Experience and lessons learned from P4P pilots for energy efficiency

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Smart Energy Services to Improve the Energy Efficiency of the European Building Stock

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This report aims to review the current experience of Pay-for-Performance (P4P) schemes outside the EU, in particular with examples from the U.S. as well as one case from the EU (Germany), and to document the main enablers and obstacles for the roll out of the first P4P pilots in the EU. Results include recommendations for the market and regulatory conditions that would be necessary for the replication of the studied P4P pilots/programmes in the EU.

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T5.2 – Derive P4P arrangements that align the interests of all the parties involved
Cluster 3 – Dissemination and outreach
T8.1 – Policy developments in EU as risk and opportunity

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Abbreviations and Acronyms

Acronym	Description
AMI	Advanced Metering Infrastructure
BayREN	Bay Area Regional Energy Network
CEI	Continuous Energy Improvement
CPUC	California Public Utilities Commission
DCSEU	District of Columbia Sustainable Energy Utility
EPC	Energy Performance Contracting
EPP	Energy Performance Program
ESCO	Energy Service Company
ESM	Energy Savings Meter
ETO	Energy Trust of Oregon
EU	European Union
FY	Financial Year
HVAC	Heating, ventilation and air-conditioning,
IEA	International Energy Agency
ISO NE	Independent System Operator New England
M&V	Measurement and Verification
NJCEP	New Jersey's Clean Energy Program
NRDC	Natural Resources Defence Council
NYSERDA	New York State Energy Research and Development Authority
O&M	Operations and Maintenance
P4P	Pay-for-Performance
PG&E	Pacific Gas and Electric Company
PSE	Puget Sound Energy
RFP	Request for proposals
SCL	Seattle City Light
SMB	Small and Medium-sized Businesses
SME	Small and Medium-sized Enterprises
WP	Work Package
UK EDR	United Kingdom Electricity Demand Reduction
VEIC	Vermont Energy Investment Corporation

Executive summary

Europe's buildings have the potential to play a key role in our future energy systems. Making them more efficient reduces the need for expensive power plant capacity, defers the costly upgrading of network infrastructure, and enables this infrastructure to be used with more flexibility. The fact that energy efficiency is not adequately compensated for these benefits (SENSEI, 2020) acts as a barrier to its deployment. It deprives it of valuable funding and means that we all pay more to ensure the adequacy, reliability and security of our energy systems. This is at odds with the Efficiency First (E1st) principle, which requires that energy supply and demand solutions are treated on an equal footing, considering their respective costs and benefits.

To ensure that energy saving solutions are not overlooked or undervalued, decision-makers need to be confident in the energy savings that energy efficiency measures will deliver. This puts a premium on good quality evaluation, measurement and verification of energy efficiency interventions. In several of the more forward-thinking U.S. states, energy utilities have launched and piloted building programmes which utilise energy metering technologies to provide greater certainty over energy savings and drive improved performance. These Pay-for-Performance (P4P) schemes reward end users or aggregators for delivering energy savings, measured against a business-as-usual scenario. A certain level of operating performance, monitored with metered energy data, is required to obtain the incentive, often with repeated payments to reward persistent savings.

In this report we examine the rationale for P4P energy efficiency programmes and review 11 cases from North America and elsewhere in-depth. This enables us to provide a set of key implications and recommendations which, if acted upon, should speed up the rate of energy efficiency improvement in the EU's buildings while reducing the costs of the energy transition.

Definitions and concepts are outlined. P4P energy efficiency programmes aim to deliver greater and more persistent energy savings by compensating energy efficiency resources based on a comparison of metered energy consumption and modelled counterfactual energy consumption (*i.e.*, consumption in the absence of the energy efficiency action). These schemes aim to boost energy efficiency policy effectiveness (ability to deliver on goals) and to increase the efficiency of public spending (more value for each € spent). Compared to traditional energy efficiency programmes, the performance risk is shifted from those who fund the programmes to the private sector. This aligns the incentives of those receiving public support with policy objectives,

by redirecting them from installing as many measures as possible to obtaining as many savings as possible.

The case studies document the factors that enable P4P programmes to succeed, the implementation barriers and the lessons learned. An in-depth review was conducted for each case study, including bilateral online interviews with programme managers or other relevant stakeholders. Seven of the cases target large commercial or institution buildings, two target smaller commercial buildings, one targets the residential sector, and one is more open regarding the type of buildings. In the cases reviewed:

- The drivers are often the desire to modernise energy efficiency policies and deliver energy efficiency as a grid resource.
- The schemes are often set in the context of energy efficiency obligations. The use of metered data for energy efficiency is not widespread for capacity mechanisms. To date, most of the P4P programmes have been implemented in the commercial sector.
- The choice of the Measurement and Verification (M&V) methodology is the basis of P4P schemes. Smart meters enable data access and can make M&V more practical, especially for sectors such as residential buildings and Small and Medium-sized Enterprises (SMEs).
- There is not a standard compensation model. Several solutions are put in place to ensure that the private sector can bear the performance risk, including coupling the performance payment with an upfront, non-performance-based incentive.

Based on this review, the report provides policy and regulatory recommendations for a successful replication of the P4P approach in the EU. These are:

1. Begin piloting P4P programmes now.
2. Start small and build upon experience.
3. Focus on clear, precise and detailed measurement rules.
4. Involve stakeholders in programme development and communicate clearly to target audiences.
5. Consider adapting payment structures to fit market conditions.
6. Ensure that P4P programmes integrate well with broader climate and energy objectives.
7. Accelerate smart meter rollout.
8. Publish evaluation results and share knowledge.

1 Introduction

The policies currently deployed by the European Union (EU) to mitigate climate change are not sufficient to contribute to the Paris Agreement's temperature goals (European Commission 2020). This acknowledgement, as well as concerns from citizens about the impact of climate change, has put climate action very high on the new Commission's political agenda, leading to a set of initiatives under the banner of the European Green Deal (European Commission 2019 b).

In all the EU policy scenarios outlined by the Commission (2018) to limit global warming to 1.5°C, energy efficiency plays a pivotal role. Energy efficiency can also participate in Europe's economic and social recovery, responding to the crisis brought by the COVID-19 pandemic. As noted by the International Energy Agency (IEA),[1] energy efficiency offers many opportunities for recovery plans, with labour-intensive projects that start quickly and are rooted in local supply chains such as construction and manufacturing.

Unfortunately, the global rate of progress in energy efficiency has been slowing over the past few years – a trend that has major implications for consumers, businesses and the environment (IEA, 2019). This global trend can be seen in the EU, too (Thomas & Rosenow, 2020).

Policymakers now face a twin challenge. First, they need to intensify the impact of energy efficiency policy portfolios, by both raising policy ambition and ensuring that programmes are effective. This is particularly important in the buildings sector, which needs to completely decarbonise by 2050.[2] This involves improving the efficiency of public support schemes, as shown by the recent report by the European Court of Auditors on the cost-effectiveness of energy efficiency spending (2020).

Secondly, as more end uses switch to electricity and the electricity grid becomes increasingly dominated by renewable energy sources, policymakers need to ensure that demand-side policies are aligned with other interacting elements of the energy transition.[3] This means, for

[1] See for example: https://www.iea.org/events/the-role-of-energy-efficiency-in-covid-stimulus-packages

[2] For an overview of investment needs in the residential sector by 2030, see Figure 5, average annual investment needs 2021-2030, in European Commission 2019 a.

[3] For an example of how demand-side policies could incentivize demand-side management measures and actions in the residential sector, see Stavrakas & Flamos, 2020.

example, that policies affecting buildings should continuously look at how buildings and their occupants can provide more services to the energy system.[4]

The starting point of the SENSEI project is the recognition that cost-effective energy efficiency measures are a means to enable end users to access energy services such as heating, cooling and lighting more cheaply. They can also bring other important benefits to the energy system, the environment and the society.[5]

Yet many energy saving opportunities[6] are left untapped, due to barriers which prevent the deployment of these solutions through market forces only. The fact that energy efficiency is not adequately compensated for the benefits it brings to the energy system acts as a barrier to its deployment. It deprives it of valuable funding while passing up opportunities to reduce the resource costs of delivering adequate, reliable and secure energy systems. This is at odds with the efficiency first principle,[7] which requires treating energy supply and demand solutions on an equal footing, considering their respective costs and benefits.

One of the explanatory factors for this imbalance is that there is no single actor that captures the value of the benefits brought by energy efficiency. This makes it difficult to trade this value (SENSEI, 2020). Another factor is that energy efficiency projects are very often small and involve many actors. This scattered value chain, illustrated in **Figure 1**, makes the design of energy efficiency policy challenging.

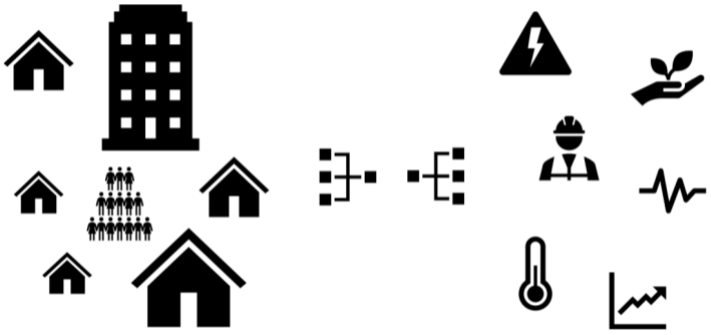

Figure 1 – The energy efficiency value chain

[4] For an overview of the links between residential heating systems and the electricity sector, see Rosenow & Lowes, 2020.

[5] For an overview, see Lazar & Colburn, 2013.

[6] For a recent update of energy savings potential, see analysis by Fraunhofer ISI (Brugger *et al.*, 2019).

[7] The principle is enshrined in several pieces of legislation. For more information, see Horizon 2020 funded ENEFIRST project (2020).

In the United States, several energy utilities have piloted and launched buildings programmes making use of possibilities offered by energy metering technologies (Szinai *et al.*, 2017). These programmes reward end users or aggregators for delivering energy savings against a business-as-usual (*i.e.*, baseline) scenario. Savings are based on metered consumption, and the beneficiaries need to achieve a certain level of operating performance to receive all or part of the incentive payment. By focusing on the output (*i.e.*, energy savings) rather than on other indicators (*e.g.*, number of technology units deployed, etc.), these Pay-for-Performance (P4P) programmes intend to align incentives with policy objectives, to incentivise the persistence of energy savings over time, and to boost the market for energy services.

Conditioning incentives on the use of metered energy data is not a common practice in the EU, outside of the industrial energy efficiency space.

Given the improved technological capability to analyse large data sets of metered energy usage, it is worth taking a fresh look at P4P programmes, as suggested by the Natural Resources Defense Council in 2017 (NRDC, 2017). Can P4P approaches bring value to the existing policy toolbox used by EU policymakers? How can existing worldwide experience inform policymakers and stakeholders? Can the approaches seen in North America be replicated in the EU?

This report reviews P4P cases from all around the world to come up with a set of key implications and recommendations for policymakers and other practitioners considering piloting P4P schemes for creating energy efficient buildings in the EU. It considers relevant policy contexts and the programme administrators' perspectives on 11 case studies of P4P programmes. The main goal is to identify and highlight the actions needed in order to bridge the gap between market needs, policy goals and scientific research.

The report is structured as follows:

	**Section 2** proposes an analytical framework. ▪ How can P4P schemes be defined (2.1)? ▪ What are their main design features (2.2)? ▪ What is the value proposition offered by these schemes (2.3)?
	**Section 3** looks into 11 examples of P4P programmes/pilots ▪ What methodology was used to select these case studies (3.1)? ▪ What are the main specifications/requirements of the programmes reviewed and how do they operate (3.2)? ▪ What lessons can be drawn from these case studies (3.3)?
	**Section 4** goes back to the value proposition and builds on the case study analysis to propose policy and regulatory recommendations for the EU.

2 P4P schemes – Analytical framework

Section 2 introduces concepts that are further used and discussed in the report. **Section 2.1** proposes a definition of P4P schemes and compares them with other related concepts. **Section 2.2** describes the features of P4P schemes. **Section 2.3** summarises the value proposition of P4P schemes.

2.1 Definition

Pay-for-performance (P4P) energy efficiency programmes aim to deliver greater and more persistent energy savings by compensating **(paying)** energy efficiency resources based on a comparison of metered energy consumption and modelled counterfactual energy consumption, *i.e.* consumption in the absence of the energy efficiency action **(performance)**.

In other words, energy savings are used as the indicator for the energy efficiency project's performance, and payments are done on an ongoing basis "as the savings occur" (Szinai *et al.*, 2017).

