MSc Program
Renewable Energy In Central and Eastern Europe

A Comprehensive Comparison of Two Innovative Energy Efficiency Transaction Models

Can Metering Energy Efficiency and Paying for Performance Transform the Energy Efficiency Market?

A Master's Thesis submitted for the degree of
"Masters of Science"

Supervised by
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November, 2016
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Affidavit

I, **Cathy d’Almeida** hereby declare

1. that I am the sole author of the present Master Thesis, “A Comprehensive Comparison of Two Innovative Energy Efficiency Transaction Models”
“Can Metering Energy Efficiency and Paying for Performance Transform the Energy Efficiency Market?”

80 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and

2. that I have not prior to this date submitted this Master Thesis as an examination paper in any form in Austria or abroad.

Vienna, ________________ ______________________________
Date Signature

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- Rob Harmon, Director of MEETS Coalition
- Bill Campbell, Head of Sustainability, Structuring and Compliance, Equilibrium Capital,
- Matt Golden, Environmental Defense Fund Senior Energy Finance Consultant and Investor Confidence Project, Project Lead
- Martha Campbell, Senior Associate, Rocky Mountain Institute
- Dr. Steven Fawkes, Senior Adviser, Investor Confidence Project Europe.

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Abstract

A large percentage of the building stock in the US was built prior to any real efficiency standards[1] hence, “42% of total energy and 75% of all electricity is used in the built environment and most of it is wasted. We can triple or quadruple the efficiency of our building stock by 2050 and the savings are worth 4 times the cost.” [2] In addition, “there is a global abundance of private capital”[3] looking for good sustainable investments. But today, even in states with high energy efficiency (EE) spending like California, experts estimate that “the economic efficiency potential is two to three times greater than what is achievable with the current voluntary incentives and policies”[4].

This thesis will compare two new EE transaction models in the US; Metered Energy Efficiency Transaction Structure (MEETS^{TM}) and P4P Residential Program (Pacific Gas & Electric in CA). These models, although different in many ways, share the following elements;

1. Pay-For-Performance (PFP) on,
2. all metered (to industry standard protocols) energy efficiency on a,
3. whole-building basis.

This thesis will compare the differences between these models in terms of markets, technical approaches, depth of energy savings, regulatory and contractual requirements and impacts to the key market players and answer the following question; Can metered energy efficiency models that PFP based on whole-building savings break down the key hurdles to acquiring the energy efficiency potential in the US building stock?

The content and conclusions draw upon a combination of technical reports from leading energy organizations, interviews with key experts, financial analysis on depth of energy savings potential based on documented case studies and the most recent news articles and blogs from industry.

	MEETS	**Both Models**	**P4P Residential**
Key Impact	Deep energy retrofits scaled in Commercial, providing long-term distributed energy resources, financed the same as renewables, without undermining the economics of the utility/grid.	EE that can be utilized as a reliable grid energy resource and funded by private capital due to stable cash flows and standard contracts.	Strategic wide-spread deployment of low cost ECMs (i.e., Smart Meters) in residential, providing short term, in length, distributed energy resources.
Key Benefits	Transaction structure that breaks down key barriers, such as split incentives, utility loss of revenue, consumer short-term finance limits, to deep energy retrofits.	PFP based on metered EE against historic baselines on a whole-building basis maximizes value to all parties.	A platform that scales shallow to medium depth EE through various business models while minimizing Program Administration Costs.
Requirements	Regulations allowing utilities to purchase EE under a long-term PPA and then charge for EE at retail rate; Dynamic Baseline EE Meter; securing long-term contracts with building owners.	New regulations similar to CA SB350 & AB802, that allow PFP on metered EE from historic baselines on whole-building basis.	New utility revenue models to replace lost revenue from efficiency; static baseline EE meter, smart meters and standard data transfer; customers must sign over energy data & incentives.

For the energy efficiency market to really accelerate all the right conditions need to be met. These include a well identified large market potential in combination with high demand from the utilities and regulators. In addition, an abundance of private capital must be available targeting sustainable investments. The technologies required, mainly the energy efficiency meter, must be deployed. Lastly, key regulations that pay for metered performance of energy efficiency and in some cases new utility revenue models need to be enacted. With the right conditions, new EE transaction structures that pay for metered performance should flourish. Transaction structures that fully realize Amory Lovins’ principle that efficiency is, in fact, energy and result in stable, reliable cash flows will attract the uncommitted large private capital and unleash the well identified market potential.

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[1] Michaels, Joelle, “Commercial Building Energy Consumption Survey (CBECS).”
[2] Sam Champioin, *Amory Lovins of RMI on 23.5 Degrees - The Weather Channel*.
[3] Poulson, Henry M. Jr, “How to Raise Trillions for Green Investments.”
[4] Elkind, Ethan N., “Powering the Savings.”

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1 INTRODUCTION

This thesis will compare two new energy efficiency models in the US.

1. Metered Energy Efficiency Transaction Structure (MEETS^{TM}) and
2. P4P Residential Program (PG&E in California)

These models have many differences but they share the following 3 elements. Both models

1. Pay-For-Performance on,
2. All metered (to industry standard protocols) energy efficiency on a,
3. Whole-building basis.

At the heart of both of these models is an energy efficiency meter which calculates energy savings or energy efficiency. Each energy efficiency meter uses a different approach to measure energy savings but both have a place in their respective target markets. The energy efficiency meters provide near real-time access to metered gross savings and a standardized approach to measuring energy efficiency such that all parties calculate the same level of savings.

By metering and measuring energy efficiency and paying for it based on performance we create stable reliable cash flows which can then be financed like any other supply side energy resources. In doing so we are able fully realize an important principal created by Amory Lovins 40 years ago that efficiency (negawatt-hours) is energy (megawatt-hours) and unleash a well identified huge market potential.

1.1 THE PROBLEM

"The Building Sector consumes nearly half (47.6%) of all energy produced in the United States and Seventy-five percent (74.9%) of all the electricity, "[5] according to US EIA data compiled by Architecture2030. In addition, a large percentage of the buildings were built prior to building codes and therefore use energy very inefficiently. Over 44% of the commercial buildings were built prior to 1980's or pre-building codes [6] and in California 75% of the housing stock was built prior to any real efficiency standards and therefore these buildings have over twice the energy requirements than comparable houses built in 2005.[7] Many of these buildings are in desperate need of repair and contain significant energy efficiency potential. According to EIA's 2012 survey, "one in three U.S. commercial buildings are failing and in need of major renovations"[8] and building energy savings of 38–69% can generate $1.4 trillion in positive net present value by 2050, according to Amory Lovins and Rocky Mountain Institute "[9].

It is widely acknowledged the risk that GHG emissions poses to the health of our planet and there is an urgent need to reduce global emissions significantly and quickly. The building sector is responsible for 38% of US greenhouse gas emissions[10], making buildings the largest contributor to GHG emissions over industry and transportation (figure 1). As part of the Paris Climate Agreement, "the United States intends to achieve an economy-wide target of reducing its greenhouse gas emissions by 26-28 per cent below its 2005 level in 2025 and to make best efforts to reduce its emissions by 28%".[11] This target represents a substantial acceleration of the current pace of GHG emission reduction. "Several U.S. laws, as well as existing and proposed regulations thereunder, are relevant to the implementation of the U.S. target, including the Clean Air Act (42 U.S.C. §7401 et seq.), the Energy Policy Act (42 U.S.C. §13201 et seq.), and the Energy Independence and Security Act (42 U.S.C. § 17001 et seq.). "[12] Already many states have put plans in place to meet these federal mandates which include a significant amount of energy efficiency acquisition. Utilities are being mandated to increase their acquisition of energy efficiency but today's programs achieve 5-20% in savings and we must get to 25-

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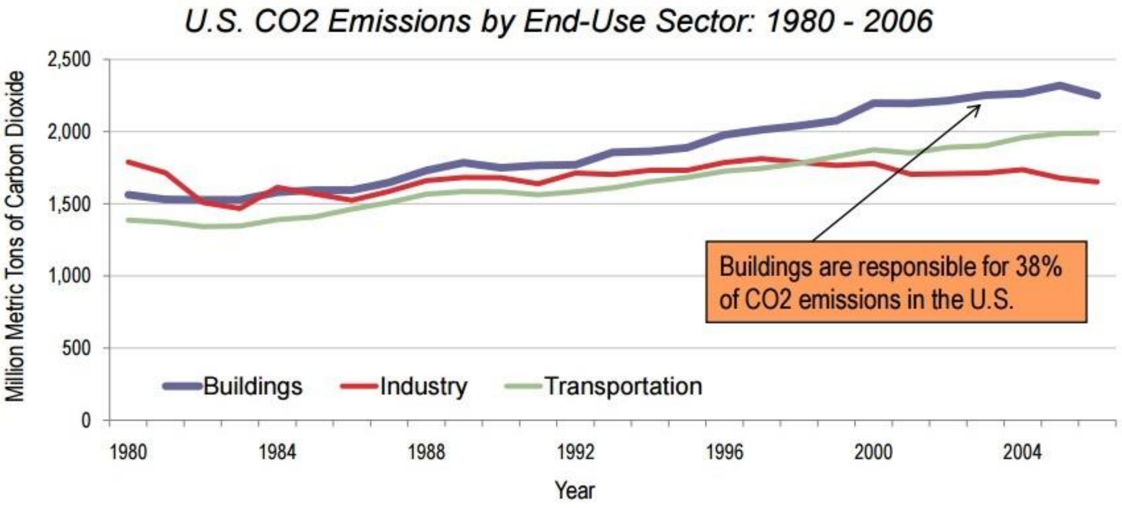
[5] Architecture 2030 and EIA, "Why the Building Sector."
[6] Michaels, Joelle, "Commercial Buildings Energy Consumption Survey (CBECS)."
[7] Elkind, Ethan N., "Powering the Savings."
[8] Adams, Elaine Gallagher et al., "Retrofit an RMI Initiative, Managing Deep Energy Retrofits."
[9] Ibid.
[10] "Empire State Building Case Study, Cost Effective Greenhouse Gas Reductions via Whole-Building Process, Outcomes, and What Is Needed next."
[11] "CAIT Climate Data Explorer, Detailed View."
[12] Ibid.

40% of savings levels to achieve targets.[13] Utilities are going to have to develop programs that achieve deeper saving to meet these challenging EE targets.


U.S. CO2 Emissions by End-Use Sector: 1980 - 2006

Buildings are responsible for 38% of CO2 emissions in the U.S.

Source: EIA data - Table 12.2: http://www.eia.doe.gov/emeu/aer/envir.html

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Figure 1 The building sector's overall contribution to the US GHG emissions. [14]

One of the key hurdles to acquiring deeper energy efficiency is that most energy efficiency today is consumer or building owner financed and the payback times required for an investment is very short. According to a McKinstry report[15], in the owner-occupied commercial sector the average expected payback period is 3.6 years and in the residential sector a simple payback of 2.5 years is expected. There are many other hurdles to acquiring deeper energy efficiency such as split incentives where the tenant receives the benefits of energy savings from a Landlord investment, access to capital, etc. This will be discussed in further detail in following sections.

In addition, states such as California that have seen a significant increase in the installation of solar are seeing "duck curve" net electricity load shapes. This results in over generation of power at the 12:00 hour which results in negative pricing in the power markets. In addition, there is a steep ramp in net load as solar energy production declines between 3:00-6:00.

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[13] Galen L. Barbose, Charles A. Goldman, Ian M. and Hoffman, Megan Billingsley, "The Future of Utility Customer Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025."

[14] "Empire State Building Case Study, Cost Effective Greenhouse Gas Reductions via Whole-Building Process, Outcomes, and What Is Needed next."

[15] Granade, Hannah Choi et. al, "Unlocking Energy Efficiency in the US Economy."

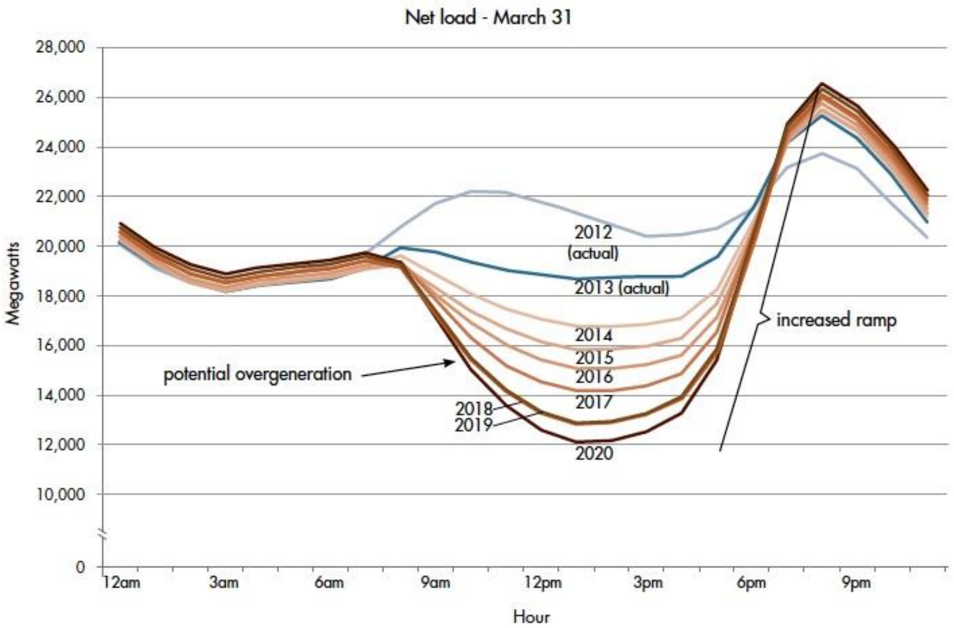

Figure 2 Duck Curve Load Shape. Source: CAISO. [16]

Based on the significant cost reduction of solar over the past 10 years and the fact that solar, especially utility scale solar, has already reached grid parity, we expect this issue to spread more broadly and deepen in impact. This offers significant opportunity to providers of storage and metered energy efficiency that can be utilized as demand capacity to permanently change the electricity load shape or "teach the duck to fly". [17]

But today, the current cost structure treats energy efficiency and other Distributed Energy Resources (DER) as reduced demand, putting our utility industry, including the grid operators, under financial risk. The combination of the wide spread adoption of renewable energy, energy efficiency and other DER together with the need to cover existing and new infrastructure costs including power plants, transmission and distribution, under the existing rate structure is undermining the current economics of our utility industry. According to an article from Forbes the biggest impact from the growth of renewables and DER is on the utilities revenues due to a reduction in load. [18] This article goes onto say that utilities could face up to 15% reduction in energy demand over the next 10 years resulting in a loss of $18 billion to $48 billion a year.[19] These numbers could become even bigger with the increased mandates for energy efficiency. In addition, in order to enable large scale DER new investments in a smart and reliable grid are required. In a recent report by John Farrell from Institute for Local Self Reliance, the path our utilities are on "do not align with current financial incentives for most investor-owned utilities (or the typical business practices of most utilities; private, public, or cooperative)."[20] Farrell goes onto say that the grid is "a valuable network" and proposes a strategy forward called Utility 2.0. [21]

1.2 THE OPPORTUNITY

There is significant untapped energy efficiency opportunity in the built environment in the US. According to a report completed by NREL in 2012, there are "multiple pathways to achieve approximately 50% savings from the baseline projected building energy use in 2030." and "the average cost of these savings is less than half the production cost of energy (as compared to currently available or near-term resources). " [22]

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[16] Lazar, Jim, "The Duck Curve on California's Grid Will Encourage Innovation and Creative Thinking."
[17] Ibid.
[18] Helman,Christopher, "Will Solar Cause A 'Death Spiral' For Utilities?"
[19] Ibid.
[20] Farrell, John, "Beyond Utility 2.0 to Energy Democracy."
[21] Ibid.
[22] Farese, Gelman, and Hendron, "A Tool to Prioritize Energy Efficiency Investments."

There are many benefits to building owners, utilities and society for acquiring energy efficiency including improving our building stock, reducing GHG emissions and adding significant new jobs. There is broad support towards increasing the acquisition of EE but acquiring the technical and economically available EE has been difficult. A 2015 study done by Navigant found that in California the "economic efficiency potential in existing buildings was two to three times greater than what would be market achievable via current voluntary incentives and policies"[23] (see figure below). And meeting new targets " will be challenging, especially since, in the view of some analysts, the era of easy savings is over as baseline efficiency is rising, building codes are becoming more stringent, and equipment and appliances more efficient".[24] Therefore states, utilities and regulators are looking for new, innovative and cost effective ways to acquire energy efficiency that don't put upward pressure on rates and utilities at financial risk.

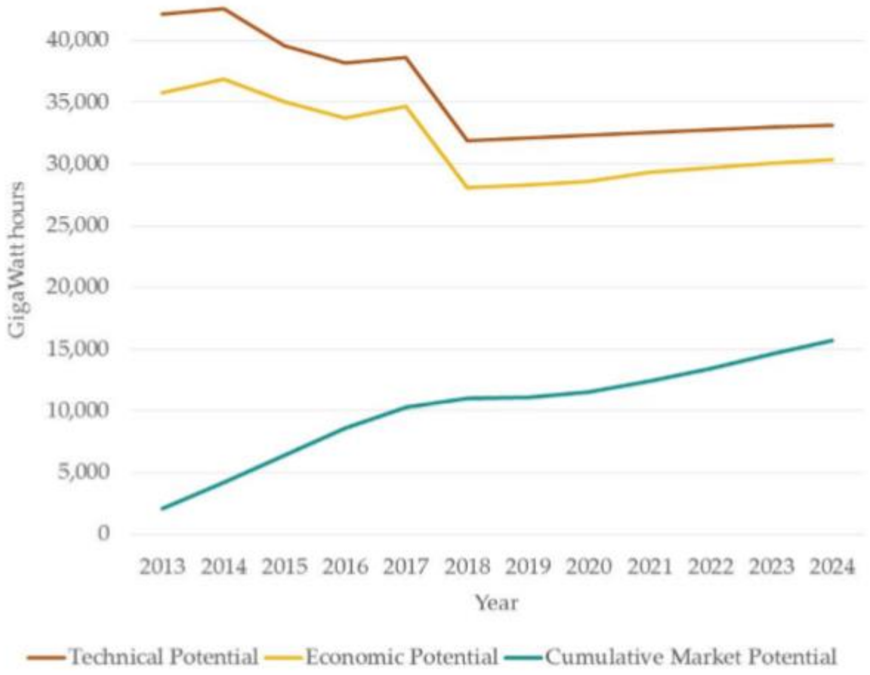

Figure 3 Cumulative Market achievable EE under existing incentive and regulatory schemes (dubbed market potential) compared to technical and economic potential if incentive and regulatory schemes could get access to full EE value at the building. A 2015 Navigant Study conducted on the effectiveness of CA current efficiency efforts.[25]

Today there are increased mandates for utilities to increase their acquisition of EE and to reduce GHG emissions. Overall "Spending on energy efficiency programs is expected to double from 2010 levels to $9.5B in the medium case ($8.1B on electric and $1.4B on gas EE programs) by 2025 driven mainly by compliance with statewide legislative or regulatory savings or spending targets.[26] And annual incremental savings are expected to increase by 50% to 0.76% of retail sales or 28.8TWh. [27] California's "50/50/50" plan which aims to increase electricity from renewable sources to 50 percent, reduce petroleum use by 50 percent, and double building efficiency by 2030."[28] And new legislation

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[23] Elkind, Ethan N., "Powering the Savings."

[24] Misuriello, H., S. Kwatra, M. Kushler, and S. Nowak., "Building Energy Code Advancement through Utility Support and Engagement."

[25] Elkind, Ethan N., "Powering the Savings."

[26] Galen L. Barbose, Charles A. Goldman, Ian M. and Hoffman, Megan Billingsley, "The Future of Utility Customer Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025."

[27] Ibid.

[28] Golden, Matt, "California's Latest Legislation Is a Paradigm Shift for Energy Efficiency."

driving new utility regulations such as CA SB350 which puts in place “pay for performance programs” and “Incentive payments shall be based on measured results.”[29] There is also CA AB 802 which moves the state towards meter-based energy efficiency and counting efficiency starting from a building baseline rather than energy code.[30] New York State is also paving the way towards new energy regulations with their new state Docket called “Renewing the Energy Vision (REV). This docket “aims to convert utilities into platform providers for the distribution grid” by developing new revenue based models that encourage investment in DERs and energy efficiency.[31] They are proposing new revenue models that provide alternatives to the current cost-of service rate structure of today. New York and California are leading the way but many other states and institutions are working to develop “Utility 2.0 model” or utility future models in an effort to allow for integration of large quantities of energy efficiency and renewable energy into our grid without the risk of financial instability.

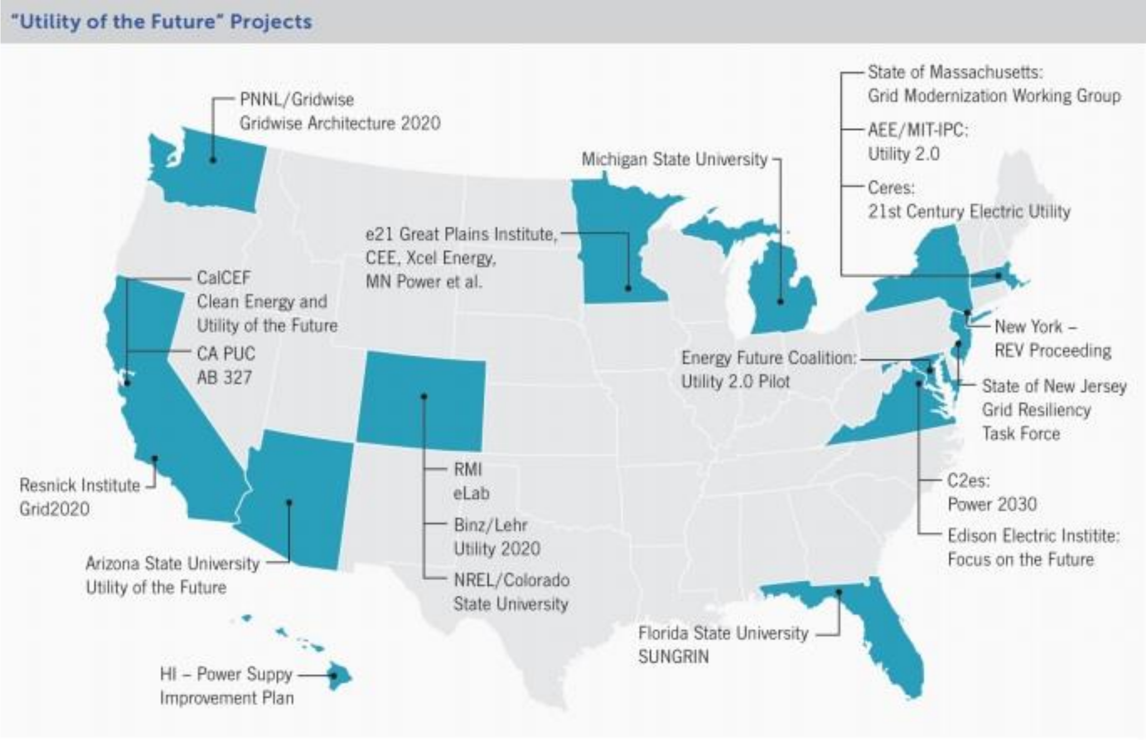

Figure 4 Overview of States and Institutions working on utility of future models.[32]

1.2.1 Commercial

There are over 80 billion square feet (7.43B M^2) of commercial buildings in the U.S.[33], which utilizes 20% of total energy by end use and accounts for more than 35% of the generated electricity[34]. The commercial office building accounts for more square footage than any other building type.

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[29] Ibid.

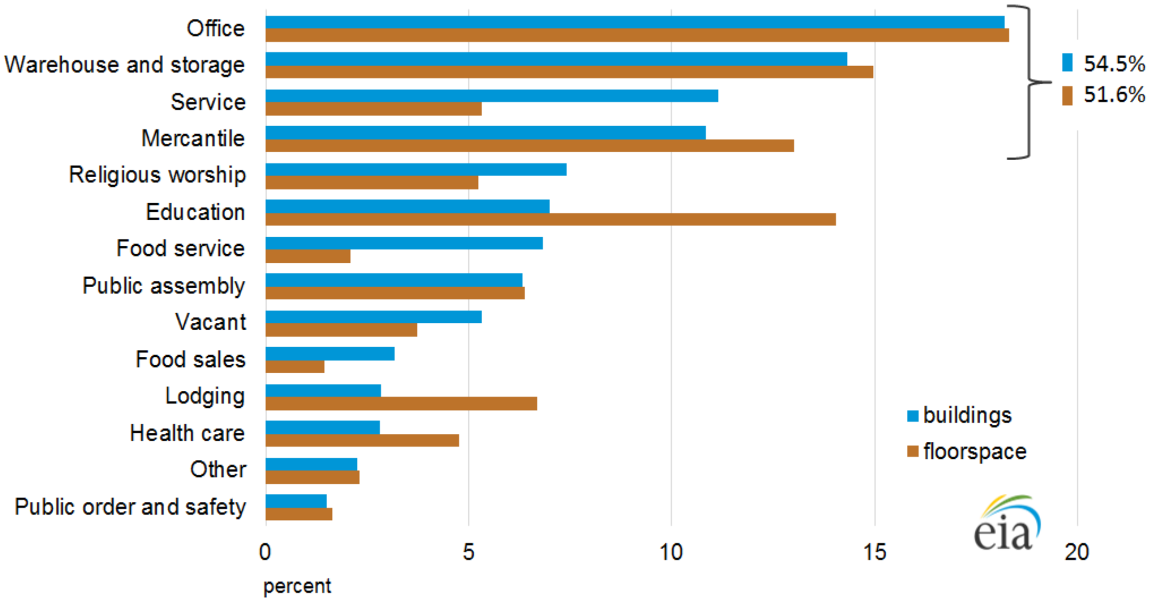
[30] Ibid.

[31] Bade, “Little Less Talk: With New Revenue Models, New York Starts to Put REV into Action.”

[32] Bade, “The Top 10 Trends Transforming the Electric Power Sector.”

[33] Michaels, Joelle, “Commercial Buildings Energy Consumption Survey (CBECS).”

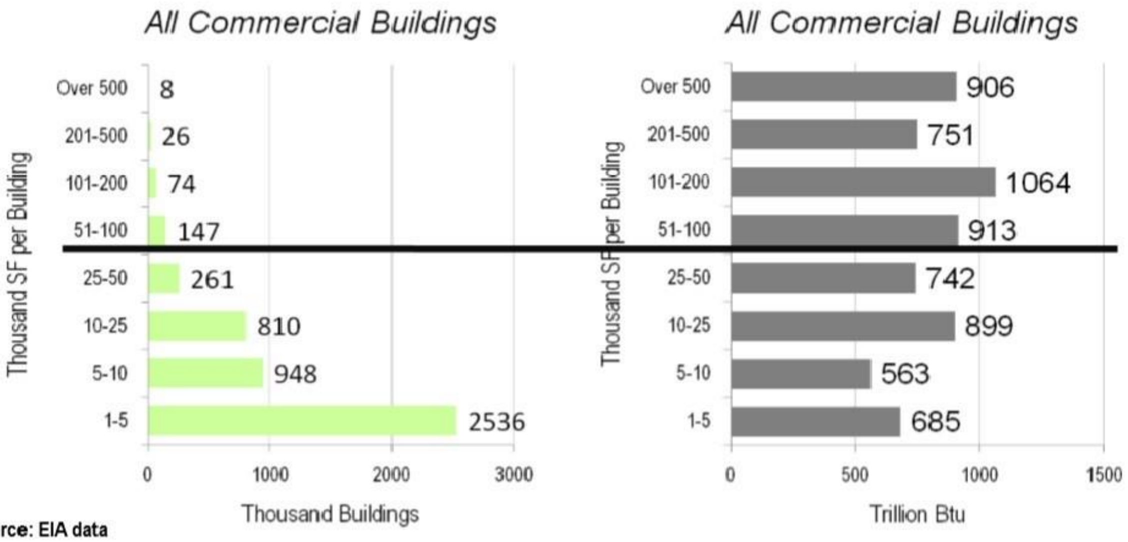
[34] Adams,Elaine Gallagher et al., “RetroFIT, an RMI Initiative, Introducing the Retrofit Depot: Deep Energy Retrofit Guides.”



Source: U.S. Energy Information Administration, 2012 Commercial Buildings Energy Consumption Survey

Figure 5 Total Floor Space by Building type. [35]

Commercial buildings typically have a long life span and 44% were built before 1980 which was prior to most building energy efficiency codes.[36] According to EIA's 2012 survey, "one in three U.S. commercial buildings are failing and in need of major renovations, offering a unique opportunity for owners to not only get their buildings back in working order, but also to make them significantly more efficient and valuable." [37] But current building stock is being retrofitted at 2.2% per year with an average reduction of 11% in energy consumption per building below the 2003 national average.[38] There is significant potential for more. In addition, typical energy service companies (ESCOS) address mainly the large public commercial buildings are missing a significant percentage of the market.



Source: EIA data

Figure 6 Shows that 95% of the US building stock are mid-sized to small buildings which is responsible for 44% of the GHG emissions. [39] *Note: 50,000 square feet (SF) = 4645 Square Meters.*

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[35] Michaels, Joelle, "Commercial Buildings Energy Consumption Survey (CBECS)."
[36] Ibid.
[37] Adams, Elaine Gallagher et al., "Retrofit an RMI Initiative, Managing Deep Energy Retrofits."
[38] Dan York, Steven Nadel, Ethan Rogers, Rachel Cluett, Sameer and Kwatra, Harvey Sachs, Jennifer Amann, and Meegan Kelly, "New Horizons for Energy Efficiency: Major Opportunities to Reach Higher Electricity Savings by 2030."
[39] "Empire State Building Case Study, Cost Effective Greenhouse Gas Reductions via Whole-Building Process, Outcomes, and What Is Needed next."

"Study after study reaffirms the large efficiency opportunity that currently exists in the U.S., predicting that ~30% of commercial building energy use could be cost-effectively cut by 2030 (McKinsey 2009, NAS 2010). More recently, Amory Lovins and Rocky Mountain Institute predicted building energy savings of 38–69% to generate $1.4 trillion in positive net present value by 2050. "[40].

