Energy Code & Policy Impacts Low-GWP Options

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Acknowledgements

Thanks to:

What I'll Discuss

- Tools overview
- Energy efficiency vs. GHG reduction
- New EE Program options coming down the pike
- Regulatory landscape
- Ideas of what's needed

Market survey – what we did

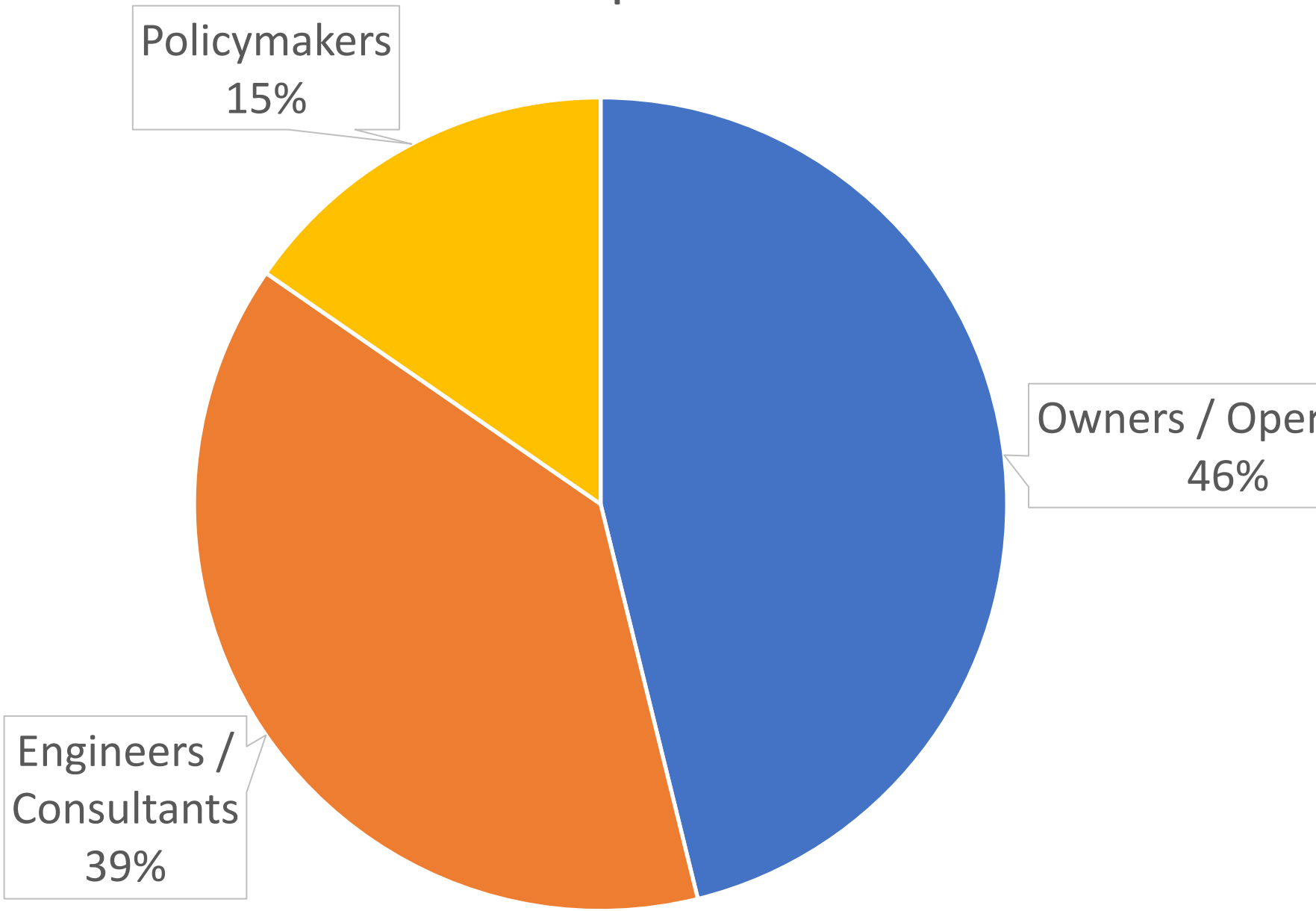
Goals

1. Estimate the impact of new regs in CA on Energy Efficiency
2. Determine the need/demand for modeling tools

Conducted interviews with industry participants

- Owners/operators (making up about 25% of the CA supermarket)
- Vendors
- Design engineers / consultants
- Policymakers