The structure of the cash flows is one of the main differences between a P4P programme and a traditional subsidy scheme, as shown in **Figure 2.**

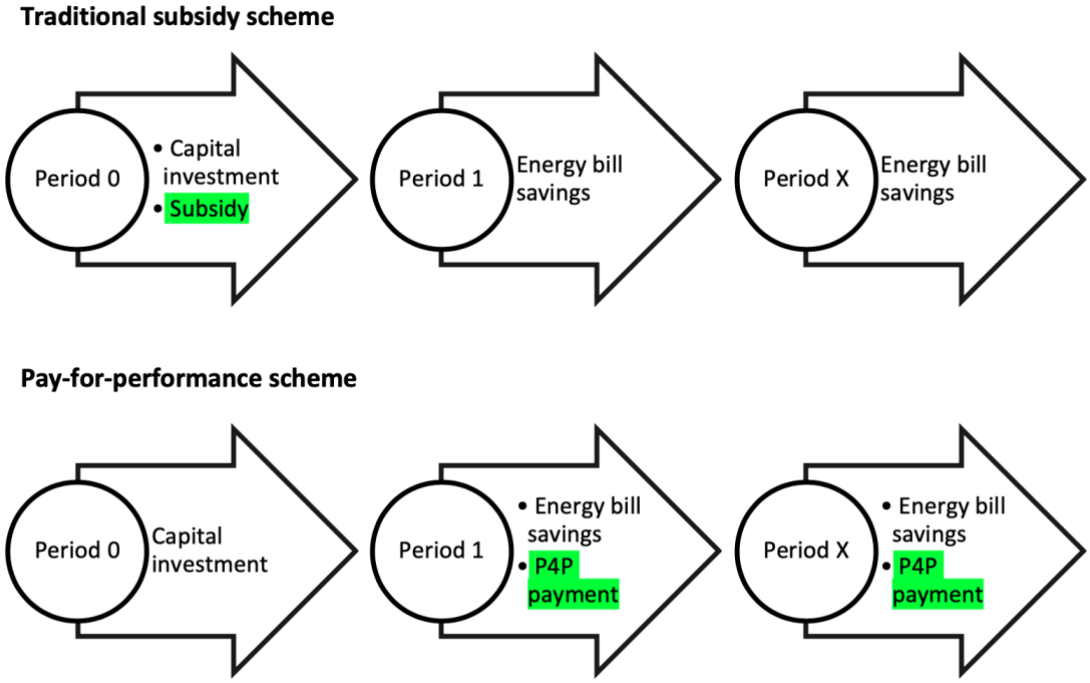

Figure 2 - Cash flows under traditional subsidy and P4P schemes

Payments are channelled from an organisation which is willing to pay to support energy savings (usually a public authority or a utility) to projects. These projects can be structured in the form of **energy performance contracting** (EPC),[8] although this does not have to be the case. This is particularly interesting given that the SENSEI project aims to reinforce the existing EPC approaches to EPC by integrating it in the P4P schemes.

To date, P4P programmes targeting buildings have mostly been run by utilities that are subject to energy efficiency resource standards (commonly known as Energy Efficiency Obligation Schemes in the EU), but more applications could be imagined. For example, P4P structures could also be applied to capacity mechanisms. These schemes are often established by system operators to ensure that adequate capacity will be able to meet load, including during peak periods. While they are not a first best solution to issues of electricity system adequacy and reliability, where they are in place, energy efficiency is often excluded either explicitly or implicitly[9] from participating (SENSEI, 2020). In a few cases, energy efficiency is allowed to bid into auctions. Applying a P4P approach would mean that the administrative entity would enter into agreements with aggregators or building owners to purchase the energy efficiency established through metered energy data. Using smart meter data would make it possible to track results by time and location, and to value energy efficiency's contribution to reducing capacity requirements – its "demand capacity," a distributed resource which would look very similar to other distributed energy resources. This point is further discussed in **Section 3.3.1.1**.

The concept of agreeing on a price for the delivery of energy savings is not new. A number of programmes have taken this approach in the past, albeit without the focus on metered data:

- **Standard offer programmes:** P4P schemes can be seen as evolving from standard offer programmes (Neme & Cowart, 2013). These were designed in the 1990s by many utilities in the United States to meet their energy efficiency obligations. In such a programme, the utility would set a price it will pay for a measured unit of energy or demand savings and sign long-term contracts with implementing organisations to deliver the savings.

[8] The EPC involves an Energy Service Company (ESCO) which provides various services, such as financing and guaranteed energy savings. The remuneration of the ESCO depends on the achievement of the guaranteed savings. The ESCO stays involved in the measurement and verification (M&V) process for the energy savings in the repayment period (European Commission, n.d.).

[9] Participation rules which are not adapted to the specificities of energy efficiency projects can prevent their participation.

- **Demand-side management bidding programmes:** These schemes, which started in the late 1980s, can also be considered as precedents of P4P schemes. These utility programmes are based on auctions which set a quantity of energy or demand savings to be achieved over a certain period of time.

Standard offer and demand-side management bidding programmes are considered as "first generation" P4P schemes (Szinai *et al.*, 2017).

The P4P concept is also related to the **concept of energy efficiency feed-in-tariff** (Bertoldi, Rezessy, & Oikonomou, 2013; Neme & Cowart, 2013). Proponents of this approach have looked at renewable energy deployment, which has traditionally been supported by a guaranteed financial incentive linked to the amount of energy produced (*i.e.*, feed-in-tariff).[10] An energy efficiency feed-in-tariff would grant a systematic incentive based on the amount of energy saved by the end user. Like P4P schemes, energy efficiency feed-in-tariffs focus on the output (energy savings) rather than on the means (technological upgrade or other intervention).

2.2 Design

The following paragraphs introduce the payment flows and performance assessment under P4P schemes. Specific examples are presented in **Section 3**.

2.2.1 Payment flows

P4P schemes support energy efficiency projects on an ongoing basis, *i.e.*, as savings occur. The following elements are examined in the programme design:

2.2.1.1 Who pays?

A public authority, a utility or another entity is in charge of channelling the payments to the entity who is tasked with delivering the performance. Payments can be directed in different ways, and ratepayers or taxpayers usually bear the costs of the programme.

[10] This is sometimes completed by an incentive facilitating the investment upgrade (*e.g.*, subsidy, preferential interest rate, etc.).

2.2.1.2 Who receives?

End users (*e.g.*, households, businesses, etc.) are the final beneficiaries of the programme, but they do not necessarily receive payments which are proportional to the energy saved. Indeed, aggregators or programme implementers, whose number varies according to the programme, often act as intermediaries between end users and the organisation delivering payments. These aggregators engage end users to save energy by offering services, and they can decide if and how they share performance rewards with them. Contractual arrangements are usually made between the organisation delivering payments and the aggregator, and between aggregators and end users. Aggregators can decide to work with subcontractors, if allowed.

2.2.1.3 How much?

Payments are proportional to the amount of energy saved. A price per unit is usually set in advance. It can also be the result of a bidding process, where aggregators compete on a number of parameters, including the price at which they propose to deliver the service. Prices may vary according to the fuel saved. Public authorities can decide to offer a higher price for more challenging energy savings actions (*e.g.*, deeper savings,[11] hard-to-reach sectors, longer lifetimes, complex measures, etc.). Further conditions may apply to obtain the payments (*e.g.*, minimum project size, etc.). Payments can be entirely proportional to performance. If part of the payment is not linked to the amount of metered energy savings, other milestones are defined. A cap can also be set on the amounts paid.

2.2.1.4 For what?

The eligibility of projects can depend on several factors, including the depth of the energy savings, fuel saved, customers, sectors, geographical area, measures, and the objective pursued (energy savings or demand response). Rules can either exclude certain activities from benefiting from the programme or specifically target certain segments or activities. The extent to which a P4P programme shall be "measure-agnostic" is to be decided. The programme usually provides indications (*i.e.*, guidelines, rules and/or detailed methodology) on how to establish the baseline[12] upon which the energy savings are calculated.

[11] E.g, achieving more than 15% of energy savings.

[12] Establishing a baseline or a counterfactual allows comparing the energy consumption before and after an intervention. This difference is the energy saved by the project.

2.2.1.5 When?

The duration of the programme, the frequency and the rules for initiating the payments are also important features of P4P schemes. It is possible to channel upfront payments into a project and combine this with penalties in case of underperformance. This can help project participants or aggregators with dealing with some upfront costs of their projects. Penalties can, for example, be imposed for under-delivery of energy savings by implementers, who will have to redeem (*e.g.*, by paying off the damage or by installing more measures) if the verified savings amount is lower than the contracted savings amount.

2.2.2 Performance assessment

P4P schemes use metered energy data to link payments to savings. The following points are part of the programme design:

2.2.2.1 How are data collected?

Smart meters are not strictly necessary for P4P programmes – what is required is a reliable set of meter readings. However, P4P schemes often use advanced energy metering technologies. The type of technology required to participate in the programme can vary, from advanced meter reading, which communicates information from the consumption site to the utility, to advanced metering infrastructure (AMI, *i.e.*, "smart meters") which sets a two-way communication between the consumption site and the utility (Szinai *et al.*, 2017). The frequency of data survey is decided as part of the programme design and can vary depending on the technical possibilities and the needs of the programme. Aggregators can provide the metering equipment as part of the service offer.

2.2.2.2 How is data analysed?

Data analysis is needed to set the baseline. Most of programmes require some access to historical data and use data analytics to "correct" this data set for factors like weather. Data analysis can also help deal with portfolios of small projects. This can indeed ease predicting the energy consumption of a "fleet" of buildings (NRDC, 2017). Data analytics can also help account for measures which are usually difficult to track such as behaviour and operational upgrades (NRDC, 2017) or to account for a mix of investment upgrades and behavioural measures (thus better taking into account how end users are running and maintaining the equipment).

2.3 The P4P value proposition

Section 2.3 outlines the P4P value proposition — in other words the benefits that are expected from P4P schemes. These schemes offer a boost in energy efficiency policy effectiveness (the ability to deliver on goals) and an increase in the efficiency of public spending (more value for each € spent).

2.3.1 A tool to boost the effectiveness of energy efficiency policies

Compared to traditional energy efficiency programmes, with P4P schemes the performance risk[13] is shifted from those who fund the programmes (taxpayers or ratepayers) to the energy service providers or aggregators, who are best placed to manage it. These organisations often work with clients to choose which measures to install, are responsible for the quality of their installation and provide advice on how to optimise their operation. By paying more attention to performance, the risk of underperformance can be reduced. The remaining performance risk can then be managed at the portfolio level through aggregation, which spreads the risk across many projects, each of which may either under- or over-perform.

This risk transfer **aligns the incentives of those receiving public support with policy objectives**. Indeed, most energy efficiency programmes provide subsidies for the installation of measures.[14] This provides an incentive for the private sector to install as many measures as possible, without necessarily ensuring high quality installation and maintenance. P4P schemes redirect the incentives to obtaining as many energy savings as possible. In principle, this should result in a higher quality of installation and maintenance and a more targeted deployment of measures where they can deliver the largest savings amounts.

This boost to effectiveness may have several other beneficial effects, such as:

- **Expanding the energy services market to new segments.** In the residential sector, energy services are less developed for various reasons including high transaction costs and market fragmentation (Labanca *et al.*, 2015). If the price paid by P4P programmes is

[13] The "performance risk" captures the probability for a portfolio of energy efficiency projects of achieving the projected savings (Shaban, Golden, & Tine, 2018).

[14] For an example of the effect of subsidy programmes on energy conservation technology diffusion, and how lower-income households respond to such subsidy programmes, see Spyridaki, Stavrakas, Dendramis, & Flamos, 2020.

sufficient, it may enable aggregators' business models to succeed in new sectors, including the residential sector.

- **Increasing trust in energy efficiency to act as an energy system resource.** In the EU, analyses of engineering and deemed savings adopted in different countries[15] show that savings estimates for a similar individual action may vary greatly among countries (Labanca & Bertoldi, 2016). This has raised questions about the credibility of the amount of energy savings expected from Member States' policies.[16] Better understanding the performance profile of energy efficiency projects can put them on an equal footing with energy supply projects. This would help in enabling them to be compensated for the reliability, adequacy and environmental services they provide, for example when network services are procured.
- **Increasing end consumers' trust in energy efficiency solutions.** Providing more information about the performance of an intervention can make them more attractive. This is only possible if the information is understandable for consumers and if the information source can be trusted.

2.3.2 A tool to improve the efficiency of public spending

The payment structure of P4P programmes encourages business models relying on economies of scale and brings transparency into the project's performance. This can help in:

- **Triggering business innovation through the emergence of aggregators.** The aggregator model is often considered a more effective means to engage with a large number of end users (NRDC, 2017). This can help public authorities or utilities to obtain a greater impact for each € spent on energy efficiency programmes.
- **Attracting private capital into energy efficiency projects.** Data availability is instrumental for standardising the energy efficiency investment process. This was a recommendation from the Energy Efficiency Financial Institutions Group (2015) to unleash investments in

[15] In the context of the implementation of Article 7 of the EU Directive 2012/27/EU on energy efficiency.

[16] According to a study done for the European Commission's Energy Directorate (Forster *et al.*, 2016), there are "some credibility issues in relation to the eligibility, additionality, materiality and double counting of notified savings" for some policy measures, and this could be "a risk to the delivery of the expected energy savings."

energy efficiency. The transparency brought into business models and their performance can also help attract investors.