"Retrofitting existing commercial buildings for energy efficiency is one of the greatest opportunities facing the building industry."[41] Based on the many factors including large financially available EE in the US building stock, low rate of acquisition of EE, diminishing opportunities from traditional resources (lighting) and increased mandates, the comprehensive or deep retrofit presents an attractive market opportunity.

Despite the large market opportunities and pressures, achieving deep energy retrofits in the commercial office sector are very difficult to achieve. There are many barriers to achieving deep energy retrofits which will be described in detail in future sections.

1.2.2 Residential

According to a 2009 study conducted by McKinsey, "Residential buildings account for roughly 60% of all cost-effective energy efficiency potential in 2020 within the buildings sector, with 71% of that potential associated with improving the building shell and heating and cooling equipment, mostly in existing homes. "[42] In California, the residential sector represents 31% of electricity consumption and 44% of total natural gas consumption within PG&E's service territory"[43]

In California, 75 percent of the existing housing stock was built before the Title 24 standards, representing a greater portion of the demand. For example, the energy requirements for space heating, cooling, and water heating in residential buildings constructed during the 1970s (pre-Title 24 and other efficiency standards) are over twice the energy requirements for comparable systems in houses built in 2005. As a result, this older stock of buildings represents a critical and largely untapped market for energy efficiency improvements to meet state goals.[44]

Despite that huge market potential there are still many barriers to market adoption of energy efficiency including lack of capital, short pay-back expectations, lack of interest and lack of education and/or knowledge. Transaction costs in the residential market is high therefore typical retrofits happen when equipment reaches end of life.

1.3 KEY RESEARCH QUESTIONS

The main question this thesis will attempt to answer is; Can metered energy efficiency models that PFP based on whole-building savings break down the key hurdles to acquiring the energy efficiency potential in the US building stock? The sub-questions are as follows;

1. What are the differences between the 2 approaches and their strenths and weaknesses?
2. What market segments will these models serve?
3. What depth of energy savings can be achieved with these models?
4. What technology, regulations and contracts, are required to make these programs work?
5. What impacts will these new models have on the key market players (utility/regulator, building owner, tenant, investor, Energy Service Company) in an energy system?

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[40] Adams, Elaine Gallagher et al., "Retrofit an RMI Initiative, Managing Deep Energy Retrofits."

[41] Harrington,Eric and Carmichael,Cara, "Retrofit, An RMI Initiative Project Case Study: Empire State Building."

[42] Chris Neme, Energy Futures Group, Meg Gottstein, Regulatory Assistance Project, and Blair Hamilton, Vermont Energy Investment Corporation, "Residential Efficiency Retrofits: A Roadmap for the Future."

[43] Jacobson, Erik, Director Regulatory Relations, "Submission of High Opportunity Projects and Programs (HOPPs) Proposal - Residential Pay-for-Performance Program."

[44] Elkind, Ethan N., "Powering the Savings."

1.4 HYPOTHESIS

Based on the huge untapped energy efficiency potential in both the commercial and residential sector, the increased EE and GHG emission reduction mandates in the US, the multitude of market accelerators (RMI Energy+, Investor confidence project, Better Buildings Accelerator, etc.) and the increased value these new PFP metered energy efficiency models offer, I expect these new models will be a the future of utility run energy efficiency programs and be a significant driver in the acceleration of energy efficiency acquisition in the US.

The biggest hurdle will be getting the regulations in place across multiple States in the US to support these new models. The biggest risk, in the large scale acquisition of energy efficiency together with the huge growth in solar, is to the financial health of the utilities and the grid.

2 RESEARCH AND ANALYSIS METHODOLOGY

Resources used for this thesis include a combination of industry reports on energy efficiency and the state of the utility industry, industry articles, presentations, interviews and self-analysis. There are many government and non-profit organizations involved in researching and reporting on this industry. In addition, I received tremendous support in the form of interviews, email exchanges and feedback on self-conducted analysis from the key individuals involved in the design and roll-out of the two energy efficiency models analyzed in this thesis. Also I conducted an interview with an industry expert from Rocky Mountain Institute early in the process to understand these new models and recently conducted an interview with a commercial building developer involved in deep energy retrofits on commercial buildings. Both of these models are new and therefore many of my resources are from late 2015 and 2016.

2.1 LITERATURE REVIEW

2.1.1 Government Agencies

Energy Efficiency is a strategic initiative of the US Energy Department and therefore many government agencies are involved in this research as well as developing and driving EE programs. These resources were used to extract perspectives and statistics on the current and forecasted state of the energy efficiency market in the US.

- US Department of Energy
    - National Renewable Energy Labs NREL [45]
    - Pacific Northwest National Lab PNNL[46]
    - Lawrence Berkley National Laboratory LBNL [47] [48]
    - US Energy Information Administration (EIA) [49]
        - Commercial Building Energy Consumption Survey CBECS [50]
- Environmental Protection Agency EPA (no resources cited but EPA is referenced in many sources).
- Educational Institution: UC Berkley Law and UCLA Law [51]

2.1.2 Private Non-Profit Organizations

There are several non-profit organizations who are actively in involved in researching and driving the advancement of energy efficiency in the USA and Internationally. My focus for this thesis is the USA and therefore these organizations are headquartered or focused on the US market. I am utilizing reports and data from the following organizations. Many of these publications and reports reference each other's work and are peer reviewed and funded by agencies in the list below.

2.1.2.1 Energy Efficiency Organizations

- Rocky Mountain Institute RMI
    - ✓ Technical Reports and Articles [52] [53]
    - ✓ Commercial Energy+ Program [54] [55]
- Natural Resources Defense Fund (NRDC) [56]

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[45] Farese, Gelman, and Hendron, "A Tool to Prioritize Energy Efficiency Investments."

[46] Baechler and Webster,Lia, "A Guide to Performance Contracting with ESCOs."

[47] Sohn, et al., "Assessment of Automated Measurement and Verification (M&V) Methods."

[48] Billingsley, and Schiller, "The Total Cost of Saving Electricity through Utility Customer-Funded Energy Efficiency Programs: Estimates at the National, State, Sector and Program Level."

[49] US Energy Information Administration, "Demand Response Saves Electricity during Times of High Demand."

[50] Michaels, Joelle, "Commercial Buildings Energy Consumption Survey (CBECS)."

[51] Elkind, Ethan N., "Powering the Savings."

[52] Lovins, Amory, "The Negawatt Revolution."

[53] Campbell, Martha; Lawrence, Duncan; Mandel, Jamie; Newcomb, James; Wanless, Eric; Wetzel, Dan, "Integrated Utility Services: A New Business Model for Fort Collins Utilities."

[54] Calhoun, Koben, "Commercial Energy +, An Optimized Approach to Efficient, Intelligent and Productive Buildings."

[55] Rocky Mountain Institute, "Case Studies."

[56] Ettenson, Lara, "NATURAL RESOURCES DEFENSE COUNCIL (NRDC) RESPONSE TO THE ADMINISTRATIVE LAW JUDGE'S RULING REGARDING COMMENTS ON PHASE II WORKSHOP 3."

        - ✓ Investor Confidence Project (ICP) [57]
- American Council for Energy Efficiency Economy ACEEE [58] [59]
- Northwest Energy Efficiency Alliance NEEA
    - ✓ Better Bricks [60]
- Northwest Power Council – Regional Power planning for Northwest [61]
- Institute for Local Self Reliance ILSR [62]
- Architecture 2030 [63]
- New Buildings Institute NBI [64]

2.1.2.2 MEETS

The MEETS Coalition www.meetscoalition.org website has several documents and presentations that I utilized; "The Metered Energy Efficiency Transaction Structure", "Powering Through the Savings" and "Redirecting At-Scale Capital Cash Flows", "Dynamic Baseline Meters, Functional and Regulatory Specifications" , IEEE Paper "X-View™: The Reichmuth Framework II"

2.1.3 Utility

PG&E and the California Public Utility Council published documents that detailed the P4P Residential Program including;

- PG&E Proposal for P4P Residential Pilot "Submission of High Opportunity Projects and Programs (HOPPs) Proposal - Residential Pay-for-Performance Program"
- Recorded Presentation delivered by Matt Golden to California Public Utility Council (CPUC), "PILOTING METERED PAY-FOR-PERFORMANCE IN CALIFORNIA"

2.1.4 Articles, Blogs and Newsletters

I read and referenced several articles and blogs written by Matt Golden published through

- Environmental Defense Fund blogs.edf.org,
- OpenEE.org or
- Efficiency.org
- Greentech media (GTM).

The following News sources are tracking the key developments in the energy industry in the US. I referenced articles from the following sources.

- Electricity Policy, Electricitypolicy.com [65]
- UtilityDive, utilitydive.com
- Greentechmedia (GTM), greentechmedia.com
- Forbes

2.2 INTERVIEWS

I conducted Interviews which included face to face, phone and follow-up emails, with several industry experts giving me significant depth of knowledge on my topic area.

- Rob Harmon, MEETS Coalition Direction. Several phone call, emails and a face to face meeting to understand the MEETS model in depth.
- Matt Golden - Environmental Defense Fund Senior Energy Finance Consultant and Investor Confidence Project, Project Lead. Lead developer of the P4P Residential Program. Principal in

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[57] "Investor Confidence Project Protocols."

[58] Molina, Maggie, "The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs."

[59] Kwatra,Sameer and Essig,Chiara, "The Promise and Potential of Comprehensive Commercial Building Retrofit Programs."

[60] "BetterBricks, Powerful Energy Ideas. Delivered by NEEA."

[61] NW Power and Conservation Council, "Seventh Northwest Conservation and Electric Power Plan,"

[62] Farrell, John, "Beyond Utility 2.0 to Energy Democracy."

[63] Architecture 2030 and EIA, "Why the Building Sector."

[64] "New Buildings Institute (NBI)."

[65] Mitchell, Cynthia, "A New Energy Efficiency Manifesto: California Needs a More Integrated, Cost-Effective Approach."

Efficiency.org, an entity that developed the Open EE Meter. I had 2 phone interviews and several follow up emails with Matt to understand the P4P Residential program in depth.
- Bill Campbell, Head of Sustainability, Structuring and Compliance, Equilibrium Capital. I had several email exchanges and a face to face meeting to understand in depth the structure of MEETS and the financial models used to analyze depth of savings possible through a MEETS transaction.
- Martha Campbell, Senior Associate for Rocky Mountain Institute. I conducted a phone interview and had several follow up emails providing me with a good overview of both programs and RMI's perspective.
- Dr. Steven Fawkes, Senior Advisor for Investor Confidence Project in Europe. I conducted an interview to gain perspective on how MEETS could fit into the European framework and how it could complement the ICP protocols.
- Sam Walker, Energy Trust of Oregon, Senior Project Manager. He provided an overview of the utility run EE programs in Oregon and specifically results from their whole-building pilot PFP program.
- Howard Reichmuth, Chief Technology Officer, Terry Egnor, Director, Measurement and Verification and Eric Youngsman, Chief Operating Officer of Energy RM. Face to Face meeting to clarify the technical workings of the Delta Meter.

2.3 FINANCIAL ANALYSIS METHODOLOGY

Financial Analysis was conducted to assess the different cash flows from energy retrofits under each model and how this will impact depth of energy savings and the types of measures that will be implemented.

2.3.1 MEETS

MEETS is designed to enable deep energy efficiency retrofits in the commercial sector. These transactions are investor, not consumer or building owner, financed therefore long-term contracts are possible. In addition, with a utility paying, to the investor, revenue on metered energy efficiency, through a standard power purchase agreement (PPA), the risks are fairly low. The contracts will be longer term, typically 20 years and therefore it is important to analyze the discounted cash flow in this scenario to get an accurate picture. Discounted cash flows were analyzed under different scenarios showing what parameters MEETS model is most sensitive to.

The following equations were used to make this analysis.

Year 1:
Nominal Cash Flow = Investment Cost
Note:

- It is assumed that development and transaction costs are included in the Investment Costs. Also there are no replacement costs factored into any of these models because the information was not available.
- Investment cost should be the incremental or marginal capital cost for energy efficiency retrofit.

Year 2 through Year 20:

Nominal Cash Flow = Costs (O&M + EE metering + Energy Tenancy Lease) + PPA Cash Flow

PPA Cash Flow = Metered Energy Savings per year * (retail rate for energy + energy efficiency incentive)

Note:

- Estimate costs of ongoing persistence monitoring used is $.05 / square foot as provided by Bill Campbell.[66] It is assumed that building owners will cover the standard O&M and the Energy Tenant will cover persistence monitoring costs. A 1% escalation rate is applied.

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[66] Campbell, Bill, Head of Sustainability, Structuring and Compliance, Equilibrium Capital.

- EE Metering is priced at $2400/year per building or per meter.
- Energy Tenancy Lease is estimated at 10% of the PPA cash flow.
- Demand Savings is also a possible cash flow that should be included in the PPA. It was not factored into this analysis for simplicity and because demand savings was not included in the pilot project.
- An escalator of 2% is applied to the PPA. A 2% escalator was chosen specifically because this is how the MEETS pilot is structured.[67] This escalator is a variable that will be negotiated with each utility and dependent on the utilities forecasted escalation in retail rate of energy. For the utility to earn a positive rate of return on the PPA the retail rate of energy escalation must be higher than the PPA escalator.

Nominal cash flow is then discounted and added together over the life of the investment to come up with total Discounted Cash Flow. This is also called the Net Present Value for the project.

$$DCF = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_n}{(1+r)^n}$$

CF = Cash Flow

r = discount rate (WACC)

The Weighted Average Cost of Capital used for this analysis is 10%. This is project capital costs WACC which should be pre-tax to understand what you have to cover from project cash flow including the taxes that are paid on profits from ROE and interest. Most Investor Owned Utilities (IOU) have a pre-tax WACC of around 10% [68] whereas Customer or Public Owned Utilities and other sectors will be lower. It is anticipated that the IOU will act as an investor in some of the early MEETs projects therefore a 10% WACC is used for the calculations and then a sensitivity analysis is prepared to show how varying WACC impacts the MEEETS cash flow.

Sensitivity Analysis of the financial model to different parameters was done by taking one of the case studies and tweaking one parameter while holding all of the others constant. This was done for the following parameters;

1. Retail rate for electricity (which impacts PPA cash flow)
2. Incremental Capital Costs
3. Length of PPA or investment duration
4. Energy Tenancy rate
5. WACC

2.3.2 P4P Residential Program

In the P4P Residential Program the Aggregator owns the energy efficiency incentive (EEI) and the building owner or customer, owns the energy savings (CES). Because the customer owns the energy savings, it is expected that they will finance the projects. However, if the capital cost is low enough, it may be in the Aggregator's best interest to deploy the ECM for free. In addition, it is not clear who will pay the O&M on the equipment but it is in the Aggregator's best interest, during the PFP contract period, 2 years for pilot, to make sure the equipment is functioning well. In addition, the length of the Energy Efficiency Incentive contracts are 2 years for the pilot and estimated maximum time still to be determined. According to Matt Golden, the maximum time for the PFP contracts could be 6-8 years when the program is fully deployed. [69] In this program baselines are static and therefore not adjusted for non-routine changes therefore this contract time will need to be based on the length of time one can expect the baseline on a portfolio of homes to stay fairly "constant". There are many factors that can change the baseline on a portfolio of residential homes' such as adding conditioned floor space, increasing or decreasing the number of occupants, adding air conditioning, upgrading

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[67] Hayes, Denis, Harmon, Rob, and Kahn, Brad, "The Metered Energy Efficiency Transaction Structure."

[68] Campbell, Bill, Head of Sustainability, Structuring and Compliance, Equilibrium Capital.

[69] Golden, Matt, Environmental Defense Fund Senior Energy Finance Consultant and Investor Confidence Project, Project Lead, April 19, 2016.

HVAC system or lighting, adding additional appliances, fuel switching, etc. All of these factors would be considered non-routine changes and can significantly change the baseline on a portfolio of homes.

2.3.2.1 Analysis of Simple Payback for Residential Customers and Energy Efficiency Incentives for Aggregators

We will assume that building owners will finance the capital expense for the energy conservation measure (ECM) or project. As already stated, on average a residential building owner expects a 2.5 years[70] simple payback on energy efficiency projects or 3.5 years realized cash flow which gives you an implied cost of capital of about 15%[71]. Mckinstry's report even uses a far larger WACC for residential of 40% because they assume a 20-year cash flow potential on projects of which only 3.5 years are available and the unavailable years between 3.5 to 20 are a risk premium. [72] Financing mechanisms such as PACE, used in this program, can increase this expected payback time because the payments are attached to the property tax therefore a building owner does not have to worry about fully recouping their investment before moving. For simplicity sake, for this analysis, a simple payback method will be used.

First a simple payback, for the building owner, will be calculated for different case studies using the following method. This is done by calculating the average yearly customer energy savings (CES) and dividing this by the upfront capital costs. For simplicity sakes an escalator to the rate for electricity and natural gas will not be applied. PACE financiers may choose to get more sophisticated with their financial analysis to the customer which would include discounting a cash flow over the life of the measure and including an escalator for energy rates.

Average Yearly CES ($) = (Average energy savings (kWh) * Average rate for electricity ($/kWh)) + (Average energy savings (therm)*Average rate for therm of natural gas ($/therm))

Simple payback (YR) = Capital Cost ($) / CES ($/YR)

Next the NPV of the EEI is calculated based on the estimated energy savings. The Aggregator owns the Energy Efficiency Incentive (EEI) in this model.

**Average yearly EEI ($)= (Average energy savings (kWh) * EEI for electricity ($/kWh))
+ (Average energy savings (therm)* EEI for natural gas ($/therm))**

NPV of EEI or Total DCF is then calculated by discounting the yearly EEI and adding them together for each year of the contract using the equation above.

Note:

- The pilot project has a 2-year Power Savings agreement
- The EEI for the pilot is $0.80/KWh saved per year and $1.80 / therm saved per year.
- The WACC used for this analysis is 10%

2.3.2.2 Analysis of Savings from Different Business Models

In this analysis Customer Simple payback and NPV of EEI are analyzed for different Business models / measures deployed in the same way as described in section 2.3.1.2.

2.3.2.3 NPV Analysis using Average Estimated Energy Savings under different Conditions

Using the same methodology as described above the NPV of EEI is calculated under different length of Power Savings Agreement contracts and different EEI rates. The CES remains constant but the NPV of the energy efficiency incentive varies. After the pilot the PSA length may extend beyond 2 years, it will be modeled 6 and 8 years in length. In addition, the plan is for the program to move from an energy efficiency rate-payer funded program to procurement. Once it moves into procurement different business models will be competing for PSA contracts and therefore it is realistic to expect the EEI or PSA yearly incentives to go down and therefore lower incentives have also been modeled.

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[70] Granade, Hannah Choi et. al, "Unlocking Energy Efficiency in the US Economy."
[71] Campbell, Bill, Head of Sustainability, Structuring and Compliance, Equilibrium Capital.
[72] Granade, Hannah Choi et. al, "Unlocking Energy Efficiency in the US Economy."

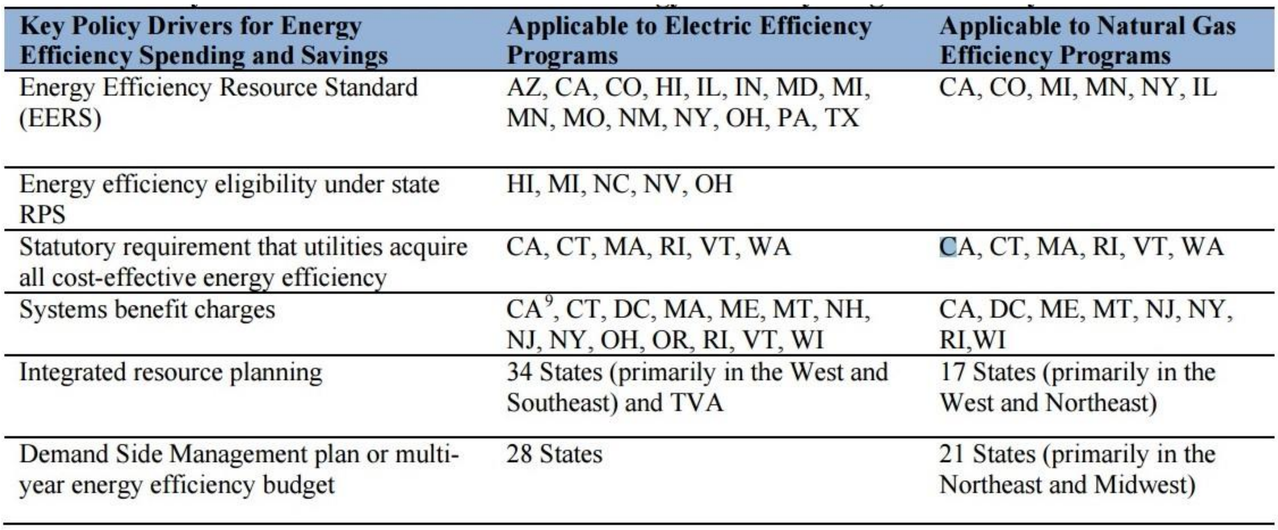
3 CURRENT STATE OF ENERGY EFFICIENCY

Efficiency in the electric and natural gas markets are pursued through a number of different policies and programs both at the federal and state levels, designed to encourage and support private investment by individuals and businesses. These programs include minimum efficiency standards for electric and gas-end products, building codes, product labeling (ENERGY STAR®), tax credits, and a broad-array of incentive based utility programs funded mainly by consumers or rate- payers. This thesis will focus on utility energy efficiency programs.

Utility consumer-funded energy efficiency programs started in the 1970's in response to the energy crisis and grew and expanded in the 1980's and 1990's with integrated resource planning and demand side management. These programs saw a sharp decline in the 1990's in many states due to a restructuring of the electric industry. Then in the wake of the western energy crisis 2000-2001, utility EE programs regained focus and today are considered an important strategy to manage and contain costs for the utility industry. [73]

Spending on energy efficiency programs is expected to double from 2010 levels to $9.5B in the medium case ($8.1B on electric and $1.4B on gas EE programs) by 2025 driven mainly by compliance with statewide legislative or regulatory savings or spending targets. [74] A significant share of increase is also attributed to increase in utility DSM planning and integrated resource planning. Today there are only 7 states in the US that don't have an established policy framework for electric energy efficiency program activity. Natural gas efficiency programs have significantly lower spending compared to electric EE programs for multiple reasons. Today there are 23 states in the US that have little or no customer funded natural gas efficiency programs. These policy drivers are summarized in the table 1 below.

Table 1 Policy drivers for energy efficiency spending and savings[75]



Key Policy Drivers for Energy Efficiency Spending and Savings	Applicable to Electric Efficiency Programs	Applicable to Natural Gas Efficiency Programs
Energy Efficiency Resource Standard (EERS)	AZ, CA, CO, HI, IL, IN, MD, MI, MN, MO, NM, NY, OH, PA, TX	CA, CO, MI, MN, NY, IL
Energy efficiency eligibility under state RPS	HI, MI, NC, NV, OH	
Statutory requirement that utilities acquire all cost-effective energy efficiency	CA, CT, MA, RI, VT, WA	CA, CT, MA, RI, VT, WA
Systems benefit charges	CA[9], CT, DC, MA, ME, MT, NH, NJ, NY, OH, OR, RI, VT, WI	CA, DC, ME, MT, NJ, NY, RI,WI
Integrated resource planning	34 States (primarily in the West and Southeast) and TVA	17 States (primarily in the West and Northeast)
Demand Side Management plan or multi-year energy efficiency budget	28 States	21 States (primarily in the Northeast and Midwest)

The majority of funding for electric energy efficiency has mainly been driven out of the West (CA, OR, WA) and Northeast (MA, NJ, NY, CT) United States. The top 10 states account for 70% of the spending on electric EE programs. Many other states are ramping up their spending due to policy drivers mentioned above and are forecasted to reach similar spending levels (% of retails savings) to the top states as of today. Natural gas efficiency spending is more highly concentrated where the top 10 states account for 80% of the spending. [76]

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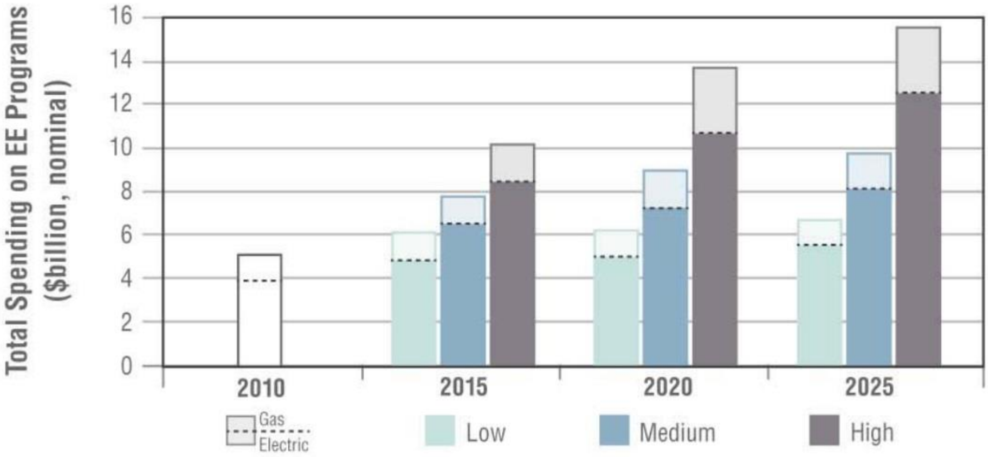
[73] Galen L. Barbose, Charles A. Goldman, Ian M. and Hoffman, Megan Billingsley, "The Future of Utility Customer Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025."

[74] Ibid.

[75] Ibid.

[76] Ibid.



Source: 2010 spending based on CEE (2012)

Figure 7 Projected spending on Electric and Gas energy efficiency programs. [77]

As can be expected a doubling of spending on efficiency programs should lead to an increase in savings. The forecast for the medium scenario is for annual incremental savings to increase by more than 50% from .49% of retails sales (18.4TWh) in 2010 to .76% of retails sales or 28.8 TWh by 2025. In the leading states incremental sales is closer to 1% of retail sales.

3.1 HOW UTILITY ENERGY EFFICIENCY PROGRAMS WORK TODAY

The majority of utility energy efficiency programs today are voluntary, rate-payer funded and consumer financed programs which encourage light / easy to acquire and fast payback ECMs such as lighting retrofits and ventilation measures. These programs provide financial incentives in the form of rebates at the point of sale before installation, or grants after installation, for individual energy conservation measures (ECM). These ECMs typically achieve 5-20% savings with a simple payback of 1-5 years. The most common measures in the commercial sector are lighting (LED and T5/T8 fixtures), Variable speed drives installed on HVAC fans, Lighting Occupancy Sensors, LED Refrigerated Case Lighting and Energy Management Systems (EMS). [78] In the residential sector it is lighting, insulation and appliances. The incentive amount is based on estimated or deemed savings of the ECM over the life of the measure. These estimates are based on complex analysis and calculations and are often overestimated. Savings are not measured and verified over the life of the measure. In a study done by PG&E to evaluate the results of a Whole-House Retrofit Program they found that 30% of the participants have either neutral or negative savings.[79] Because the EE grant or rebate is paid upfront there is no incentive or little interest to assure that the ECM is truly saving energy.

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[77] Ibid.

[78] Joseph St. John, Joseph Teng, Karen Maoz and Andrew Stryker, DNV GL, "'What Will It Cost?' Exploring Energy Efficiency Measure Costs over Time and across Regions."

[79] Jacobson, Erik, Director Regulatory Relations, "Submission of High Opportunity Projects and Programs (HOPPs) Proposal - Residential Pay-for-Performance Program."

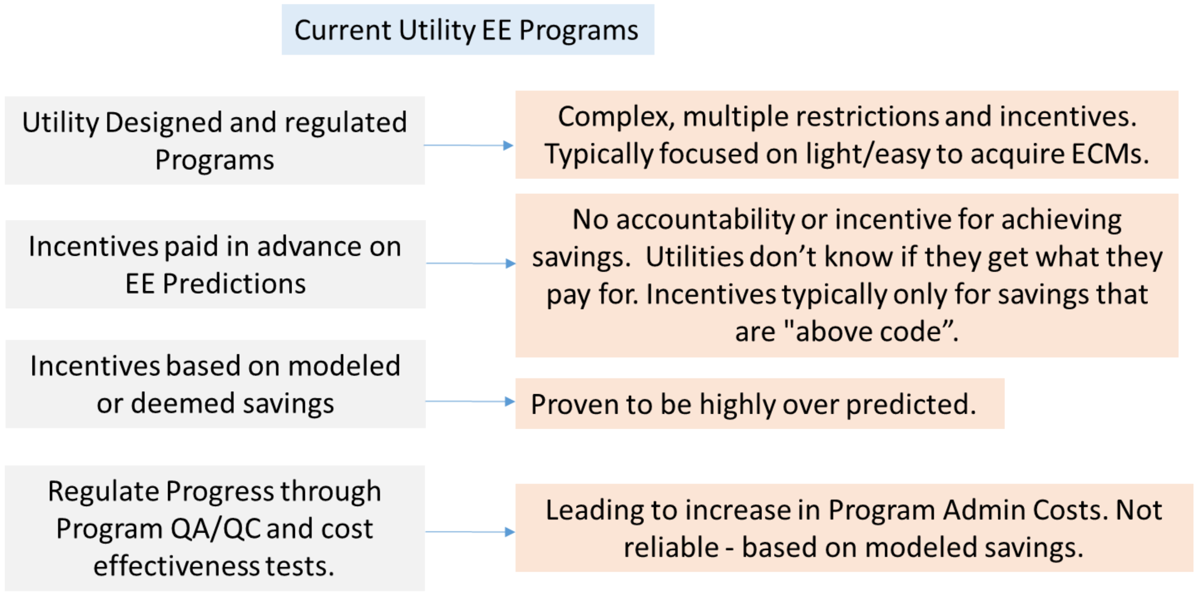

Figure 8 Summary of current Utility energy efficiency programs. Own diagram.