Participants



1. Existing Store Make-up

> 95%

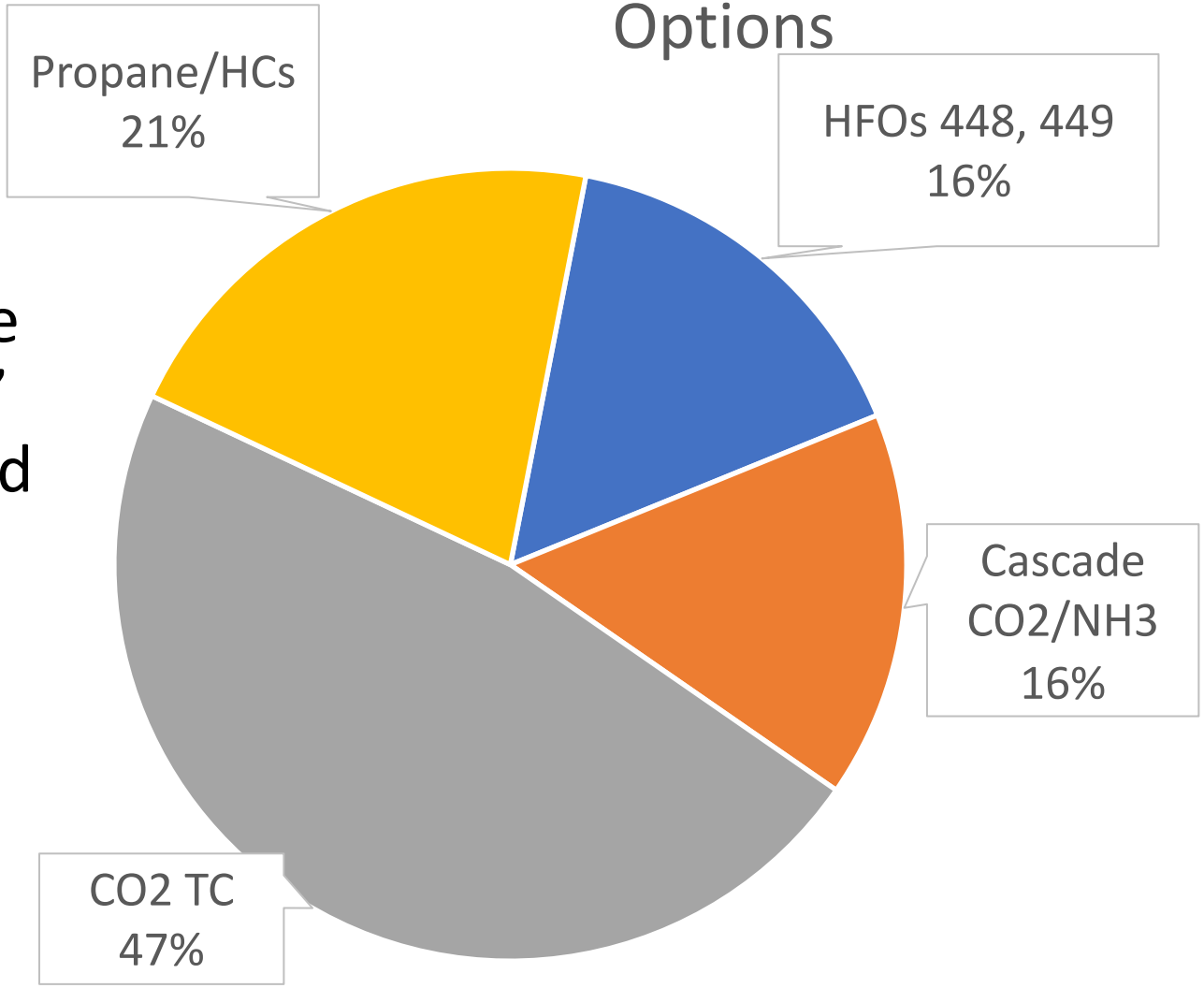
Configuration	Heat Rejection	Refrigerants
Multiplex / Parallel	Air-cooled	HCFC / HFC
Multiplex / Parallel	Water-cooled	HCFC / HFC
Distributed compressors	Water-cooled	HCFC / HFC
Singles	Air-cooled	HCFC / HFC
Multiplex / Parallel	Air-cooled	448 / 449
CO2 TC / CO2 booster	Adiabatic	CO2

Most common

Vast Majority of stock using traditional approaches

2. New Construction Trends

- Larger chains are “experimenting” with naturals and low-GWP
- Expect slow growth ~ 1%
- “overbuilt”



3. Retrofit Trends

- Many choosing 448 / 449 as the only practical retrofit option
- Doing a few stores to gain experience
- Will not do many of those until required

Modeling tools

Decision makers need independent tools to assess GWP & Energy

- Vendor – neutral
- Level playing field
- New system design options and fixtures
- Easy to use
- Reliable / trustworthy

Regulatory need

- Assessing code impacts
- T-24 compliance
- GWP analysis
- Incentive determination

Current Modeling Options

Software	Whole Building	Refrig System	Description	Limitation(s) vis-à-vis ideal
DOE 2.2R	✓		Detailed, customizable	Does not (yet) do CO2 TC & others;
EnergyPlus	✓		Variable time step simulation with CO2 TC	Steep learning curve, time consuming, much customization required for NH3, hydrocarbons
Genetron		✓	Large number of refrigerants; Performs multi-runs	Uses theoretical compressor/refrigerant data; not independent
Pack Calculation Pro		✓	Uses compressor performance data, weather-based analysis	Annual weather is pre-installed without a viewable source, fewer refrigerant options

Current options are all difficult to use – not practical for most design engineers as part of design practice

