U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Achieving Energy Savings in Commercial PACE Programs: Trends, Tools and Case Studies

Part of the Technical Webinar Series for U.S. DOE's Commercial PACE Working Group

November 28, 2018

Purpose

- *C-PACE Technical Webinar Series*: To provide in-depth technical content about C-PACE program elements to state and local participants in DOE's C-PACE Working group with support from market experts.

- *Today's Webinar*: To inform state and local governments about trends and tools for estimating, verifying, and achieving energy savings from C-PACE programs.

Housekeeping

- The recorded webinar, transcript and slides will be available to C-PACE Working Group participants.
- Duration: 90 minutes.
- Attendees are in listen-only mode.
- Attendees are encouraged to type questions and feedback in the webinar interface tool throughout the webinar. We will have time at the end to answer questions.

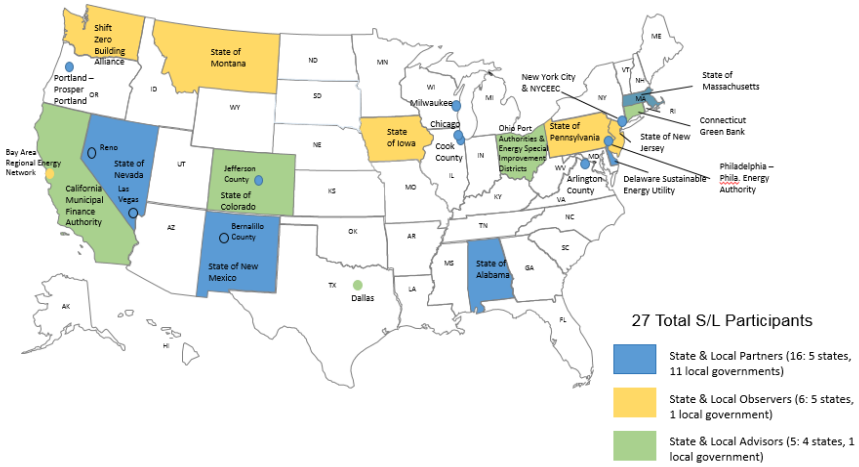
Agenda

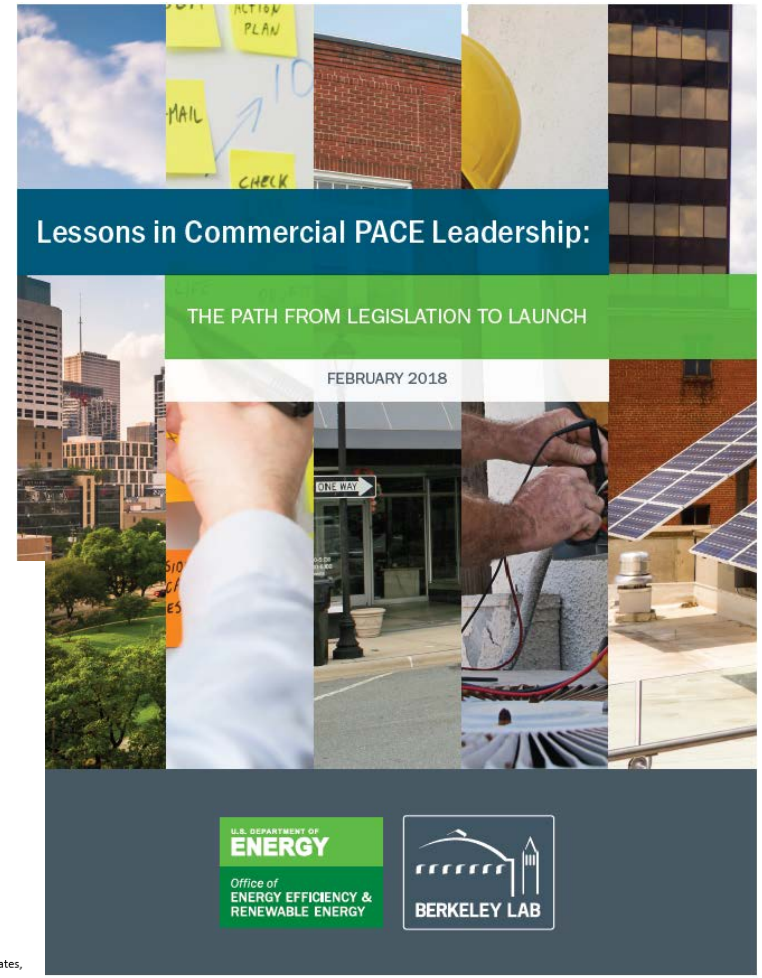
- **Background from DOE**
- **Featured Speakers**
  - Mike Centore, PACENation
  - Matt Golden, OpenEE & Investor Confidence Project
  - Carmen Best, OpenEE
  - Mackey Dykes, Connecticut Green Bank
- **Q&A**

Background: Resources from DOE

- *Lessons in Commercial PACE Leadership: The Path from Legislation to Launch*

- Commercial PACE Working Group
  - *Welcoming new participants!*





Learn more at DOE's State and Local Solution Center: *https://www.energy.gov/eere/slsc/state-and-local-solution-center*

Background: Why Today's Topic?

- **Public sponsors, capital providers, and building owners want C-PACE projects to achieve energy and dollar savings.**

  How can savings be ensured? Implement guidelines to rigorously estimate energy savings pre-installation (e.g., energy audits), and possibly implement evaluation, measurement and verification (EM&V) guidelines to track realized energy savings post-installation.

1. ***What are the energy savings and technology trends with C-PACE projects to-date?*** **More to come from PACENation**
2. ***What is available in terms of standard, commonly used technical guidelines for audits, and EM&V?*** **More to come from the Investor Confidence Project and OpenEE**
3. ***How have leading C-PACE sponsors navigated this issue?*** **More to come from the Connecticut Green Bank**

PACENation

Building the clean energy economy

Mike Centore
Director, Market Research

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pacenation.org

Agenda

PACENation
Building the clean energy economy

1. Introduction

2. Available data
- Installed measures

3. Program implementation examples
- Auditing, calculation, and technical standards
- Measurement, verification, and evaluation

4. Market perspectives
- Further questions and discussions
- Data sharing, transparency, and standardization

PACENation

Our mission is to promote Property Assessed Clean Energy financing by providing leadership, support, problem solving, data and networking opportunities for a growing universe of PACE market participants.

Our work includes:

- National PACE events
- Market research
- Policy and market development
- Informational resources for members

pacenation.us

Energy savings and C-PACE

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- PACE is a **public-private partnership**
- Energy and cost savings from efficiency, and greenhouse gas mitigation are often defined as a public benefit in PACE legislation
- Reliable data is necessary to show positive outcomes are being achieved
- Standardization enables continued scale

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Cumulative C-PACE financing

(2009-2018)

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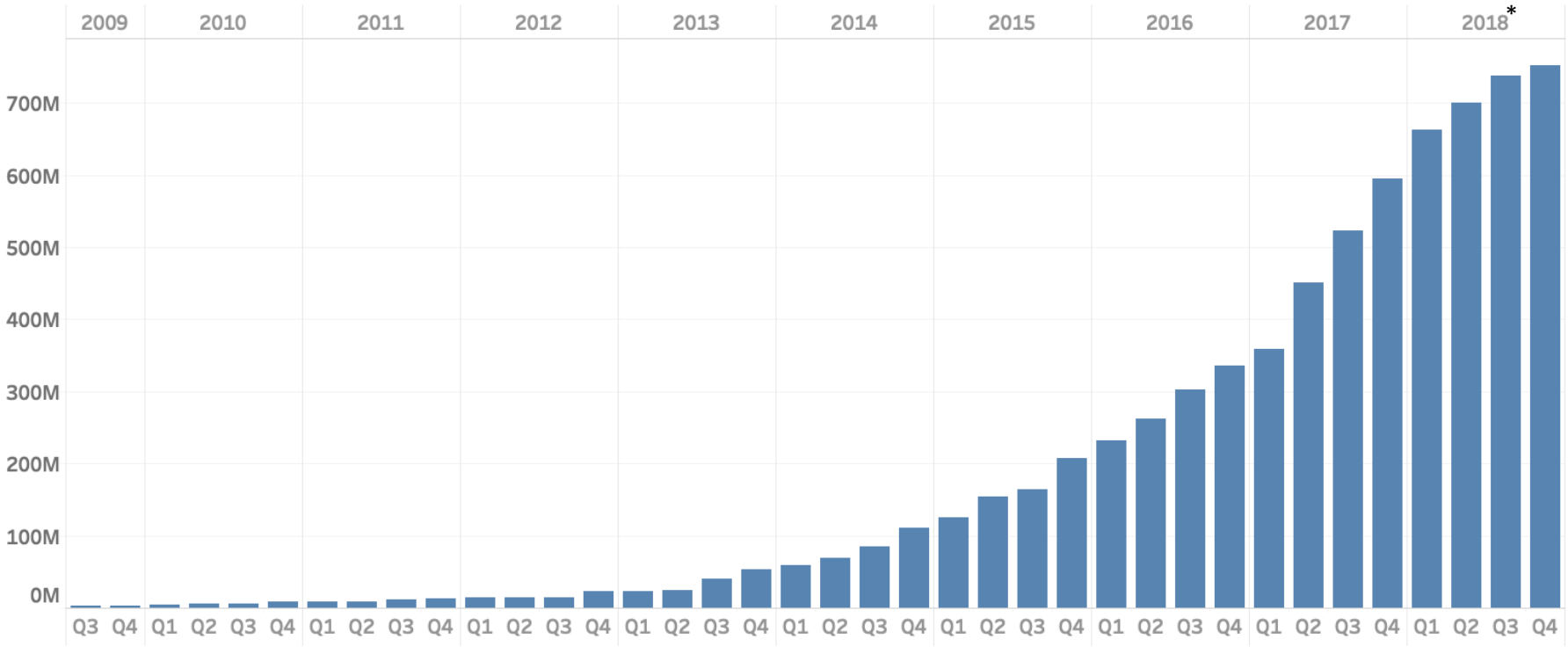

