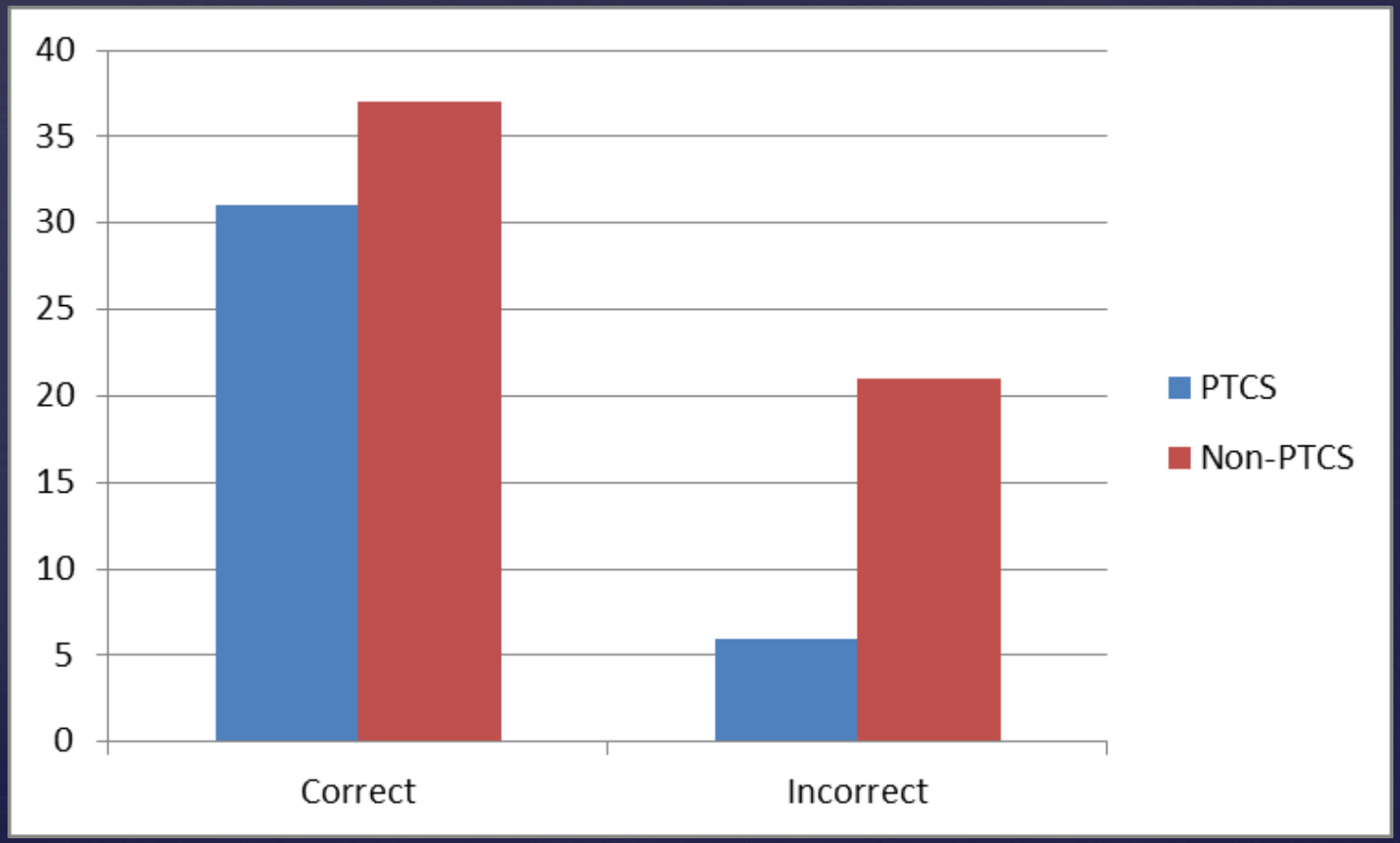


Controls – Compressor Lock Out

- At low outdoor temperatures compressors are less effective at meeting the heating load
- It is most efficient to let the compressor work at all temperatures as it will produce some part of the heating load
- If a cut out must be used it should not be cut out above 5 F

Compressor Lock Out Settings

- 28% of sites had the compressor locked out above 5 F
- Most of the 72% of sites with correct lock out had lock out disabled



What this all means…

- The baseline installation practices have not improved that much since 2005
- Refrigerant charge appears to be more of a problem than in 2005
- PTCS appears to only be most effective at ensuring the right lock out control settings
- Savings will change based on new baseline
- Still don't know what the efficient case savings are, they are modeled