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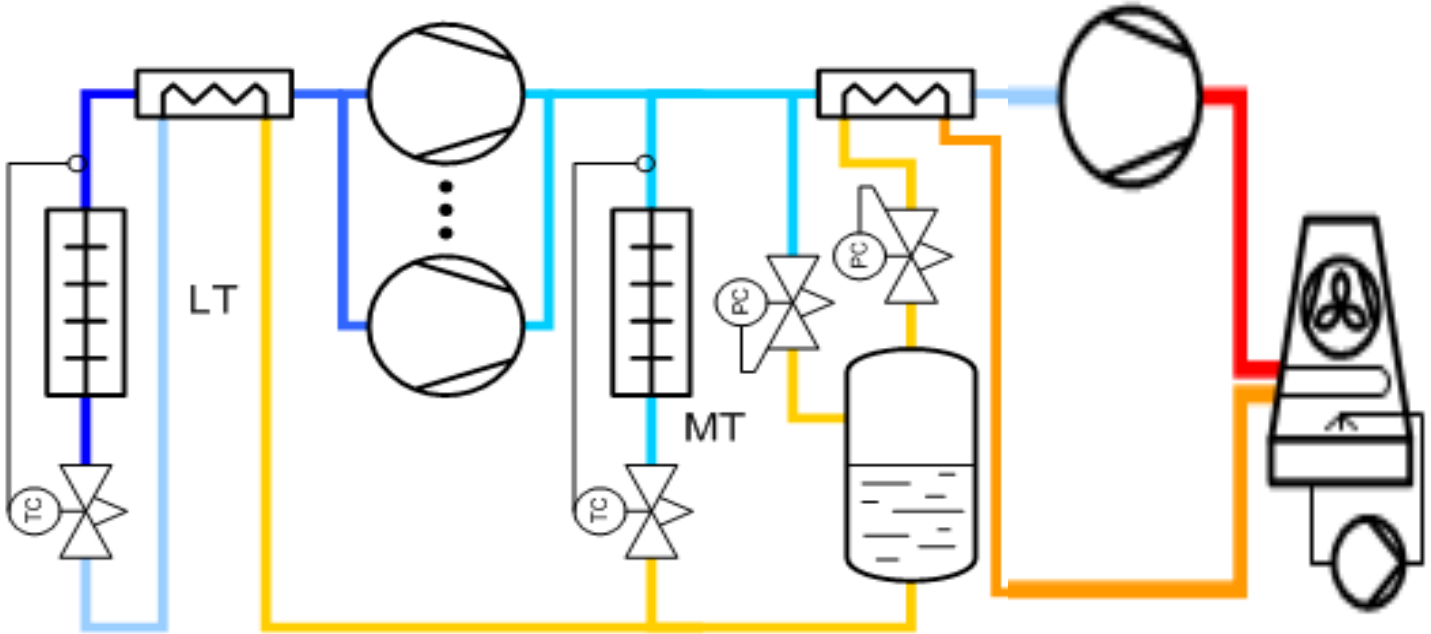
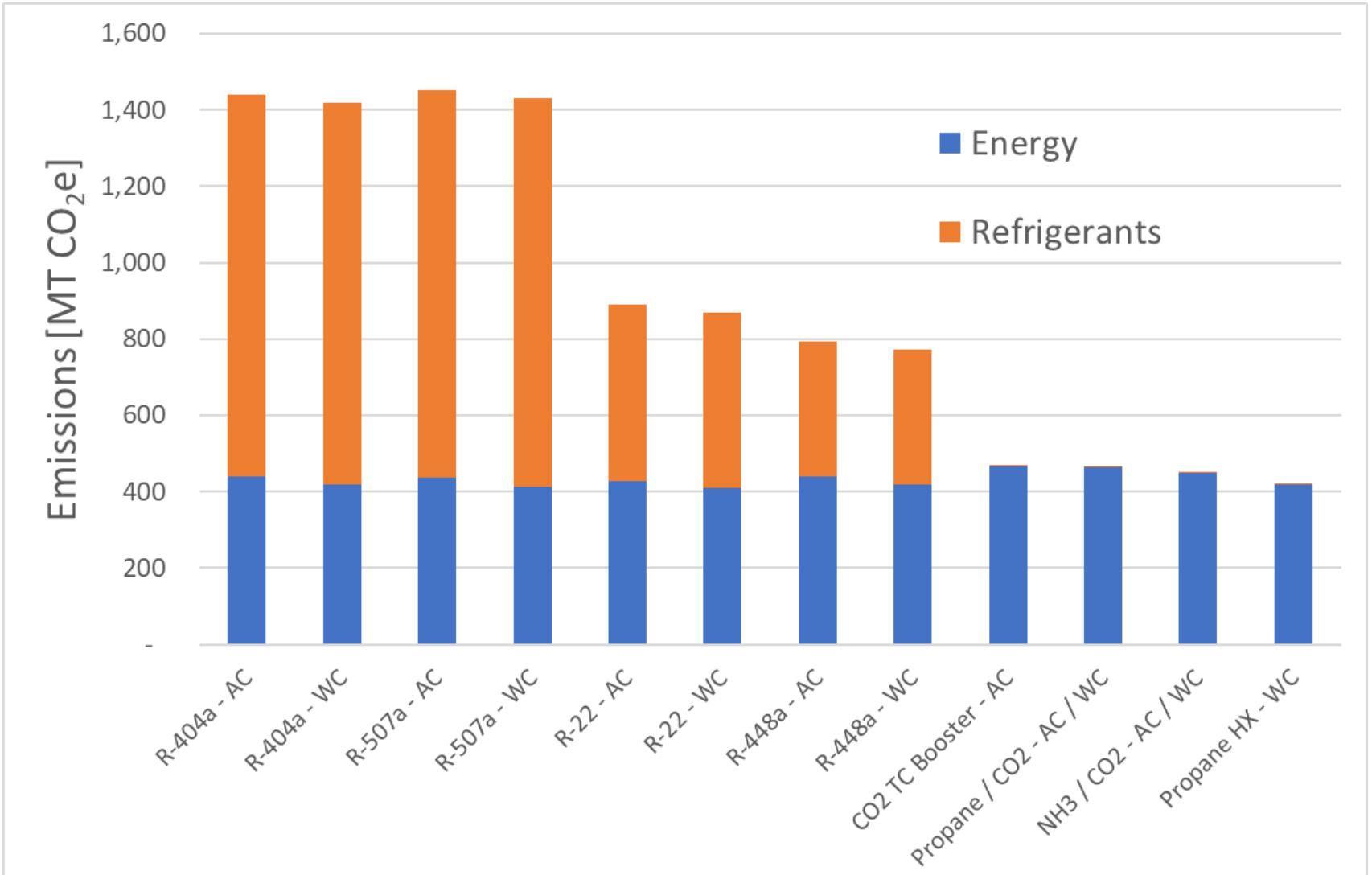
Pack Calc Pro – Lots of Design/Refrigerant Options