Energy efficiency programs are typically consumer financed or in other words, financed by the building owner. In the commercial sector often the tenants pay the energy bill and so there is little incentive for a building owner to invest. If a building owner does occupy the building they will typically implement investments with a 3-5-year payback and energy investments compete for capital with all other investments. In the residential sector access to capital is often an issue and home owners typically only invest in those measures that are at end of life and spend the minimal possible.

There are some innovative Pay for Performance Energy Efficiency Programs running today. An example is Puget Sound Energy's Resource Conservation Management (RCM) program. This program provides incentivizes of $.04/kWh energy efficiency based on O&M and Behavioral savings for a 3-yr period of time. [80] Calculations are done at the end of the year at a Whole-Building level to normalize for weather and to separate out any energy savings from other individual ECMs that were implemented. Gross savings of 10 to 15% are typically realized with this program over the 3-year contract. [81] Energy Trust of Oregon also has a pilot PFP program that provides yearly incentives for energy measures implemented at a Whole-Building level for a 3- year period of time. There are different incentive levels for different measures implemented. In this program a 3rd party implementing the ECMs receive the incentives. So far they are seeing up to 20% savings from the building participating in the program.[82] Although there are some good whole-building PFP programs currently running, none of them use automated EE meters and they typically pay different incentives for different measures both of which leads to complex measurement and verification. In addition, these programs have limited contracts (<3 years). According to Bill Campbell from Equilibrium Capital, studies have shown that a conventionally retro commissioned building loses about half its efficiency in the first five years if it is not monitored and managed over time.[83]

3.1.1 Cash Flows in an Energy Efficiency Transaction

There are 3 key cash flows that are possible by obtaining energy efficiency from a building. The more a transaction model can monetize the deeper in energy savings you can go.

1. The Retail value of energy from reduction of both energy and peak demand.
2. Energy Efficiency or Savings Incentives (EEI)
3. Demand Response (DR)

Energy Efficiency incentives are today typically paid out upfront based on deemed savings however in the PFP models these will be paid out over time. The Demand Response cash flow is well established,

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[80] Puget Sound Energy, "Resource Conservation Manager."
[81] Ibid.
[82] Sam Walker, Senior Project Manager - Commercial, Energy Trust of Oregon.
[83] Campbell, Bill, Head of Sustainability, Structuring and Compliance, Equilibrium Capital.

especially for larger resources, but it is coming on line for smaller aggregated resources such as systems that use behavioral changes across a portfolio of homes or even home water heaters.

3.1.2 Energy Efficiency Cost Effectiveness

Utilities and the energy regulation industry spend a great deal of time and money analyzing the cost effectiveness of energy efficiency for both electricity and natural gas. The main reason for this is that energy efficiency incentives are rate-payer funded and therefore utilities need to prove they are delivering value to this captive consumer community. In addition, utilities in many states are required and therefore regulated to acquire all the cost-effective energy efficiency.

3.1.2.1 Levelized Cost of Energy Efficiency (LCOEE)

Energy efficiency is widely touted as the lowest cost resource as compared to supply side resources. The number that is often referenced is the levelized cost for energy efficiency (LCOEE) or for conserved energy (LCOCE Based) and is often compared to the levelized cost of supply side resources as seen in the figure below. In a study conducted by ACEEE analyzing electric energy efficiency programs across 20 US states from 2009 to 2012, the LCOCE ranged from $0.013 to $0.056 per kWh which when compared to supply side resources is the least cost resource option for utilities. There are similar findings for natural gas efficiency programs which come in at an average levelized cost of $.35 per therm saved compared to an average cost of $.49 per therm. [84]

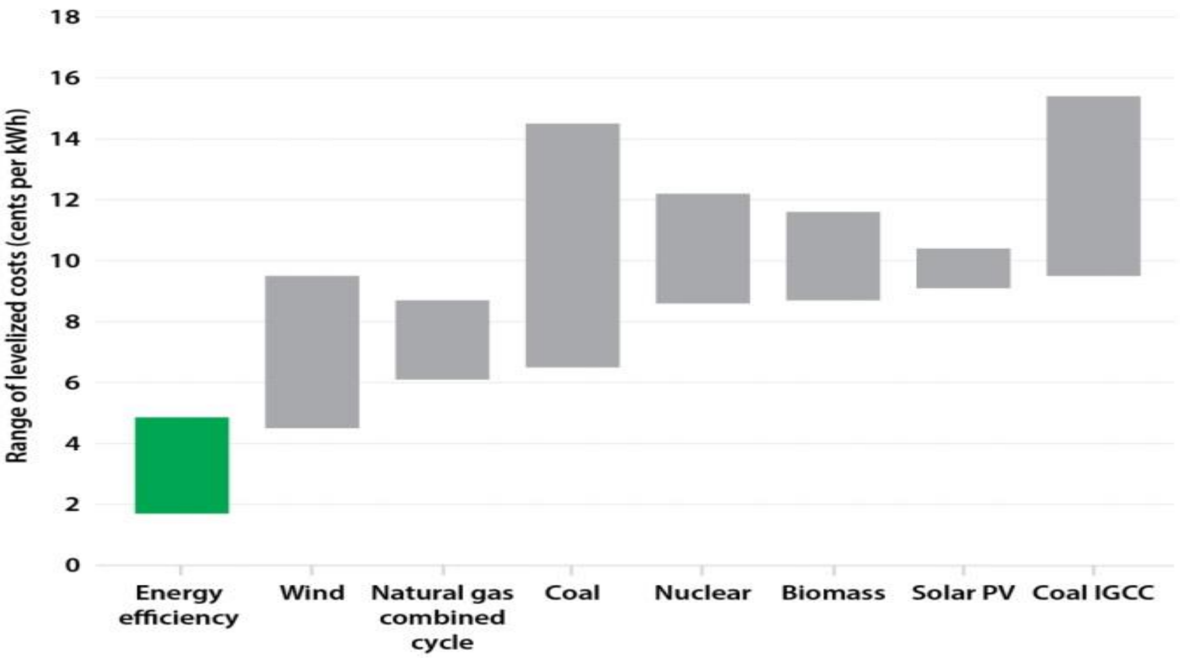

Figure 9 Levelized costs of electricity resource options. Source: Energy efficiency data represent the results of this analysis for utility program costs (range of four-year averages for 2009-2012); supply costs are from Lazard 2013. [85]

There are 2 key components missing from this LCOEE number; 1. Consumer costs for acquiring the EE measure and 2. Utility's lost revenue. In a more complete study done by Berkley Lab, the average LCOEE across a study of 20 different states shows $.046 $/kWh. In this study both utility costs and consumer costs were included. This study shows that the utility and the consumer costs were almost equal (table 2 below).[86] However what is not included in any of these LCOEE calculations is the Utility's lost revenue. This is a critical factor to why Utilities have no incentive to acquire EE beyond legal mandated targets and in fact make EE non-competitive to supply side resources.

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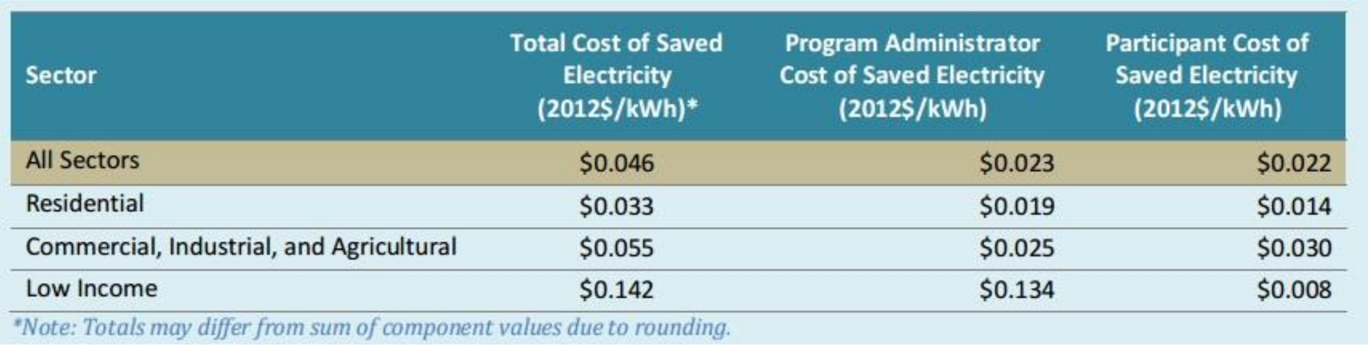
[84] Molina, Maggie, "The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs."

[85] Ibid.

[86] Billingsley, and Schiller, "The Total Cost of Saving Electricity through Utility Customer-Funded Energy Efficiency Programs: Estimates at the National, State, Sector and Program Level."

Table 2 Levelized costs of saved electricity at the national level by market sector. [87]



Sector	Total Cost of Saved Electricity (2012$/kWh)*	Program Administrator Cost of Saved Electricity (2012$/kWh)	Participant Cost of Saved Electricity (2012$/kWh)
All Sectors	$0.046	$0.023	$0.022
Residential	$0.033	$0.019	$0.014
Commercial, Industrial, and Agricultural	$0.055	$0.025	$0.030
Low Income	$0.142	$0.134	$0.008

**Note: Totals may differ from sum of component values due to rounding.*

There are of a number of issues with these studies that must be kept in mind. First of all, there is often incomplete reporting of total cost data, varying approaches used by program administrators and certain costs excluded from the analysis. This study attempted to standardize and validate the data. Still the costs associated with "recovery of "lost revenues" and performance incentives for utility shareholders or other program administrators are often regarded as a component in the total cost of saved energy" [88] but not included in this study.

Secondly the energy savings from utility run programs are only estimated or deemed and have been proven to be highly overestimated. This stems from the fact that the majority of energy efficiency incentives are paid upfront based on modeled savings. According to an article by Matt Golden, "the engineering tools regulators require today to estimate deemed savings have a massive bias towards overestimation." "In California, the Title24 HERSII based energy model required until earlier this year, over-predicted energy savings by nearly 300 percent while New York and other states overestimation ran closer to 150 percent."[89]

But energy efficiency has significantly more value than just energy savings and so when looking at energy efficiency you must compare the total costs to the total benefits and will be discussed in the next section.

3.1.2.2 Cost Effectiveness Tests

Utilities and regulators know that energy efficiency has significant more value or benefits than supply side resources and these benefits must be quantified and compared to the total costs to provide a true representation of the cost effectiveness of energy efficiency. Keep in mind however that all of these tests rely on the estimated or deemed energy savings that are often overinflated.

There are 5 different cost effectiveness tests but 3 are predominately used by utilities among most states. They are Program Administrative Cost (PAC), Total Resource Cost (TRC) and Societal Cost Test (SCT). Typically, one program test is used to screen at a program level and another or ideally 2 additional tests are applied at a Portfolio level. The costs and benefits that are included in each test is shown in the figure below. [90] Note that the RIM tests, which is not widely used, is the only one that measures the cost of lost revenue to the utility. This is a significant risk / cost to the utility and will be discussed in a future section.

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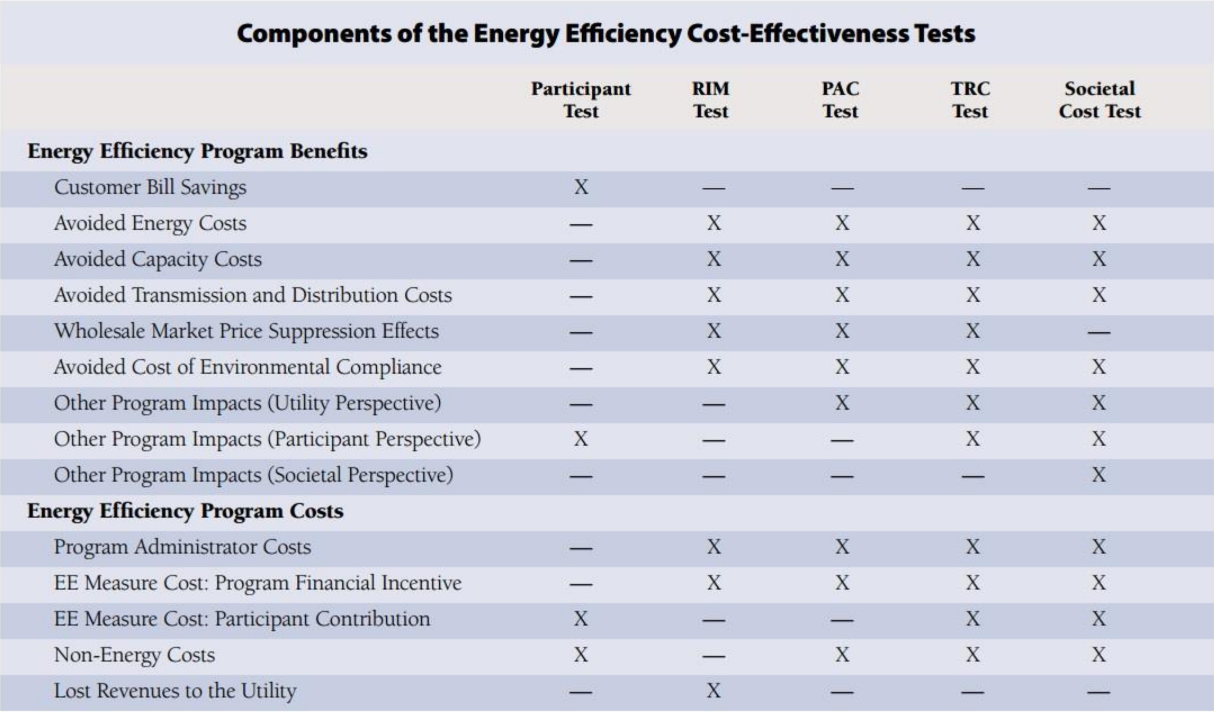
[87] Ibid.

[88] Ibid.

[89] Golden, Matt, Principal, "Ensuring Confidence in Metered Energy Efficiency Markets."

[90] Woolf, Tim et al., "Energy Efficiency Cost-Effectiveness Screening."



Components of the Energy Efficiency Cost-Effectiveness Tests

	Participant Test	RIM Test	PAC Test	TRC Test	Societal Cost Test
Energy Efficiency Program Benefits					
Customer Bill Savings	X	—	—	—	—
Avoided Energy Costs	—	X	X	X	X
Avoided Capacity Costs	—	X	X	X	X
Avoided Transmission and Distribution Costs	—	X	X	X	X
Wholesale Market Price Suppression Effects	—	X	X	X	—
Avoided Cost of Environmental Compliance	—	X	X	X	X
Other Program Impacts (Utility Perspective)	—	—	X	X	X
Other Program Impacts (Participant Perspective)	X	—	—	X	X
Other Program Impacts (Societal Perspective)	—	—	—	—	X
Energy Efficiency Program Costs					
Program Administrator Costs	—	X	X	X	X
EE Measure Cost: Program Financial Incentive	—	X	X	X	X
EE Measure Cost: Participant Contribution	X	—	—	X	X
Non-Energy Costs	X	—	X	X	X
Lost Revenues to the Utility	—	X	—	—	—

Figure 10 Components of energy efficiency cost-effectiveness tests. [91]

3.1.3 Measurement and Verification

For the majority of utility energy efficiency programs, "measurement and verification of efficiency is essentially an estimation of savings based on statistics integrated across thousands of discrete and dispersed efficiency measures"[92]. Therefore, energy efficiency is not actual metered load reductions.

For the pay for performance utility programs currently in place today, measurement and verification is done manually on a yearly basis. This is typically a very cumbersome process because everything is calculated manually including weather normalization, energy savings for measures that are not included, energy savings from different measures that are paid out at a different rate and all of this has to be in agreement with the building owner, who is being paid for the savings. This is an iterative process that can take a long time and therefore adds significantly to the PAC.

3.1.3.1 International Performance Measurement and Verification Protocol (IPMVP)

In 1997, the International Performance Measurement and Verification Protocol (IPMVP) was "born" and today it is the most widely recognized M&V framework. This framework is typically utilized by energy managers, ESCOs and is integrated into the Investor Confidence Project protocols.[93] Utility run energy efficiency programs typically would not use these protocols because they are based on field measurements.

This effort initially started in the early 1990s when it was recognized that standards were required for measurement and verification. This effort was initiated by the U.S. Department of Energy and Lawrence Berkley National Laboratory with the important goal "to help create a secondary market for energy efficiency investments by developing a consistent set of M&V options that could be applied to a range of energy efficiency measures in a uniform manner resulting in reliable savings over the term of the project".[94]

In the table below you can see a description of the 4 different IPMVP options and their typical applications. IPMVP Option C is utilized in the P4P Residential Pilot program and IPMVP Option D is utilized for MEETS. Option D typically utilizes a calibrated simulated baseline but in the MEETS model the Dynamic Baseline meter is flexible and can use baselines from calibrated simulations, metered historical data, code baseline, etc.

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[91] Ibid.

[92] Elkind, Ethan N., "Powering the Savings."

[93] "Investor Confidence Project, Project Profile."

[94] Efficiency Valuation Organization, "Efficiency Valuation Organization."

Table 3 Description of the 4 IPMVP Options and typical applications [95]

	Description	Typical Applications
A Partially Measured Retrofit Isolation	Savings are determined by partial field measurements of the energy use of the system to which an ECM was applied. Some or all of the parameters may be stipulated if appropriated.	Lighting retrofit where pre- and post-retrofit fixture Wattages are measured. Operating hours of lights are typically agreed upon.
B Retrofit Isolation	Savings are determined by field measurement of the energy use of the systems to which the ECM was applied.	Variable speed drive on a pump. Electricity use is measured by a kWh meter installed on the electrical supply to the pump motor.
C Whole Facility	Savings are determined by measuring energy use at the utility meter level. Bills may be corrected for weather	Several ECMs affecting many systems in a building. Utility bills are used.
D Calibrated Simulation	Savings determined through simulation of the energy use of the whole-facility or sub-facility. Simulation routines are demonstrated to adequately model actual energy performance in the facility. Energy Use Simulation calibrated with hourly or monthly utility billing data. Energy end use metering may be used to help refine input.	Multi-faced energy management program affecting many systems in a facility but where no meter existed in the baseline period. Energy Use measurements after the installation of gas and electric meters are used to calibrate a simulation. Baseline energy use determined using the calibrated simulation, is compared to a simulation of reporting period energy use.

Option D model is a thermodynamic model of a specific building which allows for calibration, or baselines to be kept up to date when routine and non-routine changes occur. Option C is Whole Building model, but does not represent actual energy flows in the building and therefore cannot be calibrated. The Option D building model can be developed through both a “built-up” or “inverse” process. “The built up model requires substantial amounts of building data to construct a physical model and can be expensive and difficult to build up and keep calibrated.”[96] The inverse model relies on past energy bills to build up the thermodynamic model of the building. Using an inverse model approach, as is done with the DeltaMeter in use on the MEETS pilot project, makes the use of Option D as simple and cost effective as Option C but with the ability to be calibrated. Option D therefore should be used for longer term (>2 years) pay for performance energy efficiency contracts and/or when external factors are expected to impact a building’s energy performance.

3.2 REDUCING RISKS AND BREAKING DOWN HURDLES TO EXTRACT MORE VALUE FROM ENERGY EFFICIENCY

For many years the utility industry has understood that energy efficiency has the same physical effect as energy generation at the same point on the grid and has been recognized to deliver more value or benefits than a supply side resource. Energy efficiency’s load shape is highly valuable because efficiency delivers negawatts to the grid precisely when the utility’s demand is the highest. However as of today, this value has not been fully realized and therefore EE’s full investment potential is not being realized. In order to extract the full value or benefits from energy efficiency the risks have to be reduced and hurdles overcome for all players in the model. The key to this is metering energy efficiency to utility grade standards over the life of the measure and paying for performance as energy efficiency is acquired.

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[95] Prepared by Efficiency Valuation Organization, “International Performance Measurement and Verification Protocol, Concepts and Options for Determining Energy and Water Savings Volume 1.”
[96] Hayes, Denis, Harmon, Rob, and Kahn, Brad, “The Metered Energy Efficiency Transaction Structure.”

Already the industry recognizes energy efficiency as a valuable energy resource. Amory Lovins coined the term Negawatt back in 1989 to define a watt of energy saved through conservation or efficiency measures and argued that "the best energy policy for the nation, for business, and for the environment is one that focuses on using electricity efficiently."[97] The most recent Northwest Regional Power Plan, 7th Plan, calls for energy efficiency to meet 100% of the region's load growth through 2030 based on energy efficiency's cost effectiveness, avoidance of volatile energy price risk and risk of deploying large-scale capacity power plants, mitigation of the risk of future carbon pricing policies and along with energy savings the ability to meet future capacity needs by reducing both winter and summer peak demand.[98] Energy efficiency, unlike a supply side resource, also helps to improve the efficiency, productivity and indoor air quality of our building stock and reinvests money back into local jobs and industries.

Fundamentally if energy efficiency is metered just as supply side energy and paid for as it is delivered, this significantly reduces the risk to all key player groups. Matt Golden sums it up this way, "As energy efficiency moves from a deemed rebate approach into a performance-based marketplace where efficiency is measured as a demand-side capacity resource, the value of efficiency is going to increase."[99]

The table below outlines the key risks, hurdles and benefits by key player under the current utility energy efficiency models. Reducing Risks and overcoming hurdles enables the different players to extract more benefits from energy efficiency. This in turn increases the overall value of EE which is the key to fully scaling this energy resource. You will see this table used for each model in the following sections to compare how MEETS and P4P Residential programs address these issues.

Table 4 Key risks, hurdles and benefits that exist today in current energy efficiency models for the different players involved. Own Comparison.

Risks (R), **Hurdles (H)**, **Benefits (B)**

	Risks, Hurdles and Benefits	Current Utility EE Model (Measure based incentives)
Utilities		
R	Utilities get the EE they pay for?	No and/or not verified
R	Cost Effectiveness of acquiring EE	Decreasing
R	Utility Program Admin Costs	Increasing
R	Rate-payer Incentive funded?	Yes
R	Declining retail revenues contributing to Utility Death Spiral?	Yes
H	Do current regulations support model?	Yes
H	Is technology available to support model?	Yes
H	Are baselines set at historical use?	No, typically set at current code.
B	Ability to use EE as a grid management tool	No
B	Meet new EE and GHG emission mandates	Difficult
B	Opportunity to invest for regulated rate of return	No
B	Improve alignment between regulatory participants?	No
Investor		
H	Eliminate Split Incentives	No
R	Are there Stable / predictable/ low risk cash flows	No
R	Are there Long Term Cash Flows	No
R	Is there an incentive to maximize EE generation over life of measure?	No
R	Are there well understood standard contracts	No

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[97] Lovins, Amory, "The Negawatt Revolution."
[98] NW Power and Conservation Council, "Seventh Northwest Conservation and Electric Power Plan,."
[99] Golden, Matt, Principal, "Ensuring Confidence in Metered Energy Efficiency Markets."

B	Long term, stable, good yield, green investment vehicles	No
Building Owner		
H	Eliminate Split Incentives	No
H	Eliminate Attribution Issue	No
H	Eliminate issue of owner lack of expertise, time in EE	No
B	Improves ability to leverage capital for EE	Minimal
B	Increases Net Operating Income	Yes (only if owner occupied)
B	Increase Building Value at point of sale	Minimal
B	Comfortable, healthy, efficient building	Minimal
B	Can Leverage Green Benefits	Minimal
Tenant		
B	Comfortable, healthy, efficient building	Minimal
B	Can Leverage Green Benefits	Minimal
Rate Payers/Society		
R	Cost Effectiveness of acquiring EE	Decreasing
R	Rate-payer funded?	Yes
R	Risk of Utility rate increases?	Yes
R	Financial Stability of utilities at risk?	Yes
B	Greening of energy supply	Yes
Energy Services Companies		
R	Existing well-Trained employee base	Yes
B	Increase Business Opportunities	No (stable)
B	Allows for innovative solutions	No

3.2.1 Utilities and Regulators

For the utilities and regulators, if energy efficiency is metered to utility grade standards, energy efficiency can be utilized as a grid management tool, similar to supply side energy, to meet local energy and capacity needs. If EE is both metered and paid for based on performance, these players would be confident that they are receiving what they pay for and would be able to extract more value from this resource. In addition, Program Administrative Costs could be reduced significantly through standardizing and automating the measurement and verification process (metering EE). Also by allowing for the utility to keep their retail revenues and unit sales in an EE model, the risk to rate increases and the financial stability of the utility decreases and utilities would have incentive to acquire all mandated energy efficiency plus more.

3.2.1.1 Utility Death Spiral

There is significant risk today with the financial stability of utilities from widespread adoption of DER and energy efficiency under the current cost of revenue structure where DER and energy efficiency are treated as lost revenue. This risk is passed onto rate payers in the form of higher rates and to society in the reduction of utilities as high-grade investment vehicles. It is something coined the “utility death spiral”. “The Utility Death Spiral is a self-reinforcing and accelerating upward spiral in rates from a reduction in units of energy sold from efficiency, solar and other distributed energy systems, forcing utilities to spread fixed costs over fewer units which in turn makes rates go up and incentives customers to make further investments in efficiency, solar and other DER. [100]

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[100] Hayes, Denis, Harmon, Rob, and Kahn, Brad, “The Metered Energy Efficiency Transaction Structure.”

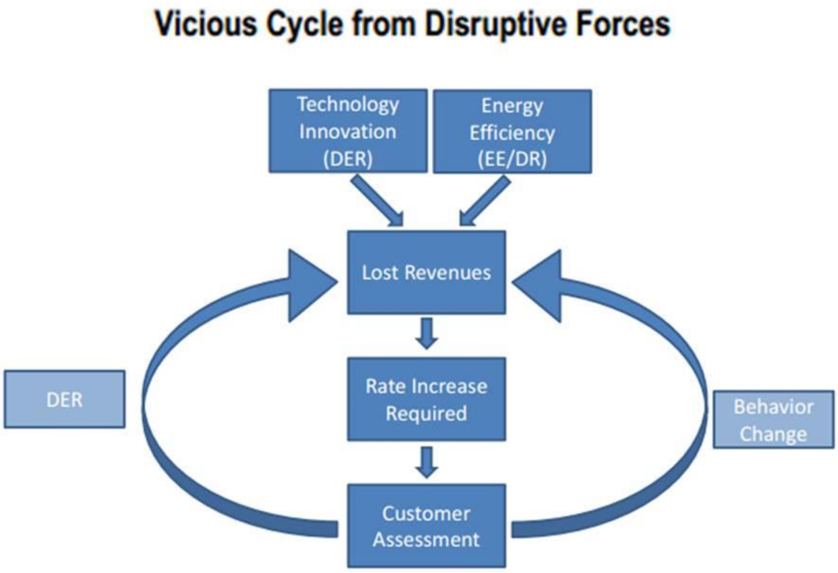

Figure 11 The threat of the "utility death spiral" is pushing companies to rethink their rate structures, often with controversial consequences. Credit Edision Electric "Disruptive Challenges" [101]

Utilities meet their revenue requirements by selling units of energy. The financial health of utilities is tied directly to their retail sales because their fixed costs are recovered through charges based on how much people use. In a 2014 WSJ Article, Steven Piper, an energy analyst for SNL Energy was quoted as saying "Utilities typically need to expand sales volume by 1% or more a year just to maintain their expensive, sprawling networks of power plants, transmission lines and substations". Rocky Mountain Institute writes "A day is coming when solar plus battery systems will become cheaper than utility-sourced electricity, making customer grid defection a possibility"[102]. Utility sales today are not growing with GDP as they have in the past based on many factors, and DER resources, like rooftop solar and energy efficiency, transacted by credits at the meter instead of as sales to and purchases from the utility, counteract the benefits of population growth. [103]

It is common today for utilities to attempt to solve their "death spiral" problem by seeking regulatory approval to charge their customers more costs on a flat charge. [104] This however is unpopular because it would dramatically reduce the potential for savings from energy efficiency and other DERs. Many states are allowing utilities to decouple profits from their sales which breaks the link between the amount of energy sold and the actual (allowed) revenue collected with the purpose of increasing the incentives for utilities to increase energy efficiency efforts. The results to this have been mixed California is trying to establish a way for Investor Owned Utilities (IOU) to return the same value to shareholders on DER as they do today on power plants and transmission grids in a new draft proposal issued by Commissioner Mike Florio in April of 2016.[105] Today IOUs in CA return value to their shareholders with the formula (r-k), r being the return on equity and k being the cost of capital. Today the difference is between 2.5-3% only on power plants and transmission grids but money spent today on DER including energy efficiency are operating expenses that are a pass-through to rates. New York's new REV program is adding additional revenue mechanisms in addition to a "cost-of-service" revenue model in an attempt to embrace DER without sacrificing the stability of the utilities. [106] California and Illinois both are proposing solutions that allow utilities to earn a regulated rate of return

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[101] Bade, "The Top 10 Trends Transforming the Electric Power Sector."
[102] Bronski,Peter, "Distributed Defectors."
[103] Smith, Rebecca, "Electric Utilities Get No Jolt From Gadgets, Improving Economy Electricity Sales Anemic for Seventh Year in a Row."
[104] Hayes, Denis, Harmon, Rob, and Kahn, Brad, "The Metered Energy Efficiency Transaction Structure."
[105] Bade, Gavin, "How California Wants to Align Utility Revenue Models with DERs A New CPUC Proposal Puts Forth an Innovative Framework for Utilities to Earn a Rate of Return on DER Procurements."
[106] GUERRY, IAN, "Deep Energy Efficiency Is Finally Ready to Scale and Utilities Will Actually Love It."

on DERs under the existing “cost-of-service” revenue model [107] and “other states like Massachusetts and Minnesota have similar dockets open”[108]. Utility “business model transformation has become perhaps the greatest singular focus of the utility industry”. [109]

3.2.1.2 Program Administration Costs Increasing

“In pay-in-advance model of energy efficiency, we don’t measure results in a usable way and instead attempt to ensure good outcomes by micromanaging every step of the retrofit process with an avalanche of regulation.” [110]

Cost effectiveness of utility energy efficiency programs has been declining in California as seen in the figure below and are forecasted to continue declining “due to a forecasted shrinking supply of easy efficiency upgrades.” [111] Program administrator non-incentive costs have grown to represent about half of program expenditures. ” In other words, we are spending $1 on administrative costs to try and make sure the other $1 is spent wisely -- and then failing.”[112]

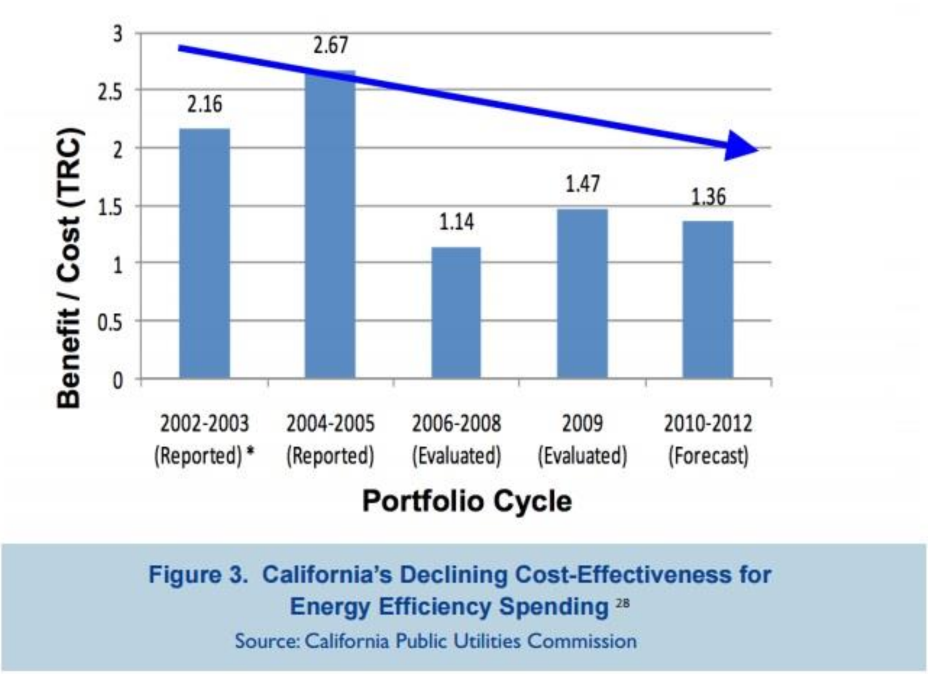

Figure 3. California’s Declining Cost-Effectiveness for Energy Efficiency Spending [28]

Source: California Public Utilities Commission

Figure 12 Benefits / Cost (TRC) ratio from California’s Investor Owned Utilities. [113]

3.2.1.3 Increasing Energy Efficiency targets, Decreasing “Low Hanging Fruit”

As discussed earlier in this report, based on current policies it is estimated that spending will double for EE programs with a target of 50% increase in savings without a significant impact on customer rates. “Meeting these targets will be challenging, especially since, in the view of some analysts, the era of easy savings is over as baseline efficiency is rising, and building codes are becoming more stringent, and equipment and appliances more efficient.”[114] However meeting this targets pose a significant risk to rates, because if they meet it, utilities will substantially reduce the number of units they sell. Rates are basically utility costs divided by units sold, and fixed costs don’t go away when units do – so they get concentrated on fewer and fewer units (death spiral.) That causes political challenges and also exacerbates the economic risk to the grid. Utilities are going to have to develop programs that achieve deeper saving without undermining the economics of the utilities, to meet

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[107] Ibid.