*Not yet finalized

Financeable measures

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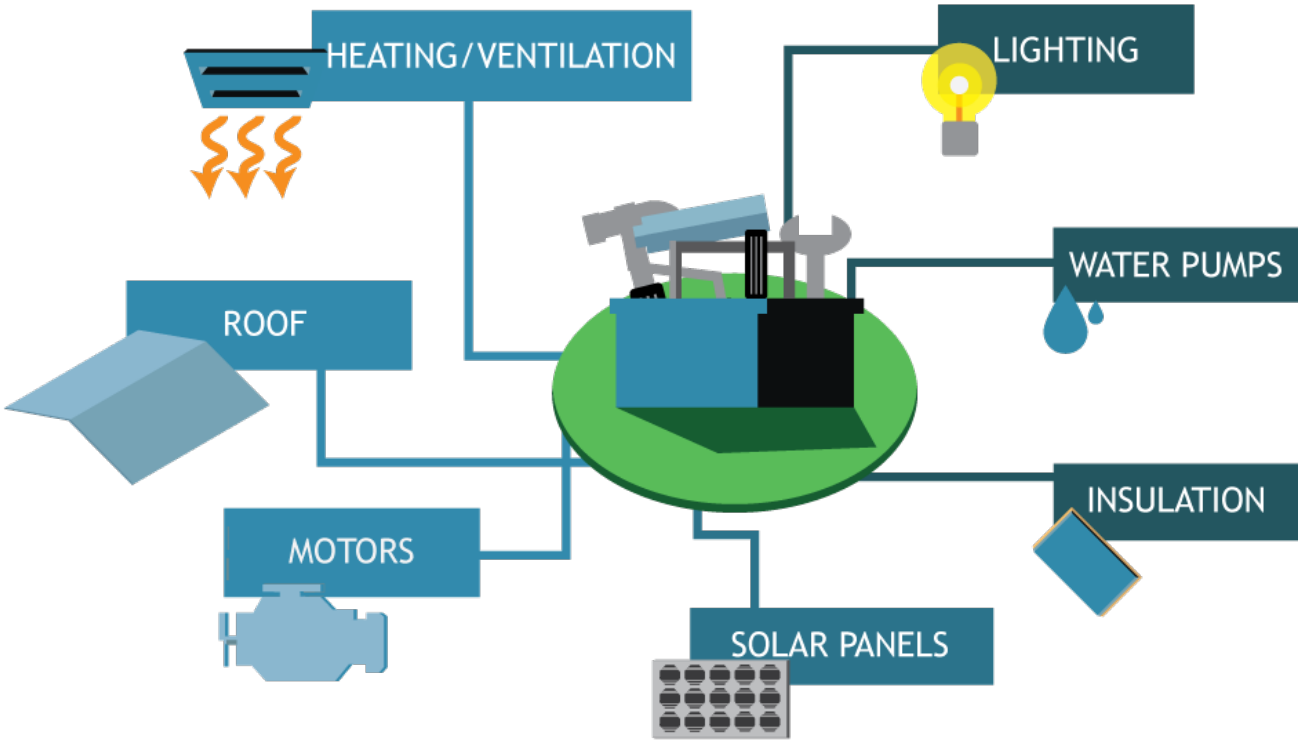
Building the clean energy economy



In many cases:

- Cogeneration
- Microgrids
- Fuel Cells
- Energy storage
- Seismic strengthening
- Hurricane resilience

What is being funded?

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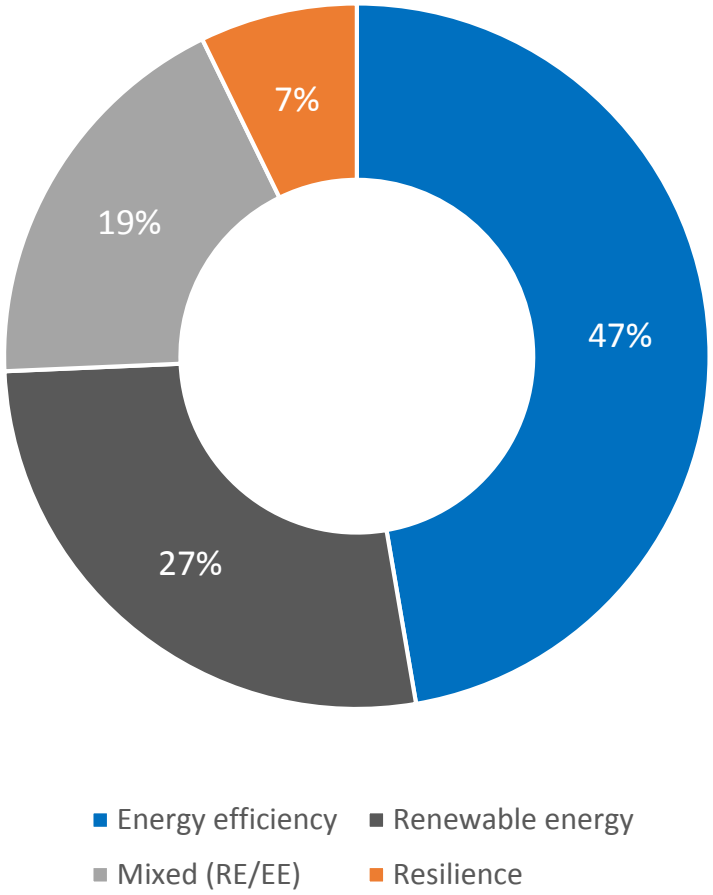
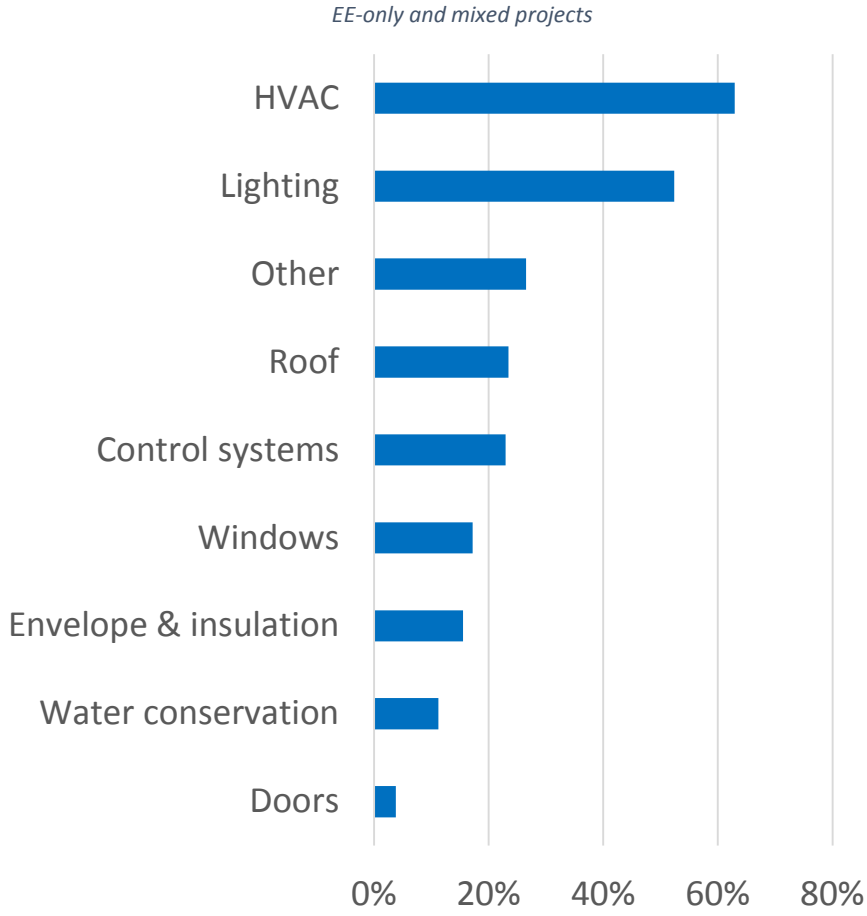
C-PACE funding by category:

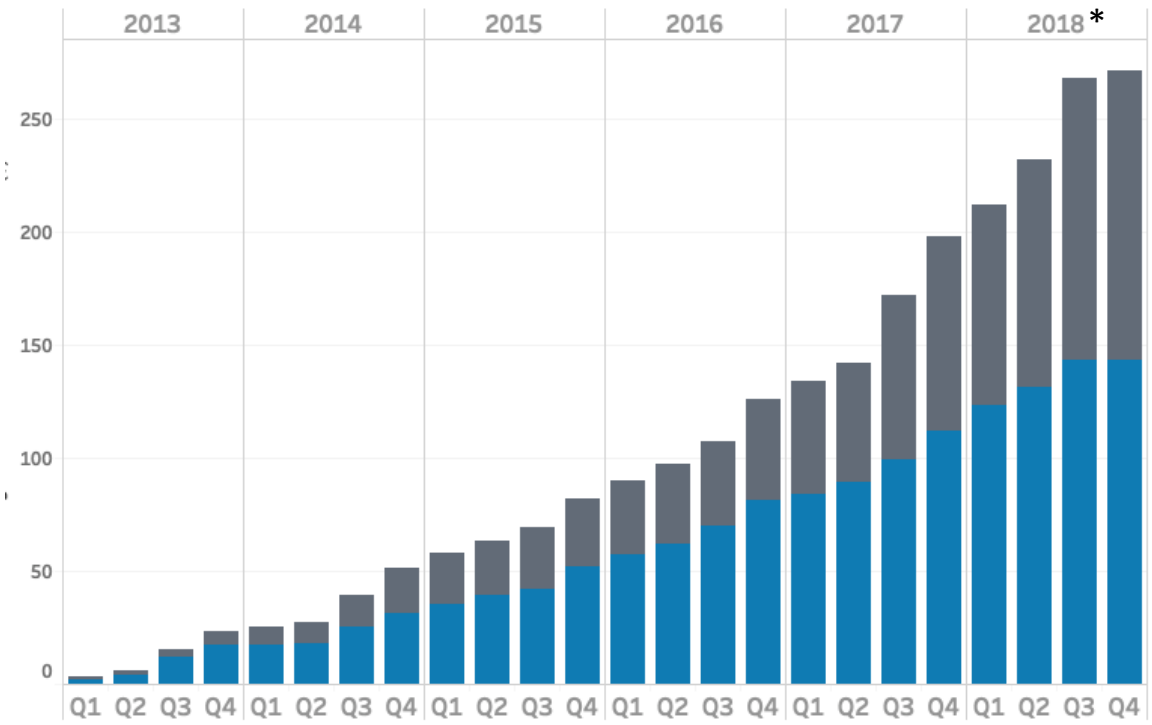


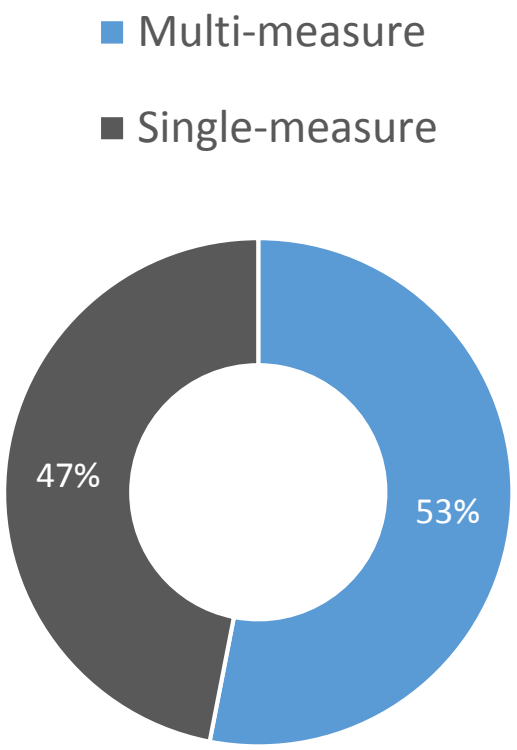
Specific measures (% of projects):