E.g. CO2 Transcritical Booster with Hybrid Evap Condenser

Efficiency vs GWP Tradeoff in CA



For LA weather, typical store size, leak rates

Rule of Thumb – Existing Stores

1 % Efficiency Improvement ≈ Refrigerant GWP decrease of 17 pts

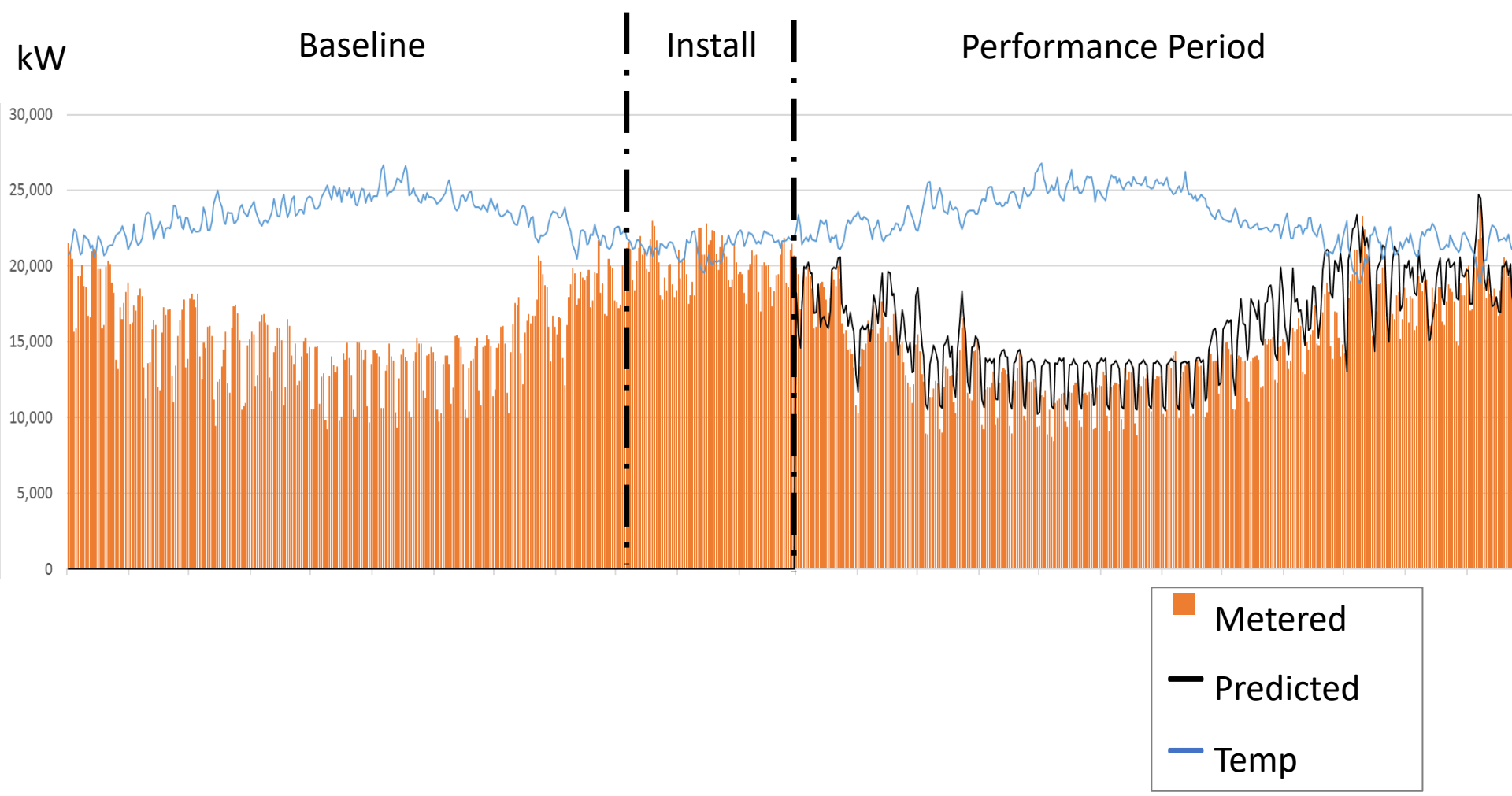
Or if your GWP is 1700, you need to have zero energy use to have the same emissions as a CO2 TC store

New EE Program Models in CA

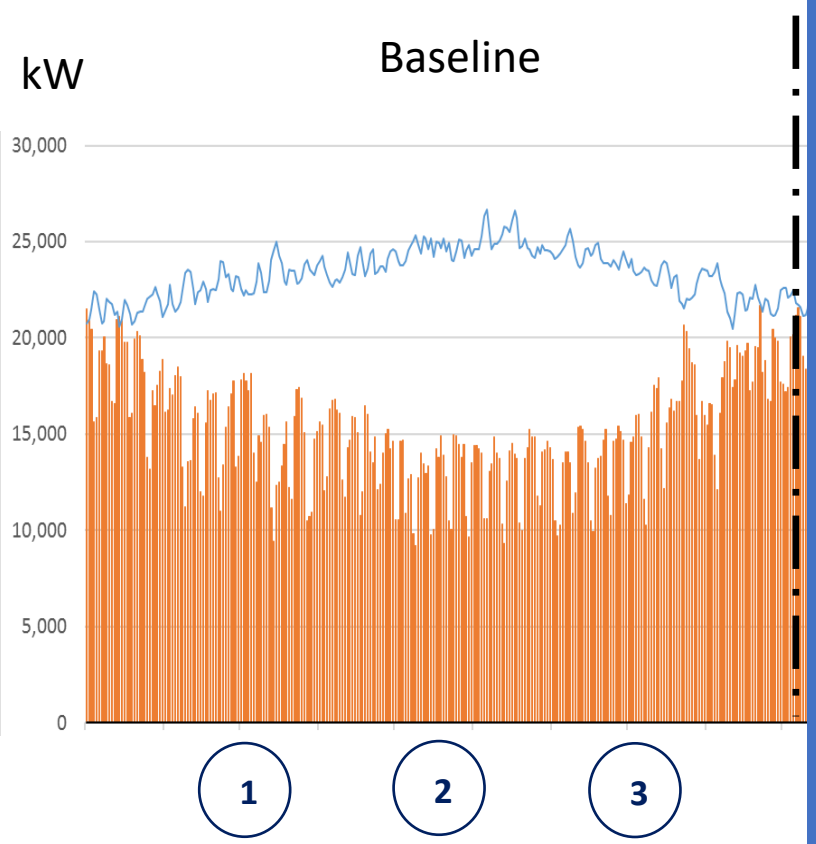
NMEC = Normalized Metered Energy Consumption