[108] Bade, “The Top 10 Trends Transforming the Electric Power Sector.”

[109] Ibid.

[110] Golden, Matt, Principal, “Ensuring Confidence in Metered Energy Efficiency Markets.”

[111] Elkind, Ethan N., “Powering the Savings.”

[112] Golden, Matt, Principal, “Ensuring Confidence in Metered Energy Efficiency Markets.”

[113] Elkind, Ethan N., “Powering the Savings.”

[114] Misuriello, H., S. Kwatra, M. Kushler, and S. Nowak., “Building Energy Code Advancement through Utility Support and Engagement.”

these challenging EE targets. Today's programs achieve 5-20% in savings but we must go 25-40% of savings levels to achieve targets.[115]

3.2.2 Investment Community

To attract capital investment, repayment cash flows must be established and transaction costs reduced. The investment community is looking for stable, reliable and long term cash flows delivered from a low risk source in well understood and standardized contractual agreements. "The lack of standardization in the development and documentation of energy efficiency projects is the major barrier to increasing the flow of investment into energy efficiency" and Citigroup states that "No two projects or contracts are alike. Securitization is not practical or possible under these circumstances."[116]

The Investor Confidence Project (ICP) in the US and Europe is working towards reducing the risk of EE projects by developing standards for project development, documentation, performance verification and under-writing.[117] But performance verification is done manually on a yearly basis which can be a complex process.

3.2.3 Building Owner and Building Tenants

For a Building owner, investing in energy efficiency is limited mainly by the hurdle of split incentives. In other words, the energy savings from EE investment goes to the tenant who pays the energy bill in a non-owner occupied building and the future potential of energy savings goes to the future building owner. In the building sector there are difficult hurdles in terms of investment payback requirements. In the owner-occupied commercial sector, the average expected payback period 3.6 yrs[118] and in the residential sector it is typically less than this. Because of the issue of split incentives, the capital constraints, the building owners typically don't invest to realize the full potential of energy efficiency.

Building tenants typically will not invest in anything but shallow or fast payback energy efficiency measures due to the hurdle of their own limited tenancy. Energy savings must be shared with future tenants and therefore the investment horizon will be limited. In addition, both tenants and building owners often don't have the interest, time and expertise to pursue energy efficiency.

In addition, energy costs are typically a small % of the overall operating costs of a building and Energy efficiency retrofits are often complex to implement. "Most U.S. buildings' expenses break down into a similar distribution —largely fixed costs, followed by utility bills, repairs and maintenance expenses (R/M). On average, building owners spend 22% of their operating costs on energy and water. Corporate facilities typically spend slightly more on utilities ($2.70 per square foot-year), while general multi-tenant buildings spend less ($2.25 per square foot-year). Many operators, when assessing only the value of energy bill reductions, will choose not to invest in energy retrofits ". [119]

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[115] Galen L. Barbose, Charles A. Goldman, Ian M. and Hoffman, Megan Billingsley, "The Future of Utility Customer Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025."

[116] Fawkes, Steven Dr., "The Investor Confidence Project."

[117] Ibid.

[118] Granade, Hannah Choi et. al, "Unlocking Energy Efficiency in the US Economy."

[119] "Category Expenses by Building Type for Commercial Sector."

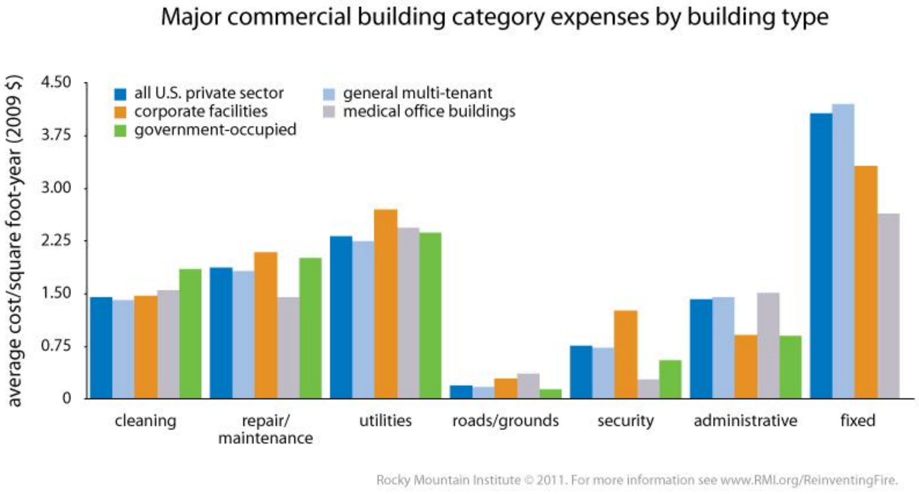

Figure 13 Major commercial building category expenses by building type. [120]

3.2.3.1 Attribution

When a building is renovated, it is typically subject to new building energy codes, which in most states requires far more efficiency than is found in many existing buildings. Therefore, efficiency programs cannot claim the credit for all the savings from a retrofit unless they influence the building owner to make a major capital investment years earlier than would have occurred or influence a customer to upgrade a building beyond code requirements. [121]

This represents a major barrier to deep energy retrofits because customers will only implement light or shallow ECMs which don't trigger a code reset and major renovations will have a different trigger and focus other than energy savings.

3.2.3.2 Increased Value from Deep Energy Retrofits

What is not included in any of the Energy Efficiency Cost effectiveness tests is the additional value a building owner receives from a deep energy efficiency retrofit. In a deep energy retrofit there is significantly more value (see figure below) over just energy savings that does not get monetized and accounted for. In a report from Rocky Mountain Institute guidance is provided on how to quantify these numbers.

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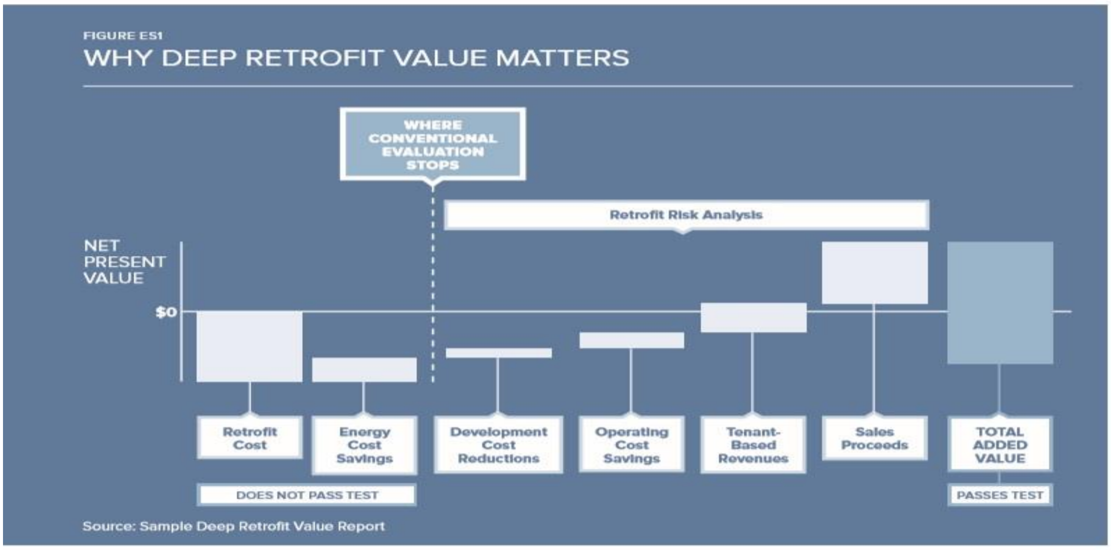
[120] Ibid.

[121] Kwatra,Sameer and Essig,Chiara, "The Promise and Potential of Comprehensive Commercial Building Retrofit Programs."

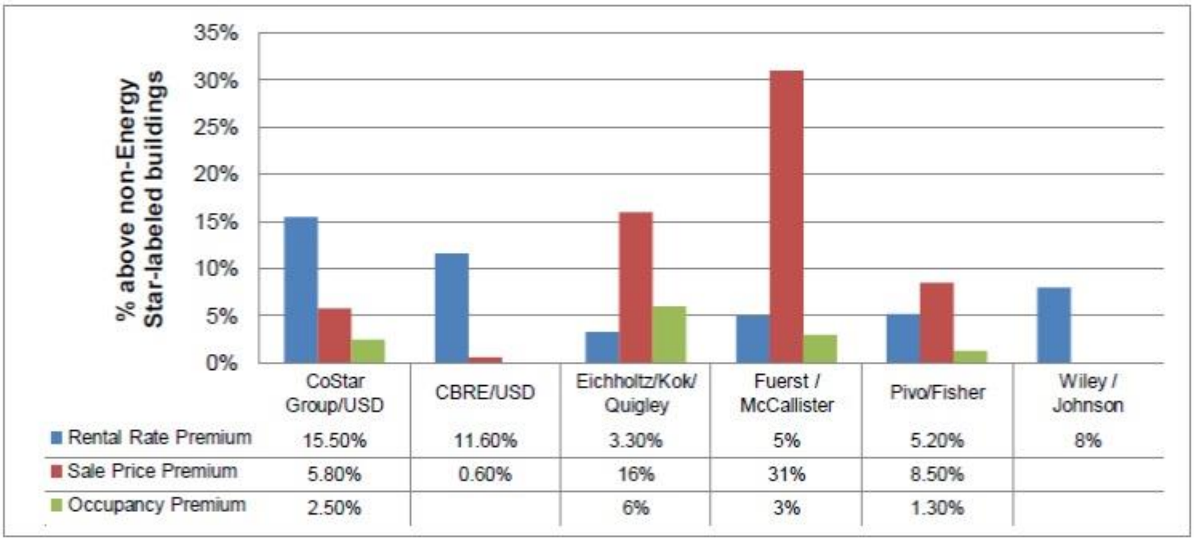


Source: Sample Deep Retrofit Value Report

Figure 14 Additional Values from deep energy efficiency retrofits that are significant. [122]

- Development Cost Reductions – If energy efficiency retrofits are timed with other capital improvements they have very little incremental or cost premium.
- Non-Energy Operating Cost Savings – Savings can be obtained from maintenance, insurance and occupant churn rate. Also increase in building occupied space through equipment downsizing.
- Tenant Based Revenues – These are realized through enhanced demand resulting in increased rents, occupancies, absorptions, and tenant retention.
- Sales – Increased market value for the property comes from increased Net Operating Income (NOI) due to increased tenant revenues and lower operating costs, increased investor demand and risk reduction (both contributing to cap and discount rates). [123]

Below are the results showing the integration of several studies on the impact to rental rates, market price and occupancy from energy efficiency retrofits of buildings in the commercial sector. Rental premiums as high as 15% and sales premiums above 30% show that there is strong value beyond energy savings.



	CoStar Group/USD	CBRE/USD	Eichholtz/Kok/ Quigley	Fuerst / McCallister	Pivo/Fisher	Wiley / Johnson
🟦 Rental Rate Premium	15.50%	11.60%	3.30%	5%	5.20%	8%
🟥 Sale Price Premium	5.80%	0.60%	16%	31%	8.50%	
🟩 Occupancy Premium	2.50%		6%	3%	1.30%	

Figure 3. Impact of energy efficiency on rental and property value. ***Source:*** **Institute for Market Transformation (IMT).**

Figure 15 Impact of energy efficiency on rental and property values. Source: Institute for Market Transformation (IMT) [124]

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[122] Bendewald, Michael, Miller, Douglas, and Muldavin, Scott, "HOW TO CALCULATE AND PRESENT DEEP RETROFIT VALUE A GUIDE FOR INVESTORS."

[123] Ibid.

3.2.4 Rate Payer / Society

All rate payers, representing the majority of people in the US, finance utility energy efficiency programs. All rate-payers bear the increasing costs of the programs that are passed through in the rates and the financial risks associated with utility lost retail revenue.

The forecasted increase in EE program spending poses a risk of rate increases. Because utilities pay out incentives in year 1 on deemed savings their costs are front loaded so achieving a steep increase in EE will cause rates to rise in the short term and can cause political challenges.

3.2.5 Energy Services Companies

Energy Services Companies stand to benefit significantly from new metered pay for performance programs if they stay on top of the trends and are open to the changes that these new models will require. In particular, ESCOS would be required to move away from their own internal, non-transparent, way of measuring energy savings to transparent measurements.

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[124] Kwatra,Sameer and Essig,Chiara, “The Promise and Potential of Comprehensive Commercial Building Retrofit Programs.”

4 HIGH LEVEL COMPARISON OF TWO METERED PAY-FOR-PERFORMANCE ENERGY EFFICIENCY MODELS

This thesis compares two different Metered Pay-For-Performance (PFP) Energy Efficiency models; Metered Energy Efficiency Transaction Structure (MEETS™) and Pacific Gas and Electric Company's P4P Residential Program. These models have many differences but they share the following three elements;

1. Pay-For-Performance on,
2. all metered (to industry standard protocols) energy efficiency on a,
3. whole-building basis.

Pay-For-Performance (PFP) is defined as a model that pays or incentivizes energy efficiency based on realized performance as opposed to deemed savings. EE Meters are basically software that provide a consistent accounting of energy efficiency savings. Whole-Building energy efficiency programs measure and incentivize energy efficiency savings from the aggregate of all energy conservation measures (ECM) as opposed to individual ECMs. The majority of energy efficiency programs today are based on deemed savings from individual ECMs. There does exist good examples of Pay-For-Performance and whole-building EE programs but no major program or model has brought together, until now, all 3 elements.

At the heart of both of these models is an energy efficiency meter which calculates energy savings against a historic baseline. Savings from energy efficiency measures are physically the same as energy from a supply side resource at that same spot on the grid but in order to realize this you must be able to measure energy flows. CalTRACK, based on the Open EE Meter, is used in the P4P Residential program and the DeltaMeter® in used in MEETS. The DeltaMeter® is a Dynamic Baseline Meter which uses a thermodynamic model (IPMVP Option D[125]), developed through an inverse process using historic energy bills, of a specific building to enable adjustments to the baseline when routine or non-routine changes occur. CalTRACK uses statistical correlations and inverse fit techniques (IPMVP Option C[126]) to equations creating a static baseline based on historic energy bills that can be weather normalized on a yearly basis. Smart meters and standard data transfer protocols are required for the P4P Residential program and can enhance MEETS but are not required. Each energy efficiency meter uses a unique approach to measure energy savings but both have a place in their respective target markets. The energy efficiency meters provide near real-time access to metered gross savings and a standardized approach to measuring energy efficiency such that all parties calculate the same level of savings.

By measuring energy efficiency in this way allows utilities to incorporate EE into their energy supply portfolio and use it as a grid management tool. In the future, as with other distributed energy resources (DER), it is possible to pay a different value for location, time of day, duration and quantity of the resource. In addition, measuring energy efficiency and paying for performance provides a stable and reliable cash flow that the investment community can rely on. In these PFP metered energy efficiency models EE will become a more valuable resource to all players in the energy supply chain which in turn will accelerate the energy efficiency market.

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[125] Prepared by Efficiency Valuation Organization, "International Performance Measurement and Verification Protocol, Concepts and Options for Determining Energy and Water Savings Volume 1."
[126] Ibid.

Table 5 High Level Comparison of MEETS to CA P4P Residential. Own comparison.

	MEETS^{TM}	**CA P4P Residential**
High Level Program Overview		
Summary	Deep Energy Retrofits at scale in new and existing Commercial Buildings	Shallow to Medium Energy Efficiency at Scale in existing residential buildings
Program Overview	Energy efficiency transaction structure which aligns interests of all stakeholders breaking down traditional barriers to achieving deep energy retrofits at scale.[127]	"Develop a framework intended to build a platform for scalable residential retrofits while minimizing administrative and implementation costs"[128]
Target Market Segment	Commercial Office and multi-family residential - new and retrofit	Residential - Retrofit
Who Developed Model?	MEETS Coalition early members (Energy^{RM}, Equilibrium Capital). Now run by a member supported coalition.	Natural Resources Defense Council (NRDC)'s Proposal, supported by PG&E and other stakeholders[129]
Key Program Goals	Advance deep energy retrofits in the commercial built environment which strengthens our utilities, attracts long-term capital, stabilizes the grid and improves our building stock.	Acquire EE based on time/location/duration to be utilized as a resource to manage net load issues (Duck Curve). Meet aggressive EE mandates. Leverage existing market players. Reduce Program Admin Costs.
Innovative Concepts	Building is a Grid Power Plant, EE is metered, billed and purchased by utility just as an energy supply resource, move from consumer to capital market financing, Energy Tenant^{TM} has the right to acquire EE and tenancy remains through new ownership.	EE is metered and aggregated at a portfolio level which statistically reduces uncertainty and therefore becomes a stable, reliable commodity. Deregulate EE business model but hold accountable for savings.
Key Players in Model	Energy Tenant^{TM} (ET) / Investor, Utility, Building Owner	EE Aggregator, Investor, Utility, Building Owner
Status of Program	Pilot for >1 yr on new building (Bullitt Center) in Seattle with Seattle City Light.	Pilot Project rolling out in late 2016 with PG&E.
Program Details		
Length of PFP Contract	20-30 years Power Purchase Agreement (PPA)	2 yrs. (pilot), future length of Power Savings Agreement (PSA) is to be determined but depends on length of time you can expect a baseline to remain stable on a portfolio of homes.

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[127] MEETs Coalition, "Metered Energy Efficiency Transaction Structure."

[128] Jacobson, Erik, Director Regulatory Relations, "Submission of High Opportunity Projects and Programs (HOPPs) Proposal - Residential Pay-for-Performance Program."

[129] Ibid.

Rate paid for EE	Retail Rate for Energy plus Energy efficiency incentive (EEI)	Pilot is paying $.80/kWh and $1.80/ therm on gross savings 2 times at the end of each year. This is below the average incentive paid which is $1.00/kWh[130]. Long term different rates can be applied based on location, ECM, time of day and net savings.
Who Pays for Energy Efficiency?	No rate payer incentive funds, project is self-financed through energy efficiency PPA. PPA provides positive returns to the utility (EE is bought and sold through procurement like a supply side resource)	Pilot: Rate Payer incentive funds. Future plan is for EE or Demand Capacity to go through procurement like a supply side resource.
Who Owns Energy Savings?	Energy Tenant™ (paid out in a PPA via utility)	Customer - but can sign over for better rate / service.
Who Owns Demand Savings?	Energy Tenant™ (should be included in PPA)	Customer - but can sign over for better rate / service.
Who finances Capital?	Energy Tenant™ /Investor	Customer (via PACE) or own capital
Technology Required	Dynamic Baseline Meter	CalTRACK (Open EE Meter), smart meters and standardized transmittal of energy data (PG&E Share My Data)
M&V Strategy	IPMVP Option D, dynamically adjusts for routine changes (weather and occupancy) and dynamically monitors and allows adjustment for non-routine behaviors.	IPMVP Option C, no dynamic adjustments. Results are normalized for weather on a yearly basis.
Baseline	Multiple supported; existing buildings use historical; new buildings use composite baselines of current code-based buildings in area, can use simulated.	Building historic energy usage
Requirements for Program		
Regulations Required	Utility to charge building owner retail rate of energy for EE, pay for metered EE on a whole-building basis based on Dynamic Baseline Meter.	Utilities allowed to pay incentives for whole-building metered EE from historical baseline based on CalTRACK EE Meter.
Contracts Required	Energy Tenancy contract between Energy Tenant™ with building owner, PPA between utility and Energy Tenant™	Pilot: Contract between Aggregator and PG&E to pay EEI (SPA) and contract between building owner and aggregator to pass over EE incentives and allow access to energy data.
Mandates Required	Energy Efficiency and GHG mandates are good to help drive change of regulations but not required long term.	Energy Efficiency Mandates (CA SB350) and GHG mandates.
Financing Required	Long term (20-30 yrs) financing	PACE if customer requires capital

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[130] Ibid.

5 METERED ENERGY EFFICIENCY STRUCTURE (MEETS™)

5.1 HIGH LEVEL OVERVIEW

Meets is an energy efficiency transaction structure designed to break down the barriers to enable deep energy retrofits in new and existing Commercial Office market segment. MEETS can also work for other commercial buildings and for light to medium retrofits but it is ideally suited for deep energy retrofits in commercial office buildings that are tenant occupied.

A deep energy retrofit, sometimes referred to as Comprehensive retrofit is defined by Kwatra and Essig "as a suite of measures, across multiple energy systems, undertaken to improve building energy efficiency by using an integrated whole-building approach to achieve savings larger than those possible from the installation of isolated measures."[131] RMI defines it "as a whole-building analysis and construction process that achieves much larger energy cost savings— sometimes over 50% reduction—than those of conventional, simple retrofits and fundamentally enhances the building value." [132]

5.2 PLAYERS IN THE MEETS MODEL

In the MEETS model and for energy efficiency in commercial buildings, there are four principal groups of players that are involved: building owners, utilities, 3rd party developers or investors, utilities and tenants.[133] The utility regulators also play a role in defining regulations for Independent owned utilities (IOU).

One of the key players mentioned above will act as the EnergyTenant™. The EnergyTenant™ is defined as "an operator whose relationship to the facility is a tenancy[134]" and "engages in a MEETS transaction – with the building owner (as a tenant) and with the buyer of the energy yield"[135]. In other words, the Energy Tenant is responsible for and has a strong interest in installing and maintaining energy improvements in the buildings. The Power Purchase Agreement (PPA) is a contractual agreement between the utility or the buyer of the energy efficiency yield.

Any party can play the Energy Tenant role. This could be the building owner, a 3rd party developer or investor and/or the utility. In the case of the Bullitt Center where the first MEETS transaction has been implemented, the building owner is the EnergyTenant™. Typically, you would want an Energy Tenant who will have a long term relationship with the building, however, the party playing this role is easily transferable.

If the energy tenant is not the building owner an energy tenancy lease is set up which gives the energy tenant the right to harvest energy efficiency from the building. The energy tenancy lease brings with it typical tenancy rights that are useful such as the tenant does not own the tenant improvements (building owner does) but has the right to use them and tenancy is persistent across changes in ownership.

An investor provides the capital to the Energy Tenant for the energy efficiency retrofit. Any party can be the investor such as the building owner (in the case of the Bullitt Center), the utility or a 3rd party bank or investment firm. If the utility acts as the investor they are able to earn their regulated rate of return. Utilities would make a good investor because they have access to low cost capital, they have a long term relationship with the building and they have visibility into where energy efficiency and

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[131] Kwatra,Sameer and Essig,Chiara, "The Promise and Potential of Comprehensive Commercial Building Retrofit Programs."

[132] Adams, Elaine Gallagher et al., "Retrofit an RMI Initiative, Managing Deep Energy Retrofits."

[133] Hayes, Denis, Harmon, Rob, and Kahn, Brad, "The Metered Energy Efficiency Transaction Structure."

[134] MEETS Coalition, "Use of Trademarks in MEETS™ AC."

[135] Ibid.

demand capacity is required on their grid and where there is energy efficiency potential in their customer base.

Utility regulators will be critical in defining the regulations that will enable this model. Utility regulators are responsible for regulations of Independent owned utilities (IOU) but public utilities define their own regulations. Regulators are concerned that utilities meet their EE targets and requirements cost effectively such that it doesn't trigger rate increases. They are also very interested in maintaining the financial stability of the utilities. In addition, regulators approve the utilities "revenue requirement" which is the total revenue the utility requires to meet all of its costs.

5.3 HOW MEETS WORKS

The MEETS transaction is trademarked such that it brings the consistency that is needed in the financial markets for energy efficiency to be brought to scale. In order to legally use the term MEETS to describe an energy efficiency transaction all components of the legal definition must be present. Below is the trademarked definition of a MEETS transaction.

"A MEETS transaction is one in which

- The metered yield from whole-facility customer premises resources that include efficiency, is delivered to the utility – not the facility. And
- The utility bills the facility, at retail, for the metered yield of which the utility took delivery. And
- The metering is done through a dynamic baseline meter that meets utility resource grade standards.

The MEETS transaction need not be limited to efficiency yield, but always includes efficiency yield (Metered Energy Efficiency Transaction Structure). In a MEETS transaction, the yield can be delivered by any developer/operator who holds an energy tenancy or equivalent rights in the facility (the EnergyTenant™). If that developer/operator is not the utility, then the delivery to the utility is under a power purchase agreement (PPA). If the developer/operator is the utility, then the delivery is akin to any other utility-owned generation on leased property.

A MEETS transaction requires metering using a dynamic baseline meter. This meter must be utility grade. The first one on the market is EnergyRM's DeltaMeter®. Over time it is likely that other forms of dynamic baseline metering will emerge."[136]

Note that facility is used instead of building in the formal description above. This is because the MEETS model has made efficiency metering more flexible such that it can be done at a building level, multiple facility level or even community level. MEETS structure doesn't define how energy costs should be distributed but can be done on a square footage and/or sub metering basis, etc.

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[136] Ibid.