- **Lowering costs related to the evaluation, measurement and verification of energy savings:** Approaches based on deemed energy savings (*i.e.*, ex-ante calculation of anticipated benefits) have been widely used in traditional energy efficiency programmes. Indeed, verifying savings ex-post, on a project-by-project basis, has proven to be unnecessarily cumbersome and expensive, given the need to balance the desire for precision against the cost of evaluation (Neme & Cowart, 2013). Technological progress could help improve precision and ensure impact, while keeping costs under control and reducing the scope required of programme evaluations, *i.e.*, those elements related to estimating energy savings.
- **Allowing for more targeted public action, including time- and location-specific interventions:** This becomes important given the increasing need to target energy savings that occur in specific timing (*i.e.*, during the day, or seasons) or locations, in view of dealing with changes in the electricity system. By its very nature, P4P schemes encourage aggregators to search out the most cost-effective potential energy savings demanded by programme administrators.

3 P4P case studies

This section presents a detailed overview of case studies mainly outside, but also across, Europe to **a.** document enablers and implementation barriers, and **b.** summarise lessons learned from existing P4P programmes that compensate energy efficiency as an energy resource. **Section 3.1** explains the case study methodology. **Section 3.2** provides an overview of the 11 case studies. **Section 3.3.** compares the different examples and outlines some of the lessons learned.

3.1 Methodology

The following details the approach used to identify and select the cases to study and the process for analysing those selected.

3.1.1 Step 1: Identification

Desk research started with an extensive search of relevant policy, academic and grey literature documents.[17]

- Regarding academic literature and scientific articles, generic keywords (*e.g.*, pay-for-performance, energy efficiency, grid resource, etc.) were used, individually and in multiple combinations, to identify literature sources of interest. Research was mainly focused on utility energy efficiency performance programmes.
- Regarding grey literature, the search process was focused on the inclusion of state-of-the-art studies (*e.g.*, published by IEA, NRDC, etc.), and other relevant technical reports/deliverables, requests for proposals, programme manuals and business plans developed by utilities and other organisations.

[17] *E.g.*, policy briefs, technical reports, scientific articles, etc.

3.1.2 Step 2: Selection

A first list of case studies was selected by applying the following filters:

- **Administrative entities:** The cases selected concerned programmes that are managed by utilities, system operators, public bodies and/or organisations in charge of delivering on climate and energy goals.
- **Relationship between payment and performance:** The cases selected concerned programmes that base compensation on verified performance.
- **Calculation method of energy savings:** The cases selected concerned programs that calculate performance based on metering energy data, and do not rely on deemed savings methodologies.[18]
- **Scope:** The cases selected concerned programmes that include a number of aggregated projects, and not just a single one.

Search results, as derived from **Step 1**, were limited according to their relevance and impact.

Note that older and industrial sector programmes were excluded, and that an exception to the second filter was made to cover **"Continuous Energy Improvement" (CEI) by Efficiency Vermont**. The payment structure is different, although Vermont Energy Investment Corporation (VEIC), which manages the scheme administrator Efficiency Vermont, is partly remunerated against the achievement of a set of defined objectives. The programme was included in the review because it has many of the characteristics of P4P schemes (comprehensive approach, use of metered data, etc.).

Following the filters above, **11 case studies** were selected for inclusion in the final set.

3.1.3 Step 3: Analysis

In-depth review was conducted for each one of the cases under study. This analysis was supplemented by direct contacts and bilateral online interviews with programme managers or other relevant stakeholders (*e.g.*, programme evaluators) to validate the outcomes of the review process and receive additional feedback, extra insights and updates.

[18] Where programmes pay compensation for savings beyond the measurement period, savings are necessarily based on assumptions about the lifetimes of measures and the persistence of the savings calculated during the measurement period. In this respect, parts of the compensated savings in some of the programmes could be said to be deemed.

Based on the initial review, a **semi-structured questionnaire** was developed to enable a flexible interview approach that combines a predetermined set of questions with the option of discussing any interesting emerging themes or details at greater length. This questionnaire is presented in **Appendix A**, and was developed around three main thematic sections:

- **Main characteristics:** end users, target sector, actors involved, interventions and measures eligible under the programme.
- **Performance assessment:** analysis of the M&V methodology and the payment structure.
- **Lessons learned:** achievements of the programme, barriers and obstacles faced, and drivers/enablers that led to implementation.

In cases where no interviews were conducted, information available in the literature sources identified (*i.e.*, **Step 1)** was presented in a detailed manner, allowing for a well-documented analysis:

- New York State Energy Research and Development Authority (NYSERDA), and New Jersey Clean Energy Program (NJCEP) P4P: no interview was conducted, but written feedback was received from programme managers.
- Save on Energy Suite - Energy Performance Program (EPP): no interview was conducted and no written feedback was received; however, a detailed and extensive literature including annual reports, programme manuals and M&V guidelines, presentations and application forms were reviewed for the analysis.

3.2 Case study overview

In this Section, 11 cases of P4P pilots/programmes from Canada, EU and U.S. are presented. These case studies are presented in **Table 1** across the five categories reflecting the target customer segment:

- Commercial programmes: they engage businesses in energy efficiency activities. Some of the programmes selected also cover public buildings or entities. They can be restricted to the services sector or be open to the industry sector as well. This category is itself divided between:
  - programmes reaching out to large buildings.
  - programmes reaching out to smaller buildings.

- Residential programmes: they engage private households in energy efficiency activities.
- Open schemes: they do not have an eligibility requirement related to the target customer segment.

More information can be found in the individual case study factsheets in **Appendices B**, including relevant literature and other additional sources.

Table 1 – List of P4P case studies reviewed

Sections	Name	Location	Duration (incl. pilot)
Commercial programmes (larger buildings)			
Section 3.2.1 Appendix B1	New Jersey – Pay for Performance Commercial & Industrial (C&I) programme	N.J., U.S	2009-present (11 years)
Section 3.2.2 Appendix B2	Energy Trust of Oregon – Pay for Performance Pilot	OR, U.S.	2014-present (6 years)
Section 3.2.3 Appendix B3	District of Columbia Sustainable Energy Utility (DCSEU) – Pay for Performance programme	D.C., U.S.	2019-present (1 year)
Section 3.2.4 Appendix B4	Seattle City Light – Deep Retrofit Pay for Performance (P4P) programme	WA, U.S	2013-present (7 years)
Section 3.2.5 Appendix B5	Puget Sound Energy – Pay for Performance pilot	WA, U.S	2018-present (2 years)
Section 3.2.6 Appendix B6	Efficiency Vermont – Continuous Energy Improvement	VT, U.S	2014-present (6 years)
Section 3.2.7 Appendix B7	Ontario Save on Energy – Energy Performance Program	ON, CA	2013-present (7 years)
Commercial programmes (smaller buildings)			
Section 3.2.8 Appendix B8	New York State Energy Research and Development Authority (NYSERDA) – Business Energy Pro	N.Y., U.S	2019-present (1 year)
Section 3.2.9 Appendix B9	Bay Area Regional Energy Network (BayREN) – Small and Medium Commercial Buildings Pay-for-Performance programme	CA, U.S.	2018-present (2 year)
Residential programmes			
Section 3.2.10 Appendix B10	Pacific Gas and Electric Company (PG&E) – Residential Pay-for-Performance programmes	CA, U.S.	2018-present (2 years)
Open programmes			
Section 3.2.11 Appendix B11	Germany – Energy Savings Meter	DE, EU	2016-present (4 years)

The following paragraphs present a short summary of each programme focusing on its structure and purpose, as derived from the literature review and stakeholder interviews conducted.

3.2.1 New Jersey – Pay for Performance Commercial & Industrial (C&I) programme

Acronym used in the report: NJCEP

This P4P initiative is implemented in the context of New Jersey's "Clean Energy Program" (NJCEP), a state-wide programme established by the New Jersey Board of Public Utilities (NJBPU), Division of Clean Energy. Its administration relies on a programme manager (TRC Companies) and on partners (more than 100 technicians). It consists of two components: **(1)** Existing Buildings (EB) and **(2)** New Construction (NC).

- P4P EB, launched in 2009, uses a whole-building approach to energy efficiency in existing commercial and industrial buildings.[19] Contractors and building owners are encouraged to lower their total energy consumption from a "whole building perspective" – instead of going for single equipment change-outs. A portion of the incentive is paid based on the achievement of the projected first year's savings.
- P4P NC was launched in 2009 to incentivise new commercial and industrial projects[20] to perform better than required by the energy code. A standardised energy simulation software programme is used to estimate the energy savings of the proposed building design compared to a baseline (limited to building code compliance). As with P4P EB, a portion of project incentives is tied to actual building performance.

For more information, see **Appendix B1.**

3.2.2 Energy Trust of Oregon – Pay for Performance Pilot

Acronym used in the report: ETO

This P4P scheme is managed by the Energy Trust of Oregon (ETO), an independent non-profit organisation that helps utility customers in Oregon benefit from energy efficiency use and renewable energy. It engages energy service providers and the commercial sector, in particular

[19] Commercial and industrial buildings with a peak electricity demand in excess of 200 kW in any of the preceding 12 months, and 100 kW for the selected multifamily buildings.

[20] New commercial, industrial and multifamily buildings with 50,000 square feet or more of planned space, as well as buildings undergoing substantial renovation.

office buildings, healthcare, grocery stores and municipality, universities, schools, hospitals (MUSH) buildings.

The payment was partially performance-based. An initial incentive was given after the installation of energy efficiency measures (based on projected savings). The remaining savings were established using metered data, and participants received payments based on a pre-determined incentive rate at the end of each year over a three-year period. Phase I of the P4P pilot started in October 2014 and ended in 2017. Energy Trust was looking for three or more commercial office buildings to participate. Ultimately, only one project, a large commercial building in downtown Portland, was selected and the three-year contract was completed in 2017. A Phase II Pilot was launched in 2017. It has not been successful in identifying project candidates.

Given the limited interest, Energy Trust engaged stakeholders to discuss the changes needed for Phase III, which is expected to be launched in 2020 with a revamped payment structure.

For more information, see **Appendix B2.**

3.2.3 District of Columbia Sustainable Energy Utility (DCSEU) – Pay for Performance programme

Acronym used in the report: DCSEU

In the District of Columbia (U.S.), the dedicated utility District of Columbia Sustainable Energy (DCSEU) is mandated to deliver energy savings and runs a P4P programme directed to large, existing commercial and institutional buildings. The programme targets measures delivering annual savings greater than 10% (based on pre- and post-project metered data). The incentive is paid once, and the amount paid per unit of energy saved varies according to the project. Savings can only be claimed for one year's timeframe. The scheme has been in development since FY16. In FY20, the pilot will transition to a standard offering. DCSEU account managers deal with individual P4P cases. DCSEU and the customer can enter into three-party incentive agreements with energy efficiency service providers.

For more information, see **Appendix B3.**

3.2.4 Seattle City Light – Deep Retrofit Pay for Performance (P4P) programme

Acronym used in the report: SCL

Seattle City Light (SCL) is the public utility providing electrical power to Seattle, Washington (U.S.) and parts of its metropolitan area. SCL started a three-year pilot P4P programme in 2013 with three medium/large commercial buildings. Savings were established using metered data and participants received a pre-determined incentive rate for energy savings achieved over the performance period. Incentive payments were made at the end of each year of the performance period.

After the successful conclusion of the P4P pilot, City Light launched the Deep Retrofit P4P programme in 2018, which is ongoing, offering the option of a three- or five-year performance period. Seattle City Light administers the programme and a contractor implements the comprehensive retrofits including heating, ventilation and air-conditioning (HVAC) and lighting. The programme targets commercial buildings.[21]

For more information, see **Appendix B4.**

3.2.5 Puget Sound Energy – Pay for Performance pilot

Acronym used in the report: PSE

In 2018, Puget Sound Energy (PSE), a Washington state energy utility providing electrical power and natural gas primarily in the Puget Sound region, launched a commercial P4P programme with the goal of enlisting five existing commercial buildings (*e.g.*, offices, schools, universities) per year.[22] The P4P pilot aims to maximise energy savings through capital, operational and maintenance improvements, and behavioural opportunities. All proposals require a minimum 15% annual energy reduction target from capital measures, with an incentive structure that rewards a total building approach to managing the facility's resources. Up to 50% of the incentive is paid according to estimated project cost and estimated/deemed project savings (at the end of year one) and the remaining incentive is paid out annually for years two through five.

For more information, see **Appendix B5.**

[21] Buildings with interval meters, each with at least 50,000 square feet of conditioned floor area and energy use over the past year that is stable enough to allow the baseline model to meet the M&V quality requirements

[22] Customers with a building of at least 50,000 square feet with large savings potentials.

3.2.6 Efficiency Vermont – Continuous Energy Improvement

Acronym used in the report: CEI

In Vermont, a dedicated energy efficiency utility, Efficiency Vermont, has been set up to deliver energy savings based on plans agreed with the regulator. Efficiency Vermont runs a scheme called "Continuous Energy Improvement (CEI)" which applies a data-driven approach to understand how businesses and industries use energy; to set up a strategy to reduce energy use through a mix of behavioural, operational and technical measures; and to measure the actual performance against a baseline to track improvements. The pilot started in 2014 and became a programme in 2018. Participants are not rewarded upon performance; rather, Efficiency Vermont, which is managed by Vermont Energy Investment Corporation (VEIC), is remunerated against the achievement of a set of defined objectives. Efficiency Vermont pays for some related programme costs such as the installation of submeters. There is no obligation for participating companies to attain specific results, but Efficiency Vermont aims to cut consumption by 10–15% in the first three years across the portfolio of companies involved in the programme.