Some programs already in place – more coming

"Third party" programs coming but delayed



NMEC Process

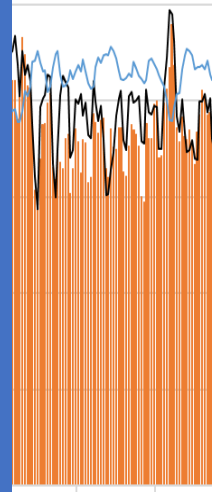


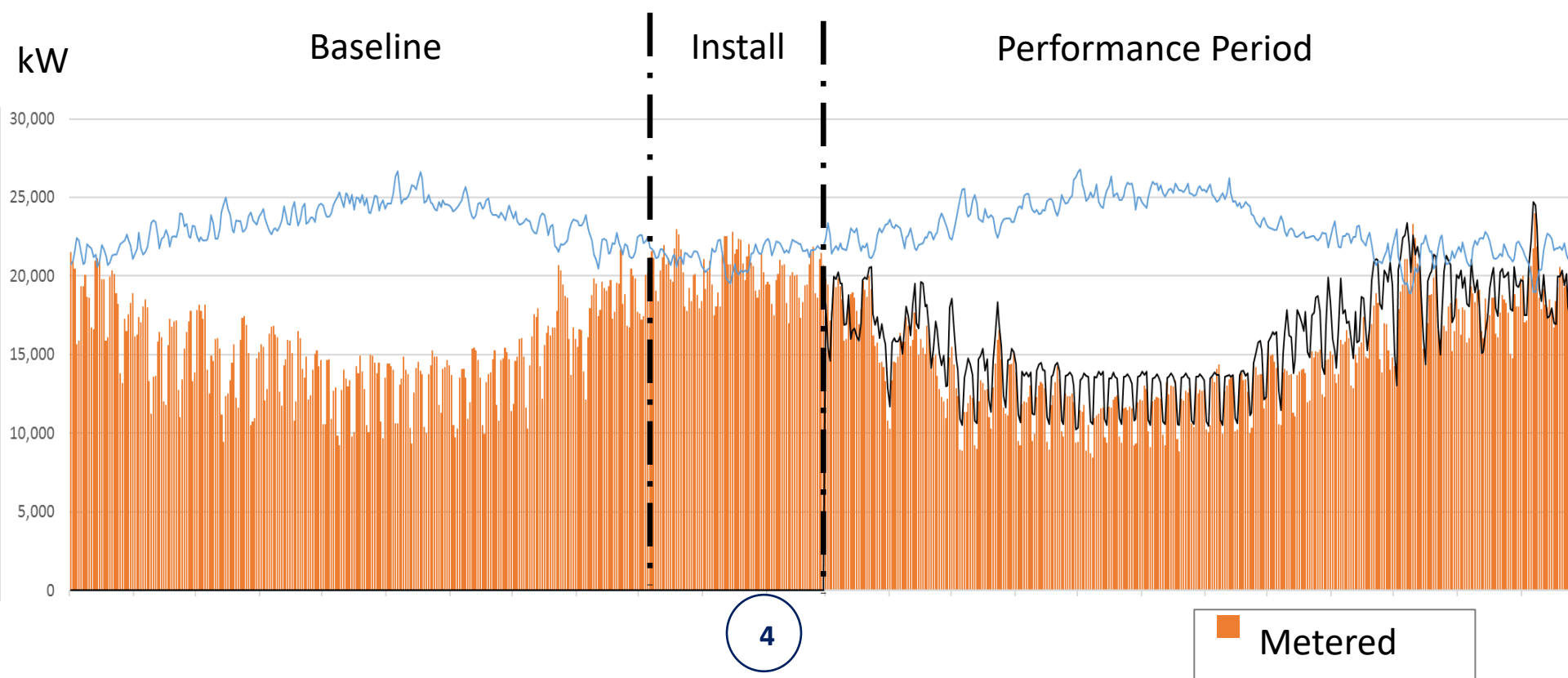
Baseline

Baseline Period

1. Project Pre-Screening
   - Facility condition
   - Savings potential (e.g. deep savings)
   - 'Predictable' energy use patterns
   - Non-routine events (NREs)
2. Develop Plan
   - Documentation of baseline equipment and conditions
   - List of measures, savings, costs, measure life

3. M&V Plan
   - Define baseline period
   - List data to be collected
   - Describe analysis procedures
     - incl. NRE treatment
   - Savings reporting & frequency