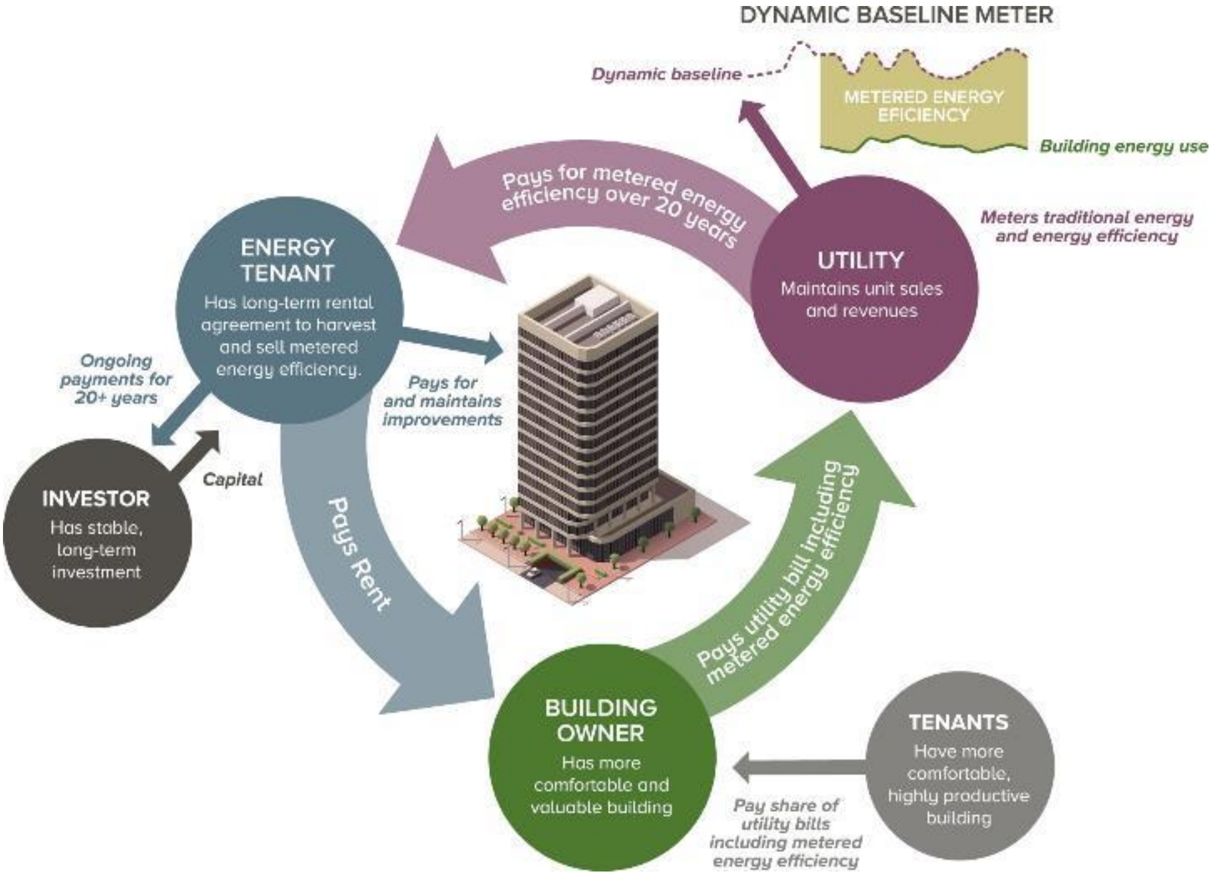

Figure 16 Metered Energy Efficiency Transaction Structure (MEETs)[137]

The figure above gives a graphical representation of how a MEETs transaction flows and the key benefits to each of the key players in the energy system. For the Building owner they receive rent from the Energy Tenant based on a percentage of the PPA, improving their NOI, and they receive a more comfortable and valuable building. The building tenants benefit from a more comfortable and productive building for the same utility cost they were paying before. The Utility maintains unit sales and revenues for energy efficiency acquired because energy efficiency is metered and charged back to the Tenant at the same rate as energy consumed. The Energy Tenant receives a stable cash flow in the form of long term PPA with the utility to acquire energy efficiency. The Energy Tenant has a long-term rental agreement to harvest (from the Building) and sell metered energy efficiency (to the Utility). This Energy Tenancy agreement is structured like a traditional Building Owners and Managers Association (BOMA) lease in that energy improvements are treated as tenant improvements and the energy tenancy overrides owner bankruptcy and change of ownership.

The Investor in this structure has a stable long-term green investment based on standardized and well understand contracts. The investor has more confidence in this structure because the Energy Tenant has an incentive to measure and monitor energy efficiency over the life of the PPA contract. In addition, the revenue payments come from the utility, a low risk counterparty. The MEETs structure aligns the interests of all parties.

The key barrier to deep energy retrofits in the commercial sector of split incentives is eliminated in this model because energy savings which are typically realized by building tenants are captured by the utility and passed through to the Energy Tenant/investor in the form of a PPA. This Energy Tenancy and PPA can be passed through to new building owners and therefore a current building owner does not need to worry about "splitting incentives" with future building owners.

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[137] "How MEETs Works."

One of the innovative concepts developed by MEETS is the idea that a commercial building is a Grid Power Plant which generates energy efficiency or negawatt hours. The long term PPA, a contract that is required to finance and build any type of Power Plan, eliminates one of the key barriers to financing. The beauty of the MEETS structure is that a unit of energy that is saved, Negawatt hour, is the treated in the same way as a unit of energy produced.

5.4 DYNAMIC BASELINE ENERGY EFFICIENCY METER

At the core of this model is the Dynamic Baseline Meter or what is sometimes referred to as a meter of normalized consumption. Currently the DeltaMeter® by EnergyRM is the only Dynamic Baseline meter on the market. The DeltaMeter® uses a thermodynamic model (IPMVP Option D) of the building, developed through an inverse process using historic energy bills of a specific building to enable adjustments to the baseline when routine or non-routine changes occur. This means a physical or thermodynamic model of the building is created which allows for dynamic and automated adjustments to the baseline for routine changes (temperature and occupancy). Non-routine changes are detected and analyzed. If the results are >5% off from expected than it will be analyzed for non-routine behaviors such as changes in occupancy, plug-loads or building use and the baseline will be adjusted as required.[138] Energy efficiency or savings is the difference of actual building energy use from this dynamic baseline.

Dynamic adjustments of baselines are required in a MEETS transaction and makes the following elements possible;

- Allows for long term building baselines (20-30 years)
- Allows for EE to be rendered as often as needed (most probably monthly billing cycles)
- Is a utility grade transaction tool that makes customer billing for EE possible.

The DeltaMeter is supported by a suite of analytical software tools, The X---View Framework™, that unifies the specialized perspective of both building operators and building / retrofit designers. The tools provide detailed diagnostics by end use on a particular building and areas of potential savings (energy audit), the tools provide first order of savings potential for each building, high level model of energy performance on given designs, tracks predicted and actual energy savings performance against an adjusted baseline. The inputs to these tools is simply historic energy and basic information such as building square footage, occupancy, year built, etc. This process could substantially reduce the initial analytical costs by a factor of 50. [139]

The DeltaMeter® and X-View Framework has evaluated over 7000 different buildings of multiple types with strong results. In an independent 3rd party review of the meter by Quantum Energy Services and Technology (QuEST) for compliance with the International Performance Measurement and Verification Protocol (IPMVP) they found that the DeltaMeter® "not only meets the requirements for adherence to IPMVP, but it is even more rigorous, includes more features, and is a clearer, more prescriptive process than has been commonly implemented previously. This enhanced process is sufficiently robust to meet the requirements to be part of a utility's energy supply portfolio and to provide building operators an improved basis for performance."[140] And "Indeed the output from this enhanced M&V process as a virtual meter, and refer to savings estimated by the virtual meter as efficiency generation (EG)."[141]

5.5 HOW DEEP IN ENERGY EFFICIENCY CAN MEETS GO?

MEETS allows a building owner to go much deeper in energy savings than conventional energy efficiency investments today. This is mainly because conventional energy efficiency and associated capital financing only accesses a small bit of the energy savings potential because of the split incentive barrier (with current tenants and building owner and with current and future building owners)– except in institutional buildings. If you can access it all, you have a lot more value to play with.

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[138] Harmon, Rob, "Dynamic Baseline Meters, Funcational and Regulatory Specification."

[139] Reichmuth and Egnor, "X-View™: The Reichmuth Framework II."

[140] Ibid.

[141] Egnor,Terry, "DeltaMeter® Validation and Testing Summary."

The cash flow for a MEETS model is the PPA payment for metered energy efficiency and also demand savings. The utility pays the Energy Tenant a steady stream of payments over the life of the PPA. It is in all parties' best interest to complete a deep energy retrofit from the start. Typically building owners implement individual energy efficiency measures one at a time with a 3-5-year investment horizon, but this does not allow a building owner to "tunnel through the cost barrier" which as you will see allows you to get deeper energy savings (typically >50%) for lower cost. Also, in the MEETS model, you would have to renegotiate a PPA for every project which also forces a new baseline to be set. Although doing a deep energy retrofit is more difficult in terms of upfront planning and resources, it will bring to scale energy efficiency at the lowest possible costs and greatest benefits to all parties.

5.5.1 Tunneling through the Cost Barrier

This phrase, attributed to Amory Lovins of Rocky Mountain Institute, describes the following concept. "Whole-system engineering – optimizing an entire system for multiple benefits, not isolated components for single benefits – can often "tunnel through the cost barrier." As a result, very large, even order of-magnitude, savings can cost less than small or no savings, by capturing the interactive effects between components."[142]

The old design approach of technical systems and in fact energy efficiency programs is to look at the single benefits from an individual or isolated components vs a whole-system approach. With this approach, in traditional economic thinking, you would assume that for each increment more of energy savings you would pay a higher marginal cost as illustrated in the figure below.

Figure 17 Old Design Mentality [143]

With this piecemeal design mentality and the fact that the expected payback for a commercial building retrofit project is 3.5 years based on energy costs savings alone[144], deep building retrofits are very difficult to push forward.

Using a whole-system or integrated design approach, you are able to achieve much greater savings at a lower cost. Integrative design is a highly collaborative and iterative design process that promotes resource efficiency. It employs whole-systems thinking to derive multiple benefits from single expenditures, often economically justifying much larger resource savings than is typically achieved.[145] This allows one to "tunnel through the cost barrier" achieving greater energy savings at significantly less cost.

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[142] Lovins, Amory and Sheikh, Imran, "Save More Pay Less."

[143] Ibid.

[144] Bendewald, Michael, Miller, Douglas, and Muldavin, Scott, "HOW TO CALCULATE AND PRESENT DEEP RETROFIT VALUE A GUIDE FOR INVESTORS."

[145] Ibid.

Figure 18 Illustration of what it means to tunnel through the Cost Barrier. [146]

One must first start with the building envelope to reduce the need for cooling, heating and lighting and then decide if you can eliminate some, redesign and/or retrofit the large systems. [147] Deep energy retrofits should always touch the building envelope. Envelope technology has significantly improved since the 1990s so any building before that time should be retrofitted (walls, roof, windows, etc.).   This in turn can minimize or completely eliminate the need for heating and cooling. [148]   This impact can be seen in the figure below from a California Energy Commission Pier Building Program.

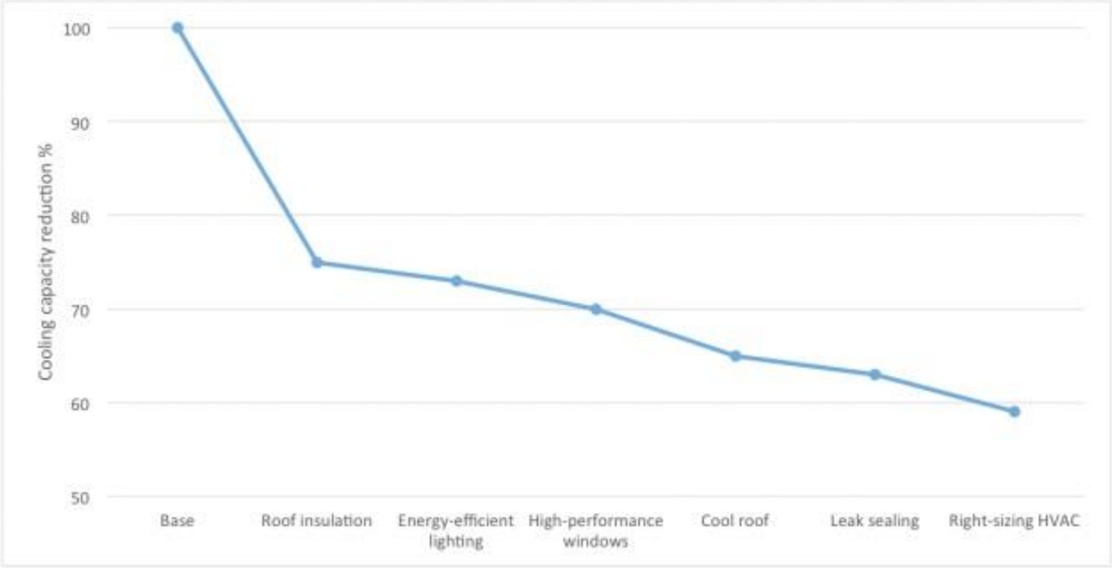

Figure 19 Impact of integrated design. Source: Integrated Building Design (EDR 2006) based on California Energy Commission Pier Building Program. [149]

A classic example of a successful Integrated Design project is the retrofit on the Empire State Building where a >38% energy savings was achieved with minimal incremental costs.   This case study shows that by spending the time upfront to do more detailed whole-system planning they were able to achieve significantly more energy savings than traditional retrofits and at a very minimal incremental cost. In order to achieve this the building envelope and lighting was addressed such that winter heat loss was cut by two-thirds and summer heat gain by half, the advanced glazing along with improved

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[146] Lovins, Amory and Sheikh, Imran, "Save More Pay Less."

[147] Harrington,Eric and Carmichael,Cara, "Retrofit, An RMI Initiative Project Case Study: Empire State Building."

[148] Ibid.

[149] Kwatra,Sameer and Essig,Chiara, "The Promise and Potential of Comprehensive Commercial Building Retrofit Programs."

lighting and office equipment cuts the building's peak cooling load by one-third such that the old chiller plant could be retrofitted as opposed to upgraded and enlarged. The costs and savings are shown in the figure below. [150]

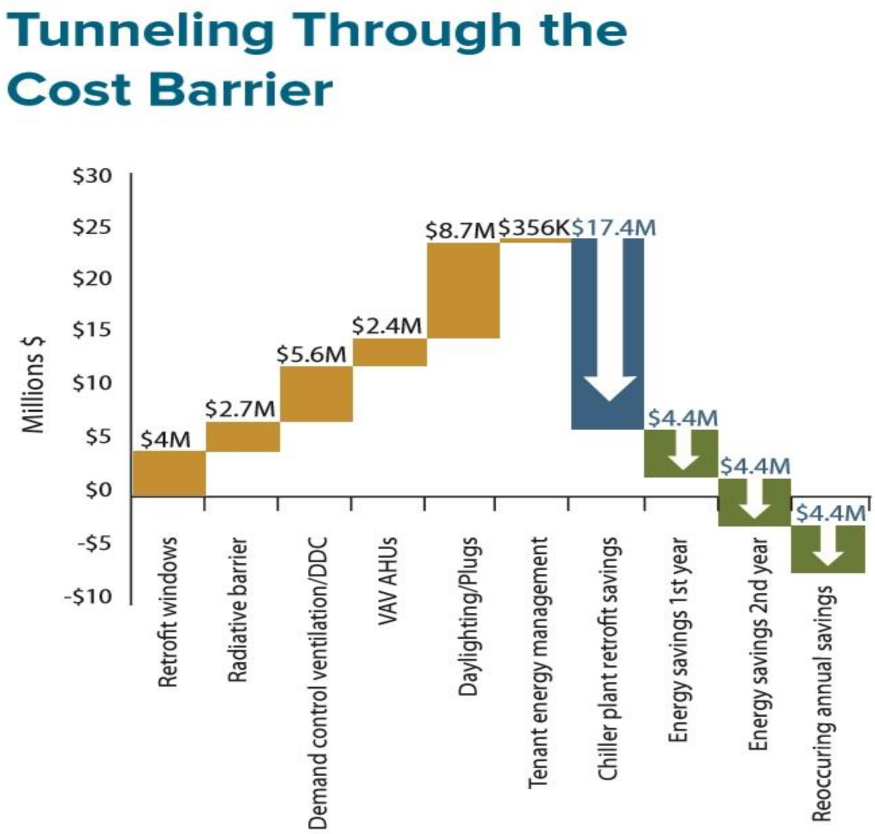

Figure 20 Empire State Building Energy Retrofit illustration of Tunneling through the Cost Barrier. [151]

5.5.2 MEETS Cash Flow

In a MEETS model the cash flow to the Energy Tenant comes from metered energy savings paid out based on the terms of a PPA. The PPA payment in a MEETS transaction is retail tariff of energy plus the value of whole building energy efficiency incentives. Energy efficiency incentives may be different for different utilities but $.025/kWh is a conservative average. Typical time period for a PPA will be 20 to 30 years. In these examples only the value of energy efficiency savings is included but demand savings can and should also be part of the PPA and therefore even higher cash flows can be expected.

5.5.3 Utility Incentive Structure

From this actual example at Bullitt Center in Seattle, WA, shown in table 6 below, you can see that a MEETS model can finance a much deeper energy efficiency retrofit than with the typical utility incentive structure that pays for deemed savings upfront. In addition, the MEETS model has no cost to the utility or rate-payers but in fact provides a positive benefit of $33,000 over the 20 year PPA. The traditional utility incentive structure costs the rate payers $84,000 all in year one and is based on deemed savings. Please note that MEETS works both for electricity and natural gas efficiency. In the case of the Bullitt Center they are an all-electric building so only electricity rates are included in these numbers below.

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[150] Harrington,Eric and Carmichael,Cara, "Retrofit, An RMI Initiative Project Case Study: Empire State Building."

[151] Ibid.

Table 6 ***Cash Flows to Utility and Investor with MEETS vs an Incentive Structure based on Bullitt Center*** *(20 year PPA at $0.841 per kWh saved, 2% escalator on PPA ($0.0591/kWh only) & 4.5% retail rate escalator.)* [152]

50,000 square foot Bullitt Center with retail energy price of 5.91 cents/kWh

	Traditional Incentive Structure	**MEETS**
Total Utility Payments for Saved Energy	$ 84,000 (incentive)	$ 1.22 million (PPA)
Total Utility Collections for Saved Energy	$ 0	$ 1.25 million
Utility / Ratepayer Cost or (Benefit)	$ 84,000	($ 33,000)
NPV Dollar Value of Payments for Saved Energy To Investor (5% WACC)	$ 84,000	$ 740,000
$NPV per Square Foot	$ 1.68	$ 14.80
Utility Payment per kWh	2.5 cents (deemed and paid upfront)	8.41 cents with escalator, as delivered for 20 years

In a similar transaction with higher electricity rates the benefits of MEETs to both the investor and the utility/rate payer is even more significant as seen in the Table below.

Table 7 ***Cash Flows to Utility and Investor with MEETS model vs an Incentive Structure****, (20 year PPA at $0.175 payment per kWh saved with a 2% escalator on PPA ($0.15/kWh only) and 4.5% retail rate escalator, 5% WACC.)* [153]

50,000 square foot Bullitt Center with retail energy price of 15 cents/kWh

	Traditional Incentive Structure	**MEETS**
Total Utility Payments for Saved Energy	$ 84,000 (incentive)	$ 2.6 million (PPA)
Total Utility Collections for Saved Energy	$ 0	$ 3 million
Utility / Ratepayer Cost or (Benefit)	$ 84,000	($ 353,000)
NPV Dollar Value of Payments for Saved Energy to Investor (5% WACC)	$ 84,000	$ 1.6 million
$NPV per Square Foot	$ 1.68	$ 31.60
Utility Payment per kWh	2.5 cents (deemed and paid upfront)	17.5 cents with escalator, as delivered for 20 years

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[152] Ibid.

[153] Ibid.

5.5.4 Deep Energy Retrofit Case Studies

This next section will look at the MEETS model sensitivity to different project variables using the following case studies;

1. Commercial Office, CA with 80,000 sf of space, energy savings of 70% equaling 14.2 KWh/sf (152 kWh/m^2) or 48.4 KBTU/sf (520.8 KBTU/m^2), Marginal or Incremental Capital cost $1,371,200. [154]
2. Empire State Building, NY with 2,700,000 sf of space, energy savings of 38% equaling 8.21 kWh/sf (88.3 kWh/m^2) or 28 KBTU/sf (301.3 KBTU/ $m^{2)}$, marginal or incremental capital cost of $13,200,000. [155]
3. Retail Building #1, Florida, 43,000 sf of space, energy savings of 72% equaling 7.6 kWh/sf (82.6 KWh/$m^{2)}$ or 26 KBTU/sf (279.8 KBTU/m^2), marginal or incremental capital cost of $301,000.[156]
4. Retail Building #2, Nevada, 98,000 sf of space, energy savings of 44% equaling 7.7 kWh/sf (83.5 kWh/m^2) or 26.4 KBTU/sf (284 KBTU/m^2), marginal or incremental capital cost of $490,000.[157]
5. Retail Building #3, New York, 52,000 sf of space, energy savings of 10.77 kWh/sf (116 kWh/m^2) or 36.7 KBTU/sf (395 KBTU/m^2), marginal or incremental capital cost of $1,092,000 [158]

Note that in Case Study #1 Commercial office building, the development and transaction costs of approximately 21% are included in marginal capital cost. It is assumed that development and transaction costs are included in the marginal capital costs provided in the RMI case studies but that is not clearly stated. The project overhead costs of 21% are expected to go down significantly as more deep energy retrofits and MEETS transactions are completed. [159]

Assumptions that are used for the following sensitivity analysis are as follows;

1. It is assumed that the buildings are all-electric for simplicity of the analysis and for the fact that the amount of savings from natural gas vs electricity is not clearly spelled out in the case studies.
2. A conservative incentive rate for electricity savings of $0.025/kWh saved will be used. This is calculated by using the 1st year incentive ($.30/kWh) as the NPV of the overall incentives over the life of the PPA contract.
3. An annual escalation rate for the PPA is 2%. This is used in the pilot in Seattle and is realistic for future MEETS projects in Seattle because the average annual escalation rate for electricity is forecasted to be 4.5%. This scenario allows a utility to earn a positive return on investment over the 20 year PPA. This escalation rate is a variable dependent on the utility.
4. An annual escalation rate of 1% is applied to Operating Costs or OPEX.
5. These are my own calculations based on case studies outlined.
6. Methodology used for financial analysis is outlined in section 2.3.

5.5.4.1 Variation in Retail Rate of Electricity

The NPV of a MEETS cash flow is very sensitive to the retail rate of electricity and natural gas as well as the efficiency incentive that is paid. You will be able to finance much deeper energy retrofits in regions where retail electricity rates are at the national average $0.1059 [160] or above. Retail rates for electricity vary significantly from region to region and also between Investor Owned Utilities (IOU) and Customer Owned Utilities (COU). Natural gas also has variations in retail prices however not as significant as for electricity. The table 8 below shows typical commercial rates and incentives for specific utilities. These rates are averages and will vary depending on the customer total and time of day usage.

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[154] Campbell, Bill, “Redirecting Existing At-Scale Cash Flows to Support Low-Carbon Energy.”

[155] Rocky Mountain Institute, “Case Studies.”

[156] Ibid.

[157] Ibid.

[158] Ibid.

[159] Campbell, Bill, Head of Sustainability, Structuring and Compliance, Equilibrium Capital.

[160] “Electric Power Monthly.”

Table 8 Average rates and 1st year efficiency incentives for electricity and natural gas across different utilities [161]

	Pacific Gas and Electric (CA)	ConEdison (NY)	Southern California Edison (CA)	Seattle City Light (WA)
Average Commercial Electricity Price (kWh)	$0.19	$0.193	$0.18	$0.072
Average Electric Efficiency Incentive (first year kWh)	$0.30	$0.13	$0.30	$.30
Efficiency incentive per kWh (20 year)	$.035	$.015	$.035	$.035
Average Commercial Gas Price (therm)	$.70	$1.22	$.71	$.71
Average Gas Incentive (first year therm)	$1.00	$2.00	$1.00	$1.00
Efficiency incentive per therm (20 yrs)	$0.12	$.24	$0.12	$0.12

Table 9 shows the NPV of the cash flow for the case studies detailed in section 5.6.4 above using retail electricity rates that you would find in Seattle at $.072/kWh and incentives of $.025/kWh. In table below only 2 of the case studies have a positive NPV Cash flow.

Table 9 This is a 20 year PPA at $0.097 / KWh using 10% WACC (retail electricity rate of $0.072/kWh and incentive of $.025/kWh). This is the average commercial electricity rate for Seattle City Light. All other inputs such as marginal capital costs and reduction in energy use can be found listed in section 5.6.4. Own Comparison.

What Can MEETS Finance?					
Deep Retrofit Case Studies	**NPV of PPA/sf**	**NPV of Total Costs/sf**	**NPV Opex/sf**	**Marginal Capex/sf**	**NPV Cash Flow/sf**
Commercial Office, CA	$13.41	$19.19	$2.05	$17.14	($5.78)
RMI Empire State Building	$7.76	$6.13	$1.24	$4.89	$1.63
RMI Retail 1	$7.18	$8.65	$1.65	$7.00	($1.47)
RMI Retail 2	$7.31	$6.39	$1.39	$5.00	$0.91
RMI Retail 3	$9.97	$11.84	$1.84	$10.00	($1.88)
Input Variables					
PPA kWh: yrs, $/kWh, Escalator	20	$0.0970	2%		
PPA KW: yrs, $/kW, Escalator	20	$0.0000	2%		
O&M: $/sf, Escalator	$0.050	1%			
EnergyTenant: % of PPA	10%				
Meter Costs $/yr	$2,400.00				
Discount Rate	10%				

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[161] Campbell, Bill, Head of Sustainability, Structuring and Compliance, Equilibrium Capital.

Table 10 below shows the results when you change the retail electricity rate to $0.106 which is the national average.   For all of the case studies only the Commercial Office retrofit is not financeable.

Table 10 This is a 20 year PPA at $0.13 / KWh using 10% WACC (retail electricity rate of $0.106 / kWh and incentive of $.025/kWh).   This is the average electricity rate across the US.   All other inputs such as marginal capital costs and reduction in energy use can be found listed in section 5.6.4. Own Comparison.

What Can MEETS Finance?					
Deep Retrofit Case Studies	**NPV of PPA/sf**	**NPV of Total Costs/sf**	**NPV Opex/sf**	**Marginal Capex/sf**	**NPV Cash Flow/sf**
Commercial Office, CA	$18.10	$19.66	$2.52	$17.14	($1.56)
RMI Empire State Building	$10.47	$6.40	$1.51	$4.89	$4.07
RMI Retail 1	$9.69	$8.90	$1.90	$7.00	$0.79
RMI Retail 2	$9.86	$6.65	$1.65	$5.00	$3.21
RMI Retail 3	$13.45	$12.19	$2.19	$10.00	$1.26
Input Variables					
PPA kWh: yrs, $/kWh, Escalator	20	$0.1309	2%		
PPA KW: yrs, $/kW, Escalator	20	$0.0000	2%		
O&M: $/sf, Escalator	$0.050	1%			
EnergyTenant: % of PPA	10.00%				
Meter Costs $/yr	$2,400.00				
Discount Rate	10%				

Table 11 and 12 below the results when you change the retail electricity rates of $0.15 and $0.19/kWh. In both of these scenarios all case studies are financeable under the MEETS model.

Table 11 20 yr PPA rate $0.175/KWh using 10% WACC (retail electricity rate of $0.15 / kWh and incentive of $.025/kWh).   All other inputs such as marginal capital costs and reduction in energy use can be found listed in section 5.6.4.   Own Comparison.

What Can MEETS Finance?					
Deep Retrofit Case Studies	**NPV of PPA/sf**	**NPV of Total Costs/sf**	**NPV Opex/sf**	**Marginal Capex/sf**	**NPV Cash Flow/sf**
Commercial Office, CA	$24.20	$20.27	$3.13	$17.14	$3.93
RMI Empire State Building	$13.99	$6.75	$1.86	$4.89	$7.24
RMI Retail 1	$12.95	$9.23	$2.23	$7.00	$3.73
RMI Retail 2	$13.19	$6.98	$1.98	$5.00	$6.20
RMI Retail 3	$17.98	$12.65	$2.65	$10.00	$5.33
Input Variables					
PPA kWh: yrs, $/kWh, Escalator	20	$0.1750	2%		
PPA KW: yrs, $/kW, Escalator	20	$0.0000	2%		
O&M: $/sf, Escalator	$0.050	1%			
EnergyTenant: % of PPA	10.00%				
Meter Costs $/yr	$2,400.00				
Discount Rate	10%				

Table 12 20 yr PPA rate $0.215/KWh using 10% WACC (retail electricity rate of $0.19 / kWh and incentive of $.025/kWh). This is an average retail electricity rate for ConEdison in New York and PG&E in Northern CA. All other inputs such as marginal capital costs and reduction in energy use can be found listed in section 5.6.4. Own Comparison.

What Can MEETS Finance?					
Deep Retrofit Case Studies	**NPV of PPA/sf**	**NPV of Total Costs/sf**	**NPV Opex/sf**	**Marginal Capex/sf**	**NPV Cash Flow/sf**
Commercial Office, CA	$29.73	$20.82	$3.68	$17.14	$8.91
RMI Empire State Building	$17.19	$7.07	$2.18	$4.89	$10.12
RMI Retail 1	$15.91	$9.52	$2.52	$7.00	$6.39
RMI Retail 2	$16.20	$7.28	$2.28	$5.00	$8.92
RMI Retail 3	$22.09	$13.06	$3.06	$10.00	$9.03
Input Variables					
PPA kWh: yrs, $/kWh, Escalator	20	$0.2150	2%		
PPA KW: yrs, $/kW, Escalator	20	$0.0000	2%		
O&M: $/sf, Escalator	$0.050	1%			
EnergyTenant: % of PPA	10%				
Meter Costs $/yr	$2,400.00				
Discount Rate	10%				

5.5.4.2 Variation in WACC or Discount Rate

Project capital costs WACC should be pre-tax to understand what the Investor has to cover from project cash flow including the taxes that are paid on profits from ROE and interest. Most Investor Owned utilities have a pre-tax WACC of around 10% and they are one possible investor in this model so this is the rate used for the financial analysis in the cases above. [162]

It is possible that an outside investor or building owner may have a lower WACC so it is important to look at how a variation of WACC will impact the NPV of Cash flow. In the Table below you can see that if you adjust the discount rate from 10% to 7% and 5% for the Commercial office building case study using the retail rate for electricity of $0.15 /kWh this can have a significant impact on the NPV of cash flow.

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[162] Ibid.

Table 13 Varying the WACC or Discount Rate between the base-case of 10% down to 5% has a significant impact on the NPV. Marginal Capital Costs of $1,371,200 and energy savings of 14.2 kWh/sf is applied (see section 5.6.4). *Own Comparison.*

What Can MEETS Finance?					
Deep Retrofit Case Studies	**NPV of PPA/sf**	**NPV of Total Costs/sf**	**NPV Opex/sf**	**Marginal Capex/sf**	**NPV Cash Flow/sf**
Commercial Office, CA #1	$24.20	$20.27	$3.13	$17.14	$3.93
Commercial Office, CA #2	$24.20	$19.06	$1.92	$17.14	$9.53
Commercial Office, CA #3	$24.20	$17.85	$0.71	$17.14	$14.61
Input Variables					
PPA kWh: yrs, $/kWh, Escalator	20	$0.1750	2%		
PPA KW: yrs, $/kW, Escalator	20	$0.0000	2%		
O&M: $/sf, Escalator	$0.050	1%			
EnergyTenant: % of PPA	10%				
Meter Costs $/yr	$2,400.00				
Discount Rate	#1 - 10%	#2 - 7%	#3 - 5%		

5.5.4.3 Variation in Energy Savings

The depth of energy savings is dependent on the energy use index (EUI) of the building prior to the retrofit and the potential for cost effective energy savings of the building. The EUI (KBTU/sf/yr) of a building is dependent on the climate region in which the building resides in, the year it was built (building codes, building materials and techniques improved significantly since the 1980s) and the overall quality of the construction. Energy Savings opportunities are also dependent on the climate in which the building resides. Cost effective energy savings are best determined, as previously discussed, in an Integrated Design process.