Multi-measure projects

Efficiency only





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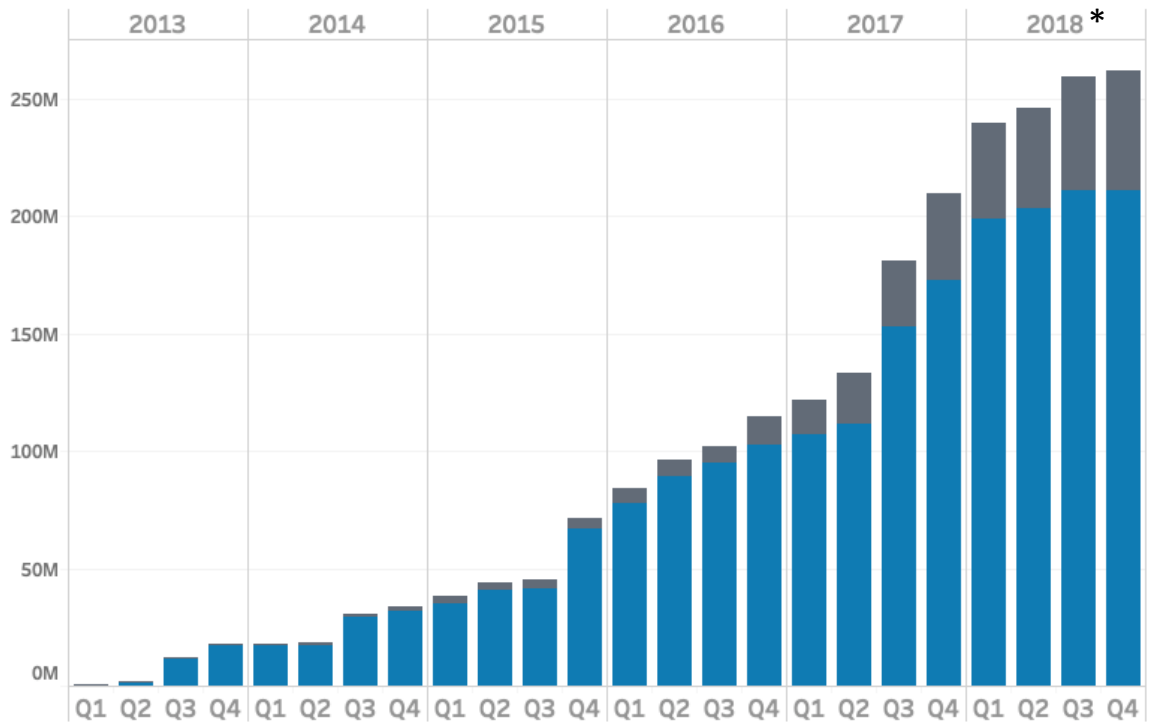
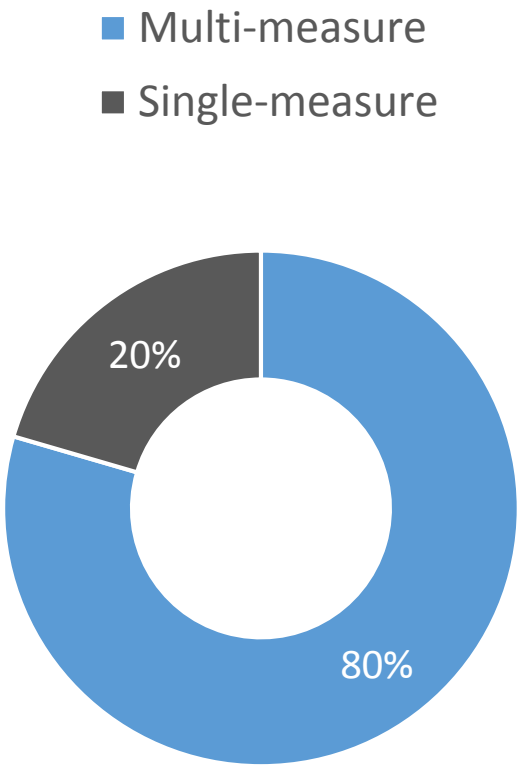
Multi-measure funding

Efficiency only





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ASHRAE

ASTM INTERNATIONAL
Helping our world work better

BUILDING PERFORMANCE INSTITUTE INC · BPI

EVO | Efficiency Valuation Organization

FEMP
Federal Energy Management Program

INVESTOR READY ENERGY EFFICIENCY SM
Energy Performance Protocol
TARGETED COMMERCIAL v1.1
INVESTOR CONFIDENCE PROJECT

ISO

Uniform Methods Project

…and others

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Examples: Implementation in C-PACE programs

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Implementation examples

Auditing	Long-term M&V	Technical standards
ASHRAE level 1-3 is common	Annual reporting through EPA portfolio manager, w/ read-access granted to administrator	
Other options include solar feasibility studies, or fast-tracked analysis, depending on project type and complexity	Other options include use of city benchmarking program, or better buildings challenge	Flexible options allowing for industry standard and proprietary energy models

Highlight: TX PACE E&E Tracker

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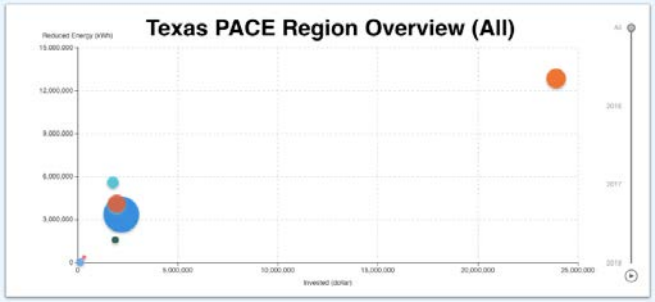

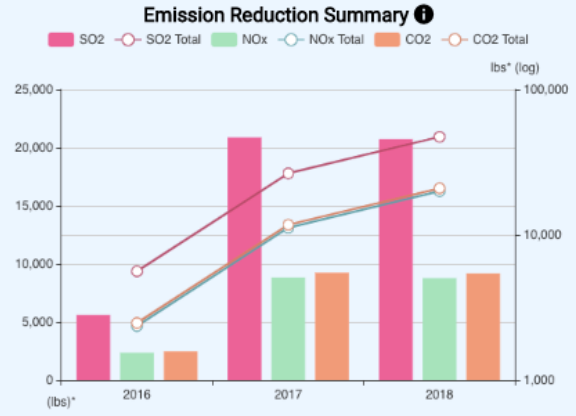

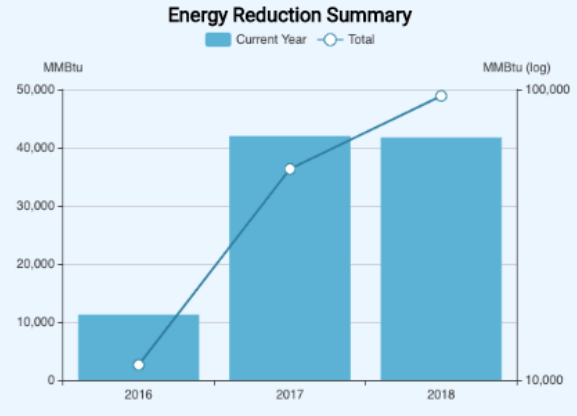

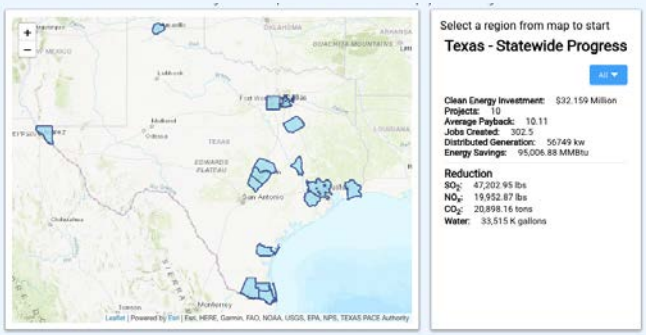

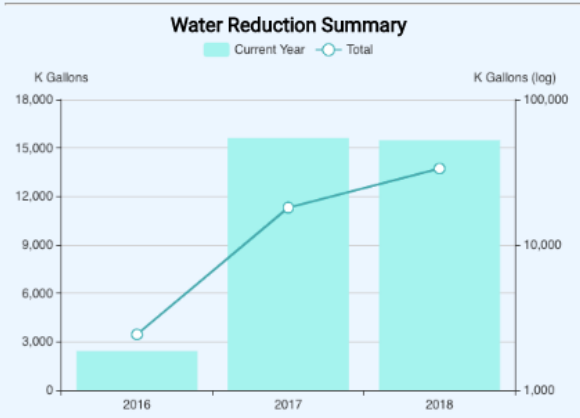

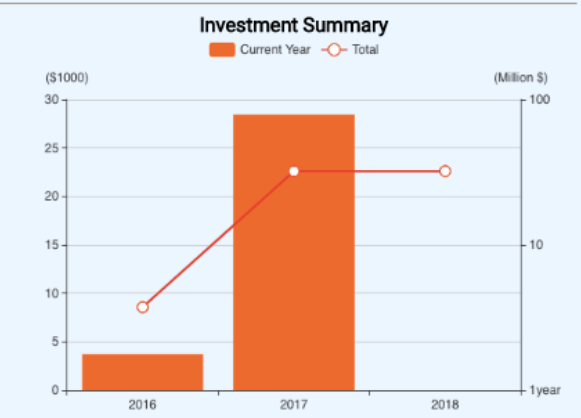

Source: HARC & TX PACE Authority
http://pace.harcresearch.org

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Perspectives on program requirements