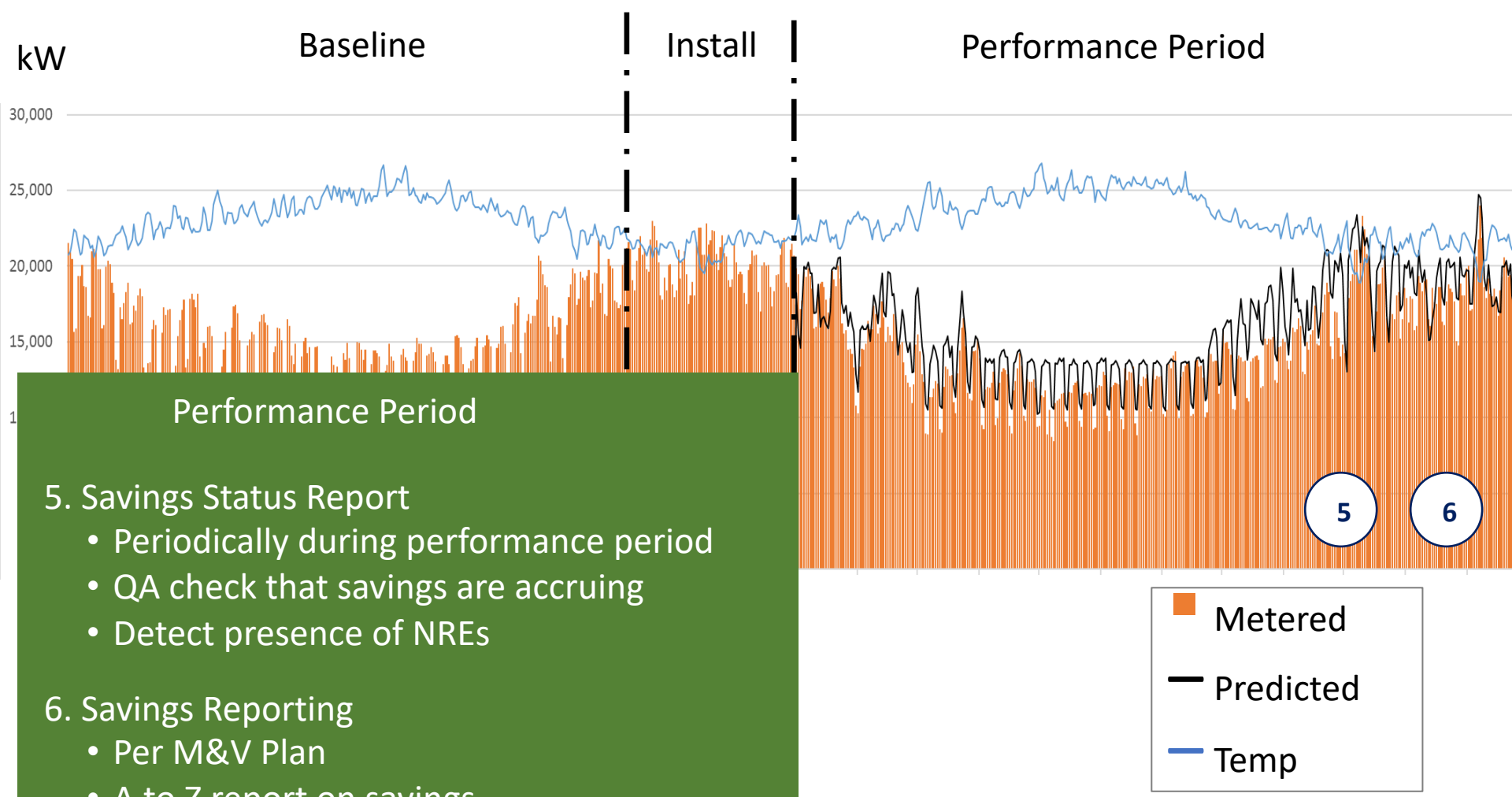




Installation

Installation Period

4. Measure Verification
   - Document installation & proper operation
     - Inspection
     - Functional testing
     - Trend analysis