The depth of energy savings will impact the amount of cash flow derived from a PPA as does the retail rate for electricity and the efficiency rate. But marginal capital costs are impacted by how deep you go in energy savings and therefore it is unrealistic to look at this one variable in isolation. We can see how this variable directly correlates to the level of sensitivity to the NPV of cash flow under the conditions of changing electricity rates. This can be shown in Table 14 below.

5.5.4.3.1 Variations across Climate Regions

The case studies used in this analysis are buildings that reside in many different climate zones. Ideally you would adjust the building's EUI and energy savings based on the climate zone to compare apples to apples but this can get very complex and not enough information was provided. It is important however to be aware of these variations.

In a study conducted by Green Building Services[163] it was found that in the commercial building sector the following EUI adjustment percentage factors were required. You will see that the space heating is one of the biggest energy use requirements.
Portland, OR = 1 (medium space heating, little space cooling)
Phoenix, AZ = 1.02 (high space cooling, no space heating)
Chicago, IL = 1.33 (high space heating, medium space cooling)
Atlanta, GA = 1.08 (medium space heating and cooling)

In addition, there are different ECMs for different climate regions. For example, Low-e coated glazing/solar film on the windows is appropriate for regions with medium to high cooling loads and HVAC heating efficiency retrofits for those regions with medium to large heating loads.

5.5.4.4 Variation of Marginal Capital Costs

What we need to use for analyzing NPV in a MEETS financing model is the marginal or incremental capital costs. This is the gross capital costs minus the savings that can you achieve with timing your

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[163] "Operating Energy Use Methodology for Quantifying the Value of Building Reuse."

project together with another capital project minus savings from using integrated design which enables you to “tunnel through the cost barrier”. The marginal cost will have a significant impact on the financeability of a project and is negotiable with the building owner. If the building owner is the energy tenant than this is not an issue.

The marginal capital costs as well as the gross capital costs vary greatly from project to project and are often not well documented. “RMI and New Buildings Institute recent case studies estimate gross capital cost is $67 / sq foot. Journal of Sustainable Real Estate for energy related equipment estimates $10-$75/sq foot and U.S. Department of Energy’s Advanced Energy Retrofit Guides, the gross capital cost for the deep retrofit of a 200,000 square foot prototypical office building is between $4 and $5 per square foot and the soft cost of a deep energy retrofit in general can total as much as $0.50 per square foot.” [164]

If you look at our case studies above, the marginal capital costs range from $5.00 to $17.14 / sf. There can be many factors that impact this number including different building construction and starting EUI, different accounting and documentation methods and timing of the retrofits in relation to other large capital projects. As more Deep Retrofits and MEETS projects get completed a better picture of the marginal capital cost will be formed as well as learning that will result in reduction in the development and transaction costs.

Taking the commercial building retrofit example at the $.15 / kWh retail rate and varying the marginal capital cost you can see the MEETS model is very sensitive to this.

Table 14 Varying the Marginal Capital Cost between the base case of $17.14 down to $5.00 / SF has a significant impact on the NPV. Own Comparison.

What Can MEETS Finance?					
Deep Retrofit Case Studies	**NPV of PPA/sf**	**NPV of Total Costs/sf**	**NPV Opex/sf**	**Marginal Capex/sf**	**NPV Cash Flow/sf**
Commercial Office, CA #1	$24.20	$20.27	$3.13	$17.14	$3.93
Commercial Office, CA #2	$24.20	$14.13	$3.13	$11.00	$10.07
Commercial Office, CA #3	$24.20	$8.13	$3.13	$5.00	$16.07
Input Variables					
PPA kWh: yrs, $/kWh, Escalator	20	$0.1750	2%	$0.1750	2%
PPA KW: yrs, $/kW, Escalator	20	$0.0000	2%	$0.0000	2%
O&M: $/sf, Escalator	$0.050	1%			
EnergyTenant: % of PPA	10%				
Meter Costs $/yr	$2,400.00				
Discount Rate	10%				

5.5.5 Variation in Energy Tenancy Rate

This is a variable rate and possible can be negotiated along with the marginal capital cost with the building owner. If the building owner is the Energy Tenant than the tenancy rate is 0%. NPV of cash flow is sensitive to this variable as well.

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[164] Bendewald, Michael, Miller, Douglas, and Muldavin, Scott, “HOW TO CALCULATE AND PRESENT DEEP RETROFIT VALUE A GUIDE FOR INVESTORS.”

Table 15 Using the Commercial Office example at $.15/kWh and varying the energy tenancy rate from 10% of PPA to 0% of PPA you can see the impact on the NPV Case Flow. Own Comparison.

What Can MEETS Finance?					
Deep Retrofit Case Studies	**NPV of PPA/sf**	**NPV of Total Costs/sf**	**NPV Opex/sf**	**Marginal Capex/sf**	**NPV Cash Flow/sf**
Commercial Office, CA #1	$24.20	$20.27	$3.13	$17.14	$3.93
Commercial Office, CA #2	$24.20	$19.06	$1.92	$17.14	$5.14
Commercial Office, CA #3	$24.20	$17.85	$0.71	$17.14	$6.35
Input Variables					
PPA kWh: yrs, $/kWh, Escalator	20	$0.1750	2%		
PPA KW: yrs, $/kW, Escalator	20	$0.0000	2%		
O&M: $/sf, Escalator	$0.050	1%			
EnergyTenant: % of PPA	#1, 10%	#2, 5%	#3, 0%		
Meter Costs $/yr	$2,400.00				
Discount Rate	10%				

5.5.6 Variation in length of PPA

The length of a PPA will be typically between 20 to 30 years and the length of the contract will have obvious impacts on the NPV Cash Flow as seen in Table below.

Table 16 Using the Commercial Office example at $.15/kWh and varying the length of the PPA from 20 years to 30 years you can see the impact on the NPV Cash Flow. Own Comparison.

What Can MEETS Finance?					
Deep Retrofit Case Studies	**NPV of PPA/sf**	**NPV of Total Costs/sf**	**NPV Opex/sf**	**Marginal Capex/sf**	**NPV Cash Flow/sf**
Commercial Office, CA #1	$24.20	$20.27	$3.13	$17.14	$3.93
Commercial Office, CA #2	$26.36	$20.54	$3.40	$17.14	$5.82
Commercial Office, CA #3	$27.84	$20.72	$3.58	$17.14	$7.12
Input Variables					
PPA kWh: yrs, $/kWh, Escalator	#1, 20	#2, 25	#3, 30	$0.1750	2%
PPA KW: yrs, $/kW, Escalator	#1, 20	#2, 25	#3, 30	$0.0000	2%
O&M: $/sf, Escalator	$0.050	1%			
EnergyTenant: % of PPA	10%				
Meter Costs $/yr	$2,400.00				
Discount Rate	10%				

5.5.7 Summary of MEETS Model to Variations in Project Variables

Below in Table 17 is a summary, using the Commercial Office Building case study, showing the sensitivity of the MEETS model NPV Cash flow to the key project variables. Based on own calculations the NPV Cash flow is calculated for the lowest project variable and the highest project variable to come up with the change (Δ) NPV Cash Flow. The absolute value of Δ NPV / Δ variable shows a rate of change or how sensitive the NPV Cash flow is to a change in project variable.

The MEETS model shows that it is most sensitive to a change in the WACC or Discount Rate and the retail rate of electricity. Since the retail rate of electricity is the most variable parameter across the US this will be further analyzed.

Table 17 Sensitivity of NPV Cash flow to a change in different project variables for Commercial Office Building Case Study. The project variable is subtracted to come up with the Δ variable. Own Comparison.

Commercial Office Building Project Variables	**Δ Variable**	**Δ NPV Cash Flow**	**Δ Cash Flow / Δ Variable**
Retail Electricity Rate ($.0720 to $.19/kWh)	-0.12	-14.69	124.49
WACC or Discount Rate (10% to 5%)	0.05	-10.68	213.60
Marginal Capital Costs ($17.4 to $5 / SF)	12.40	-12.14	0.98
Energy Tenancy Rate (10% to 0%)	10.00	-2.42	0.24
Length of PPA (20 to 30 yrs)	10.00	3.19	0.32

It is important to note that the level of sensitivity the NPV Cash Flow has to the changing retail rate of electricity is a function of the energy savings per square foot. In Table 18 below you can see that the higher the energy savings per square foot the more sensitive the NPV of cash flow is to the retail electricity rate. In this analysis, where marginal capital costs were not adjusted for change in energy savings levels, there is a direct correlation. This makes sense because both variables, energy savings and retail electricity rate, impact the PPA cash flow.

Table 18 *Sensitivity of NPV of Cash flow in relation to Change of retails rate of electricity is a function of the total reduction in energy use per square foot. Own Comparison.*

Project Variable: Retail rate for electricity vary from $.0720 to $.19 kWh	**Δ Variable**	**Δ NPV Cash Flow**	**Δ Cash Flow / Δ Variable**	**Kwh/sf energy savings**
Commercial Office	-0.12	-14.69	124.49	14.2
Empire State Building	-0.12	-8.49	71.95	8.21
Retail 1	-0.12	-7.86	66.61	7.6
Retail 2	-0.12	-8.01	67.88	7.7
Retail 3	-0.12	-10.91	92.46	10.77

5.5.8 Capital Cash Flows

Many of the project variables in a MEETS transaction will be different from building to building and the development and transaction costs will go down over time as more deep energy retrofits and MEETS transactions are completed. Therefore, a key factor to consider is how much additional financing the MEETS transaction can provide vs traditional capital financing given the same set of project variables.

The following graph compares capital cash flows that are available in a MEETS transaction (green line) compared to conventionally available financing (blue line). The red line represents first costs for an energy retrofit based on depth of savings. The first costs include capital costs, development (A&E) and transaction costs (lawyers and finance fees). Conventionally available capital assumes 5.5-year payback time. With conventional financing you cannot afford much beyond 20% in energy savings. The blue line would not exist in a building where tenants pay the energy bill. Also note that you can see on the red curve that if you go beyond 60% depth savings you can “tunnel through the cost barrier” whereby achieving 70% depth at a lower capital cost than 60% depth.

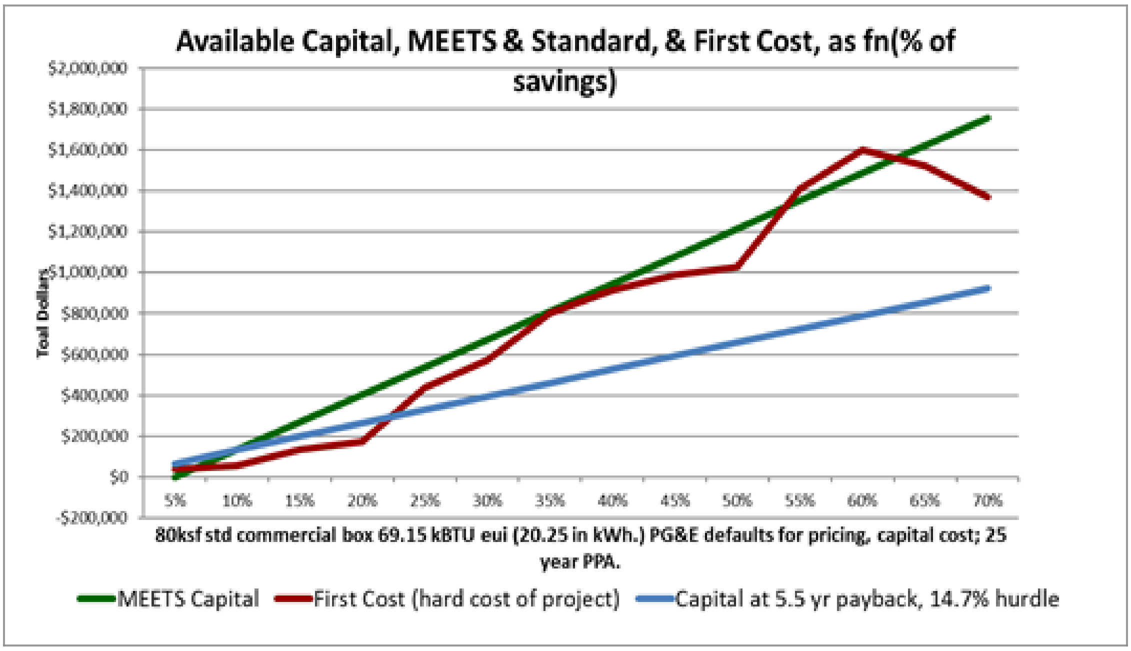

Figure 21 Red Curve: Initial project cost to do the work to save each incremental kWh (70% depth is saving 14 kWh/sf annually). Blue Curve: How much capital can you free up for up-front cost, using today's transaction structure (5.5-year simple payback, 14.7% hurdle rate). Green Curve: How much capital you can afford to invest for up-front costs, using the MEETS structure. This factors in a 25 year PPA price ($.19 / KWh retail rate plus $.030 first year electric incentives), 10% rent and all operating costs associated with running a MEETS structured power plant. [165]

5.6 SUMMARY OF KEY BENEFITS MEETS OFFERS TO DIFFERENT PLAYERS

	Risks (R), Hurdles (H) and Benefits (B)	MEETS Model	Comments
Utility / Regulators: In this model the utility can play their typical role or if regulations allow they can be the EnergyTenant and/or the investor.			
R	Utilities get the EE they pay for?	Yes	Because EE is metered, to utility grade standards, and paid for based on actual performance through the life of the PPA.
R	Cost Effectiveness of acquiring EE improved?	Significantly	EE in a MEETS model provides a net positive revenue to utilities. No incentive $ are required.
R	Utility Program Admin Costs reduced?a	Significantly	EE is metered and incentives are paid out at the same rate on a whole-building basis.
R	Rate-payer Incentive funded?	No	Self-financed through an energy efficiency PPA
R	Declining retail revenues contributing to Utility Death Spiral?	No	Utilities maintain unit sales and revenues in this model.
H	Do current regulations support model?	Seattle (pilot), California (new Regs)	Utilities must be allowed to bill the customer the same rate for energy saved as energy consumed. They must also accept metered EE based on a Dynamic Baseline Meter utilizing IPMVP Option D framework. Seattle City Light has approved this for the pilot and California's new regulations support this concept.
H	Is technology available?	Yes	Dynamic Baseline Meter

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[165] Campbell, Bill, "Redirecting Existing At-Scale Cash Flows to Support Low-Carbon Energy."

H	Are baselines set at historical use?	Historic Baseline advised (flexible)	The MEETS model doesn't dictate this but it is in all parties' best interest to use historic baselines. Utilities keep all unit sales and revenues and building owner gets higher MEETS PPA cash flow.
B	Ability to use EE as a grid management tool	Yes	EE, measured to utility grade standards, is a reliable, location-specific, at-scale load resource. Utilities can plan and manage EE as a substitute for local capacity. EE's load shape is highly valuable because it delivers negawatts to the grid precisely where demand is the highest.
B	Meet EE and GHG mandates	Improved	MEETS allows utilities to meet EE and GHG emission targets without a risk to their financial stability and therefore without the risk of rate increases.
B	Opportunity to invest for regulated rate of return	Yes	If utility acts as the Investor in this model and if regulations allow.
B	Improve alignment between regulatory participants?	Yes	EE can be acquired at scale without financial risk to utilities and rate-payers.
Investor – The investor can be either a 3rd party bank or investment company or the utility. This model offers a long-term stable green investment vehicle.			
H	Eliminate Split Incentives	Yes	All Energy Savings are captured and passed through to Energy Tenant in the form of a PPA.
R	Are there Stable / predictable/ low risk cash flows	Yes	EE is metered for the life of the PPA and Energy Tenant has incentive to maximize the EE. Investors and Banks view loans again PPAs as low risk because utilities are investment-grade institutions.
R	Are there Long Term stable Cash Flows	Yes	20-30 year PPAs
R	Is there an incentive to maximize EE generation over life of measure?	Yes	Energy Tenant is paid based on EE performance over the life of the PPA.
R	Are there well understood standard contracts	Yes	PPA, a typical contract used for supply side resources, is used.
B	Long term, stable, good yield, green investment vehicles	Yes	Meets the pent-up demand in the investment community.
Building Owner: A building owner can play their typical role or they can act as the Energy Tenant and/or investor which allows them to capture all of the PPA cash flow and minimize negotiations on marginal capital costs.			
H	Eliminate Split Incentives	Yes	The single biggest barrier to EE investments in non-owner occupied commercial offices.
H	Eliminate Attribution Issue	Yes	MEETS does not define the baselines used but it is in all parties best interest to use baselines based on historic energy use.
H	Eliminate lack of expertise, time, and interest in EE	Yes	Energy Tenant has the responsibility, technical know-how, and strong incentive to maximize EE acquisition.
B	Improves ability to leverage capital for EE	Yes	Stable cash flow from long term PPA contract that is based on metered results with aligned incentives to maximize the return through the life of the contract.
B	Increases Net Operating Income	Yes	Energy Tenancy rental rate, increase rent based on a more comfortable, productive building, lower O&M.

B	Increase Building Value at point of sale	Yes	Yes, especially for deep energy retrofits.
B	Comfortable, healthy, efficient building	Yes	Yes, especially for deep energy retrofits.
B	Can Leverage Green Benefits	Yes	Yes, especially for deep energy retrofits.
Tenant			
B	Comfortable, healthy, efficient building	yes	Yes, especially for deep energy retrofits at the same utility rate.
B	Can Leverage Green Benefits	Yes	Yes, especially for deep energy retrofits
Rate Payers / Society			
R	Cost Effectiveness of acquiring EE improved?	Significantly	No reliance on utility incentive $. Net Positive revenue to utility.
R	Rate-payer funded?	No	No rate-payer money required. No reliance on utility incentive
R	Risk of Utility rate increased?	No	Utility does not lose unit sales and revenues in this model and has the opportunity to invest for regulated rate of return.
R	Financial stability of Utilities at risk?	No	Utility does not lose unit sales and revenues in this model and has the opportunity to invest for regulated rate of return.
B	Greening of energy supply	Yes	All EE has zero GHG emissions but in this model rate-payers are not at risk to rate increases.
Energy Services Companies			
R	Existing well-Trained employee base	Medium	Deep Energy Retrofits are not widely implemented but they are increasing as is the workforce involved. Will need to scale and train additional workforce to meet needs.
B	Increase Business Opportunities	Yes	Large number of new deep retrofit projects. And new long-term operational-services relationship opportunities with building owners and Energy Tenants.
B	Allows for innovative solutions	Yes	Payment for EE is based on performance at the whole-building level. How you achieve it is not regulated or dictated which leaves room for innovative solutions.

5.7 POTENTIAL ISSUES WITH MEETS MODEL

Entering into a 20 to 30-year agreement with a commercial building owner is always difficult. Especially institutional investors who are concerned about anything that might be an encumbrance upon sale of the asset. MEETS is new and therefore Institutional investors will be cautious. You can do a short-term MEETS with a 2 to 5-year payback such as lighting retrofit or retro commission, which would give an ET time to establish a relationship with the building owner. However then when you do the next project the building baseline will be reset, thereby reducing the overall cash flow to the project. You can consider an ET with a long term relationship to the building such as the utility. This is a model that can work but the utility will mostly likely act as the investor and hire a contractor to do the energy tenancy or management work.

Deep Energy Retrofits, to be done well, require an Integrated Design Process that involves participation by many parties including the building owner. If the building owner is not the Energy Tenant (ET) then the ET will facilitate this process but it requires the building owner’s participation. Normally deep energy retrofits don’t get done unless the building is in need of a major retrofit and/or a major piece of equipment is at the end of life. There will be a negotiation on what the energy tenant finances and what the building owner will pay for and what measures actually get done. Typically, the building owner would pay for normal improvements and the ET would pay for capital improvements and equipment that goes beyond code. In addition, the building owner may want to install nicer components (i.e. window trim) that don't impact energy savings. In this case most likely the building owner will pay for this. The time requirements of the building owner during the Integrated Design Process and negotiations involved in a deep energy retrofit might be barriers to successful completion of the project.

To scale deep energy retrofits requires a more streamlined and standardized analytical process. This is one of the key goals of the Rocky Mountain's Commercial Energy+ program and the New Buildings Institute. In addition, EnergyRM has modeling tools called X-View which has the potential to reduce "the initial analytical costs by a factor of 50." The X-View software tools interconnect the building modeling tools with the building operating tools and provide the baseline for the DeltaMeter to measure and verify energy efficiency performance and adjust the baseline as required. [166]
Another potential issue is who is responsible for equipment maintenance. Since the building owner legally owns the equipment it is expected that the building owner is responsible for maintenance but it is in the Energy Tenant's best interest to fix the equipment as quickly as possible and assure everything is running efficiently. What is expected in the MEETS model is that basic maintenance be covered by the building owner and escalated O&M and monitoring of building systems controls will be taken care of by the Energy Tenant.

In this model there is potential for conflict between the building tenants and the ET. If a building tenant increases their plug load significantly or never shuts off their equipment, lights, etc. this will cause less energy efficiency to be realized. Tenants will get billed more for energy used but less for energy saved and so they may not see a difference in their bills. But the ET will see a decrease in their PPA payment because an increase in plug loads is not energy savings and baselines will be adjusted. There needs to be some incentive for the building tenant to realize benefits from energy savings. It would be wise to institute some kind of "Green Lease" as is instituted in the Bullitt Center, which would give tenants an energy budget and also incentives to reduce their energy use.

Lastly there are relatively few deep energy retrofits that have been completed. They are gaining ground in this segment such as in Chicago (RMI Energy+) [167]and the ICP retrofits[168] but effort will need to put into training a workforce that can conduct and scale deep energy retrofits.

5.8 COMPLIMENTARY COMMERCIAL ENERGY RETROFIT PROGRAMS

MEETS breaks down many of the traditional barriers that prevent deep energy retrofits of Commercial buildings. But as of today, deep energy retrofits are complex, require good planning and education. To facilitate this many non-profit energy efficiency programs can complement and support a MEETS transaction such as the RMI Energy+, Investor Confidence Project, New Buildings Institute, etc.

5.8.1 Rocky Mountain Institute (RMI) Commercial Energy+ Program

This program, offered by RMI is focused on scaling deep energy retrofits in the commercial building sector. RMI has a goal to "reduce energy use by 20 percent across more than a billion square feet of commercial building space saving 9.2 million metric tons of CO2."[169] RMI recognizes the need and market potential for deep energy retrofits in the commercial sector. Their program intends to move from individual building custom solutions to "a package of configurable, ready-to-deploy efficiency measures and technologies that can be procured and deployed at scale to make buildings immediately smarter, more energy efficient, and more interactive with the electricity grid."[170]
RMI Commercial Energy+ and MEETS are complimentary.

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[166] Youngson, "The X---View Framework™."
[167] Calhoun, Koben, "Commercial Energy +, An Optimized Approach to Efficient, Intelligent and Productive Buildings."
[168] "Investor Confidence Project, Project Profile."
[169] Calhoun, Koben, "Commercial Energy +, An Optimized Approach to Efficient, Intelligent and Productive Buildings."
[170] Ibid.

5.8.2 Investor Confidence Project

The Investor Confidence Project is a project of the Environmental Defense fund and is intended to make energy efficiency more attractive to investors. This is achieved by defining "a clear road-map from retrofit opportunity to reliable Investor Ready Energy Efficiency™" through "a suite of Commercial and Multifamily Energy Performance Protocols".[171] The hope is that transaction costs will be reduced through the utilization of consistent and transparent standards and practices.
The Investor Confidence Project started in the USA and was brought to Europe with a goal to solve the following issue; "The lack of standardization in the development and documentation of energy efficiency projects is the major barrier to increasing the flow of investment into energy efficiency". [172]
The ICP protocols call out specific M&V procedures to be conducted based on IPMVP option C protocols. For the large projects non-routine adjustments are recommended when "unexpected changes" [173] happen in a building. M&V is done manually and on a yearly basis over the life of the investment which takes time and adds complexity. ICP does not have a solution to the split incentives problem which then attracts mainly owner occupied buildings with >20-year investment horizon.

MEETS projects do not require the use of ICP standard performance protocols but they can benefit from them. ICP investors would benefit from having energy savings automatically measured, to industry grade standards and protocols and throughout the life of the contract. In addition, ICP projects could be more attractive to commercial building owners who have tenants in a MEETS transaction structure.

5.8.3 New Buildings Institute

A non-profit entity that was founded in 1997 involved in "assesses technologies, promotes design approaches, and helps guide policies and programs that will significantly improve the energy efficiency of commercial buildings."[174] NBI works with all the players in the commercial building market to break down the barriers to acquiring energy efficiency. NBI and MEETS are complimentary.

5.9 COMPARISON OF MEETS MODEL TO OTHER TRANSACTION STRUCTURES TO FINANCE EE

There are other transaction structures available today to finance energy efficiency. Some have been in existence for some time (ESCOs) and others are fairly new and only available in certain States/Counties (PACE). They all have made a big contribution to pushing forward more energy efficiency projects but they do have limitations. In a study recently published by California Berkley / UCLA Law, an outcome from a workshop with multiple experienced energy efficiency professionals, a comparison was made between different transactional structures for financing energy efficiency and what barriers these different transaction structures addressed. (See table 19). This table shows that MEETS breaks down significantly more barriers than the other transaction structures.

This comparison is made between the following transaction structures:

1. Credit Enhancement and Debt-Financing
    - On-Bill Financing (OBF) /On-Bill Repayment (OBR) - loan programs that utilize the customer's utility bill as the repayment mechanism. OBF involves investor-owned utility originating the loan (from ratepayer funds), while OBR involves a loan from a third-party lender that the customer repays via the utility bill.[175]
    - PACE – assist owners in financing renewable or energy efficiency projects via a private-public funding partnership. This financing covers 100 percent of the project's upfront cost and is recovered via an assessed property tax over the course of 20 years. PACE is available only in counties or districts where local governments have authorized the tax collection recovery program.[176]

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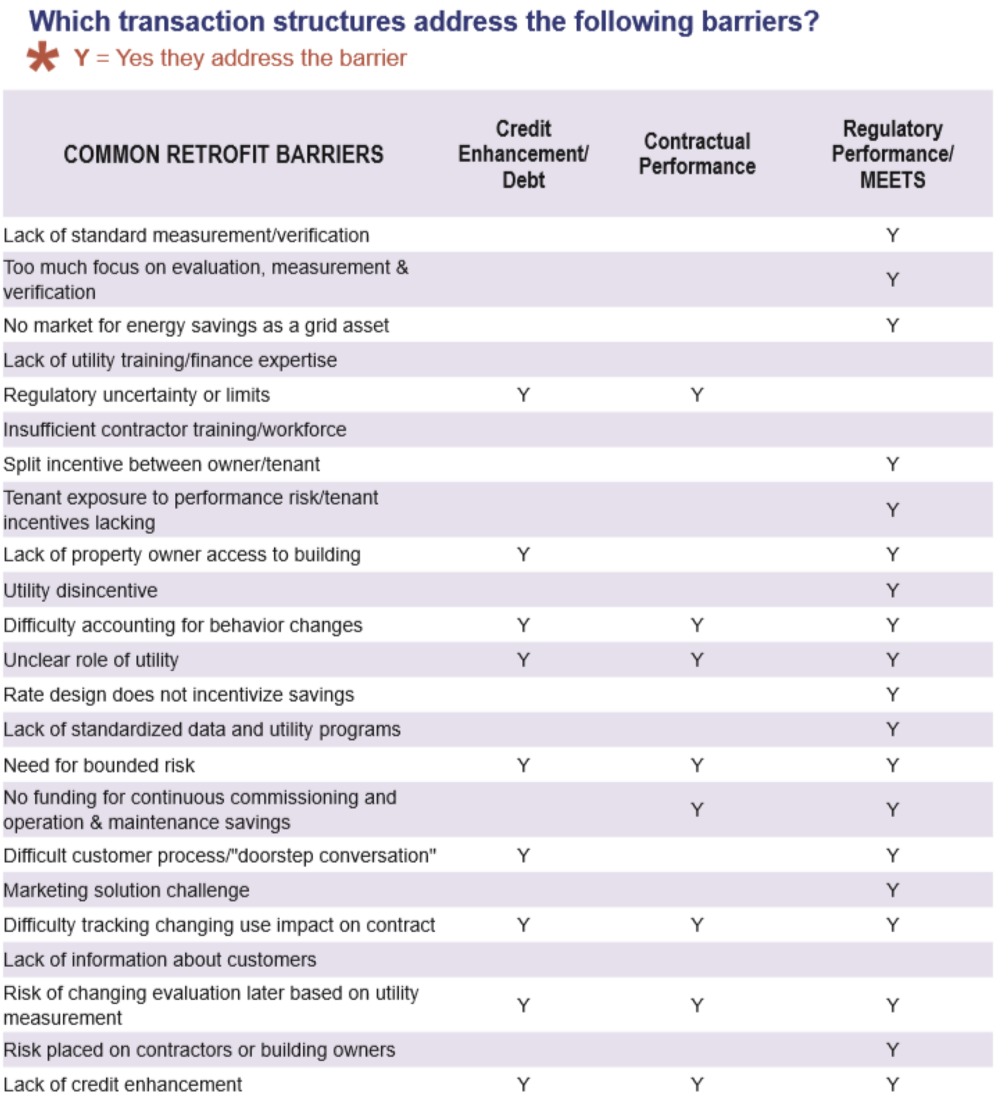
[171] "Investor Confidence Project Protocols."
[172] Fawkes, Steven Dr., "The Investor Confidence Project."
[173] "Investor Confidence Project Protocols."
[174] "New Buildings Institute (NBI)."
[175] Elkind, Ethan N., "Powering the Savings."
[176] Ibid.

2. Contractual Performance-Based Financing
   "This model involves third parties paying for the retrofits and then sharing in the "profits" (energy savings) with the building owners or tenants. The third parties, typically contractors, guarantee the savings. Prominent examples include ESCOs, ESA and MESA."[177]
3. Metered/Regulatory Performance-Based Financing
   MEETS is in this category and the only example today.