C-PACE SURVEY

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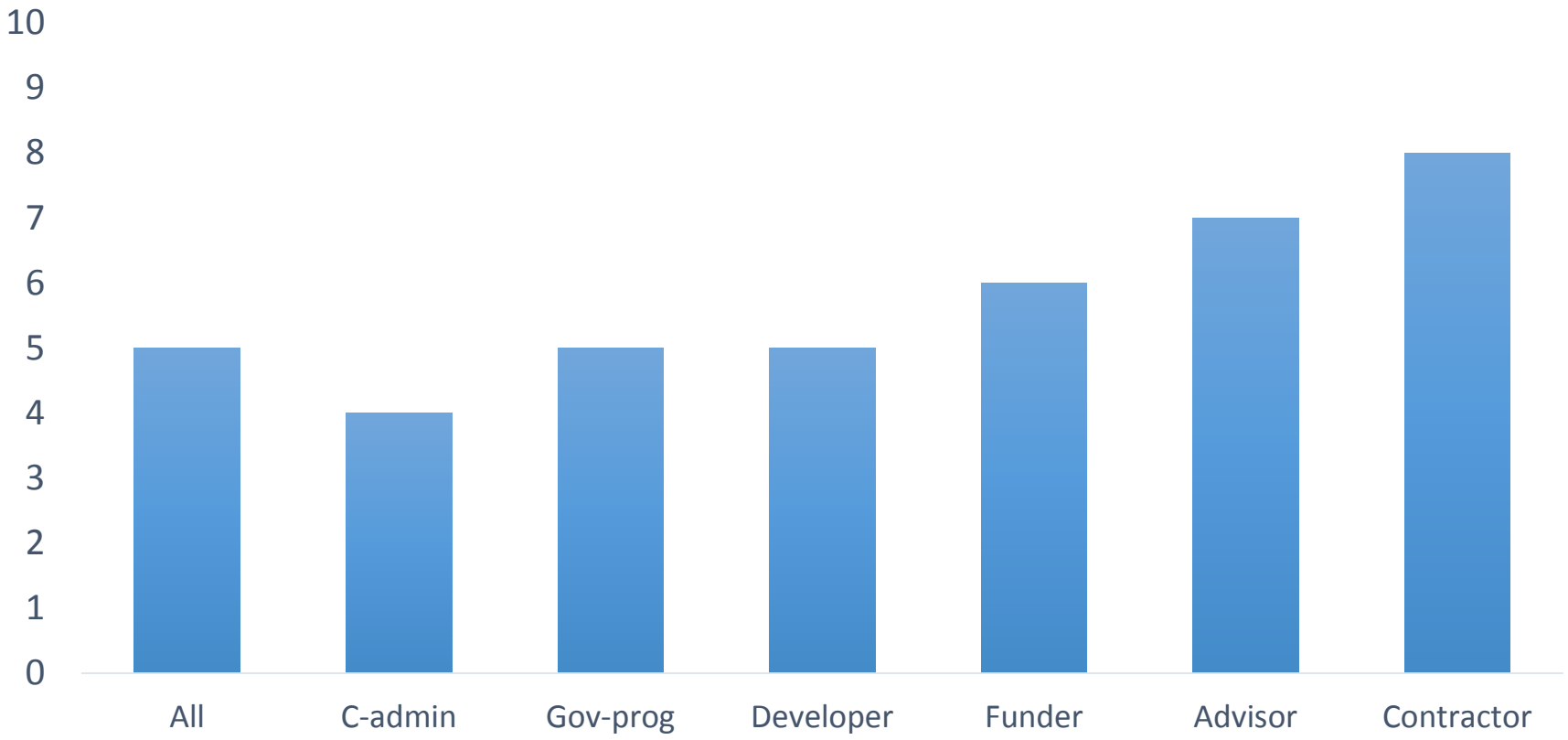
On a scale of 1-10, how much has burdensome program administration been a barrier to C-PACE's ability to scale?



Perspectives on program requirements

C-PACE SURVEY

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Selected responses: "Examples of burdensome program administration?"

- **Administrator:** "…energy savings supporting documents"
- **Funder / Administrator**: "Energy audit and legal review."
- **Administrator: "**Qualification process, guidelines for approved measures for financing."
- **Contractor / Project Developer**: "Creating additional standards beyond the statute and at the discretion of the administrator."
- **Administrator**: "Tough underwriting and technical standards in market with low energy and water prices"

Data-sharing and standardization

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C-PACE Data Protocol

	Level one	Level two	Level three (in progress)
	Shares below data on quarterly schedule.	Shares below data on quarterly schedule.	Shares below data and is compliant with PACENation data best practices
PACE program name	y	y	y
Project name	y	y	y
Location			
Street	y	y	y
City	y	y	y
State	y	y	y
Zip	y	y	y
Date the project closed	y	y	y
Total PACE amount ($)	y	y	y
Financing term (years)	y	y	y

Contact mike@pacenation.org for full list of data points

Program standardization efforts

KEEPING PACE IN TEXAS
PACE in a BOX

MID-ATLANTIC PACE ALLIANCE

SEF / PEA

+ Others in development

Contact us to get connected to others working on program standardization

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Mike Centore
Director, Market Research

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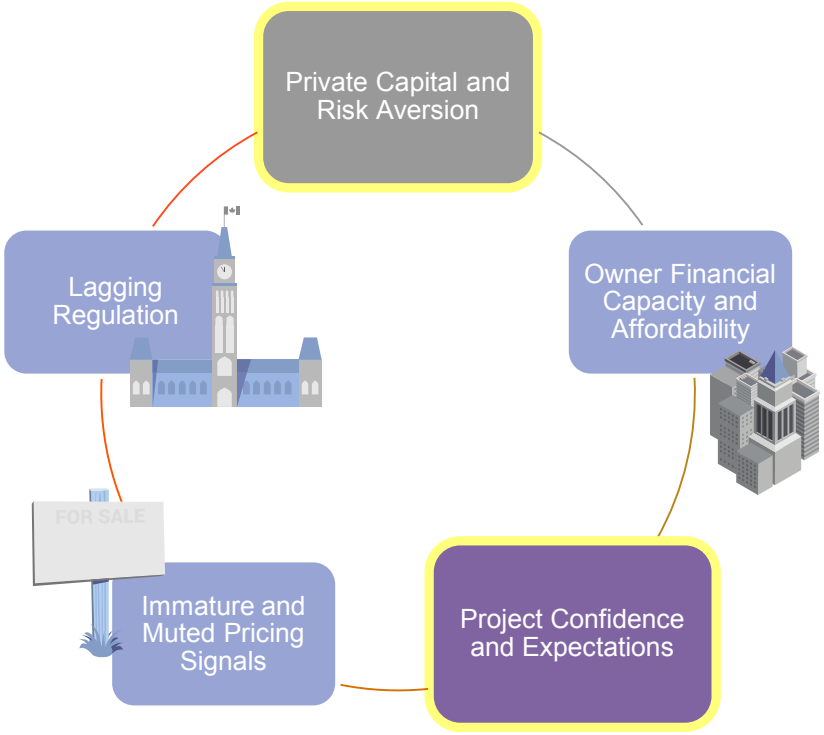
INVESTOR
CONFIDENCE
PROJECT
BUILDING STRONG MARKET
INFRASTRUCTURE FOR THE
RETROFIT ECONOMY


Too many economically viable retrofits
don’t take place in our buildings today…

Barriers to a Strong a Retrofit Economy



INVESTOR CONFIDENCE PROJECT

- ↑ Reliability of savings
- ↓ Transaction Cost
- ↓ Investor risk

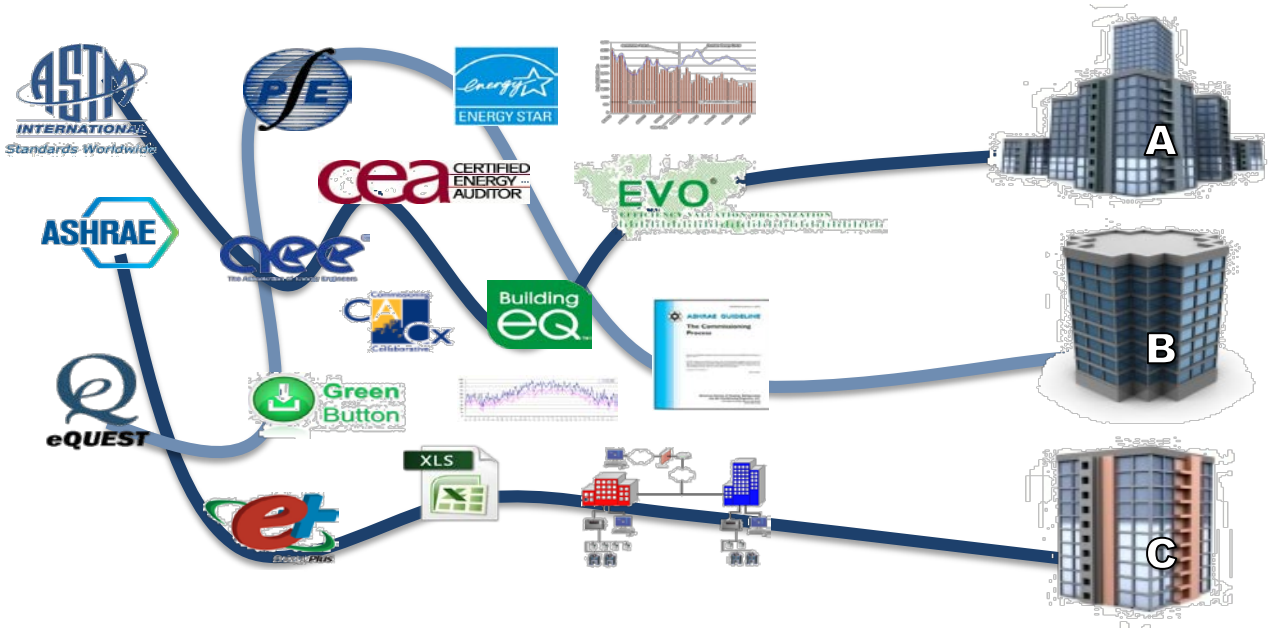
Investor Ready Energy Efficiency (IREE) Certification

ICP's Investor Ready Energy Efficiency™ (IREE) Certification ensures **transparency, consistency,** and **trust-worthiness** through **best practice** and **independent verification**.

GBCI®

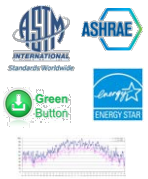
Administering IREE Certification globally

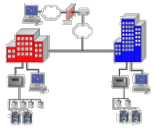
Energy Efficiency as it Exists Today



A consistent roadmap for project development…

Baselining → Savings Projections → Verification → OM&M → M&V





BASELINING

- Existing Building
- Drawings
- Weather File
- Energy Usage
- Energy Rates
- Occupancy

SAVINGS

- Model File
- Calibration Data
- Bid Packages
- Certifications

COMMISSION

- Cx Plan
- Cx Authority
- Test Procedures
- Facilities Req.