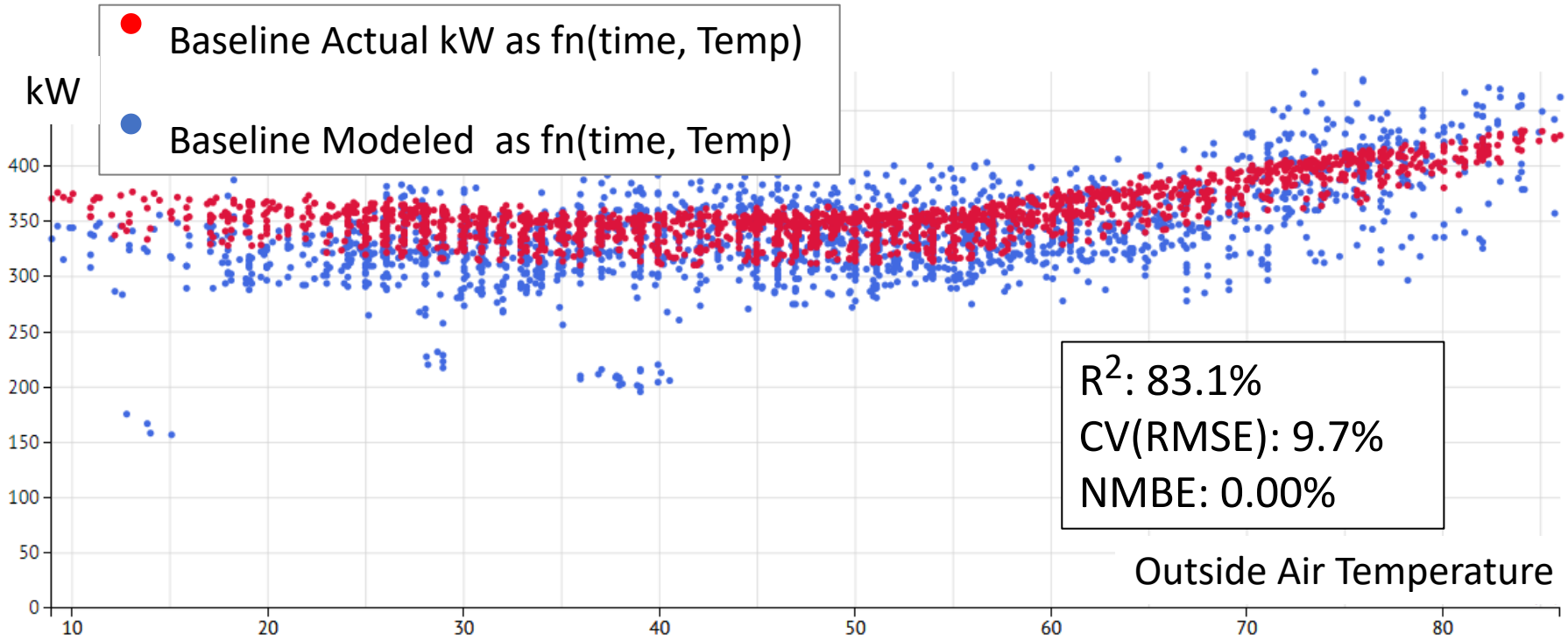


Performance Period

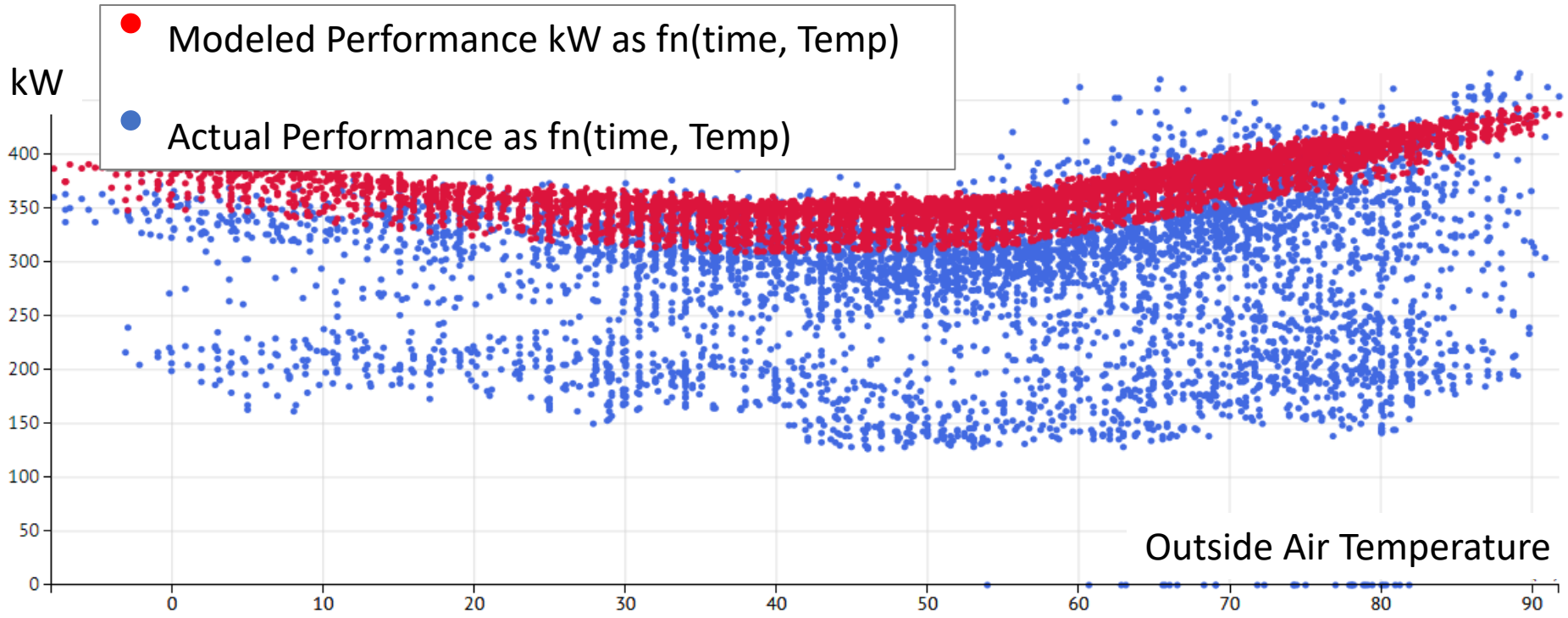
5. Savings Status Report
   - Periodically during performance period
   - QA check that savings are accruing
   - Detect presence of NREs

6. Savings Reporting
   - Per M&V Plan
   - A to Z report on savings
     - Raw data to final savings
     - NRE impacts included

Performance



Prescreen for statistical fit



Annual Savings: 275,001 kWh
Normalized Savings: 270,648 kWh
Relative Savings: 9.9%
Relative Uncertainty: 1.3%

Normalized Metered Energy Consumption (NMEC)

PROs

- Uses existing baseline
- Program pays only for real savings
- Allows all “normal replacement” measures
- Credit for BRO savings
- Method provides error estimates

CONs

- Will still undergo CPUC “custom review”
- Complicated “Effective Useful Life” calcs needed
- New approach to regulators and participants
- Not-recurring events (NRE’s) may obscure savings

Capital and BRO Measures

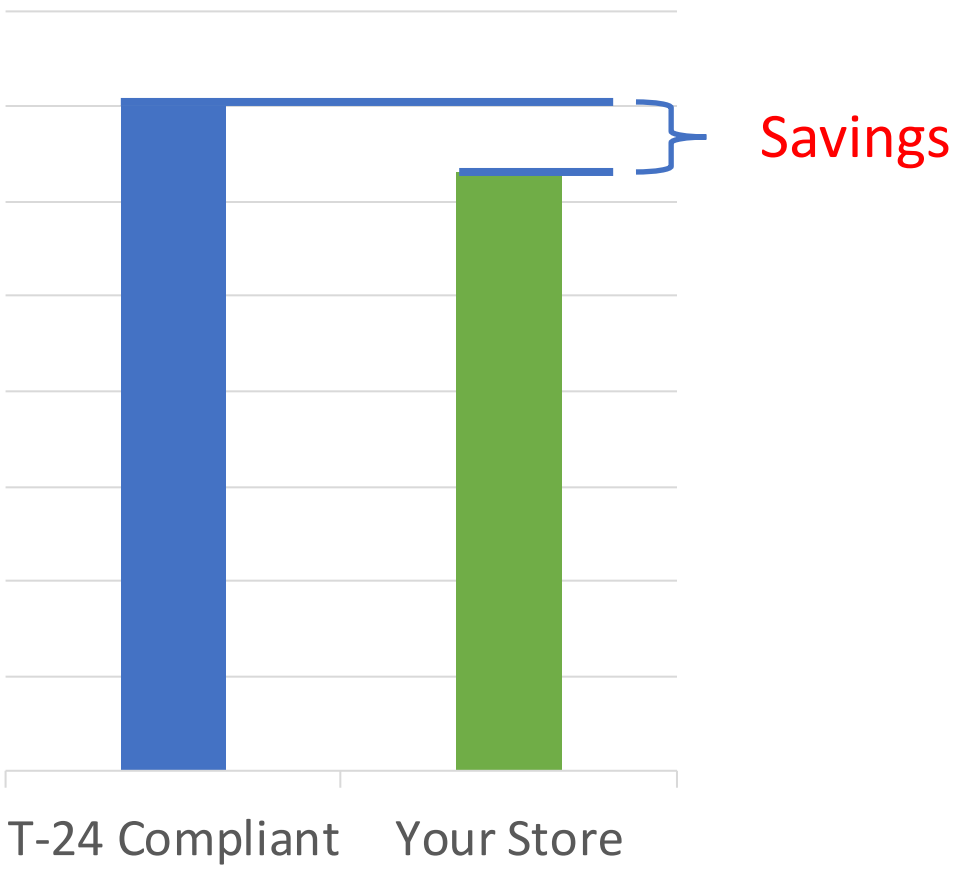
Capital Measures

- Equipment replacements – cases, compressors, controls etc.
- Major retrofits – CAV to VAV system conversions
- Add-on measures – E.g. VFDs added to fans
- Generally higher savings, longer EUL, and longer payback