Table 19 A Table comparing different transaction structures and what barriers they address. [178]



Which transaction structures address the following barriers?

✱ Y = Yes they address the barrier

COMMON RETROFIT BARRIERS	Credit Enhancement/ Debt	Contractual Performance	Regulatory Performance/ MEETS
Lack of standard measurement/verification			Y
Too much focus on evaluation, measurement & verification			Y
No market for energy savings as a grid asset			Y
Lack of utility training/finance expertise			
Regulatory uncertainty or limits	Y	Y	
Insufficient contractor training/workforce			
Split incentive between owner/tenant			Y
Tenant exposure to performance risk/tenant incentives lacking			Y
Lack of property owner access to building	Y		Y
Utility disincentive			Y
Difficulty accounting for behavior changes	Y	Y	Y
Unclear role of utility	Y	Y	Y
Rate design does not incentivize savings			Y
Lack of standardized data and utility programs			Y
Need for bounded risk	Y	Y	Y
No funding for continuous commissioning and operation & maintenance savings		Y	Y
Difficult customer process/"doorstep conversation"	Y		Y
Marketing solution challenge			Y
Difficulty tracking changing use impact on contract	Y	Y	Y
Lack of information about customers			
Risk of changing evaluation later based on utility measurement	Y	Y	Y
Risk placed on contractors or building owners			Y
Lack of credit enhancement	Y	Y	Y

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[177] Ibid.
[178] Ibid.

6 CALIFORNIA PAY-FOR-PERFORMANCE RESIDENTIAL MODEL

6.1 HIGH LEVEL OVERVIEW

California's largest utility, Pacific Gas and Electric (PG&E) is launching a pilot residential Pay-For-Performance (P4P) program in September of 2016. This "program seeks to develop a scalable model for residential retrofits that leverages rapidly emerging market actors and products while minimizing administrative and implementation costs."[179]

This program is in response to bold mandates in California's "50/50/50" plan which aims to double building efficiency by 2030.[180] In addition it is enabled by new legislation driving new utility regulations such as CA SB350 which puts in place "pay for performance programs" and "Incentive payments that shall be based on measured results."[181] And is in alignment with Assembly Bill (AB) 802 which moves the state towards meter-based energy efficiency and counting efficiency starting from a building baseline rather than energy code.[182] Matt Golden, a thought leader for this program sums up the benefits of this new P4P Residential energy efficiency model "Moving beyond the current model of top-down program and towards markets that measure and value energy efficiency as a tradable resource rather than as a rebate coupon is a paradigm shift."[183]

6.2 HOW RESIDENTIAL P4P WORK

The program works as follows. An Aggregator signs a Power Savings Agreement (PSA) with PG&E to acquire energy savings from a specific group of residential homes (2-year PSA in pilot, maximum time is still to be determined in the future). The aggregator, either directly or through contractors, implements ECMs in the homes. There are no requirements for what type of ECMs must be implemented. Energy Savings are measured at a portfolio or aggregator level against a 1-year historic pre-retrofit baseline. The aggregator receives a payment from PG&E for weather normalized energy savings that are calculated and reported through CalTRACK (Open EE meter). It is important to understand that in this model the building owner realizes the energy savings. A 3rd party aggregator might get the building owner to sign over their savings in exchange for better service, rates, etc. but this would be a separate shared savings contract which would be between the residential customer and the aggregator.

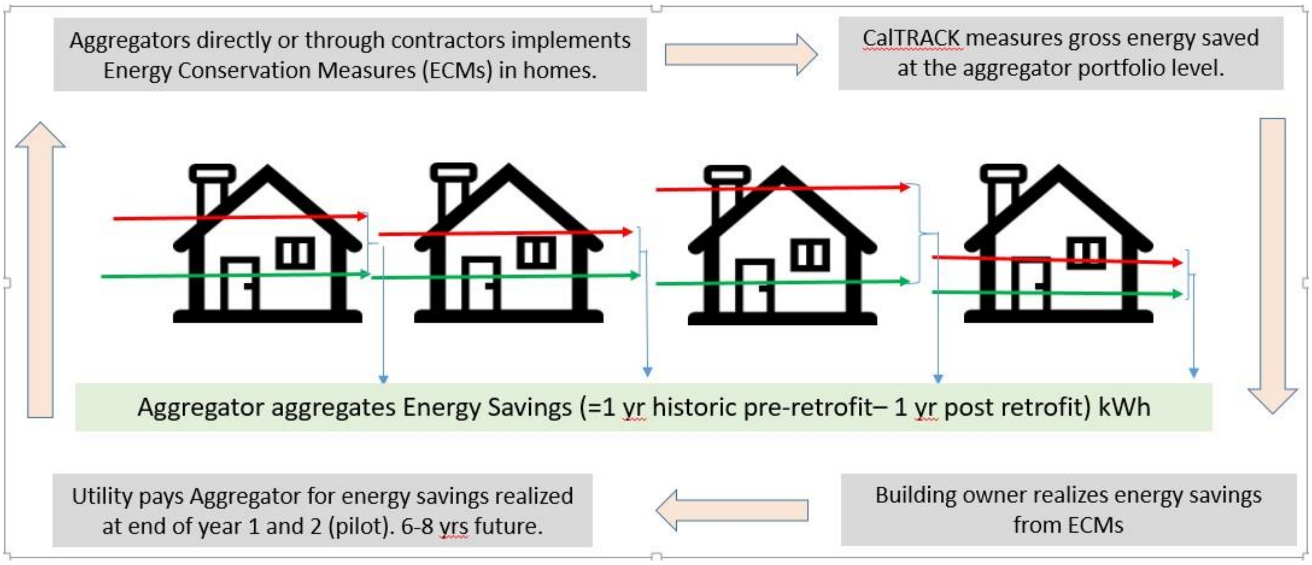

Figure 22 Overview of the PFP Residential Pilot flow. Own Diagram.

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[179] Jacobson, Erik, Director Regulatory Relations, "Submission of High Opportunity Projects and Programs (HOPPs) Proposal - Residential Pay-for-Performance Program."

[180] Golden, Matt, "California's Latest Legislation Is a Paradigm Shift for Energy Efficiency."

[181] Ibid.

[182] Ibid.

[183] Golden, Matt, "From Programs to Markets: How to Make Efficiency a Valuable Real-Time Resource." Greentech Media. 2015."

“The Program Goals and Objectives are:

1. Allow aggregators to determine the mix of interventions that is most attractive to customers and can lead to significant energy savings beyond what is currently available in residential offerings.
2. Establish a scalable model for the residential energy efficiency market by incentivizing privately financed market actors (aggregators) to deliver measureable energy savings.
3. Determine whether this platform can increase residential energy savings at less cost to ratepayers compared to current residential energy efficiency programs.
4. Demonstrate how a simpler, more transparent method to determine savings using weather normalized meter consumption data is more effective at enticing privately financed market actors to participate in rate payer funded programs and achieve greater energy savings.
5. Monetize energy savings from residential buildings and build a foundation for a model that can successfully transition to grid-tied procurement in order to effectively respond to demand side procurement needs in the future.”[184]

6.2.1 Demand Capacity and Demand Response

Energy Efficiency, especially if measured and is incentivized for location, time of use, quantity and duration can become an important demand side management tool. This is what is referred to as Demand Capacity which is a "permanent shift in load shape with a time and location component”[185] Demand capacity is measured on a portfolio level with an Advanced Metering interval (AMI) which is still being developed therefore not used in this pilot. Demand Response on the other hand is dispatchable and must have the ability to increase or shed a specified load from the grid within a contracted amount of time and duration.

6.3 PLAYERS IN THE RESIDENTIAL P4P MODEL

The key players in this model are residential building owners, utilities, investors and a new player called “Aggregator”. Third party contractors may also be involved depending on the energy efficiency measure that is implemented.

The Aggregator is contracted by the utility (PG&E in this case) to aggregate energy savings over a portfolio of homes, reported through CalTRACK. They are paid an Energy Efficiency Incentive (EEI) for delivered performance through a Performance Savings Agreement (PSA). Residential customers will need to sign over the right to the EEI and access to their energy data in order for their home to be included in this program. There will be multiple different types of aggregators in this system but it is expected that existing market actors such as PACE Financiers, Smart Thermostat and HAN companies will be prominent and in the first pilot phase. The Aggregator will also be looking for energy efficiency projects that enables them to not only participate in the Energy Efficiency program but also the Demand Response program. Being able to monetize both cash flows with the same resource will make this a very attractive business model.

For most energy retrofits the residential building owner will be expected to finance the energy efficiency measure. This will be discussed in more detail in section 6.5. If the customer does not pay cash, one of the more likely funding sources will be PACE financing. As mentioned it is anticipated that PACE financiers will be one of the key Aggregators in the pilot and future programs.

6.4 CALTRACK ENERGY EFFICIENCY METER

At the heart of this model is the energy efficiency meter called CalTRACK. CalTRACK is based on the Open EE meter which uses 12-month historic energy data to generate a building’s baseline using IPMVP Option C Regression analysis. This is a statistical / static model and therefore the building’s baselines cannot be dynamically adjusted for routine or non-routine changes. Energy Efficiency

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[184] Jacobson, Erik, Director Regulatory Relations, “Submission of High Opportunity Projects and Programs (HOPPs) Proposal - Residential Pay-for-Performance Program.”

[185] Golden, Matt, Environmental Defense Fund Senior Energy Finance Consultant and Investor Confidence Project, Project Lead, June 15, 2016.

Incentives are paid on a yearly basis based on weather normalized energy efficiency results at the aggregator level. Non-routine changes are expected to be washed out in statistics at an aggregated level. Baselines are expected to be valid for 2 years (pilot) and might increase but that is still to be determined. This time frame is dependent on how long baselines on portfolios of homes can remain stable without adjustment.

The CalTRACK system will access smart meter data via the PG&E Share My Data platform which is based on the Green Button Standard. [186] The Green Button Standard was an industry-wide development effort to come up with a secure, easy and standard data transfer protocol from Smart Meters directly to customers and 3rd parties. "Green Button is based on the Energy Services Provider Interface (ESPI) data standard released by the North American Energy Standards Board (NAESB) in the fall of 2011. The ESPI standard consists of two components: 1) a common XML format for energy usage information and 2) a data exchange protocol which allows for the automatic transfer of data from a utility to a third party based on customer authorization. [187]"

CalTRACK will provide ongoing feedback on gross savings, realization rates and other performance metrics. Gross Savings are calculated by subtracting 1-year post-retrofit energy use from 1-year pre-retrofit energy use. These gross savings are automatically weather normalized using standard methods for fitting energy use to heating/cooling degree days on a yearly basis. [188] Realization rates are a fraction of the predicted savings that are realized and are calculated by dividing the gross metered savings by the predicted savings.

In this model energy savings are aggregated over a large number of retrofits to statistically increase the confidence level in the results. Predicted savings on a single residential home retrofit are not very accurate and therefore has a low confidence level. And as previously mentioned occupancy and other non-routine changes are expected to get washed out statistically on an aggregate level. If you aggregate these savings over a larger number of projects statistically the confidence level goes up. CalTRACK will only report realization rates after 30 projects are completed and energy savings incentives are paid based on the aggregated gross savings. Aggregating this data over several projects statistically reduces the uncertainty of the cash flow thereby making energy efficiency more financeable.

In the residential market it is not cost effective or realistic to adjust baselines for non-routine behavior on each home as is done in the MEETS model. When baselines are not adjusted it is estimated that baselines will be valid for 2 years (pilot) and maybe increased in the future if they are deemed to be stable without adjustments for non-routine changes for a longer period of time.

The key inputs required by the EE meter Energy Usage Data (pre-retrofit >12 months and post-retrofit (ongoing)), weather data, project data which includes estimated energy savings. The outputs as mentioned are gross energy savings, realization rates and other performance factors. Gross savings at a portfolio level is how aggregators are paid and is the cash flow by which capital financing is based. Gross savings are also used by the utility in their energy resource planning. The realization rates are useful to provide feedback to aggregators and contractors to improve their savings analysis methodology and tools.

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[186] Jacobson, Erik, Director Regulatory Relations, "Submission of High Opportunity Projects and Programs (HOPPs) Proposal - Residential Pay-for-Performance Program."
[187] Department of Energy, "Green Button."
[188] "CalTrack."

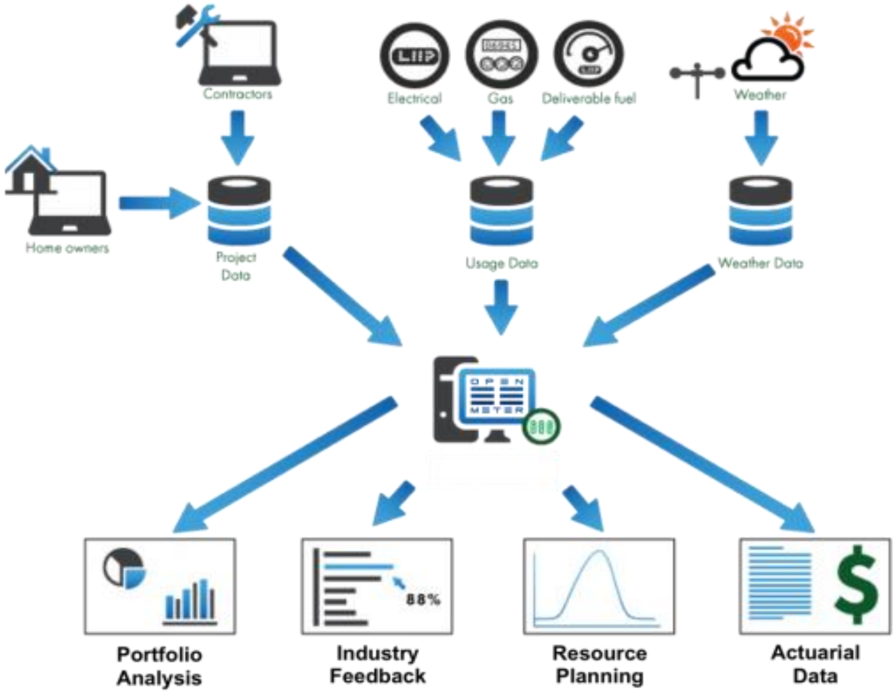

Figure 23 CalTRACK Meter, based on OpenEE meter inputs and outputs. [189]

6.5 DEPTH IN ENERGY EFFICIENCY POTENTIAL

In this model the Aggregator monetizes only the energy efficiency incentive (EEI). The customer keeps their own bill savings. For the pilot the EEI is $.80 / KWh and $1.80 per therm per year for 2 years paid on gross savings.[190] These incentives are paid on gross energy savings on a whole building basis including operational and behavioral measures. For the pilot project the following targets are identified;

- Total number of residential retrofits 4200
- Average Savings per home per year is provided in the Submission of High Opportunity Projects and Programs Proposal[191]. Average savings estimates per home is targeted at 6% per year for electricity (460kWh) and 16% per year for natural gas (90 therms).

In Table 20 below the yearly Customer Energy savings (CES) and NPV of Energy Efficiency Incentive (EEI) is calculated based on the estimated average savings per home in this PG&E pilot. This will be called the Average CA Pilot home. The following assumptions are used:

- The CES is calculated based on the estimated annual energy savings and the cost of energy at $0.19/kWh and $0.70 / therm (average as documented in section 5.6.5). It is assumed that this is constant yearly without an escalation rate applied.
- For EEI assume a payment each year for 2 years of $.80 / KWh and $1.80 per therm
- WACC of 10% is applied

In this program the customer owns their energy savings and therefore it is assumed that they will finance the energy efficiency project. As stated in section 2.3.2.1, on average a residential building owner expects a 2.5-year simple payback on energy efficiency projects. If a 2.5-year simple payback is applied in this Average CA Pilot case than capital costs can be no more than $376 (2.5 yrs.*$150). The expectation is that PACE financing will increase this expected payback time for this program enabling deeper energy retrofits to be completed.

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[189] Ibid.

[190] Jacobson, Erik, Director Regulatory Relations, “Submission of High Opportunity Projects and Programs (HOPPs) Proposal - Residential Pay-for-Performance Program.”

[191] Ibid.

Table 20 Yearly Customer Energy Savings to the NPV of Energy Efficiency Incentive. These numbers are based on data from a PG&E document [192] *and average utility rates from section 5.6.5. Own Comparison.*

What Can CA Residential P4P Pilot Finance?					
	Customer			**Aggregator**	**Building**
Residential Case Studies	**Yearly Customer Energy Savings (CES)**	**Capital Costs**	**Simple Payback (YRs)**	**NPV Energy Efficiency Incentive (EEI)**	**Energy Savings %**
#1. Average CA Pilot	$150	Not Provided		$920	6% electric, 16% Gas
Input Variables					
EEI Electricity: yrs, $/kWh, Escalator	2	$0.8000	0%		
EEI Natural Gas; yrs, $/therm, Escalator	2	$1.8000	0%		
Utility Rate kWh	$0.19				
Utility Rate Therm	$0.70				
Pre-Retrofit Energy Use (baseline) kWh yr	7667				
Pre-Retrofit Energy Use (baseline) therm	563				
WACC	10%				

Aggregators can acquire energy savings in different ways. They can get deep savings from a smaller set of homes or they can get shallow savings from a larger set of homes or something in between. This model does not dictate what the ECMs that must be installed but will pay for delivered gross savings on a whole building basis. The type of ECM's PG&E expects to be installed are "primarily retrofits such as heating, ventilation and air conditioning (HVAC) and insulation, also includes behavioral and operational measures."[193] In the following section we will look at different case studies which will include capital costs and energy savings to ultimately draw conclusions on depth of energy savings that are possible in this model.

6.5.1 Case Studies

To illustrate the potential depth of savings that can be realized in Residential P4P program the following case studies will be used. The Capital Costs from Whole-Home Retrofits are difficult to average because there are significant variations between residential homes, different measures installed based on the homeowner's priorities and new developments such as Smart Thermostats that provide significant energy savings for a very low capital cost. Incentives to indicate how much an Aggregator can invest in metering, customer acquisition, etc. to get a positive return on their investment.

1. Average CA Pilot: Average yearly energy savings of 460 KWh (6%) and 90 therms (16%) per section 6.5 above. Based on these numbers it is calculated that the average energy use per pre-retrofit home is 7886 kWh, 563 therms. These numbers will be used as baselines for the following case studies. The average estimated Capital Cost was not provided.
2. Smart Thermostat (NEST) with electric heat pump with yearly savings of 12% of total heating and cooling use and $250 capital cost. These numbers are based on studies done by Energy Trust of Oregon [194] and in a White Paper published by NEST[195]. Total energy use for heating and cooling in CA on average is 31%. [196]
3. Home Energy Automation (HAN) Systems yearly savings 590 kWh (7.7%) and 43 therms (7.7%). $100 capital cost. [197] [198]
4. Basic Whole Home Retrofit including roof insulation, lighting, furnace, air leakage seal, smart thermostat. The data was taken from Appendix A in a RMI document on a new utility model for Fort Collins CO (see figure below).[199] Please note that climate zones are different between Fort Collins and PG&E territory and therefore there will be differences in energy savings and

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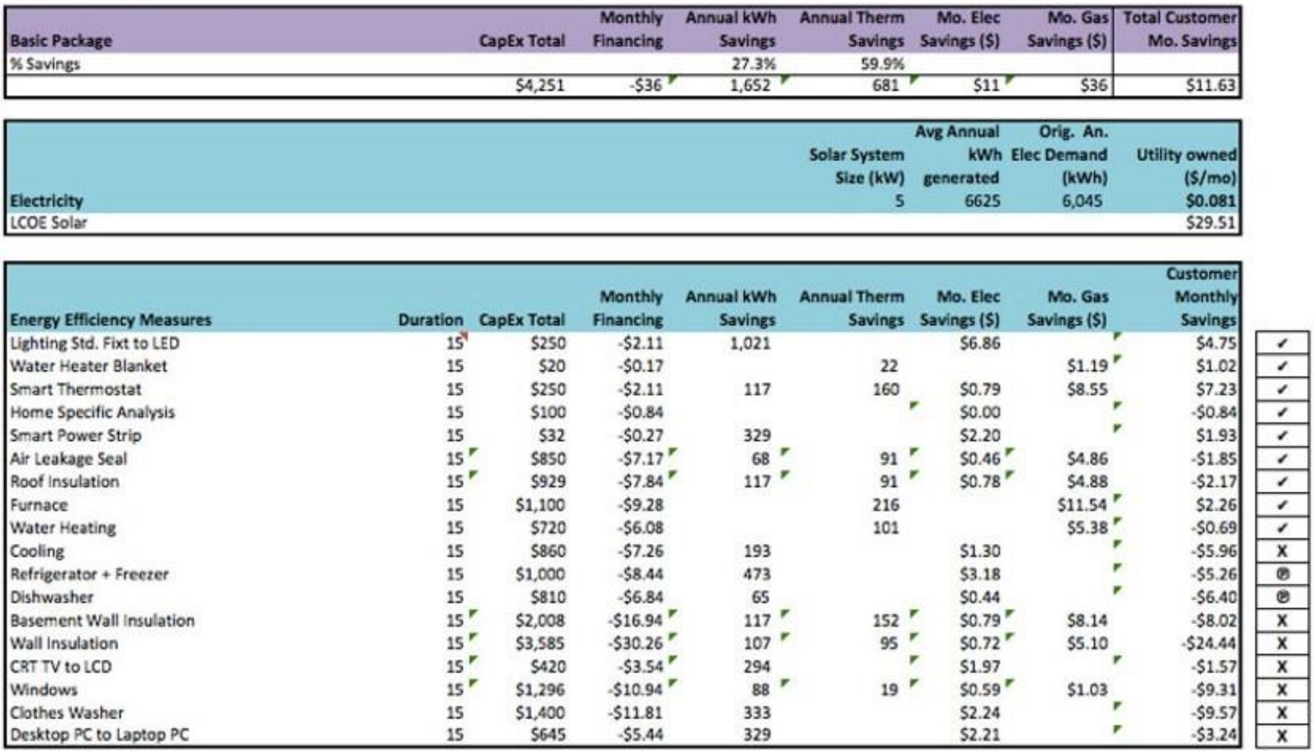
[192] Ibid.
[193] Ibid.
[194] Sam Walker, Senior Project Manager - Commercial, Energy Trust of Oregon.
[195] "Energy Savings from the Nest Learning Thermostat: Energy Bill Analysis Results."
[196] "Household Energy Use in California."
[197] St. John, "How Energy Disaggregation Can Inspire Efficiency."
[198] St. John, "California Expands the Smart Meter to Home Area Network Market."
[199] Campbell, Martha; Lawrence, Duncan; Mandel, Jamie; Newcomb, James; Wanless, Eric; Wetzel, Dan, "Integrated Utility Services: A New Business Model for Fort Collins Utilities."

types of measures installed. The capital costs for the furnace has been adjusted to reflect an average cost in California of $4433[200]. In addition, labor costs have been adjusted higher by 20%. Yearly energy savings; 2300 kWh (30%) and 338 therms (60%), total capital cost of $8214.



Basic Package	CapEx Total	Monthly Financing	Annual kWh Savings	Annual Therm Savings	Mo. Elec Savings ($)	Mo. Gas Savings ($)	Total Customer Mo. Savings
% Savings			27.3%	59.9%			
	$4,251	-$36	1,652	681	$11	$36	$11.63

Electricity	Solar System Size (kW)	Avg Annual kWh generated	Orig. An. Elec Demand (kWh)	Utility owned ($/mo)
	5	6625	6,045	$0.081
LCOE Solar				$29.51

Energy Efficiency Measures	Duration	CapEx Total	Monthly Financing	Annual kWh Savings	Annual Therm Savings	Mo. Elec Savings ($)	Mo. Gas Savings ($)	Customer Monthly Savings	
Lighting Std. Fixt to LED	15	$250	-$2.11	1,021		$6.86		$4.75	✓
Water Heater Blanket	15	$20	-$0.17		22		$1.19	$1.02	✓
Smart Thermostat	15	$250	-$2.11	117	160	$0.79	$8.55	$7.23	✓
Home Specific Analysis	15	$100	-$0.84			$0.00		-$0.84	✓
Smart Power Strip	15	$32	-$0.27	329		$2.20		$1.93	✓
Air Leakage Seal	15	$850	-$7.17	68	91	$0.46	$4.86	-$1.85	✓
Roof Insulation	15	$929	-$7.84	117	91	$0.78	$4.88	-$2.17	✓
Furnace	15	$1,100	-$9.28		216		$11.54	$2.26	✓
Water Heating	15	$720	-$6.08		101		$5.38	-$0.69	✓
Cooling	15	$860	-$7.26	193		$1.30		-$5.96	X
Refrigerator + Freezer	15	$1,000	-$8.44	473		$3.18		-$5.26	℗
Dishwasher	15	$810	-$6.84	65		$0.44		-$6.40	℗
Basement Wall Insulation	15	$2,008	-$16.94	117	152	$0.79	$8.14	-$8.02	X
Wall Insulation	15	$3,585	-$30.26	107	95	$0.72	$5.10	-$24.44	X
CRT TV to LCD	15	$420	-$3.54	294		$1.97		-$1.57	X
Windows	15	$1,296	-$10.94	88	19	$0.59	$1.03	-$9.31	X
Clothes Washer	15	$1,400	-$11.81	333		$2.24		-$9.57	X
Desktop PC to Laptop PC	15	$645	-$5.44	329		$2.21		-$3.24	X

Figure 24 A Sample Measures Bill as part of a new Integrated Services Utility Model being implemented by Fort Collins, CO. Documented in a RMI Report in Appendix A. [201]

5. Average Deep Energy Retrofit based on a study by Berkley Lab Scientists of 11 deep energy retrofits completed in Northern California. The variation in capital costs and depth of savings was significant from this report, therefore the average yearly saving of 43% and capital costs of $30,000 was used. [202] The savings split between natural gas and electricity was not provided therefore the ratios of electricity to gas savings from Case Study 1 is used. It is estimated that the overall 43% savings is split at 20% savings from electricity and 54% savings from natural gas.

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[200] “Home Advisor, How Much Does It Cost to Install a Furnace?”

[201] Campbell, Martha; Lawrence, Duncan; Mandel, Jamie; Newcomb, James; Wanless, Eric; Wetzel, Dan, “Integrated Utility Services: A New Business Model for Fort Collins Utilities.”

[202] Chen, “Saving 70 Percent or More of Energy Use in Your Home—Berkeley Lab Scientists Study the Deep Energy Retrofit.”

Table 21 Summary of Customer Simple Payback and NPV of Energy Efficiency Incentive (EEI) for case studies above. EEI for electricity is $.80/kWh saved per year, EEI for Natural Gas is $1.80 / therm saved per year for 2 years. Own Comparison.

What Can CA Residential P4P Pilot Finance?					
	Customer			**Aggregator**	**Building**
Residential Case Studies	**Yearly Customer Energy Savings (CES)**	**Capital Costs**	**Simple Payback (YRs)**	**NPV Energy Efficiency Incentive (EEI)**	**Energy Savings %**
#1. Average CA Pilot	$150	Not Provided		$920	6% electric, 16% Gas
#2. Smart Thermostat (NEST) with electric heat pumps	$291	$250	0.9	$2,130	12% heating/cooling (31% of total)
#3. Home Energy Network (HAN)	$143	$100	0.7	$955	7.7% electric, 7.7% gas
#4. Basic Home Retrofit	$673	$8,214	12.2	$4,249	30% electric, 60% gas
#5. Average Deep Energy Retrofit	$504	$30,000	59.5	$3,079	43% total (estimate 20% electric, 55% gas)
Input Variables					
EEI Electricity: yrs, $/kWh, Escalator	2	$0.8000	0%		
EEI Natural Gas; yrs, $/therm, Escalator	2	$1.8000	0%		
Utility Rate kWh	$0.19				
Utility Rate Therm	$0.70				
Pre-Retrofit Energy Use (baseline) kWh yr	7667				
Pre-Retrofit Energy Use (baseline) therm	563				
WACC	10%				

Smart Thermostats and Home Energy Networks should be the big winners in this home energy efficiency program due to their low capital costs and relatively high energy savings. The customer can achieve a payback on their investments in under 1 year based on the energy savings. These are both measures that achieve energy efficiency through control, operational and behavioral savings. These are documented in Case study 2 and 3 above. Smart Thermostats and Home Area Network (HAN) are experiencing rapid growth in the residential efficiency market. With this P4P Residential program they will be able to aggregate and monetize the efficiency savings incentive. The cost for a Smart Thermostat is ~$250 and therefore under this new model the company may install them for free in exchange for the customer's energy data and access to their energy savings incentive. In a pilot study done by Energy Trust of Oregon a 12% savings in heating was achieved when a NEST thermostat was connected with a heat pump and a 6% savings when connected with gas and electric forced air systems.[203] In other studies, a 15% savings in cooling was achieved as documented in a White Paper published by NEST.[204] The average cost for a HAN is $60-$120[205] and in a recent study of over 850 homes conducted by Bidgley and PG&E customers realized an average of 7.7% savings.[206] In both of these examples one can expect these Aggregators to achieve shallow savings depth across a large number of homes and look to capture both the EEI and Demand Response (DR) cash flows.

In case studies 4 and 5 you can see that the capital costs for a whole-building retrofit varies widely. In case study 4 the measures implemented are ones that achieved the highest energy savings for the lowest capital costs such as a smart thermostat. In case study 5 it was not documented the exact measures implemented but it can be assumed that costlier envelope measures, such as windows, were implemented. Keep in mind that doing these envelope measures can also significantly increase the outward appearance and value of the home so there might be other reasons and benefits to which measures one chooses to complete. But each home is unique and the owners will have different priorities, therefore capital cost for whole-building residential projects will vary significantly.

In case study 4 and 5 the customer will be expected to finance the capital costs but as identified in a study conducted by PG&E, capital associated with the energy efficiency retrofit has been identified as the principal reason homeowners do not complete a The Home Upgrade Program.[207] PACE financing

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[203] Sam Walker, Senior Project Manager - Commercial, Energy Trust of Oregon.

[204] "Energy Savings from the Nest Learning Thermostat: Energy Bill Analysis Results."