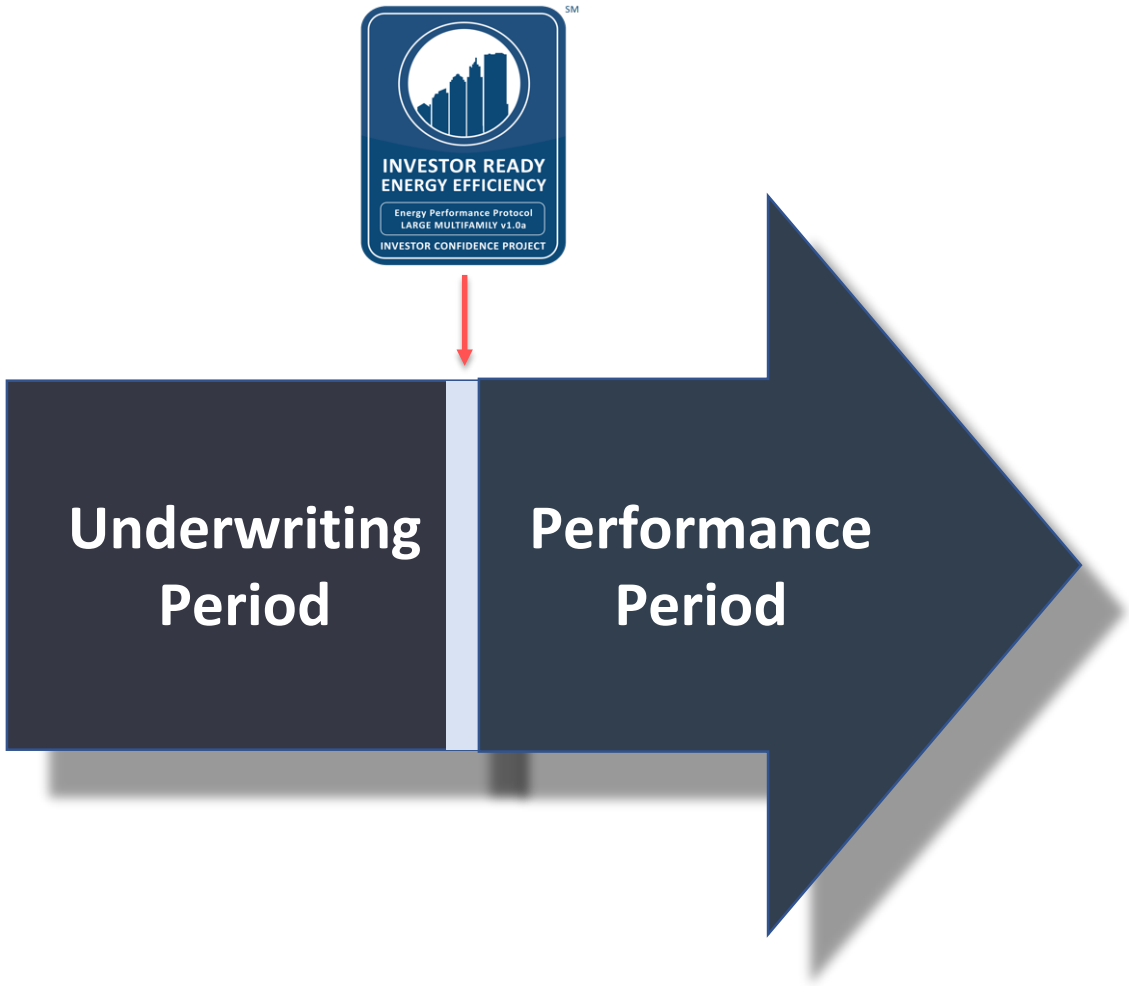
OPERATIONS

- BMS Points
- Fault Plan
- Maintenance Plan

MEASUREME

- M&V Model
- Regression Model
- Adjustments
- Impact
- Baseline Adjustments

IREE is the quality mark like LEED but for a building retrofit project


INVESTOR READY
ENERGY EFFICIENCY
Energy Performance Protocol
LARGE MULTIFAMILY v1.0a
INVESTOR CONFIDENCE PROJECT
Underwriting Period
Performance Period

ICP as a tool for Programs

PG&E On-Bill Financing:

Using ICP as a standard market based approach to qualify a project's access to 0% financing (up to $100k)

NJ Pay-for-Performance:

Certified ICP IREE Projects can qualify for additional incentives upfront and based on performance.

PACE in Texas:

Texas PACE Authority using ICP as a means to ensure standard requirements statewide.

Connecticut Green Bank:

Texas PACE Authority using ICP as a means to ensure standard requirements statewide.


NYGREEN BANK
nyserda
Energy. Innovation. Solutions.
ENERGIZE NY
planYC
New York Power Authority
NYCEEC
BPU
Better Buildings CHALLENGE
SF Environment
PG&E
CaliforniaFIRST
SECO
State Energy Conservation Office
cpace
CLEAN ENERGY FINANCE AND INVESTMENT AUTHORITY
e·on
SIEMENS
ARUP
ING
EuroACE
EUROPEAN COMMISSION
Green Investment Bank
CLIMATE STRATEGY PARTNERS
RdA
BPIE
Covenant of Mayors
Department of Energy & Climate Change
TRANE
Johnson Controls
TRC
H.T. LYONS
pepco Energy Services
ENERGY AFFORDABILITY
CPG Consultants
Reports.com
DAY EFFICIENCY
Project Developer
INVESTOR CONFIDENCE PROJECT
SUSTAINABLE REAL ESTATE SOLUTIONS
noesis
NECAEGAP
PERFORMANCE SYSTEMS DEVELOPMENT
encentivenergy
HELIOS
mpw
MISSION MARKETS
abundance
WinnCompanies
wegowise
STRATEGIC ENERGY GROUP
kWhOURS
PACEEquity
EMVC Solutions
Celtic Energy
carbonlighthouse
SPEER
ROCKY MOUNTAIN INSTITUTE
JOULE ASSETS
METRUS ENERGY
nep
ELEVATE ENERGY
Smarter energy use for all
PACENow
LENDERS COMMERCIAL FINANCE
IMT
Institute for Market Transformation
RENOVATEAMERICA
Retroficiency
EnergyPro
FIRSTFUEL
eeVs
ABUNDANT POWER
CREEKWOOD ENERGY
BASE
UNEP Collaborating Centre
Pinsent Masons
pulse energy
E-CAPITAL DEVELOPMENT
IES
INTEGRATED ENVIRONMENTAL SOLUTIONS
lucid
CRG
PROJECT ECONOMICS
GPF
Alpheon energy
Enerdigm
encentivenergy
IRIS
ALLFACILITIES energy group
ACUITY POWER GROUP
PACE TEXAS
energi.
CHEROKEE ENERGY MANAGEMENT
Green Investors
TIP CAPITAL
RENEW Energy Partners
EnergyMac
lewenterprises
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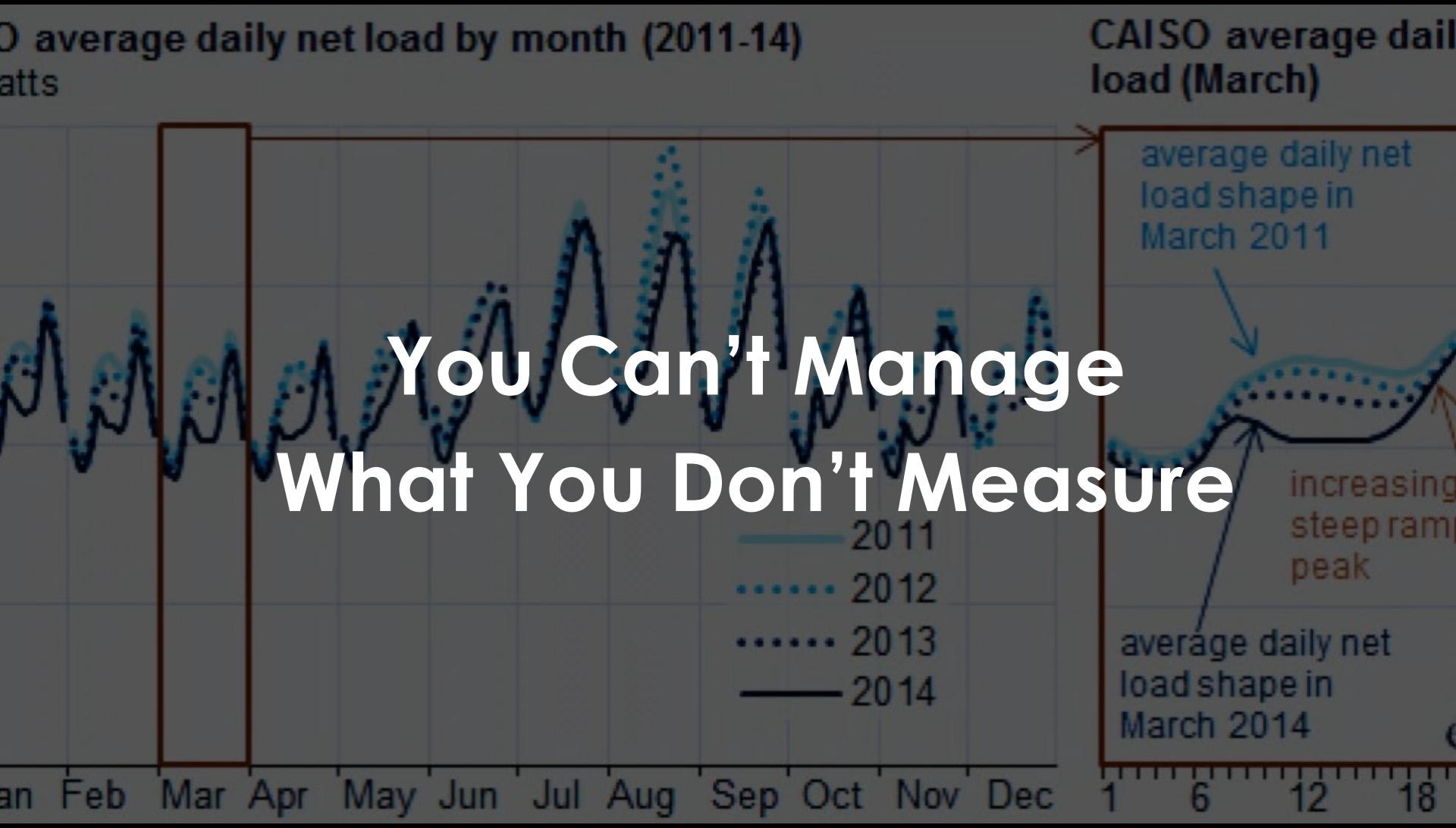
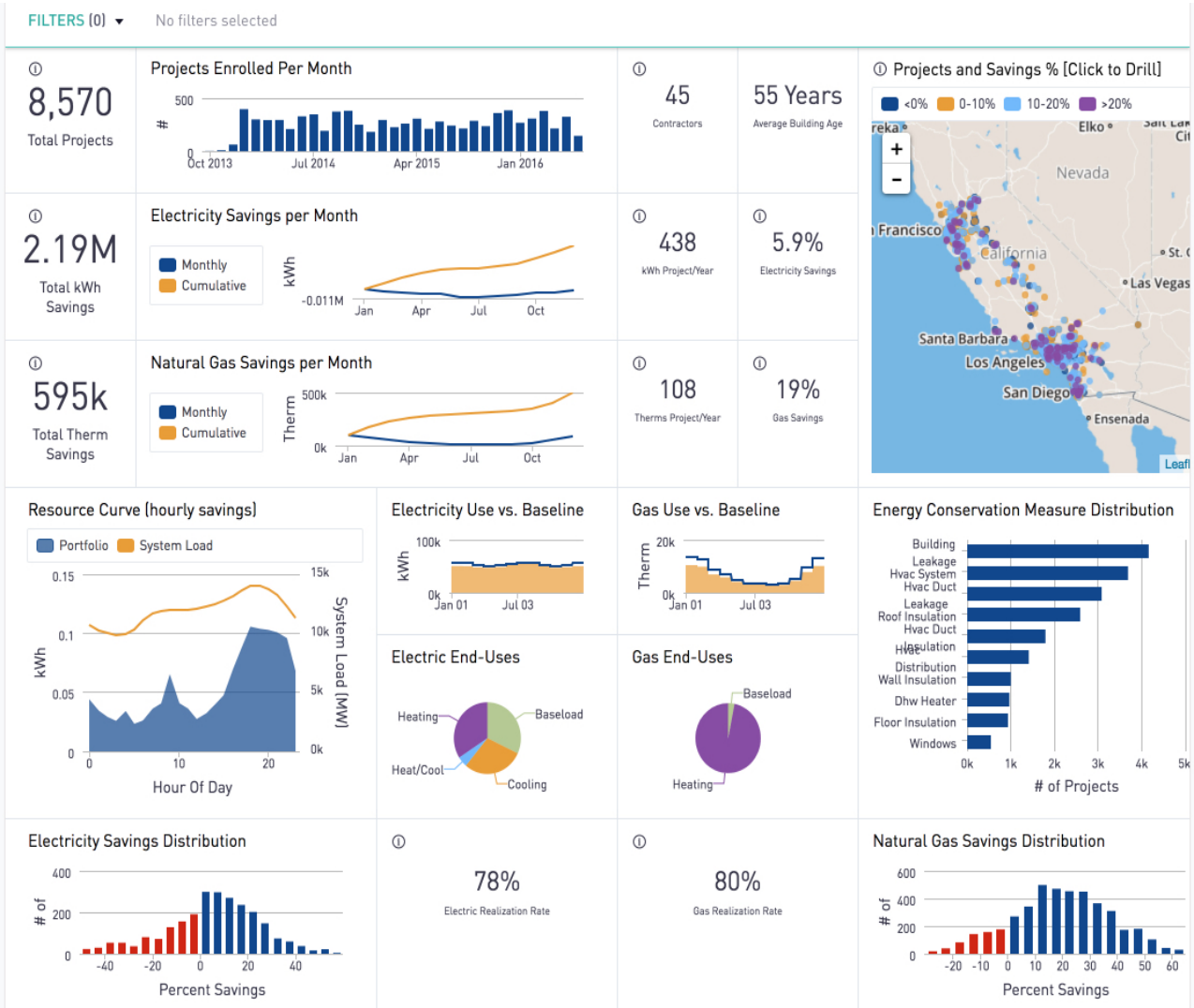
eutectics
BRIGHT POWER
spark
NJPACE
ENERGY