For more information, see **Appendix B6.**

3.2.7 Ontario Save on Energy – Energy Performance Program

Acronym used in the report: EPP

The Independent Electricity System Operator (IESO) who manages Ontario's power system offers energy-efficiency incentives and rebates through a suite of Save on Energy programmes. The Energy Performance Program (EPP) included in the suite is a P4P energy-efficiency incentive programme for customers with commercial buildings across multiple local distribution company service territories. EPP encourages whole building energy performance improvements through an incentive that provides four cents /kWh of savings per year for up to two and a half years, while it significantly reduces the administrative burden on customers. This P4P model encourages participants who are able to make behavioural and operational changes alongside capital investment projects to achieve and grow energy savings over multiple years. Participants must have a minimum annual consumption of 1,500,000 kWh per building (or group of up to five buildings).

For more information, see **Appendix B7.**

3.2.8 New York State Energy Research and Development Authority (NYSERDA) – Business Energy Pro

Acronym used in the report: NYSERDA

Business Energy Pro is a commercial P4P pilot scheme administered by the New York State Energy Research and Development Authority (NYSERDA), a public-benefit corporation in the state of New York (U.S.), and the utility Consolidated Edison, Inc. (Con Edison). In 2019, the first annual request for proposals (RFP) was launched to select one or several portfolio managers. These third party providers will engage with small and medium-sized businesses (SMB) to deliver energy savings and will be compensated over a performance period of three years. The payment per energy unit rate will vary depending on the bids. The savings will be measured and aggregated for the whole portfolio to calculate the portfolio manager's performance. The aim shall be to achieve a minimum of 5% portfolio energy reduction.

For more information, see **Appendix B8.**

3.2.9 Bay Area Regional Energy Network (BayREN) – Small and Medium Commercial Buildings Pay-for-Performance programme

Acronym used in the report: BayREN

The Bay Area Regional Energy Network (BayREN) Small and Medium Commercial Buildings P4P programme works with commercial buildings owners and managers to install energy improvements that will pay for themselves over time. To better manage performance risks for both ratepayers and participants (small and medium commercial buildings' owners), BayREN will recruit ESCOs via a competitive solicitation to act as program allies. These organisations will be compensated under an incentive structure, in which 50% of compensation will be based on approved ex ante savings calculations and payable upon project completion (Year 0). Year 1 and Year 2 performance payments will be calculated as true-up payments, representing the performance-based balance after accounting for the Year 0 payment.

For more information, see **Appendix B9.**

3.2.10 Pacific Gas and Electric Company (PG&E) – Residential Pay-for-Performance programmes

Acronym used in the report: PG&E

The utility PG&E contracted with third party providers to design and implement two-year pilot P4P programmes in the residential sector. Contractors are paid on a monthly basis for energy savings calculated using the CalTRACK method. Programme evaluations will determine whether P4P is a sustainable model for energy efficiency programmes in the residential sector and its potential application in allowing energy efficiency to act as a reliable grid resource.

For more information, see **Appendix B10.**

3.2.11 Germany – Energy Savings Meter

Acronym used in the report: ESM

The "Energy Savings Meter" (ESM) programme aims to leverage digitalisation for the benefit of energy efficiency improvements. Public funding is provided to businesses (*i.e.*, large companies and small and medium-sized enterprises) which promote digitally enabled energy efficiency solutions to their customers. These companies apply for funding to develop their digital solutions. The level of funding depends in large part on the amount of energy saved by the companies' customers. The digital services offered to customers can be combined with other offers, including support to investments.

For more information, see **Appendix B11.**

3.3 Analysis

The cases studied depict a variety of different policy objectives and contexts, energy market needs and P4P design options. In the following paragraphs the drivers and barriers for the implementation of P4P pilots/programmes are analysed and key findings are highlighted. In particular, similarities and differences of the case studies are presented based on their **Key drivers** (3.3.1), **Basic design attributes** (3.3.2), **Performance assessment** (3.3.3) and **Payment agreement methods** (3.3.4). Based on analysis of these findings, major lessons learnt from case studies are presented.

3.3.1 Key drivers

Motives for the adoption of a P4P programme vary across the selected cases. This is reflected in each programme's purpose and its regulatory drivers.

3.3.1.1 Purpose

General objectives of P4P programmes vary and are not necessarily mutually exclusive:

- **Meeting energy efficiency and savings targets**

Some entities have developed their P4P programmes in order to achieve deeper energy savings and meet their targets. Specifically, ETO aims to improve realisation rates of savings, while DCSEU's objective is to deliver more energy savings to their customers. Efficiency Vermont utilises the CEI programme to achieve demand side savings targets.

- **Using energy efficiency as a resource on the grid to support the electricity system**

The basic motivation for the majority of the schemes analysed in this report is to exploit energy efficiency as a resource to the grid. In particular, IESO (EPP) and PG&E intend to ensure the availability of energy efficiency to support the electricity system and enhance energy efficiency as a well-founded grid resource, while NYSERDA's main focus is to increase the utilisation of energy efficiency as a grid resource.

- **Improving the cost-effectiveness of energy efficiency investments**

When energy efficiency is paid in advance, with little accountability as to results, there can be a misalignment of incentives. SCL and PSE have both identified the need to rely on the use of metered data to increase the cost-effectiveness of delivered energy efficiency programmes. PG&E and DCSEU both reported that providing cost-effective programmes for ratepayers was an important factor behind the roll out of P4P. NJCEP aims to "change the way contractors and users approach energy efficiency opportunities."

- **Targeting specific sectors for energy savings**

Some programmes focus on specific sectors identified as crucial and/or with high savings potential. BayREN, for example, adopted a P4P programme targeting SMB, as utilities in the jurisdiction had not yet launched a performance-based programme for this sector. Furthermore, the NJCEP scheme engages very large commercial and industrial buildings due to the high potential of achieving energy savings.

- **Developing the energy services market**

The ESM programme was specifically designed to boost the development of an independent energy service market using digital tools, rather than achieving predetermined energy savings targets.

- **Improving understanding of energy consumption**

Some of the schemes, like CEI, aim to improve understanding about energy consumption patterns in some end-use sectors.

3.3.1.2 Regulatory drivers

All of the P4P programmes studied here are directly or indirectly driven by regulation.

- **Utility obligations**

In particular, many states in the U.S. (*e.g.*, California, Washington, Vermont, etc.) have developed energy efficiency resource standards (EERS) which require utilities to achieve a certain percentage of energy savings based on the amount of electricity or natural gas sold in the state.[23] In Ontario, Canada (EPP) the conservation and demand management (CDM) code was established in 2016 for electricity distributors. Distributors are required to meet targets for both demand reduction (MW) and energy savings (GWh) and may achieve both by implementing their own energy efficiency programmes, which must be approved by the Ontario Energy Board, or by contracting with the Independent Electricity System Operator.

- **Other objectives**

Although it is not driven by utility regulation, the Energy Saving Meter programme in Germany participates in reaching the country's energy transition objectives.

→ Lessons learned

P4P is often driven by the desire to modernise energy efficiency policies. P4P programmes are mostly driven by regulation, in particular utility energy efficiency obligations. In many cases, policymakers or regulators have specifically asked utilities or entities in charge of delivering energy savings to create innovative schemes to boost innovation, green job creation and market

[23] More information: https://database.aceee.org/state/energy-efficiency-resource-standards

transformation. In many cases, for example in California, state energy laws require innovative pilots and programmes to be applied to ensure the cost-effectiveness of these schemes funded by ratepayers. Thus, the regulatory frameworks are structured to incentivise administrators to continually improve programmes, adjust portfolios based on evolving goals or market needs, and pilot innovative approaches. In many cases, P4P programmes were a request formed by the energy market (*e.g.*, ESCOs), while in some cases the main driver was the need to improve the cost-effectiveness of energy efficiency programmes and deliver high-quality programmes funded by ratepayers.

The majority of the cases studied intend to deliver energy efficiency as a grid resource. Many of the P4P programmes were developed not only to achieve traditional savings, but also to support the electricity system and understand future demand patterns. Indeed, when a building owner invests in an efficiency project, the project delivers substantial value to load-serving entities.

3.3.2 Basic design attributes

In this section, several programme design features are examined: the type of approach followed, the administration in charge, the roles of different actors, the source of funding, the customer segment and the eligible measures.

3.3.2.1 Type of approach

P4P programmes involve a contractor, an aggregator, or even a building owner receiving payment based on energy savings. A programme administrator offers a fixed or negotiated price (which can depend on bids), which will pay for a measured unit of saved energy over a certain period (*e.g.*, five cents/kWh/year). The P4P schemes studied are mostly proposed in the context of **utility energy savings programmes**.

In theory, P4P structures could be applied in the context of **capacity mechanisms**, which can establish the procurement of energy efficiency as a grid resource (see **Section 2.1**). Our review did not identify programme making capacity payments purely based on metered data. However, we decided to examine two capacity mechanisms which allow or target energy efficiency participation and look into their performance and payment structures (see case study factsheet available in **Appendices C** and summary below). The review shows that while bidders are allowed to use methodologies which establish energy savings based on metered energy data, these methodologies were not widely used.

ISO New England Capacity Market (ISO-NE)

For more information, see **Appendix C1**.

The Forward Capacity Market in New England aims to ensure that the New England power system has sufficient resources to meet the future demand for electricity, particularly during peak periods. Resources compete in the auctions to obtain a commitment to supply capacity in exchange for a market-priced capacity payment. ISO-NE invites customer-based demand-side resources to compete against conventional generation resources.

In principle, capacity payments are based on real-time data. If capacity has cleared, it gets paid the clearing price. If the capacity resource does not deliver when called during a capacity scarcity period, it needs to pay a penalty. If other capacity resources delivered more capacity relative to their cleared capacity obligation, they get compensated from the penalty proceeds.

Some projects use meter data both before and after the installation of the energy efficiency measures to estimate savings (whether at facility or component level). However, most of the participating energy efficiency programmes use deemed savings. Aggregators were exempted from the requirement to provide a detailed breakdown of savings for each hour. They may estimate only peak-period savings produced by their projects and are subject to a penalty only during capacity scarcity periods.

UK Electricity Demand Reduction Pilot (UK EDR)

For more information, see **Appendix C2.**

In Europe, the UK has explored the potential of integrating energy efficiency into the GB (Great Britain) Capacity Market through the Electricity Demand Reduction (EDR) Pilot using a forward-looking auction to acquire peak savings from energy efficiency projects. The UK EDR offered funding to organisations through an auction for projects that reduce peak demand by installing electricity energy efficiency measures. Customers needed to propose projects that install electricity efficiency measures and were paid based on their peak savings. These projects were required to deliver verifiable peak savings between 4-8 pm on working days, November-February.

Bidders had the option to use deemed savings for standardised technologies or metered data for more complex projects using the International Performance Measurement and Verification Protocol (IPMVP) methods (see more for M&V methodologies in **Section 3.3.3.1.**).

In practice, lighting dominated the bids because it was a straightforward measure and enabled deemed calculation of predicted impact. Participants felt this was much easier than sourcing metered data. There was also a reduced chance of predicted savings not being delivered.

3.3.2.2 Administration

The administration of P4P schemes can be done by:

- **Utilities**

Programmes can be administered by investor-owned utilities, which are private enterprises acting as public utilities (*e.g.*, PG&E, PSE); public utilities (*e.g.*, SCL); and energy efficiency (*e.g.*, Efficiency Vermont) or sustainable energy (*e.g.*, DCSEU) utilities, both appointed to deliver energy savings.

- **System operators**

In Ontario, Canada, EPP is implemented and regulated by the Ontario's power system operator (IESO).

- **Public authorities or public service organisations**

P4P programmes can also be launched by public authorities like regional energy network BayREN (a collaboration between local governments), ministries (*e.g.*, German Federal Ministry for Economic Affairs, ESM programme), and state agencies (NJCEP).

Finally, it is also common that mission-based organisations (*e.g.*, ETO) and public benefit corporations (*e.g.*, NYSERDA) collaborate with utilities and government agencies to deliver sustainable energy programmes, including P4P.

3.3.2.3 Roles

Many actors are commonly involved in a P4P programme, with specific responsibilities and roles.

- **Role of administrator**

The role of an administrator depends on each programme:

  - It generally includes budgeting, financial and contract management.

- The administrator often conducts the market assessments and the programme design.
- In addition, in most of the case administrators are also responsible for market outreach.

- **Role of implementer/aggregator**

The implementation of the programme can be accomplished by contractors, ESCOs or another third-party entity responsible for a set of projects.