[205] St. John, "California Expands the Smart Meter to Home Area Network Market."

[206] St. John, "How Energy Disaggregation Can Inspire Efficiency."

[207] Jacobson, Erik, Director Regulatory Relations, "Submission of High Opportunity Projects and Programs (HOPPs) Proposal - Residential Pay-for-Performance Program."

is expected to be a key aggregator in this model. PACE finances 100% of the project at 8% rate for 20yrs.[208] The PACE loan is attached to the property tax bill as opposed to the individual which means if the customer sells their home, the new owner will acquire the debt repayment. This should increase the payback time required by a residential customer for an energy efficiency investment. PACE programs in California have been much more successful than the utility programs and "have driven over twice the volume and triple the private investments in energy efficiency projects than the Energy Upgrade California® Home Upgrade (Home Upgrade) program during a comparable time period.[209] PACE financiers make their money today from bundling and securitizing their loans but under this new program they will be able to monetize the energy efficiency incentive thereby driving more and persistent energy savings projects. In this program a PACE Aggregator is expected to offer better financing terms to the customer in exchange for signing over their energy data and energy efficiency incentive. With the type of retrofits such as case study 4 and 5 it can be expected that a building owner will achieve medium to deep energy savings.

Another aggregator might be able to monetize all or a portion of the customer energy savings as well as the energy efficiency incentive. The aggregator would in this case be able to finance at least a portion of the retrofit. In this case you could imagine a deeper level of savings can be achieved per home. The aggregator will have to set up a separate contract like a shared savings contract with each residential customer. There is significant overhead associated with this so it remains to be seen if this is a financially feasible model.

6.5.2 Case Studies under Future Scenarios

It is expected that the Power Savings Agreement (PSA) or P4P contracts will go from 2 years (pilot) to a maximum time still to be determined in the future and energy savings or demand capacity will be purchased in a competitive environment. This maximum contract time is critical because this program with the CalTRACK EE meter does not adjust baselines for non-routine changes. If a portfolio of homes goes through renovations, adds loads and/or has occupancy changes, the baselines will no longer be accurate. Since the baselines are not adjusted for non-routine changes, determining this maximum time window will be critical to assure the accuracy of the measured energy efficiency.

The following analysis takes the average energy savings per residential home expected for the California P4P pilot and adjusts the energy efficiency incentive rate and time frame to look at the sensitivity to the cash flows. Note that in MEETS model, PG&E's whole building commercial first year incentive rates of $.30/kWh for electricity and $1.00/therm for natural gas are applied. [210] If demand capacity from the P4P Residential program is in a competitive market with MEETS then we expect the Energy Efficiency Incentives to come down. If you calculate using the average first year incentive rates and discount them over a 6-year window that comes up to $.065 / kWh and $.20/therm. It is unclear how long the Power Savings agreements will be in the future but for modeling purposes a 2, 6 and 8-year time frame with different EEI rates has been evaluated.

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[208] Golden, Matt, Environmental Defense Fund Senior Energy Finance Consultant and Investor Confidence Project, Project Lead, June 15, 2016.

[209] Jacobson, Erik, Director Regulatory Relations, "Submission of High Opportunity Projects and Programs (HOPPs) Proposal - Residential Pay-for-Performance Program."

[210] Campbell, Bill, Head of Sustainability, Structuring and Compliance, Equilibrium Capital.

Table 22 Table showing NPV of EEI under different energy efficiency incentive rates and contract durations. This is using a discount rate of 10%. Own Comparison.

Change in the NPV of EEI with varying time durations and incentives.	
Average CA Pilot	**NPV Energy Efficiency Incentive (EEI)**
EEI; $.80/kWh and $1.80/therm, 2 yrs	$920
EEI; $.80/kWh and $1.80/therm, 6 yrs	$2,309
EEI; $.80/kWh and $1.80/therm, 8 yrs	$2,828
EEI; $.50 kWh and $1.00 therm, 2 yrs	$556
EEI; $.50/kWh and $1.00/therm, 6 yrs	$1,394
EEI; $.50/kWh and $1.00/therm, 8 yrs	$1,708
EEI; $.30/kWh and $.80/therm, 2 yrs	$365
EEI; $.30/kWh and $.80/therm, 6 yrs	$915
EEI; $.30/kWh and $.80/therm, 8 yrs	$1,121
EEI; $.065/kWh and $.20 / therm, 2yrs	$83
EEI; $.065/kWh and $.20 / therm, 6yrs	$209
EEI; $.065/kWh and $.20 / therm, 8yrs	$256

6.6 SUMMARY OF KEY BENEFITS RESIDENTIAL P4P OFFERS TO KEY PLAYERS

	Risks (R), Hurdles (H) and Benefits (B)	**Residential P4P Model**	**Comments**
Utility / Regulators: In this model the utility will play their typical role or if regulations allow they can invest for a regulated rate of return. Utilities will have to move beyond a Cost-of-Service rate base revenue model for this program to scale.			
R	Utilities get the EE they pay for?	Yes but only for the PSA agreement time.	Because EE is measured against a historic baseline and paid for based on actual performance but only for 2 years in pilot and possibly longer in future. Average measure life is 15 years.
R	Cost Effectiveness of acquiring EE improved?	Somewhat	PAC will go from ~50% of total costs to 20%. But energy efficiency incentives are fairly high at least for the pilot.
R	Program Admin Costs reduced?	Somewhat	PAC will go from ~50% of total costs to 20%.
R	Rate-payer Incentives funded?	Yes, for pilot	Pilot is payed for with incentive money. The goal is to move this program into procurement.
R	Declining retail revenues contributing to Utility Death Spiral?	Yes	Utilities lose retail revenue. Must find a new revenue model for future success.
H	Do current regulations support model?	Yes, CA	SB 350 and AB 802.
H	Is technology available to support model?	Yes	CalTRACK with underlying smart meters and standard data transfer protocol through PG&E Share My Data.
H	Are baselines set at historic Use?	Yes	Gross energy savings from historic baselines will be incentivized.
B	Ability to use EE as a grid management	Yes, long term goal	Ultimate goal for utility is to acquire EE as demand capacity to flatten out the duck curve in

	tool		CA's case. Note: Baselines are not adjusted for non-routine changes so increase or decrease in EE may not be accurately reflected over the PSA agreement time.
B	Meet EE and GHG mandates	Improved	Utilities require a new revenue model such as outlined in NY REV.[211]
B	Opportunity to invest for regulated rate of return	Yes	If regulations allow.
B	Improve alignment between regulatory participants?	Improved	Utilities get what they pay for over the course of the PSA assuming no significant non-routine changes. In addition, PACs are reduced but rates will be driven up putting strain on the utilities.
Investor – The investor finances the aggregated Energy Efficiency incentive cash flow.			
H	Eliminate Split Incentives	No	
R	Are there Stable / predictable/ low risk cash flows	Projected Goal	EE is metered for 2 yrs (Pilot) but might increase in the future.
R	Are there Long Term stable Cash Flows	Improved	2 yr (Pilot) Power Savings Agreement (PSA)
R	Is there an incentive to maximize EE generation over life of measure?	Improved	2 yrs (pilot) which is a small percentage of (~15%) typical measure life
R	Are there well understood standard contracts	Yes	The PSA will be a standard agreement. EE measurement is standardized.
B	Long term, stable, good yield, green investment vehicles	Projected Goal	PSA rates will remain stable over the contract term but rates will change after program moves into a competitive procurement environment.
Building Owner: A building owner will in most cases be required to finance the capital because they keep the bill savings.			
H	Eliminate Split Incentives	No	
H	Eliminate Attribution Issue	Yes	EE measured against historic energy use.
H	Eliminate lack of expertise, time, and interest in EE	Potentially	Customer will most likely still be involved.
B	Improves ability to leverage capital for EE	Yes (PACE)	PACE providers will be a key aggregator in this model.
B	Increases Net Operating Income	Yes (only if owner occupied or owner pays utility bills)	Customer owns the energy savings.
B	Increase Building Value at point of sale	Improved	For deep energy retrofits
B	Comfortable, healthy, efficient building	Improved	For medium to deep energy retrofits.

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[211] Bade, "Little Less Talk: With New Revenue Models, New York Starts to Put REV into Action."

B	Can Leverage Green Benefits	N.A.	
Tenant; Most likely this will not be done on a rental home but in some cases the owner may choose to do so.			
B	Comfortable, healthy, efficient building	Improved	For medium to deep energy retrofits.
B	Can Leverage Green Benefits	N.A.	
Rate Payers / Society			
R	Cost Effectiveness of acquiring EE improved?	Somewhat	Improved PAC from 50% to 20% of total program costs. Automated M&V can reduce this further.
R	Rate-payer Incentive funded?	Yes	For pilot with long term plan to move to procurement.
R	Risk of Utility rate increase?	Yes	Utility loses revenue and units sold in this model.
R	Financial stability of Utilities at risk?	Yes	Utility loses revenue and units sold in this model.
B	Greening of energy supply	Yes	All EE has zero GHG emissions
Energy Services Companies			
R	Existing well-Trained employee base	Yes	This workforce is in place but will need to expand as program grows.
B	Increase Business Opportunities	Yes	Expect this program to grow the Residential EE market significantly.
B	Allows for innovative solutions	Yes	ECMs and Business models are not dictated. This leaves room for innovation.

6.7 POTENTIAL ISSUES WITH RESIDENTIAL P4P MODEL

The biggest issue with the P4P Residential model is that, if successful, undermines the economics of the utility and grid because energy efficiency results in lost revenue to the utility. New revenue models, such as the models codified in New York's REV docket, will be required if this program is to be successful. The two new models are "platform-service revenues (PSRs) and Earning Adjustment Mechanisms (EAMs)" which "will help utilities move away from cost-of-service regulation."[212] Under these new models a utility is able to derive revenue from services and earn a regulated rate of return for meeting goals such as energy efficiency.[213]

Medium to deep energy retrofits will be achieved mainly through PACE aggregators because the customer owns the energy savings and therefore will be required to provide the capital. In a consumer financed structure the customer's expectations for simple payback on investments will be approximately 2.5 years but PACE financing should extend this range. In addition, when this program moves to procurement in a competitive environment against energy efficiency from for example a MEETS model, you would expect the EEI to be reduced. If the EEI drops to a rate that is competitive with a MEETS transaction this will significantly reduce the cash flow for the aggregators and therefore business models that reduces customer transaction costs as well as allows for an aggregator to monetize both the EEI and a DR cash flow will be the most successful.

Lastly the full energy efficiency potential of a measure life (average 15 years) may not be realized because the PSA will be limited to 2 years for the pilot and a still to be determined maximum for the future. The reason for this limited time is an unadjusted baseline in the residential sector can only be maintained for a certain period of time. This leads to short term in length distributed energy resources delivered through this program.

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[212] Ibid.
[213] Ibid.

7 CONCLUSIONS

The building sector consumes nearly half of the total energy produced in the United States, including 75% of all electricity and accounts for 45% of all Greenhouse Gas emissions [214] but much of the energy is wasted due to inefficiencies in design and operation. "We can triple or quadruple the efficiency of our building stock by 2050 and the savings are worth 4 times the cost" according to Amory Lovins of Rocky Mountain Institute.[215] In addition "there is a global abundance of private capital"[216] looking for vetted sustainable investments.

Despite these compelling conditions, the economic and technical potential of energy efficiency is much higher than what we are able to capture today. Traditional energy efficiency has been acquired through programs that are centrally managed, rate-payer funded and rely on consumer financing with variable and unverifiable outcomes. This illuminates the need for new models and novel approaches. At the forefront are two new energy efficiency transaction models that show significant promise, MEETS^{TM} and Pacific Gas and Electric Company's (PG&E) P4P Residential Program.

There are variations to these approaches but at the core both models;

1. Pay-For-Performance (PFP) on,
2. all metered (to industry standard protocols) energy efficiency on a,
3. whole-building basis.

Both MEETS and PG&E's Residential P4P Program contain these three core elements with the potential to significantly accelerate the acquisition of energy efficiency. These programs are designed for different market segments with distinct objectives but both programs change the way energy efficiency is measured, acquired and valued. Energy efficiency (EE) will no longer be incentivized through rate-payer funded incentives based on deemed savings, but instead will be procured alongside other energy resources based on measured performance. Energy efficiency acquired in this way will have significant more value to all players in the energy system.

This thesis compares the differences between these models in terms of markets, technical approaches, depth of energy savings, regulatory and contractual requirements, and impacts to the key market players and attempts to answer the following question; Can metered energy efficiency models that PFP based on whole-building savings break down the key hurdles to acquiring the energy efficiency potential in the US building stock?

The content and conclusions draw upon a combination of technical reports from leading energy organizations, interviews with key experts, financial analysis on depth of energy savings potential based on documented case studies and the most recent news articles and blogs from industry.

7.1 ENABLING TECHNOLOGY

Savings from energy efficiency measures are physically the same as energy from a supply side resource at that same location on the grid but, in order to realize this, you must be able to measure energy flows. At the heart of both of these models is an energy efficiency meter which calculates energy savings against a historic baseline. CalTRACK, based on the Open EE Meter, is used in the P4P Residential program and the DeltaMeter® in used in MEETS. The DeltaMeter® is a Dynamic Baseline Meter which uses a thermodynamic model (IPMVP Option D), developed through an inverse process using historic energy bills of a specific building to enable adjustments to the baseline when routine or non-routine changes occur. CalTRACK uses statistical correlations and inverse fit techniques (IPMVP Option C) to equations creating a static baseline based on historic energy bills that can be weather normalized on a yearly basis. Smart meters and standard data transfer protocols are required for the P4P Residential Program and can enhance MEETS but are not required. Each EE meter uses a unique approach to measure energy savings but both have a place in their respective target markets. The

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[214] Architecture 2030 and EIA, "Why the Building Sector."

[215] Sam Champioin, *Amory Lovins of RMI on 23.5 Degrees with Sam Champion - The Weather Channel*.

[216] Poulson, Henry M. Jr, "How to Raise Trillions for Green Investments."

energy efficiency meters provide near real-time access to metered gross savings and a standardized approach to measuring energy efficiency such that all parties calculate the same level of savings.

7.2 Metered Energy Efficiency Transaction Structure (MEETS^{TM})

MEETS is designed to achieve deep energy retrofits at scale in the commercial and multi-family sectors by breaking down key barriers and providing benefits to all stakeholders; building owners, third-party developers or investors, utilities, and tenants. MEETS has been in a pilot phase on the Bullitt Center, a commercial office building in Seattle WA, since 2015 with positive results.[217]

In a MEETS transaction, the utility meters and bills the building at the same rate, for both energy and energy efficiency. The energy efficiency yield, or energy savings, is acquired by a new player in this model, the EnergyTenant^{TM}. An Investor provides capital to the EnergyTenant who is responsible for installing and maintaining energy improvements with the building. The EnergyTenant is paid by the utility through a 20 to 30-year Power Purchase Agreement (PPA). The EnergyTenant has an Energy Tenancy with the building owner giving them the right to acquire energy efficiency from the building in exchange for a monthly rent (typically a percentage of the PPA). The tenants receive a nicely upgraded space at the same utility cost they would have paid prior to the upgrade. The roles in this transaction are flexible. For example, the building owner may act as the EnergyTenant and, in this case, the entire value of the PPA would flow to the building owner. Alternatively, the utility may be the Investor, allowing them the opportunity to earn their regulated rate of return. [218]

MEETS overcomes the split incentive issue, one of the key barriers to deep energy retrofits in the commercial sector, by setting up the utility to acquire the full economic value of energy efficiency over a 20 to 30-year time frame. The utility pays a portion of this value to the EnergyTenant and/or Investor in the form of a PPA (see Table below). This PPA with the utility creates a powerful cash flow that increases the Net Operating Income for the building which in turn increases the residual value at the point of sale. Additionally, these long term contracts override bankruptcy and building change of ownership, reducing the risks of these projects.

MEETS moves the utility away from a traditional rate-payer funded incentive structure to self-financed energy efficiency projects through an energy efficiency PPA. Unlike other energy efficiency transaction structures, MEETS does not reduce utility sales of energy to a building. This allows the utility to acquire energy efficiency in a revenue positive transaction as shown in the Table below. With MEETS the utility earns a positive $33,000 over a 20 year PPA instead of paying out an $84,000 incentive in year one. On the supply side, the utility receives verified negawatt hours from the efficiency generator (building) through a MEETS PPA. MEETS does not require utility incentives, maintains utility revenue and provides the utility with a long term, low cost, energy resource.

Table 23: ***Cash Flows to Utility and Investor with MEETS vs an Incentive Structure based on Bullitt Center*** *(20 year PPA at $0.841 per kWh saved, 2% escalator on PPA ($0.0591/kWh only) & 4.5% retail rate escalator.)* [219]

50,000 square foot Bullitt Center with retail energy price of 5.91 cents/kWh

	Traditional Incentive Structure	MEETS
Total Utility Payments for Saved Energy	$ 84,000 (incentive)	$ 1.22 million (PPA)
Total Utility Collections for Saved Energy	$ 0	$ 1.25 million
Utility / Ratepayer Cost or (Benefit)	$ 84,000	($ 33,000)
NPV Dollar Value of Payments for Saved Energy To Investor (5% WACC)	$ 84,000	$ 740,000
$NPV per Square Foot	$ 1.68	$ 14.80
Utility Payment per kWh	2.5 cents (deemed and paid upfront)	8.41 cents with escalator, as delivered for 20 years

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[217] MEETs Coalition, “Metered Energy Efficiency Transaction Structure.”

[218] Hayes, Denis, Harmon, Rob, and Kahn, Brad, “The Metered Energy Efficiency Transaction Structure.”

[219] Ibid.

In a similar transaction with higher electricity rates the benefits of MEETS to both the investor and the utility/rate payer is even more significant as seen in the Table below.

Table 24 ***Cash Flows to Utility and Investor with MEETS model vs an Incentive Structure****, (20 year PPA at $0.175 payment per kWh saved with a 2% escalator on PPA ($0.15/kWh only) and 4.5% retail rate escalator)* [220]

50,000 square foot Bullitt Center with retail energy price of 15 cents/kWh

	Traditional Incentive Structure	MEETS
Total Utility Payments for Saved Energy	$ 84,000 (incentive)	$ 2.6 million (PPA)
Total Utility Collections for Saved Energy	$ 0	$ 3 million
Utility / Ratepayer Cost or (Benefit)	$ 84,000	($ 353,000)
NPV Dollar Value of Payments for Saved Energy to Investor (5% WACC)	$ 84,000	$ 1.6 million
$NPV per Square Foot	$ 1.68	$ 31.60
Utility Payment per kWh	2.5 cents (deemed and paid upfront)	17.5 cents with escalator, as delivered for 20 years

Because MEETS is a revolutionary model, it will take time to gain market traction. MEETS will drive many new employment opportunities. However, the jobs will shift from utility run EE programs to private sector energy service companies who will develop and deploy the deep energy retrofits and act as EnergyTenants. Utility regulations will have to be adopted, similar to those in California, to allow for this structure to work. In addition, it will take time for the commercial building sector to understand and embrace the significant benefits of the long-term MEETS contracts.

7.3 RESIDENTIAL P4P PROGRAM

Pacific Gas and Electric Company's P4P Residential Program has a strong potential to drive residential energy efficiency to scale through shallow and medium depth retrofits at the lowest costs. The first pilot will roll out in September 2016 by PG&E in Northern California.[221] Although residential has a large EE potential, it has traditionally been difficult to penetrate. This program is transformational in the pilot phase, maintaining a rate-payer incentive funded approach, but is expected to move into procurement in competition with other demand-side resources. In the future, energy efficiency, or what will be called Demand Capacity, is expected to be valued based on many dimensions such as location, load shape and carbon, to address net load shape issues, capacity bottlenecks and GHG emission reduction requirements.

This program does not dictate how energy efficiency is to be acquired but creates a platform in which multiple businesses, defined as Aggregators, can compete. In the pilot phase PG&E will rely on current market actors such as PACE Financiers, Smart Thermostat and Home Energy Network providers to take on the role of Aggregator. The Aggregator, receives an Energy Efficiency Incentive (EEI) from the utility for measured energy efficiency acquired across an aggregate of residential buildings. This is a significant component of this model because it is difficult to estimate exact energy savings at an individual residential project level. By aggregating projects, it is possible to calculate savings with a high degree of confidence, thereby realizing more consistent returns and a manageable risk for investors. [222]

In this model, the building owner keeps the energy savings and therefore will be required to provide the capital for most energy efficiency measures installed. Residential consumers on average expect a 2.5-year simple payback on projects.[223] However financing options, such as PACE, may extend this

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[220] Ibid.

[221] Jacobson, Erik, Director Regulatory Relations, "Submission of High Opportunity Projects and Programs (HOPPs) Proposal - Residential Pay-for-Performance Program."

[222] Golden, Matt, "From Programs to Markets: How to Make Efficiency a Valuable Real-Time Resource." Greentech Media. 2015."

[223] Granade, Hannah Choi et. al, "Unlocking Energy Efficiency in the US Economy."

expected payback time and hence enable deeper energy efficiency retrofits. PACE Financiers are expected to be key Aggregators for those customers needing financing in this program. The Table below highlights the key player's role and benefits in this model for a Smart Thermostat and a Basic Whole-Home Retrofit example.

Table 25 ***Roles and benefits of key players in P4P Residential Model****. Calculations are based on savings from an estimated average baseline using retail rates of energy $.19/KWh and $.70/therm. NPV of Energy Efficiency Incentives are calculated using incentives of $0.80/kWh and $1.80/therm for a 2-year contract term and a 10% WACC. Own Comparison.*

	Residential Building Owner			**Utility Pays the Aggregator Based on Metered Performance**
	Capital Required	**Customer Energy Savings YRLY**	**Simple Payback**	**NPV Energy Efficiency Incentive**
Smart Thermostat with Heat Pump (Savings: 12% on heating / cooling, 31% of total)	$ 250	$ 291	0.9 years	$ 2,130
Basic Whole Building Retrofit (Savings: 30% Electric, 60% Gas)	$ 8214	$ 673	12.2 years	$ 4,249

Aggregators, such as Smart Thermostat and Home Energy Network providers, will look for ways to monetize the Energy Efficiency Incentive as well as Demand Response (DR) cash flows with their installed resources, resulting in a more attractive business model.

The P4P Residential model uses an EE meter that normalizes for weather on a yearly basis but does not detect or allow for non-routine baseline adjustments. Baselines without adjustment are estimated to be stable on an aggregate of residential projects for 2 years (pilot) and a still to be determined maximum time, which will dictate the length of the Power Savings Agreement (PSA), in the future.

The P4P Residential Program under the current cost-of-service rate model undermines the economics of the utility because the utility loses revenue from lost energy sales in this structure. For this program to scale to the level required under California's EE mandates, new utility revenue models will be required such as those proposed in New York's REV docket where a utility is able to derive revenue from services and earn a regulated rate of return for meeting goals such as energy efficiency.[224]

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[224] Bade, "Little Less Talk: With New Revenue Models, New York Starts to Put REV into Action."

7.4 CONCLUSION

The table below summarizes the expected key impacts, benefits and requirements from each of these models. Both models are in their infancy but are expected to expand quickly due to recently passed regulations in California that allow PFP on Metered EE from historic baselines and innovative public utilities such as Seattle City Light.

Table 26 ***A summary of the key Impacts, benefits and requirements of both models.***

	MEETS	**Both Models**	**P4P Residential**
Key Impact	Deep energy retrofits scaled in Commercial, providing long-term distributed energy resources, financed the same as renewables, without undermining the economics of the utility/grid.	EE that can be utilized as a reliable grid energy resource and funded by private capital due to stable cash flows and standard contracts.	Strategic wide-spread deployment of low cost ECMs (i.e., Smart Meters) in residential, providing short term, in length, distributed energy resources.
Key Benefits	Transaction structure that breaks down key barriers, such as split incentives, utility loss of revenue, consumer short-term finance limits, to deep energy retrofits.	PFP based on metered EE against historic baselines on a whole-building basis maximizes value to all parties.	A platform that scales shallow to medium depth EE through various business models while minimizing Program Administration Costs.
Requirements	Regulations allowing utilities to purchase EE under a long-term PPA and then charge for EE at retail rate; Dynamic Baseline EE Meter; securing long-term contracts with building owners.	New regulations similar to CA SB350 & AB802, that allow PFP on metered EE from historic baselines on whole-building basis.	New utility revenue models to replace lost revenue from efficiency; static baseline EE meter, smart meters and standard data transfer; customers must sign over energy data & incentives.

The question then remains; what results can one expect from these models? For the EE market to really accelerate all the right conditions need to be met. There is a well identified large market potential in both the residential and commercial market segments and higher mandates are driving increased demand from the utilities and regulators for energy efficiency. In addition, private capital is available and looking for good sustainable investments. The technologies required, mainly energy efficiency meters and for the P4P Residential Program Smart Meters, are being deployed. Lastly, key regulations such as those coming out of California and revenue structures, such as the New York REV, are supporting these models and providing good examples for other states. With these conditions in place new energy efficiency transaction structures that pay for metered performance should flourish. Transaction structures that fully realize Amory Lovins' principle that efficiency is, in fact, energy and results in stable, reliable cash flows will attract the uncommitted large private capital and unleash the well identified market potential.

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Acronyms and Terms Defined

ACEEE	American Council for Energy Efficiency Economy	
CA	California	State in the USA
Capex	Capital Expenditures	
CEEIC	California Energy Efficiency Industry Council	
CPUC	California Public Utilities Commission	Utility regulation body in California (CA)
CSO	Customer Owned Utility	
DER	Distributed Energy Resources	DER are smaller power sources that can be aggregated to provide power necessary to meet regular demand.
ECM	Energy Conservation Measure	Project conducted, or technology implemented, to reduce the consumption of energy in a building
EDF	Environmental Defense Fund	Non-profit focused on creating solutions that "let nature and people" prosper. ICP is their project.
EE	Energy Efficiency	Doing the same amount of work, or running a building based on consistent use-models, with less energy.
EE Meter		Software that provides a consistent accounting of energy efficiency savings.
EEI	Energy Efficiency Incentive	Used interchangeable with ESI or Energy Savings Incentive.
EERS	State energy efficiency resource standard	
EIA	US Energy Information Administration (EIA)	
EM&V	Evaluation, Measurement and Verification	Methodology to accurately, transparently and consistently assess results of energy efficiency programs and/or ECMs.
EPA	Environmental Protection Agency	
ESA	Energy Savings Agreements	
ESC or ESCO	Energy Services Company	A private or non-profit delivering a wide array of energy services including energy savings projects, retrofitting, energy conservation, energy supply, etc.
ESI	Energy Savings Incentive	Same as Energy Efficiency
ET	EnergyTenant™	In MEETS Model this is the entity (investor, 3rd party, utility, etc) who, under an Energy Tenancy agreement, has the right to harvest negawatts from a building.
ETO	Energy Trust of Oregon	Independent nonprofit organization dedicated to providing utility customers with low-cost, clean energy solutions.
EUI	Energy Use Index	Measure of how much energy is used in a building. Typically referenced in kWh or BTU per ft2 or m2.
GDP	Gross Domestic Product	
ICP	Investor Confidence Project	Accelerating the development of a global energy efficiency market by standardizing how energy efficiency projects are developed and savings calculated. ICP offers a series of protocols for EE retrofits and a credentialing system.
IMT	Institute for Market Transformation	
IOU	Investor Owned Utility	
IPMVP®	International Performance Measurement and	Defines standard terms and suggests best practice for quantifying the results of energy efficiency investments.

	Verification Protocol	Developed (1995) by an international coalition (led by US DOE)
IRP	Integrated Resource Planning	
ISO	Independent System Operator	Operates a region's electricity grid, administers the region's wholesale electricity markets, and provides reliability planning for the region's bulk electricity system.
kW	Kilowatt	Kilowatt (symbol: kW) is a unit of electric power.
kWh	Kilowatt hour	Kilowatt-hour is an energy unit. One KWh is defined as the energy consumed by power consumption of 1kW during 1 hour:
LCOEE	Levelized Cost of Energy Efficiency	
MEETS™	Metered Energy Efficiency Transaction Structure	A whole-building PFP model that aligns the interests of all stakeholders as it harvests energy from the commercial building sector.
NBI	New Building Institute	A nonprofit organization working to improve the energy performance of commercial buildings.
NEEA	Northwest Energy Efficiency Alliance	Mobilizing the market in the Northwest toward energy efficiency.
NRDC	Natural Resources Defense Council	A non-profit working to “safeguard the world”. NRDC together with Open Energy Efficiency (Matt Golden) is behind the design of PG&E’s P4P residential program.
NREL	National Renewable Energy Labs	
NY	New York State	
OPEX	Operating Expenses	
P4P	Pay for Performance	California Residential Pilot program refers to the term this way.
PAC	Program Administration Costs	Refers to all utility costs to administer an EE program not including the energy efficiency incentive
PACE	Property Assessed Clean Energy	A means of financing energy efficiency upgrades or renewable energy. Loan is attached to property as opposed to individual.
PFP	Pay for Performance	In this context it is a program that pays for realized energy efficiency based on pre-defined M&V strategy and baseline.
PG&E	Pacific Gas and Electric	One of the largest combination natural gas and electric private utilities in the United States. Based in San Francisco.
PPA	Power Purchase Agreement	Standard contract used by to acquire energy over time (typically 20-30 yrs.)
PSA	Power Savings Agreement	Agreement to buy energy efficiency (future Demand Capacity) in the P4P Residential program.
PSE	Puget Sound Energy	Large IOU utility in WA state.
POU	Public Owned Utilities	Publicly owned utilities include cooperative and municipal utilities. Often referred to as PUD or Public Utilities Districts.
RMI	Rocky Mountain Institute	A Non-profit with a mission to drive the efficient and restorative use of resources. Focus is on unlocking market-based solutions that can be replicated and implemented now
RPS	Renewable Portfolio Standard	
SF	Square Feet	
SLC	Seattle City Light	Public Utility serving the City of Seattle
T&D	Transmission and Distribution	The combined transmission and distribution network is known as the "power grid" or just "the grid". It is an electric power distribution system that carries electricity to customers.
WA	Washington	State in the USA

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