You Can't Manage What You Don't Measure

Track Efficiency Impacts in Real-Time



open source initiative

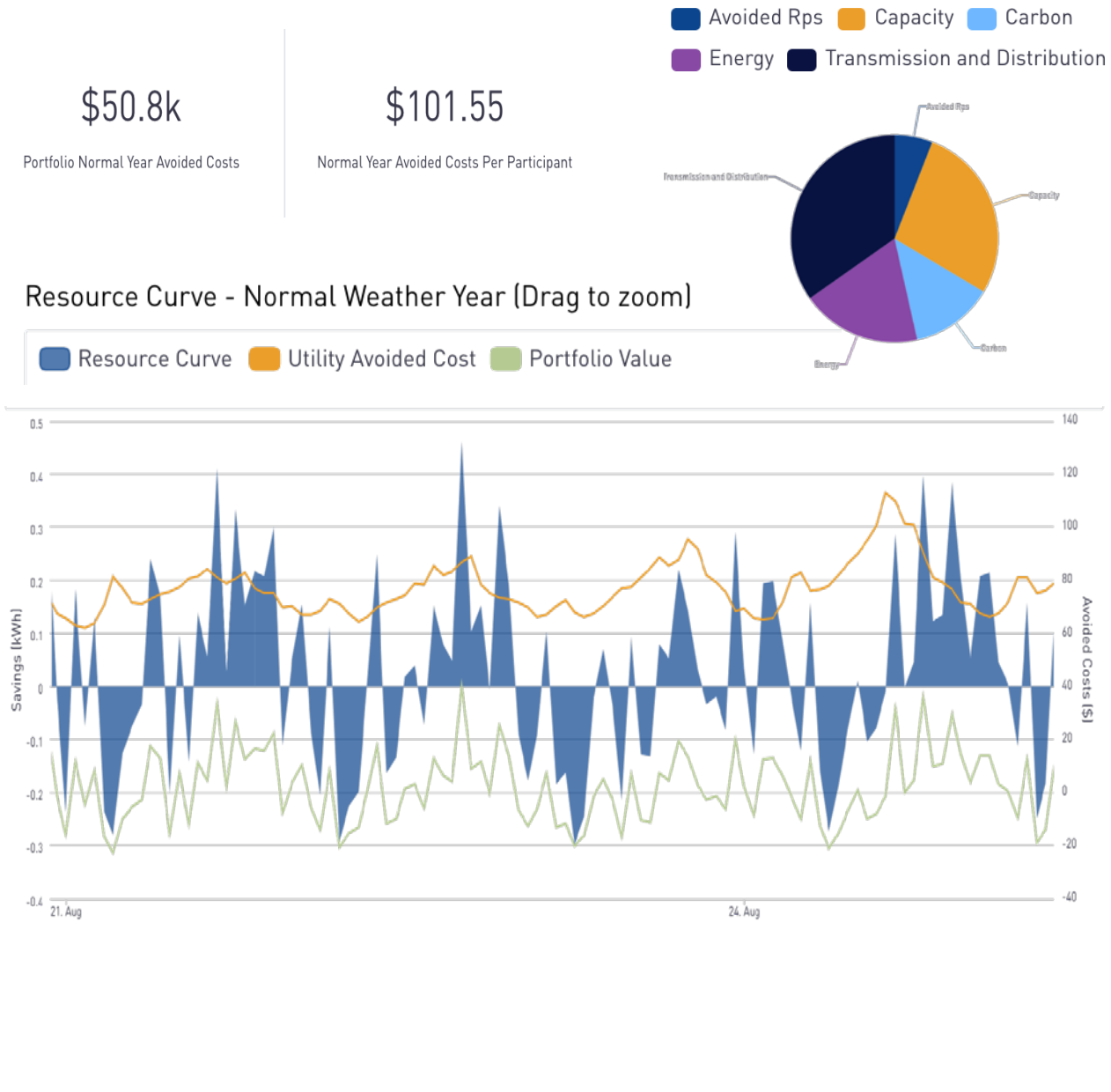
OPEN METER

Optimize Using Actionable Real-time Data

open source initiative

OPEN METER

Calculating Real Avoided Costs



open source initiative

OPEN METER

Calculating Real Carbon Reductions

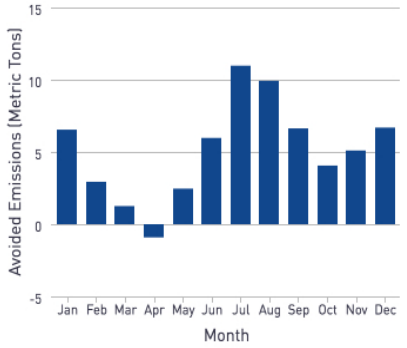
FILTERS (1) ▾ **Portfolio** Weatherization

45	0.207	0.09	436
Portfolio Avoided GHG Emissions [Metric Tons]	Avoided Emissions Factor [Metric Tons/MWh Saved]	Participant Avoided GHG Emissions [Metric Tons]	Participant Normal Year kWh Savings

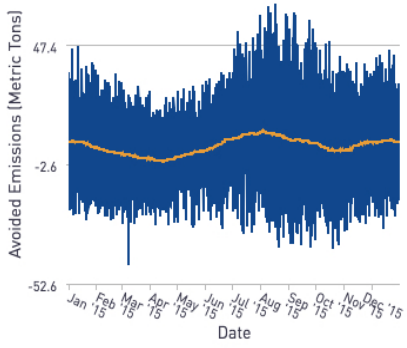
Avoided Electric GHG Emissions (Kilograms Carbon)

HOUR	1	2	3	4	5	6	7	8	9	10	11	12
1	14.1	8.3	-1.4	-6.4	1.0	8.8	14.6	10.1	0.4	2.8	1.2	5.3
2	4.2	7.5	-1.5	-5.1	1.8	5.8	11.1	6.9	-9.1	-3.3	4.2	9.9
3	5.5	4.8	2.3	-3.6	-0.4	0.6	4.1	2.9	-3.0	-2.8	5.5	2.5
4	8.0	6.8	0.9	-0.8	-3.6	2.5	1.9	3.3	-3.1	-3.9	0.2	6.6
5	8.0	8.7	1.2	-0.8	-0.6	1.8	0.2	3.3	2.8	-0.9	1.8	8.4
6	3.8	1.0	2.9	-4.1	0.7	0.9	-1.6	-6.9	-0.1	0.5	3.5	3.5
7	3.3	1.8	-0.2	2.1	0.6	0.0	2.7	-2.8	-4.9	-0.4	5.2	3.7
8	5.5	4.1	3.0	2.5	1.8	2.5	1.1	-3.3	3.8	-0.6	2.0	6.9
9	10.7	5.2	3.1	1.6	3.9	1.8	-0.7	-1.3	0.8	7.4	4.5	7.4
10	10.9	3.6	5.3	3.6	-0.2	0.9	3.5	10.2	9.7	8.6	13.3	9.7
11	8.5	0.0	2.2	-1.7	1.0	-0.4	-1.9	-3.6	0.6	1.4	1.5	9.1
12	3.6	0.2	1.3	0.2	-3.2	-1.5	0.2	-3.3	-2.6	2.7	2.7	5.0
13	2.7	-1.9	-2.8	-4.2	-1.1	-1.4	1.6	0.8	-2.9	-3.5	-1.0	-2.8
14	-0.3	-2.3	-3.1	-3.2	0.4	2.4	4.9	0.3	-0.7	-2.9	-2.8	1.1
15	0.0	-0.6	-3.1	-1.6	3.1	3.5	2.9	3.6	-1.9	-0.6	0.4	2.7
16	1.4	-6.0	-4.6	-3.9	2.7	4.6	12.6	9.0	3.3	-0.6	0.2	3.6
17	3.6	-4.1	-4.4	-4.5	1.3	7.3	16.4	19.9	9.8	8.7	8.1	10.9
18	4.4	3.2	1.7	0.0	2.7	12.5	17.5	20.6	18.4	13.6	6.6	9.5
19	2.2	4.2	3.0	1.9	7.3	13.6	25.8	29.2	26.1	19.8	11.3	11.1
20	11.0	3.7	2.3	4.6	9.2	22.5	26.3	27.1	22.3	12.6	8.9	7.3
21	9.2	9.0	4.0	1.2	7.5	15.2	30.4	26.1	26.8	11.7	18.3	6.3
22	15.0	6.0	7.5	1.4	10.2	17.3	31.8	31.6	21.4	14.1	7.8	10.1
23	8.6	2.2	6.9	0.4	8.1	14.3	30.1	36.4	26.2	9.2	14.2	15.2
24	13.2	5.1	3.6	-1.7	4.9	7.8	27.7	18.0	15.2	3.6	4.9	7.4