- These implementers/aggregators can conclude energy need assessments, develop energy reduction and energy management plans, implement the measures, and in some cases are also responsible for model/simulation development (*e.g.*, BayREN, ETO). Administrators may perform quality, model and progress reviews on the reports provided by the implementers before approving eligibility for incentives. In some cases (*e.g.*, NYSERDA), a dedicated M&V provider can be appointed to deal with data analysis.
- In some cases, implementers/aggregators may also conduct marketing and outreach. In the BayREN and PG&E P4P programmes for example, both programme administrators and their programme allies (*e.g.*, ESCOs, contractors, manufacturers, engineers and retailers) are responsible for engaging customers, while in ETO the P4P ally is responsible for customer recruitment and identifying prospective participating sites. In NYSERDA, portfolio managers are required to reach out to SMEs; in DCSEU, preferred contractors engage with potential customers; and in ESM, funding is provided to businesses (large companies and small and medium enterprises) which promote digitally-enabled energy efficiency solutions to their customers. NJCEP cooperates with a programme manager (TRC Companies) who is responsible for administration, dissemination activities, engaging participants and facilitating applications and agreement arrangements.
- Administrators often offer a pool of recommended/licensed energy implementers to avoid frauds and ensure programme achievements and customers satisfaction (e.g, PSE, ETO, NJCEP, DCSEU).
- Finally, after a pilot or a programme is completed, implementers provide feedback to administrators regarding the program's design aspects and payment structures, contributing to the programme's further development.

3.3.2.4 Source of funding

All but one of the P4P programmes examined are funded by utility customers through their **energy bills**. Energy efficiency provides benefits to all customers by avoiding the need to build new power plants, transmission lines and distribution facilities. These public benefits lower the costs for everyone, justifying the fact that all consumers participate in financing the programmes, including those who do not directly participate.

Ratepayers contribute to funding energy efficiency programmes through a small public benefit charge (*e.g.*, ETO) or other separate surcharge (*e.g.*, in PSE, CEI, NYSERDA) added to utility customers' monthly utility bills. In NJCEP the extra charge on customer bills is called "public benefit charge." Some entities include the costs of energy efficiency and demand reduction programmes in their electricity/gas rates (*e.g.*, SCL). These charges are paid by all customers and are collected at utility territory, state, province or country level.

The ESM programme is funded by **taxpayers**. Like for all energy savings programmes, while taxpayers bear the costs, they eventually benefit from lower energy system costs (due to the energy saved), which flow through in lower energy prices.

3.3.2.5 Customer segment

P4P programmes are either targeted to customers from certain sectors or to certain buildings, or are open to all customer segments.

- **Large buildings**

The majority of the P4P examples included in this report focus on large commercial, industrial, or institutional customers with a high potential of savings. In most of the cases, eligible facilities have to meet specific requirements regarding minimum total surface (*e.g.*, square feet of conditioned floor area), average annual electricity and gas consumption, and/or annual peak demand.

For example, the ETO P4P pilot targets commercial buildings (in particular office buildings), but also healthcare, grocery stores and MUSH which have at least 20,000 square feet of conditioned floor area, while the SCL and PSE programmes engage existing commercial and institutional buildings with more than 50,000 square feet of conditioned floor area. For DCSEU, the threshold is 100,000 square feet of conditioned floor area. CEI was initially designed to reach the largest commercial and industrial energy consumers in Vermont, while EPP requires each participant to have a minimum annual consumption of 1,500,000 kWh per building (or group of up to five buildings aggregated into a single baseline energy model). NJCEP includes an Existing Buildings

and a New Construction programme. For the Existing Buildings programme, commercial and industrial buildings must have a peak demand of at least 200 kW in any of the most recent 12 months, while multifamily buildings must have a peak demand of at least 100 kW in any of the most recent 12 months. New or substantial renovation of commercial, industrial and multifamily buildings must have 50,000 square feet or more of gross heated/conditioned space.

- **Smaller buildings**

On the other hand, some programmes have specific requirements regarding the maximum total surface, average annual electricity and gas consumption and/or annual peak demand.
BayREN and NYSERDA have developed P4P programmes which provide energy efficiency services to small and medium businesses, which is less common among the cases. In particular, BayREN engages commercial sites with no more than 50,000 square feet of conditioned space, with annual electricity consumption of less than 500,000 kWh and/or annual gas consumption less than 250,000 therms, while for the NYSERDA programme eligible customers are those with an average annual peak electricity demand of less than 300 kW. PG&E's Residential P4P pilot is the only known attempt to scale a whole-building programme to the residential sector with a normalised metering-based approach, aggregating savings across a portfolio of many homes.

- **Open programmes**

Finally, one of the programmes studied allows for a high degree of flexibility rather than focusing on a specific sector Applicants for ESM are free to choose the customers to whom they will address their offer (*e.g.*, households, public bodies, companies or other end users, etc.). Projects have been funded in a variety of settings, including offices and retail stores, hospitals, swimming pools, hotels, restaurants and industrial sites.

3.3.2.6 Eligible measures

Eligible measures depend on each programme's goal and purpose and on other parameters such as return of investment, savings potential, customers' needs, etc.

The P4P programmes examined target **multiple measures** combining device replacements, operational/behavioural improvements and retro-commissioning, rather than focusing on individual retrofits (*e.g.*, lighting, motors, etc.). Some of the programmes may encourage energy management, implementing employee trainings on best practices in energy management, regular maintenance of equipment and capital upgrades (*e.g.*, CEI), while others target savings primarily from building retrofits and equipment upgrades (*e.g.*, SCL). The ESM programme was specifically designed to leverage digitalisation for the benefit of energy efficiency improvements.

The projects submitted by candidates shall develop and propose innovative digital solutions for customers to save energy.

Combining a minimum number of measures (*e.g.*, in PSE, a combination of two or more measures must be selected), or achieving a minimum percentage of energy savings compared to the baseline including through certain measures (*e.g.*, a 15% electricity consumption reduction by capital upgrades is required by SCL), is often a programme requirement.

An overview of the customer segment, the target or implemented measures and the specific programme requirements is presented for each case study in **Table 2**.

Table 2 – Overview of customer segment, targeted measures and requirements across case studies

Case Study	Eligible segment	Targeted / implemented measures	Programme Requirements
New Jersey – Pay-for-Performance Commercial & Industrial (C&I) programme	Existing Buildings: ▪ Commercial and industrial buildings, peak demands ≥ 200kW ▪ Multifamily, peak demands ≥ 100kW New Construction: ▪ Commercial and industrial projects ▪ Conditioned space ≥50,000 sq. ft.	Existing Buildings: ▪ Lighting retrofit, high efficiency HVAC equipment, building management / controls, variable-frequency drives (VFDs), air-sealing, etc. New Construction: ▪ At least one measure addressing each of the following building components: envelope, heating, cooling and lighting	Existing Buildings: ▪ No single measure ▪ 15% minimum savings ▪ Max. 50% from lighting New Construction: ▪ Minimum combination of measures ▪ Minimum performance above code
Energy Trust of Oregon – Pay for Performance Pilot	▪ Commercial, in particular office buildings, but also healthcare, grocery stores and MUSH ▪ Conditioned space ≥20,000 sq. ft.	▪ Economizer tuning, Supply Air Temperature reset, Duct Static Pressure Reset, Modulate condenser flow, Secondary Pump VFDs, Adjusting cooling tower fan staging	▪ At least three capital investments ▪ 5% minimum savings
District of Columbia Sustainable Energy Utility (DCSEU) – Pay for Performance programme	▪ Large, existing commercial and institutional buildings ▪ Conditioned space ≥100,000 sq. ft.	▪ Complex multi-measure efficiency projects ▪ Re-commissioning and retro-commissioning of equipment ▪ Advanced building controls and upgraded building automation systems ▪ Energy management information system ▪ HVAC and Lighting (mostly implemented)	▪ Annual savings greater than 10%

Seattle City Light – Deep Retrofit Pay for Performance (P4P) programme	▪ Medium-large commercial buildings including MUSH ▪ Conditioned space ≥50,000 sq. ft.	▪ AHU optimization, Roof insulation, Wall insulation, Window replacement/upgrade ▪ Change induction HVAC system to high performance VAV, SOI Filter Redesign, Chillers with heat recovery, VFDs on pumps, Lighting retrofits, Pneumatic to DDC control conversion, Continuous Commissioning, Replacing faulty HVAC equipment, Replacing old inefficient HVAC equipment with efficient equipment, Eliminating simultaneous heating and cooling, Schedule corrections	▪ At least 15% energy savings from capital equipment upgrades with measure lifetimes over 10 years
Puget Sound Energy – Pay for Performance pilot	▪ Commercial and Institutional facilities (*e.g.*, 24/7 facilities, museums, medical facilities) ▪ Conditioned space ≥ 50,000 sq. ft.	▪ Capital investments ▪ Maintenance and operational improvements ▪ Behavioural energy-saving opportunities	▪ At least two measures ▪ Minimum 15% energy savings
Efficiency Vermont – Continuous Energy Improvement	▪ Large commercial and industrial facilities	▪ Process improvements in the office and on the manufacturing floor ▪ Employee engagement to foster best practices in saving energy (including trainings) ▪ Regular maintenance of equipment ▪ Capital upgrades for equipment that is out of date or reaching end of life	▪ Participants engaged as part of a cohort to encourage peer-to-peer learnings
Ontario Save on Energy – Energy Performance Program	▪ Commercial buildings that are not utilised for any industrial process ▪ Minimum annual consumption of 1,500,000 kWh per building or group of buildings	▪ Equipment retrofits, controls installation, system, recommissioning, and behavioural initiatives	-
New York State Energy Research and Development Authority (NYSERDA) – Business Energy Pro	▪ Small and medium-sized businesses (SMB)	▪ Programme is “measure-agnostic” to provide the opportunity for flexibility and innovation ▪ Behavioural, retro-commissioning, and operational and maintenance measure savings are also eligible	▪ Intervention includes more than a single measure ▪ Minimum of 5% portfolio energy reduction for either electricity or natural gas

Bay Area Regional Energy Network (BayREN) – Small and Medium Commercial Buildings Pay-for-Performance programme	▪ SMBs, commercial sites ▪ Conditioned space ≤50,000 sq. ft. ▪ Energy consumption: electricity ≤ 500,000 kWh, or annual gas ≤250,000 therms	▪ Boiler Plant Improvements ▪ Building Envelope Modifications ▪ Electrical Peak Shaving/Load Shifting ▪ Electric Motors and Drives ▪ Electric & Day Lighting Modifications ▪ Heating, Ventilating, and Air Conditioning (HVAC) ▪ Appliance and Plug-Load Reductions ▪ Refrigeration & Food Service Equipment	▪ Installation of equipment required to exceed the requirements of Title 24 of the California Code of Regulations ▪ Operational, behavioural, and retro-commissioning activities reasonably expected to produce multi-year savings
Pacific Gas and Electric Company (PG&E) – Residential Pay-for-Performance programmes	▪ Residential sector	▪ Smart thermostats, tuning and optimisation of equipment, lighting ▪ Home energy use analysis with recommendations ▪ Full-home energy retrofits (HVAC equipment and fabric improvements) ▪ Rebates on high efficiency, hybrid electric, heat pump water heaters ▪ Home maintenance, fabric improvements	▪ Offers a variety of programmes that include different offers for customers, with contractors having the flexibility to choose from a wide variety of measures and approaches
Germany – Energy Savings Meter	▪ Residential, Commercial, Industrial, MUSH ▪ Implemented projects include offices, retail stores, hospitals, swimming pools, hotels, restaurants and industrial sites	▪ Improving access to energy-related information, installing automatic control devices	▪ Eligible savings under funding coming from innovative digital installations and improvements

→ Lessons learned

Policy makers and regulators are driving the piloting of P4P programmes by utilities in the U.S. The vast majority of P4P programmes studied are implemented and administered by energy utilities. Utilities' involvement in P4P schemes facilitates data access, even if the exchange of energy consumption or utility bill data between energy utilities and public authorities is not always straightforward. In theory, P4P structures could be applied in the context of capacity mechanisms. In practice, our review shows that while bidders are allowed to use methodologies based on metered data, these methodologies were not widely used.

Implementers and aggregators support programme delivery. Many actors are commonly involved in a P4P programme, with specific responsibilities and roles. These relationships are an important part of the programme design and are sometimes captured in a manual explaining the process (*e.g.*, BayREN, SCL), which is especially helpful when building owners need to be involved in the scheme. The provision of information through webinars and presentations is also useful to increase participation in the programme.

Programmes often target multiple measures. Combining a minimum number of measures or achieving a minimum percentage of energy savings compared to the baseline, through certain types of measures, is often a programme requirement. Behavioural and operational measures are often combined with technical measures to ensure that savings are delivered.

Is the residential sector the new P4P frontier? To date, most of the P4P programmes have been implemented in the commercial sector. The majority of the P4P examples included in this report focus on large commercial, industrial or institutional customers. The P4P approach has not been very popular in the residential sector, possibly because the measurement methodology has been too expensive to scale up and not automated to this point (Granderson *et al.*, 2015). Large customers and high savings opportunities make more complex M&V procedures worthwhile for implementers. However, with the deployment of smart meters the procedure for collecting data becomes less complicated and the cost of whole-building measurement decreases, making M&V for P4P more practical for sectors such as residential buildings and SMEs.