BRO Measures = behavioral, retro-commissioning (RCx), operational

- Behavioral: savings related a change in people's behavior
- RCx: savings from improving a building systems performance
- Operational: savings from changing equipment and systems operations
- 3 year maintenance plan required

Baselines – New Construction



Tough because code requires:

- LED w/ daylighting
- Floating head
- VFD Condenser fans
- Condenser specific efficiency
- Etc…

Baselines – Existing Facilities

New tools – NMEC R Library

github.com/kW-Labs/nmecr

Open source code for NMEC analysis includes:

- LBNL's time-of-week and temperature model
- Change-point models based on ASHRAE's inverse modeling toolkit
- Simple linear regression
- Heating Degree-Day and Cooling Degree Day algorithms
- Capability for users to develop energy models based on hourly, daily, or monthly time intervals.
- Model assessment tools
- Other independent variables
- pre-screening tools
- Normalization of baseline energy use to reporting period conditions
- Normalization of both baseline and reporting period energy use to a common set of conditions for calculating "normalized savings"

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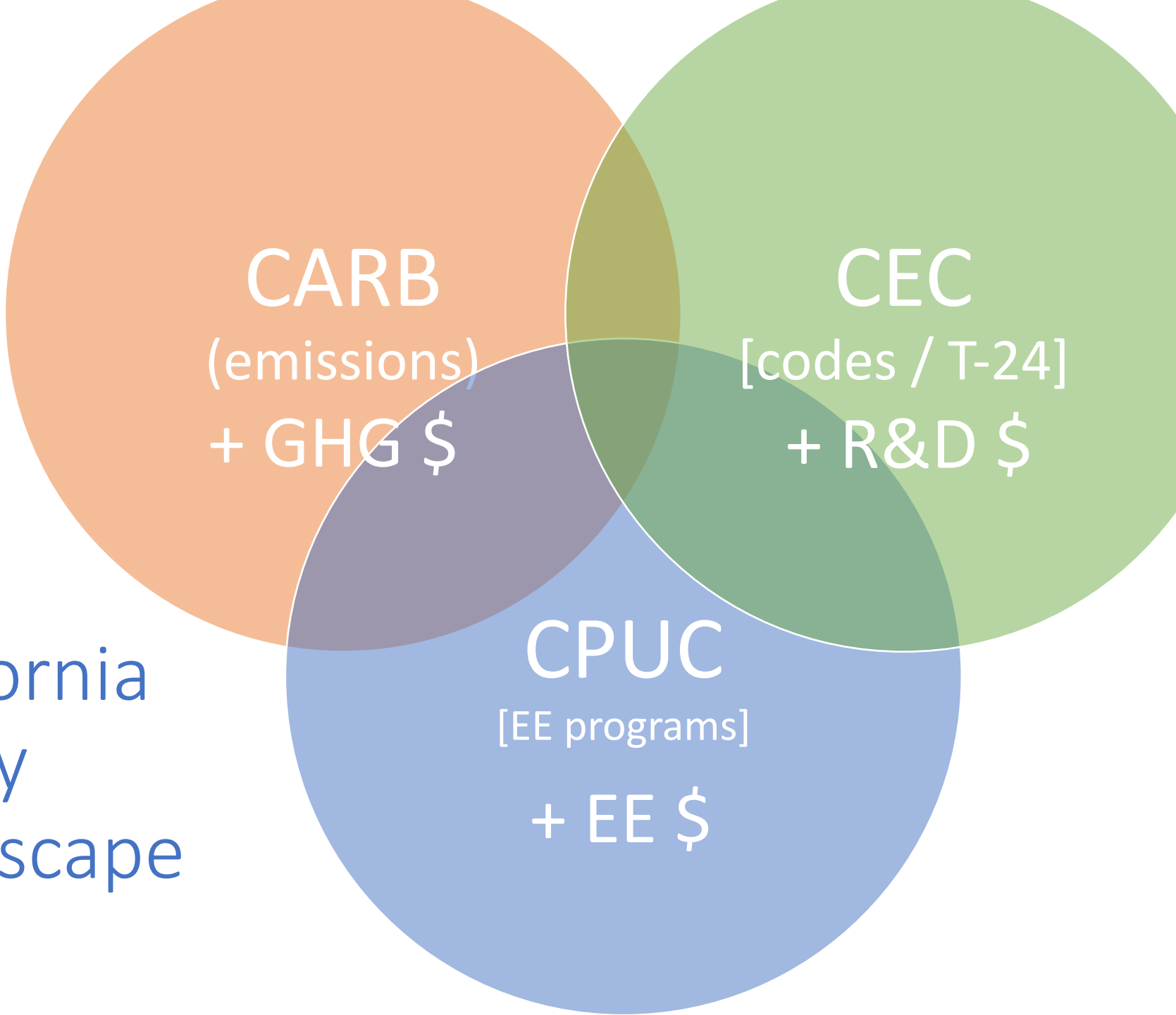

California Policy Landscape

What's needed?
(IMHO)

- Cooperation / Coordination between CPUC & CARB (at least)
- Recognition of high level policy goals at the policy-making level
- Recognition of equivalency between energy efficiency and GHG reduction goals

Thanks!

For more info
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