Avoided GHG Emissions By Month (Metric Tons)



Hourly Avoided GHG [Drag to Zoom]



OPEN

CALTRACK

- Standard Calculation Methods for Energy Efficiency and Electrification
- Monthly, Daily, and Hourly
- Public 60 Stakeholders Empirical Process
- www.CalTRACK.org

OPEN METER

- Python CalTRACK Engine
- Open Source Apache 2.0
- Available Without Restriction
- How It Works: https://goo.gl/mhny2s
- Code Repo: https://goo.gl/qFdW4P

open source initiative

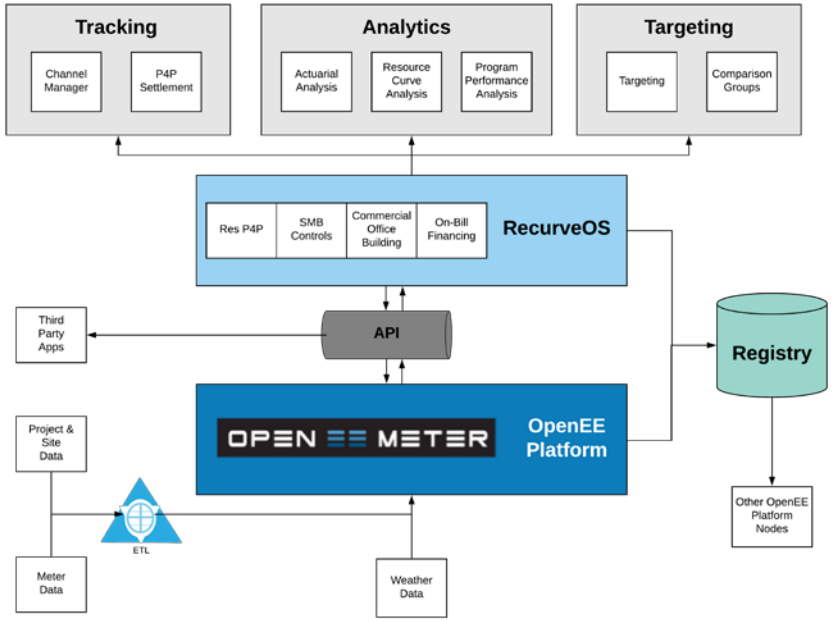
OpenEE Enterprise Platform

RecurveOS

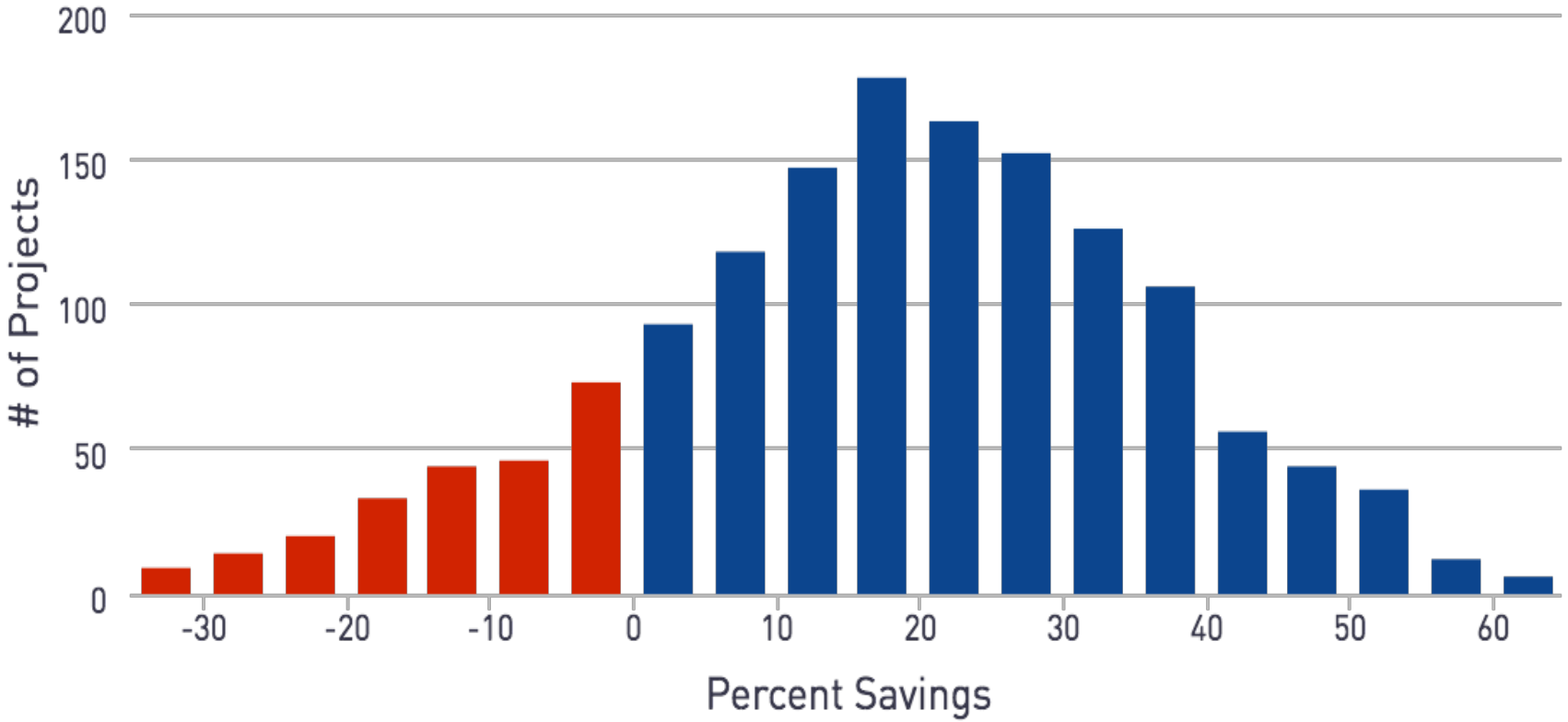
- Program and Procurement System
- Tracking, Targeting, and Analytics

OpenEE Platform

- "OpenEEmeter inside" SaaS
- Data Pipeline (ETL)
- Encryption and Security



Performance Risk is Manageable in Portfolios

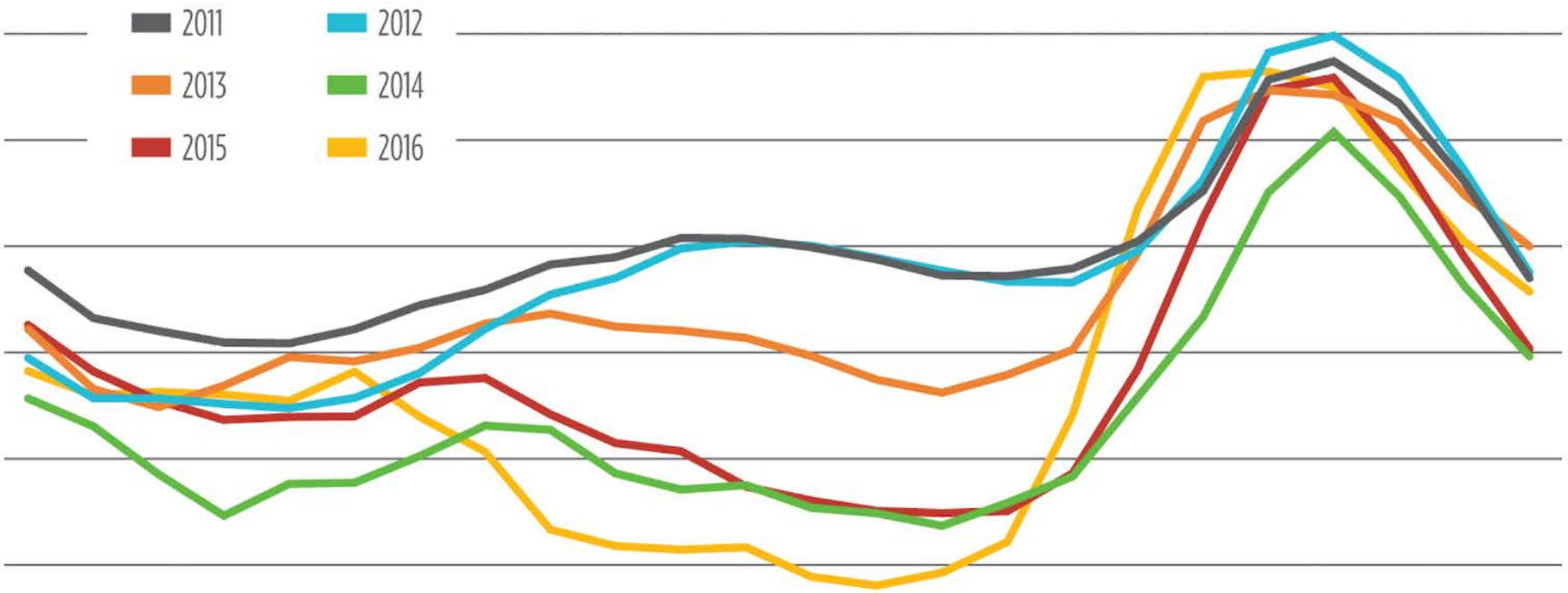


Metered Efficiency Performance Insurance

- Savings Performance Insurance based on OpenEEmeter Measurement
- Portfolio-level coverage of efficiency projects
- Underwritten based on actuarial data