3.3.3 Performance assessment method

In a P4P programme, compensation is bound up with performance; thus, it is crucial for the energy saving estimation to be reliable, accurate and clearly defined. The protocol and methodology applied can vary. A variety of savings estimation methods are used, including Building Energy System (BES) simulation models, direct device measurements, and analysis of meter or billing data at various time intervals. The protocol used, as well as the factors considered to establish the baseline, are reviewed below.

3.3.3.1 Protocol

Measuring and verifying savings from performance-based contracts requires adopting a methodology, which can influence the eligibility of measures and the programme requirements. Although M&V is an evolving science, best practices have been developed. These practices are documented in several guidelines, including the International Performance Measurement and

Verification Protocol (IPMVP) and the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Guideline 14, Measurement of Energy and Demand Savings (U.S. Department of Energy, Federal Energy Management Program, 2015). **Table 3** presents an overview of the IPMVP protocol options and examples of different energy efficiency retrofit scenarios and categorisation per option.

Table 3 – Summary of IPMVP options and examples of different applications (DELTA, 2019)

IPMVP protocol	Savings Calculation	Example of Application ***(EVO, 2019)***
Option A **Retrofit isolation: Key Parameter Measurement**	Saving are determined by field measurement of the key parameter(s), which define the energy consumption and demand of an isolated retrofit of a device. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter and the length of the reporting period.	· Pump/motor efficiency improvement · Boiler efficiency improvement · Lighting efficiency · Lighting operational control · Compressed air leakage management
Option B **Retrofit isolation: All Parameter Measurement**	Savings are determined by field measurement of the energy consumption and demand and/or related independent or proxy variables of the EE retrofit affected system. Measurement frequency ranges from short-term to continuous, depending on the expected variations in savings and length of the reporting period.	· Street lighting efficiency and dimming · Turbine-generator set improvement · Pump/motor demand shifting
Option C **Whole Facility**	Savings are determined by measuring energy consumption and demand at the whole facility utility meter level. Continuous measurements of the entire facility's energy consumption and demand are taken throughout the reporting period.	· Mix of EE measures with metered baseline data · Whole facility energy accounting relative to budget
Option D **Calibrated Simulation**	Savings are determined through simulation of the energy consumption and demand of the whole facility, or of a subfacility. Simulation routines are demonstrated to adequately model actual energy performance in the facility. This option requires considerable skills in calibrated simulation.	· Mix of EE measures in a building without energy meters in the baseline period · New building designed better than building code

At least seven of the case studies in this report estimate savings using the methodology and guidelines of **IPMVP Option C**. This approach offers a whole-building P4P approach (Touzani *et*

al., 2019). This is suitable given that almost all the programmes target operational, behavioural and retro-commissioning measures, strategic energy management, and multi-measure whole-building retrofits – and not single measures (*e.g.*, solely lighting or equipment replacement). Savings are determined by measuring energy consumption and demand at the whole facility utility meter level.

In the case of multi-measure projects, it is hard to identify the effect of a single measure alone on overall usage, especially when the savings impact is small and can be easily confused with other activities (*e.g.*, occupants leaving for vacation or missing from home for longer periods) (NRDC, 2017). According to Option C guidelines, savings should typically exceed 10% of the baseline in order to accurately discriminate the savings from the baseline data (Efficiency Valuation Organization, 2014). This can impact the programme requirements. For example, SCL requires at least 15% of the building's baseline electric consumption from capital equipment upgrades in order to improve the certainty of estimates.

The NJCEP P4P Existing Buildings programme is based on **ASHRAE Guideline 14**, Whole Building Calibrated Simulation approach. The IPMVP and ASHRAE approaches are very similar, but the ASHRAE protocol is not widespread, mainly because of the extremely high restrictions required in evaluating and discussing uncertainties. It is acknowledged that IPMVP offers a more general approach and structure, and that the ASHRAE protocol complements IPMVP in being more technical (Natural Resources Canada's Canmet ENERGY, 2008).

Energy Trust's Commercial Operations and Maintenance (O&M) Measurement and Verification Guidelines were developed utilising both IPMVP Option C and ASHRAE-14 industry standards.

Three of the case studies, particularly the P4P programmes that target smaller size facilities (*e.g.*, BayREN, NYSERDA and PG&E) utilise the **CalTRACK methods** which provide transparent and peer-reviewed implementation of IPMVP Option C. Savings are estimated using real-time data collected through dedicated smart meter technology and AMI, and are aggregated daily. CalTRACK methods (see below) reduce model uncertainty and errors regarding the estimation of savings among different buildings by aggregating the savings estimates across a set of buildings and cancelling out the overestimates/underestimates of savings. Typically, the accuracy of the aggregated savings estimates increases with the greater number of buildings in the portfolio.

The CalTRACK process began in 2012 with a decision by the California Public Utilities Commission (CPUC) to "broaden allowable software" under the state-wide initiative Energy Upgrade California.

The utility Pacific Gas & Electric Company (PG&E) led the effort to create a level playing field for an open market for software tools that contractors can use to predict savings and deliver rebates to customers. PG&E convened an inclusive process that spanned nearly four years, and included the CPUC, the California Energy Commission, investor owned utilities and other stakeholders.

This system was designed as a means to track normalised metered savings for P4P programmes. The core calculation is based on a counterfactual approach, utilizing a scenario modelling of what would be the estimated consumption of energy in a building if the energy efficiency intervention would not have taken place.

Data requirements include a full year of preintervention consumption data, corresponding local weather data and a date for the intervention. CalTRACK includes methods that describe how to use monthly billing data as well as interval data from smart meters to calculate hourly or daily derivatives.

Model uncertainty is addressed by aggregating sites into portfolios with guidance available to calculate portfolio-level uncertainty.

CalTRACK methods are developed under an open-source methods charter.

Source: CalTRACK website[24]

3.3.3.2 Baseline

The key factor for the determination of energy savings is the baseline scenario. This scenario represents what would have occurred without the implementation of the energy efficiency retrofits. Energy savings are calculated as the difference between this baseline and actual usage after an intervention. Fully specifying the baseline scenario requires a combination of technical information and **assumptions**. This depends on the measurement methodology used.

[24] Source: http://www.caltrack.org/

IPMVP Option C utilises statistical models in order to generate normalised metering estimates. They must include variables — such as weather data or occupancy — that affect energy consumption independent of the energy efficiency retrofits.

If the measurement methodology is for the whole building, the baseline is typically metered data from a period of time prior to the intervention, normalised for that period's weather and/or other variables. As a result, most of the programmes require at least a **12-month period of metered data** or more if any significant changes in the building (nonroutine events) have occurred in the past period. Statistical models adjust for building occupancy and other independent variable data if buildings stay relatively consistent through the baseline and post implementation period. But, as most of that information is not available publicly, estimation software accounts primarily for weather differences and time of day. After retrofit implementation, participants must report significant changes that affect energy consumption patterns.

The **frequency** of the baseline setting exercise is also an interesting parameter. The SCL five-year contract is the one case where the baseline is "resetting" every year. This contract is particularly designed for customers that lack initial capital or prefer to implement the energy efficiency retrofits gradually during the five-year period,.

3.3.3.3 Metering technology

The majority of the schemes reviewed in this report collect data via AMI meters in short time periods. For example, hourly or 15-minute interval data is required in SCL programme, and hourly, or sub-hourly interval data from Measurement Canada-certified meters is required in EPP.

→ Lessons learned

The choice of the M&V methodology is the basis of P4P schemes. In choosing a methodology to estimate savings from a P4P model, administrators must consider their tolerance for uncertainty, the magnitude of savings expected from the programme, and whether savings are aggregated in a portfolio. Standardised guidelines reduce the bureaucracy and complexity burden for aggregators/implementers and customers and allow the counting of savings consistently and transparently by all parties. The choice of the methodology has impacts on the programme requirements and can evolve with time. PG&E, for example, mentioned that they would like to improve their model to enable other behind-the-meter energy resources to be

incorporated (*e.g.*, EVs, storage, PV). In this way, they can expand the potential customer base for P4P programmes.

Smart meters help data access. The BayREN administrator highlighted that it was extremely difficult for the network to get access to metered data until the improvement and expansion of AMI in 2006. Automated metering enables continuous whole-building measurement. It also allows achieving time-specific energy savings which can be required to provide grid services.

3.3.4 Payment agreement method

A key element of each P4P scheme is the design of payment flows, agreements and processes between all actors involved. This varied among the cases studied. The beneficiary of the performance payment, the duration of the contract, the reward structure and prices per unit were examined.

3.3.4.1 Beneficiary of performance payment

Because the performance risk is borne by the entity paid for delivering the energy saving measures (rather than the utility or another programme administrator), the payment process is a core part of the programme's design. In some cases the administrator contracts and compensates individual customers directly, who are in turn responsible for delivering the energy savings required, while in others incentive payments are made to an implementer/aggregator.

In the ETO, NJCEP, SCL, EPP and DCSEU programmes/pilots, incentives are directly delivered to **customers** (*i.e.*, building owners), but can be assigned to the implementer (*i.e.*, ESCO, contractor or other service provider) via an incentive/agreement form. The same approach is applied by the PSE programme, but the option of assigning the rebates to the implementer is not available. PSE wanted to provide flexibility to customers to select a different implementer during the contract period.

The BayREN, PG&E, NYSERDA and ESM schemes target smaller buildings. In these schemes, the utility pays an **implementer/aggregator** who contracts customers to install the energy efficiency measures and delivers energy savings to the programme administrator. The price and other contract terms for energy efficiency measure installation and maintenance should be determined between the customer and the implementer/aggregator.

3.3.4.2 Contract duration

Long contract periods encourage deeper savings, since more measures with longer payback periods can be implemented. Nevertheless, contracts with a long duration can demotivate

implementers because they have to manage risks for a longer period (see Szinai *et al.*, 2017). For example, ETO had initially started the P4P pilot with a three-year performance period, but changed to one-year contract period for the future pilot due to the common property owner changes in the area.

The duration of the contract differs widely across the case studies. It most commonly varies **between one and five years**. In the NYSERDA programme, the performance period lasts three years; in the EPP programme, it counts up to two and a half years; while in ESM programme, the duration is designed to be five years. There are also some programmes that have shorter periods than three years. Specifically, PG&E offers a two-year contract, as does BayREN, whilst ETO, DSEU and NJCEP offer just one-year contracts.

Aiming to satisfy and engage more prospective participants, the SCL programme offers two options for contract duration. A three-year contract, which is suitable for participants who have the sufficient initial budget to make all of energy efficiency measures upfront in the first year. A five-year contract that is designed for customers who lack the initial capital or prefer to implement the energy efficiency retrofits gradually during the five-year period. Under the five-year contract, a new baseline is estimated each year.

3.3.4.3 Reward structure

The majority of the P4P schemes under study provide an **upfront, non-performance-based incentive** in addition to performance-based payments. This approach helps participants to manage cash flows and financial risks. In many cases, this upfront incentive is provided to the programme participant for the implementation of the specific mechanisms/services. For example, EPP provides an initial modelling incentive for the deployment of the energy simulation model, whilst ESM offers 25% of the project's estimated cost for digitalisation service development. In other cases, a compensation percentage (20%-60%) is made to participants after the installation of energy efficiency measures based on projected savings (*e.g.*, PSE, ETO). In NJCEP, an initial incentive is offered based on the area of the building after participants have prepared an energy reduction plan. Finally, in BayREN, 50% of the project cost will be paid to the Ally after the completion of the energy efficiency retrofits based on estimated savings, while the remaining incentives will be formed by actual savings.

In some cases, programmes have a **totally performance-based design** (*e.g.*, NYSERDA, SCL, DCSEU, PG&E). In this case, upfront payments are sometimes made to deal with cash flow issues, with adjustments taking place at a later stage to reflect the actual performance (*e.g.*, NYSERDA). This is also the case for part of the NJCEP incentive, which is delivered in advance but can be

considered as performance-based (because the following payment is adjusted if the project underperforms).

3.3.4.4 Price per unit

Another distinction among the P4P schemes reviewed concerns the price per unit of energy saved.

- **Set price versus bids**

Most of the P4P models offer a standard reward incentive for a measured unit of energy saved (*e.g.*, 5 cents/kWh saved for lighting and 15-20 cents/therm for natural gas), as set by the programme administrator.

However, a minority of the programmes rely on bidding prices. For example, in the NYSERDA, DCSEU and PG&E programmes rates depend on the bid presented by implementers and subsequent negotiations, meaning that rates will vary for each participant.

- **Prices reflecting lifetime of measures**

NYSERDA and PG&E take into account the lifetime of the measures in the price-setting mechanism. This approach aims to promote, or not discriminate against, measures with a long-term effect. The performance is therefore rewarded for services that are provided beyond the contracting period.

Table 4 summarises the payment structures for the 11 case studies except Continuous Energy Improvement by Efficiency Vermont, which is not a "pure" P4P scheme.

Table 4 - Payment structures

Programme	Pure P4P?	Payment schedule	Price setting	Contract duration
New Jersey – Pay for Performance Commercial & Industrial (C&I) programme	No, hybrid	1. After plan ready 2. After installation 3. After 1 year	For 2. and 3.: $0.09/kWh $0.90/therm Bonus for higher savings	1 year
Energy Trust of Oregon – Pay for Performance Pilot	No, hybrid	1. After installation 2. After 1 year	$0.15/kWh $1.80/therm	1 year
District of Columbia Sustainable Energy Utility (DCSEU) – Pay for Performance programme	Yes, 100% P4P	One-off payment	Project-specific	1 year
Seattle City Light – Deep Retrofit Pay for Performance (P4P) programme	Yes, 100% P4P	Yearly	For Path 1: $0.08/kWh For Path 2: $0.18/therm Bonus for higher savings	Path 1: 3 years Path 2: 5 years, baseline recalculated each year
Puget Sound Energy – Pay for Performance pilot	No, hybrid	Yearly	$0.35/kWh $5.00/therm Bonus for higher savings	5 years, including 4-year performance period
Ontario Save on Energy – Energy Performance Program	No, hybrid	Yearly	$0.04/kWh	2.5 years
New York State Energy Research and Development Authority (NYSERDA) – Business Energy Pro	Yes, 100% P4P	Quaterly	Price result of bid process Favours long lifetimes	5 years, including 3-year performance period
Bay Area Regional Energy Network (BayREN) – Small and Medium Commercial Buildings Pay-for-Performance programme	No, hybrid	Yearly	Price result of bid process Bonus for higher savings	2 years with possibility to extend
Pacific Gas and Electric Company (PG&E) – Residential Pay-for-Performance programmes	Yes, 100% P4P	Monthly	Project-specific Full lifetime reward	2 years
Germany – Energy Savings Meter	No, hybrid	Yearly	Price result of bid process	5 years

→ Lessons learned

The aggregator model is used for smaller buildings. In some programmes the administrator contracts and compensates individual customers directly, who are in turn responsible for delivering the energy savings required, while in others incentive payments are made to an implementer/aggregator. The aggregator structure is used in particular for smaller buildings.

Establishing the right payment structure requires research and consultation. There is not a standard approach to who is compensated. Interviewees highlighted the need to look at market conditions and consult stakeholders to decide on the payment structure. Although leveraging the wealth of knowledge and experience gained by other successful programmes is a key step towards success for programme administrators, best practices should be adapted to their local conditions.

Deciding on a contract duration requires balancing several factors. Contract duration is typically a feature that should also be decided with market representatives and customers, as local economic and social conditions can affect the willingness of customers to participate. Short contract durations can help mitigate risk for the implementer or aggregators. They often require putting in place a mechanism to ensure that longer-term measures are rewarded appropriately. This can be reflected in the payment structure or in the measures eligibility criteria.

Implementers/aggregators are taking the performance risk. In most of the P4P models analysed, the aggregator/service provider delivers the savings to the programme administrator and takes on the performance risk of energy efficiency measures. They make investments (*e.g.*, equipment replacements) and bear M&V costs. If project implementers/aggregators are paid by utilities one or more years after implementing a measure, and only on the basis of metered data, there is a risk of not being paid or receiving a penalty if savings do not materialise. This can increase the cost of their services and/or discourage them from participating. To be compensated for taking on the implementation risks, and to ensure that they will have a return on their investments, they may receive a higher payment per unit of energy saved. A mix of non-performance-based and performance-based payments can also alleviate risks. Another solution brought up by interviewees was the necessity to look into providing project finance.

4 Policy and regulatory recommendations

As noted in **Section 2.3**., the value proposition of P4P schemes is to boost energy efficiency policy effectiveness (ability to deliver on goals) and to increase the efficiency of public spending (more value for each € spent). This section provides policy and regulatory conditions for a successful replication of the P4P approach in the EU.

4.1 Policymakers should begin piloting Pay-for-Performance programmes now

As the electrification of end uses accelerates, with mass adoption of heat pumps and electric vehicles, and renewable energy sources come to dominate electricity generation, the value of demand-side resources to energy systems will increase substantially. The resources required to ensure electricity system adequacy will be very different, depending on the time of day, the weather, seasonal factors and location. In this environment, energy efficient buildings can play a significant role in reducing electricity system costs; but in order to be fully compensated for the services it provides, energy efficiency will need to prove that it is performing. As a result, piloting performance-based approaches such as P4P applications now will be an important first step in familiarising stakeholders with this concept and assessing whether the approach is appropriate to deliver on the objectives. Policymakers should consider requiring obligated utilities in Energy Efficiency Obligation Schemes (EEOSs) to deliver some of their targets using the P4P approach. In countries where there are capacity mechanisms, policymakers could pilot P4P in the context of applying the Efficiency First principle to these policy measures. Where there are local network constraints, regulators could provide incentives to distribution network operators to pilot P4P approaches as part of performance-based regulatory changes.

4.2 Start small and build upon experience

P4P has been used in the industrial and MUSH sectors for a long time, where ESCOs have directly contracted with end user clients for the provision of energy services, often with a P4P component. The novel application of P4P is in the buildings sector at the programme level. For large buildings or building complexes, this implies working directly with building owners or third-party energy service providers. For smaller buildings, particularly in the residential sector, this implies working with third-party aggregators to ensure that the risk of underperformance is spread across a portfolio of buildings and does not fall directly upon individual households or

building owners. These new relationships and the measurement infrastructure that accompany the P4P model will take time to build, with benefits flowing from frequent evaluation and refinement. Issues around the legal framework for aggregators may need to be addressed.

4.3 Focus on clear, precise and detailed measurement rules

The P4P approach requires a different form of M&V methodology to most energy efficiency programmes that rely on "deemed savings" estimates. The calculation of savings relies on accurate and timely meter data, and on the modelling of counterfactual energy consumption, *i.e.*, what would have happened without the programme intervention. This implies minimum requirements for the metering infrastructure and a set of detailed specifications for the modelling of the counterfactual. These specifications include how to collect and incorporate data on baseline energy consumption, variations in the weather, changes in circumstances (*e.g.*, changes in commercial use or the purchase of an electric vehicle) and exceptional events (*e.g.*, outages, or population-wide shocks such as COVID-19). Member States interested in piloting the approach should be aware of the methodological requirements outlined in Annex V of Directive (EU) 2018/2002 amending Directive 2012/27/EU on energy efficiency (EED). Having these requirements in mind early in the process will help with valuing the savings from the schemes in the context of the EED Article 7 energy savings obligation.

4.4 Involve stakeholders in programme development and communicate clearly to target audiences

P4P requires the energy efficiency industry to adapt to new forms of compensation and performance-based assessment. In this dynamic environment, it is essential to work closely with stakeholders to develop the programme design, measurement methods and reporting infrastructure (*e.g.*, data sharing platforms). A transparent, inclusive and iterative approach to programme development will increase the likelihood of better programme design and implementation. At the same time, being clear about why a P4P programme is being pursued will help to overcome legitimate concerns about changes to business models that may need to be developed. If P4P programmes are introduced where other traditional energy efficiency programmes are already in place, it is important to explain the links to consumers and avoid double counting energy savings. The Renovation platform foreseen by the Commission (2019 b) as part of the European Green Deal could be an interesting forum to discuss the P4P approach.

This open platform will bring together the buildings and construction sector, architects, engineers and local authorities, and could target housing associations or energy service companies that could roll out renovation including through energy performance contracting.

4.5 Consider adapting payment structures to fit market conditions

A pure P4P model would see payment only after the verification of savings for a period over which the metering took place and which was long enough to cover important seasonal variations; further payments would then be made on the verification of data for subsequent periods. This approach would be most appropriate for interventions relying extensively on behaviour to generate and sustain savings over time. For interventions relying more heavily on investments (*e.g.*, in fabric or HVAC improvements), it may be necessary to frontload payments to some extent in order to encourage programme participants bearing the risk of non-performance. Similarly, for measures where occupant behaviour is not a big factor in ongoing performance (*e.g.*, fabric improvements), payment for performance over the measures' lifetime based on one-year data might be appropriate. More generally, limitations to programme length are likely to necessitate the bundling of lifetime payments into a smaller number of payments over the course of a few years.

4.6 Ensure that P4P programmes integrate well with broader climate and energy objectives

P4P programmes, like many other utility programmes, competitive energy efficiency tenders and auctions, favour the take-up of the most cost-effective ways of meeting targets or achieving the specified outcomes. This is an advantage. At the same, though, there is a risk that programmes limited in their ambition by considerations of cost-effectiveness to ratepayers may be inconsistent with the achievement of broader climate and energy objectives that take account of broader societal costs and benefits. In the buildings sector, this risk could materialise in the "cream-skimming" of only the most cost-effective measures through the P4P programme, making the more costly but necessary measures more difficult to fund through other programmes. Ensuring that this risk does not materialise can be achieved through the linking of utility programmes (whether or not they involve P4P) to other taxpayer-funded programmes; for example, by allowing co-funding or by providing more per unit compensation for higher levels of savings. Performance standards and targets are also needed to guide interventions.

Information and tools such as building renovation passports[25] can also help ensure consistency between the activities taking place at a building-level and broader climate and energy goals.

4.7 Accelerate smart meter rollout

Smart meters are not strictly necessary for P4P programmes – what is required is a reliable set of meter readings – but they allow P4P to be carried out at a much lower cost and enable a wider set of energy sector objectives to be reached. For example, the widespread rollout of smart meters would mean that the value of energy efficiency at peak could be monitored and compensated.

4.8 Publish evaluation results and share knowledge

P4P programmes are still in the early stages of maturity and there is a lot of interest across Europe and elsewhere in learning from the experiences of other jurisdictions. Policymakers and programme implementers can improve the effectiveness of their interventions by drawing upon these sources. Likewise, public engagement and trust requires greater openness from energy experts, especially when the ultimate goal is to suggest implications to end users from the field of policy and practice, shaping policy strategies towards climate change mitigation. Critically, supporting efforts around Europe towards open model development, including source code, datasets and detailed documentations, along with suitable open licenses to enable use, modification, and replication, should be distributed through existing public channels.

[25] A Building Renovation Passport is defined as a document — in electronic or paper format — outlining a long-term (up to 15 or 20 years) step-by-step renovation roadmap for a specific building (Fabbri, 2017).

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Appendices A – Interview questionnaire

The questionnaire below has been used by the authors of case studies to explore a number of themes with interviewees (more information on the methodology can be found in **Section 3.1**).

ID card	
Name	• Name of the scheme.
Responsible entity	• Name of entity responsible for managing the scheme. • Category (*e.g.*, utility; third-party administrator [public or private sector]; private sector business model)
Purpose	• Purpose of the programme (1 sentence).
Start date and duration	• When did the programme start? • For how long has it been in place?
Location	• State, country, etc.
Geographical coverage	• City level, regional (*e.g.*, a set of multiple municipalities), state (*e.g.*, for the case of USA), national (country level). • If available: number of target households/buildings.
Driven by regulation?	• yes/no. If yes, describe briefly.
Website	• Official website for the scheme.
Contact person	• Name of the contact person who has been/will be interviewed (for internal use).
Summary description	• Summarise the approach, 150 words max.
Description of intervention	
End users or target sectors	• Target sector • Target users (if relevant:): *e.g.*, energy poor household, etc.
Technical measure(s) and lifetime(s)	• Table with measures (*e.g.*, AC replacement) and lifetimes (*e.g.*, 5 years).
Actors involved	• List all the actors involved and briefly describe their role. Examples - Public authority: name and describe role. - Utility: name and describe role. - Third party aggregator: name and describe role. - Installer: name and describe role. - Customers: name and describe role. - etc.
Performance assessment / valuation of benefits	
Baseline and metering methodology	• *e.g.*, CalTRACK system
Data collection	• How and how often is performance data collected; *e.g.*, performance checked on a monthly basis thanks to smart meters.

Price paid per unit rewarded	• *e.g.* ~8 $ cents/kWh and $1.8/therm.
Payment and reward structure	• Detailed description of the monetary flows of the project and the nonmonetary benefits for each actor involved. Note: - Need to clarify who the responsible parties are and who will be paid according to performance: public authority, utility, ESCO, aggregator, end user. - Need to specify if the payment is upfront, performance-based or partly up-front, partly performance-based. • If relevant: bonuses or penalties, if they exist, and when they take place.
Aggregated Portfolio Savings or Individual Project Savings	Choose one, or both.
Lessons learned for replication	
Achievements	• Achievements since beginning of the programme; *e.g.*, electricity (kWh), gas (therms) and demand (kw) savings.
Drivers for programme	• Describe regulatory and nonregulatory drivers.
If part of an obligation scheme	• Share of obligation met thanks to the programme; *e.g.* 1%, since this is a pilot programme. To be ramped up in next 3 years to 5%. • Proportion of overall utility programme spending. • Name of other programmes which contribute to the obligation scheme.
Barriers faced by the programme, and potential solutions (if identified)	• List all barriers one by one, and how they have been addressed; *e.g.*, barrier identified: risky to engage for energy efficiency installers; solution identified: etc.
Lessons learned for piloting P4P	• Possible questions to interviewees include: - What was learned from piloting the programme? - What would be the key lessons learned for others piloting P4P? - What needs to happen for P4P to scale up beyond pilots?
Next steps	• Possible questions to interviewees include: - What are the next steps for P4P in your jurisdiction? - What are the prerequisites for this to happen?
	Additional interview questions to consider: - Do you know of any other key examples of P4P we should look at?