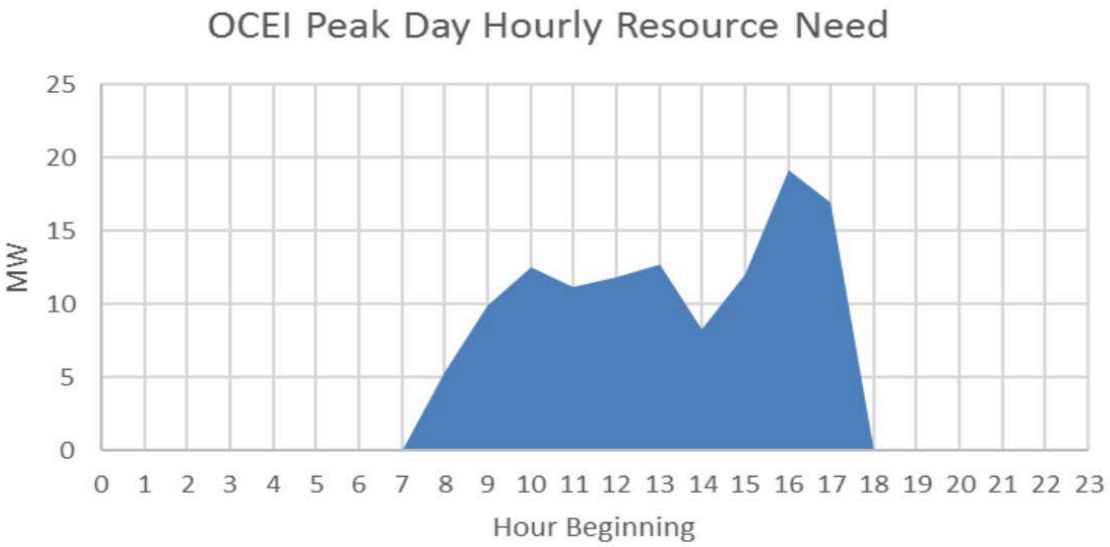
Project Finance: The long-term financing of projects based upon projected cash flows rather than the balance sheets of its sponsors.

The Big Bad Duck

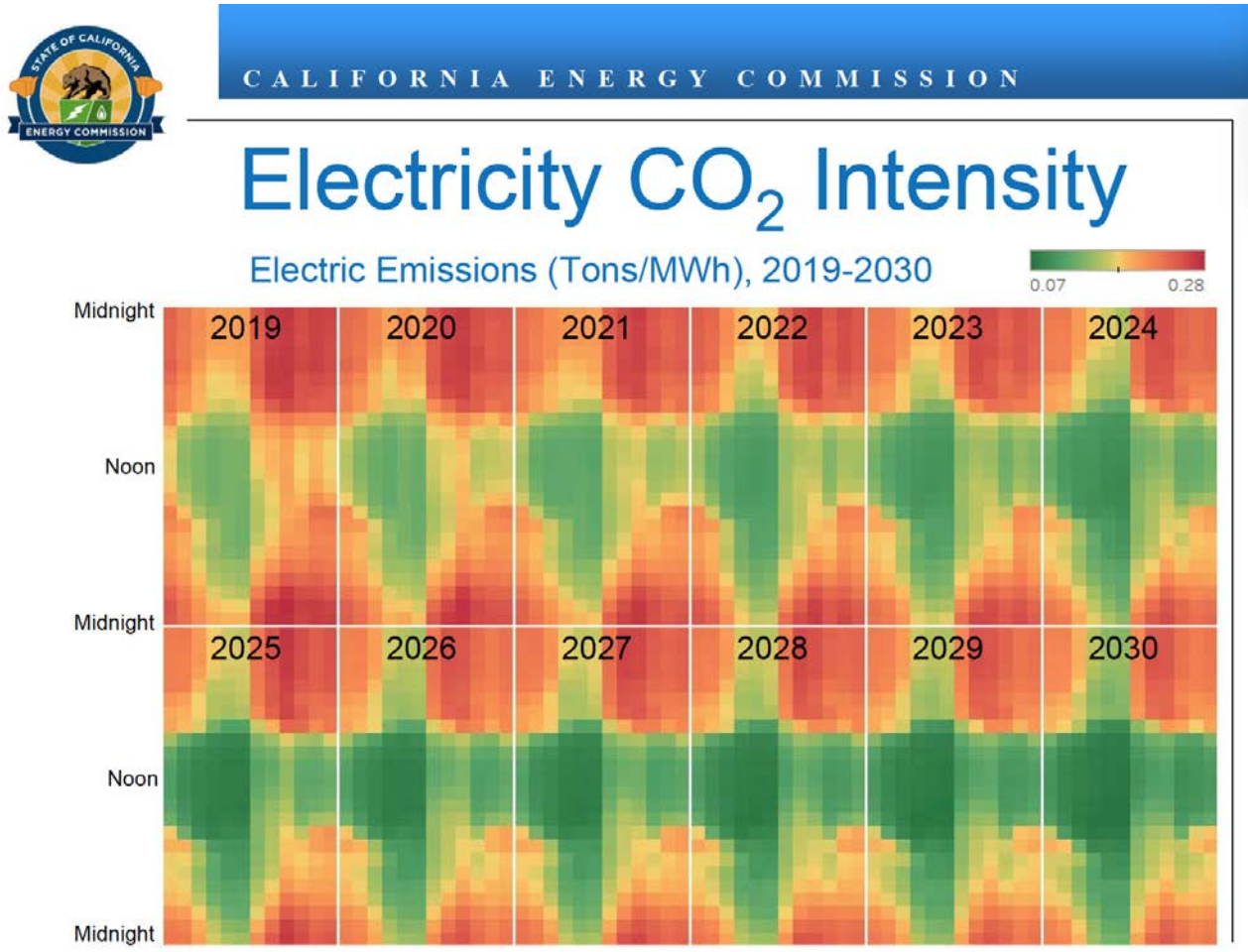


Four Years Ahead of CAISO Projections

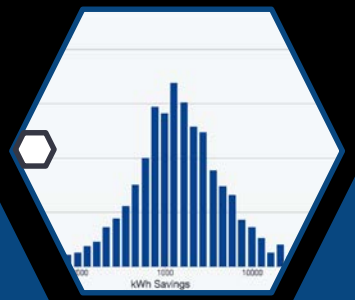
Oakland Clean Energy Initiative



What Is the Problem We Need to Solve?



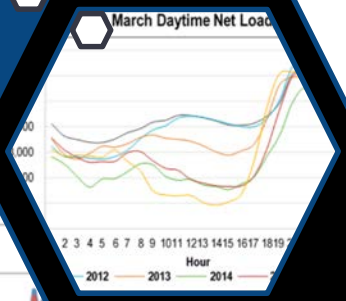
Pay for Performance



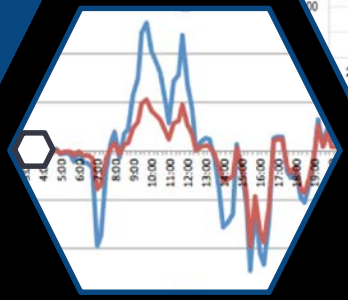
Resource Curve

Demand Capacity

Procurement



EEMeter



Matt Golden, CEO
mattgolden@openee.io

Connecticut Green Bank

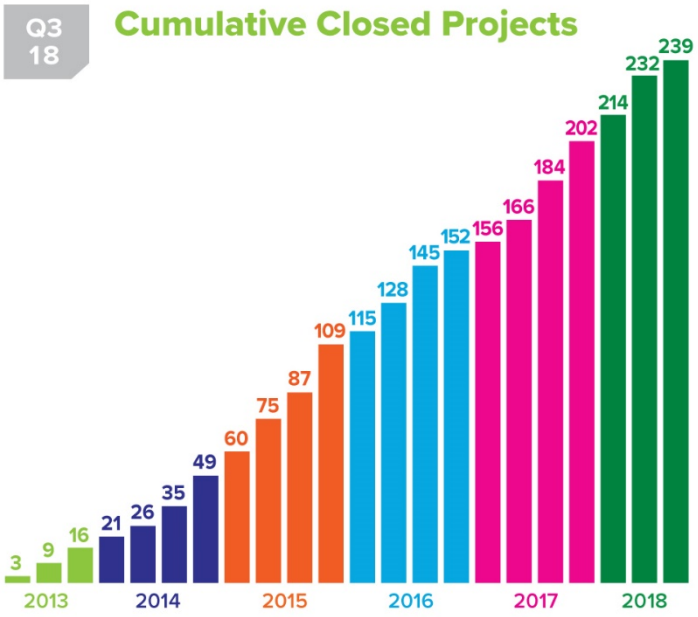
About Us

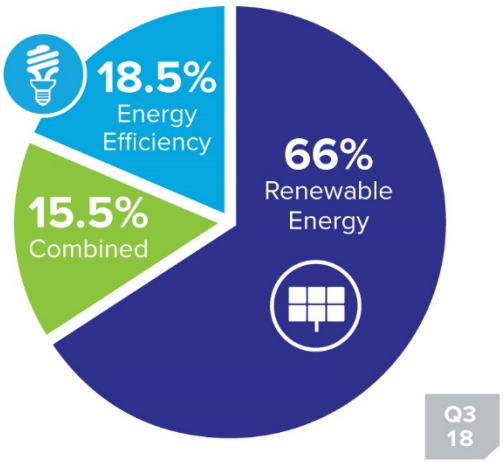
- **Quasi-public organization** – Created in 2011 and successor to the Connecticut Clean Energy Fund.
- **Focus** – Finance clean energy (i.e. renewable energy, energy efficiency, and alternative fuel vehicles and infrastructure).
- **Balance Sheet** – Approximately $190 million in assets and $130 million net position – leverage ratio from 3:1 to 12:1
- **Public Support** – Supported by a $0.001/kWh surcharge on electric ratepayer bills (about $7-$10 per household per year) that provides approximately $27 MM a year for investments, RGGI about $3 MM a year for renewable energy, federal competitive solicitations (i.e. SunShot Initiative) and non-competitive resources (i.e. ARRA-SEP), private capital, and private foundations

Connecticut Green Bank
C-PACE

CT Green Bank serves two roles

- Administrator
- Capital Provider





Connecticut Green Bank
Technical Review and ICP

CT C-PACE has statutory requirement that savings exceed the cost of the project

Developed SIR methodology and technical standards

ICP addition provides a technical platform that adds confidence for all project stakeholders

Connecticut Green Bank
M&V

SIR process leads to estimated energy savings numbers

Policymakers and other stakeholders have an interest in living up to this promise

CGB working with OpenEE on M&V

Questions?

Please type all questions into the webinar dialogue box.

Thank You

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State and Local Solution Center
http://energy.gov/eere/slsc/state-and-local-solution-center