Appendices B – Case study fact sheets

B1 – New Jersey – Pay-for-Performance Commercial & Industrial (C&I) programme

1. Overview

Responsible entity	New Jersey Board of Public Utilities (NJBPU), Division of Clean Energy
Summary	The P4P – Existing Buildings (P4P EB) programme is a market transformation initiative with a whole-building approach to energy efficiency in existing commercial and industrial buildings. A portion of the incentive is paid based on the achievement of the projected first year's savings. The P4P – New Construction (P4P NC) programme incentivises commercial and industrial projects that are designed to perform better than required by the current state energy code. A portion of project incentives is tied to actual building performance. The programme relies on a programme manager (TRC Companies) and on partners (more than 100 technicians).
Purpose	Incentivise building owners, developers or other applicants to take a comprehensive, long-term approach to incorporating energy efficiency into their buildings.
Start date and duration	The programme started in 2009 and has been in place since.
Location	New Jersey, United States
Coverage	Electric and/or gas customers of the following investor-owned New Jersey utilities (IOU) who pay a monthly Societal Benefits Charge (SBC) on their utility bills: Atlantic City Electric, Elizabethtown Gas, Jersey Central Power & Light, New Jersey Natural Gas, PSE&G, Rockland Electric Company and South Jersey Gas. New and existing commercial, industrial, multifamily and MUSH buildings' owners.
Driven by regulation?	Yes: ▪ In 1999, the Electric Discount and Energy Competition Act (EDECA) established the Renewable Portfolio Standard (RPS) requirements and the Societal Benefits Charge (SBC). ▪ P4P scheme implemented in the context of New Jersey's Clean Energy Program (NJCEP); see website for more information.
Website	https://NJCleanEnergy.com/P4P

2. P4P structure

Actors involved

- The New Jersey Board of Public Utilities (NJBPU) is a regulatory authority with a statutory mandate to ensure safe, adequate and proper utility services at reasonable rates for customers in New Jersey.
- The Office of Clean Energy was established in 2003 by the NJBPU to administer New Jersey's Clean Energy Program (NJCEP), a state-wide programme which promotes technologies that save electricity and natural gas and increase the amount of electricity generated from clean, renewable resources and distributed forms of generation.
- TRC Companies is the programme administrator for the NJCEP. It works closely with NJBPU staff to design, develop, launch and manage programmes within the NJCEP portfolio. TRC also coordinates outreach efforts and oversees the P4P partner network.
- Partners: The P4P scheme relies on a network of partners to deliver the programme. Currently, there are about 100 architecture, engineering and energy consulting firms and ESCOs approved as partners. They work directly with the programme participants, acting as their energy expert, and develop an energy reduction plan for each project, a financial plan for funding the energy efficient measures, and a construction schedule for installation, as well as conduct M&V of energy savings and building performance.
- Participants, also referred to as customers, are building owners/managers that pay into a monthly Societal Benefits Charge (SBC), which can be found as a line item on their utility bills and is the funding source for NJCEP. They must work with an approved partner in order to comply with the requirements of the programme.

Measures

Buildings eligible for the programme are:

- Commercial and industrial buildings which, for the Existing Buildings programme, must have a peak demand of at least 200 kW in any of the most recent 12 months.
- Multifamily buildings which, for the Existing Buildings programme, must have a peak demand of at least 100 kW in any of the most recent 12 months.

New or substantial renovation of commercial, industrial and multifamily buildings must have 50,000 sq. ft. or more of gross heated/conditioned space.

The programme requirements are:

P4P EB is intended to encourage contractors and building owners to look for ways to lower their total energy consumption from a whole building perspective in order to achieve deeper levels of savings than are typically achieved through one-for-one equipment change-outs. Instead of simply providing incentives to replace existing equipment with high-efficiency equipment, P4P EB seeks to transform the way in which contractors and design professionals consider energy use. The minimum scope of work for existing buildings should be:

- A minimum of a 15% annual source energy savings.
- Savings must come from a comprehensive scope of work, *i.e.*, cannot come from a single measure.
- No more than 50% of savings can come from lighting measures, albeit some exceptions are available.
- Measures must be limited to energy efficiency improvements, *e.g.*, lighting retrofit, high efficiency HVAC equipment, building management/controls, VFDs, air-sealing, etc., but cannot include energy generating and/or renewable energy technology.

The P4P New Construction Program is intended to encourage developers and design professionals to look for ways to optimise the design, operation and maintenance of new construction and substantial renovation projects in order maximise energy cost savings. The requirements are:

- Proposed design must meet or exceed the Minimum Performance Target of 5% energy cost or source energy savings for commercial and industrial buildings and 15% for multifamily buildings, compared to current energy code baseline.
- The Minimum Performance Target is based on reducing the total energy cost or source energy for the facility where electricity and/or natural gas is purchased and/or delivered by a New Jersey Investor-Owned Utility (IOU).

- Project must have at least one measure[26] addressing each of the following building components: envelope, heating, cooling and lighting.[27]

Performance assessment

The methodology used by the P4P Existing Buildings programme is based on ASHRAE Guideline 14, Whole Building Calibrated Simulation approach. The approach involves the use of computer simulation to create a pre-retrofit model of the energy use of the project (the baseline model). This model is calibrated against actual utility bills and available site measurements to obtain the calibrated baseline model. The calibrated baseline model is then used to evaluate energy and demand savings from various energy efficiency measures. Once the measures are installed, the programme evaluates post-retrofit utility bills and compares them to pre-retrofit utility bills, normalised for weather, to determine the actual savings achieved.

The New Construction programme also involves the use of computer simulation to create a "code-compliant" baseline model and an "as-designed" model based on the proposed design. The difference between the two is used to determine the energy and cost savings of the proposed design compared to a similar design built to code. Once the building is constructed and occupied, actual utility bills are collected and used to benchmark the building to determine how well it is operating.

Reward mechanism

Incentives are paid to the participant (customer) but can be assigned to the partner, but only if the participant indicates this on the Incentive Request forms. The payment structure of the programme is partially upfront and partially performance-based.

The incentives are offed in three phases upon completion of each of the programme milestones: i) approval of an Energy Reduction Plan, ii) installation of all recommended measures per plan, and iii) completion of a post-construction benchmarking report. The total performance incentive is the addition of Payments II and III (see below). Payment II takes place before the metered energy data is available, so Payment III is adjusted to take into account real performance.

[26] Measures are defined as components that exceed code requirements but cannot include energy generating and/or renewable energy technology (NJCEP, 2020a).

[27] Buildings that are not heated (*e.g.*, refrigerated warehouse) or not cooled (*e.g.*, warehouse) will not be required to have a measure addressing the missing building component.

P4P Existing Buildings Incentive Structure

Incentive #1: Energy Reduction Plan			
Incentive Amount:		$0.15	per sq ft
Minimum Incentive:		$7,500	
Maximum Incentive:		$50,000	or 50% of facility annual energy cost
Incentive #2: Installation of Recommended Measures			
Minimum Savings Target:		15%	
Electric Incentives	Base Incentive based on 15% savings:	$0.09	per projected kWh saved
	For each % over 15% add:	$0.005	
	Maximum Incentive:	$0.11	
Gas Incentives	Base Incentive based on 15% savings:	$0.90	per projected therm saved
	For each % over 15% add:	$0.05	
	Maximum Incentive:	$1.25	
Incentive Cap:		25%	of total project cost
This incentive is based on projected energy savings outlined in the Energy Reduction Plan. Incentive is paid upon successful installation of recommended measures			
Incentive #3: Post-Construction Benchmarking Report			
Minimum Savings Target:		15%	
Electric Incentives	Base Incentive based on 15% savings:	$0.09	per actual kWh saved
	For each % over 15% add:	$0.005	
	Maximum Incentive:	$0.11	
Gas Incentives	Base Incentive based on 15% savings:	$0.90	per actual therm saved
	For each % over 15% add:	$0.05	
	Maximum Incentive:	$1.25	
Incentive Cap:		25%	of total project cost
This incentive will be released upon submittal of a Post-Construction Benchmarking Report that verifies that the level of savings actually achieved by the installed measures meets or exceeds the minimum performance threshold. Total value of Incentive #2 and Incentive #3 may not exceed 50% of the total project cost. Incentive Caps apply.			

P4P New Construction Incentive Structure

Similar to the Existing Buildings programme, the New Construction programme also includes incentives based project milestones.

- Incentive #1 - Submittal and approval of the proposed energy reduction plan prepared by an approved programme partner, detailing the proposed building design and its energy cost savings compared to code compliant baseline. Incentives range from $0.08-$0.16 per square foot up to $60,000 and are contingent on moving forward with construction.
- Incentive #2 - Submittal and approval of an "as-built" energy reduction plan and commissioning report confirming energy efficiency measures are installed and performing as expected. Incentives range from $0.80-$1.40 per square foot up to 75% of the project's incremental cost.

- Incentive #3 - Submittal of building performance report demonstrating building has achieved ENERGY STAR Certification. Incentives range from $0.35-$0.40 per square foot up to 25% of project's incremental costs (NJCEP, 2020a; NJ OCE, n.d.).

Achievements

NJCEP P4P Annual Savings for Fiscal Year 2019 (NJCEP, 2020b).

Annual Electric (MWh) and Gas and other Fuel (MMBtu) Savings (committed and installed) for FY 2019	
Existing Buildings	**New construction**
52,377 MWh	13,774 MWh
165,470 MMBtu	86,781 MMBtu

Next steps

- NJCEP is thinking about preparing an evaluation of the P4P EB actual vs. projected savings for the past three years. The last analysis was back in 2017.
- New Jersey recently unveiled the state's Energy Master Plan (2019), which comprehensively addresses New Jersey's energy system, including electricity generation, transportation and buildings, and their associated greenhouse gas emissions and related air pollutants.[28] In order to facilitate and optimise access to energy efficiency programmes, the state intends to implement user-centered design in programme access and application to ensure the website and process is accessible to all customers. It will be important to closely monitor technology advancements and opportunities to explore and invest in deeper energy saving measures. Programme design will need to be updated as certain equipment and building standards are achieved on a ubiquitous basis, and as market forces such as consumer demand and pricing are altered. Continued efforts toward increased efficiency will mirror advancements in other clean energy areas moving forward.

[28] The Energy Master Plan defines 100% clean energy by 2050 as 100% carbon-neutral electricity generation and maximum electrification of the transportation and building sectors, which are the greatest carbon emission producing sectors in the state. The Energy Master Plan is the first of a series of monumental steps to ensure that New Jersey generates, uses and manages its energy supply in a way that is consistent with economic, climate and societal demands.

3. Issues of interest for setting P4P schemes

What have the main drivers been?

- In 2007, commercial and industrial (C&I) sector building energy use represented approximately 40% of the total energy consumption in New Jersey. The P4P scheme was aimed at reducing the consumption of this market sector by at least 15% across the state. Prior to the development of P4P, there were a few utility-run performance programmes in New Jersey, but they were no longer available to the public.
- The P4P programme was seen as an opportunity to complement these offerings with a market transformation programme that would combine educational and equipment incentives into one all-inclusive, whole-building programme. In designing the P4P programme, the goal was to change the way contractors and end users approached energy efficiency opportunities (Healey, Rozanova, Rooney, & Lorentzen, 2010).

What were the lessons learned?

Although NJCEP P4P was very successful its first year, it also had a few setbacks. Some of the challenges involved responding to the market's impression of this new programme. Although many contractors and building owners found the programme exciting, some found it cumbersome or confusing. P4P requires more technical knowledge than any other incentive programme in New Jersey. Some partners found these tasks harder to accomplish then they originally expected. Market barriers included:

- Customers are not aware of the programme incentives or are sceptical of new technologies.
- Despite incentives, customers do not have the money to pay for a project, and they are unsure of how to participate in programmes.
- An additional market barrier unique to the P4P programmes includes trying to move customers beyond just picking the easiest measures to really investing in measures that achieve deep energy savings while leveraging the quick paybacks.

Addressing market barriers

The P4P programmes are constantly evolving to overcome barriers to both participation and energy savings, such as:

- Designing programme requirements and incentives to guide customers into combining multiple measures under a single project, balancing both "low hanging fruit" measures with deep savings measures that may be more costly and complex.
- Requiring customers to work with a partner that acts as their energy professional and guides them through the entire programme process.
- Aligning the programme with well-known agencies in the building science sector, such as ASHRAE and Leadership in Energy and Environmental Design (LEED) due to its popularity in the new construction segment and increasing popularity with existing buildings.

Cost considerations

The P4P programme, by design, requires a high level of commitment from both partners and participants. In order to successfully evaluate energy consumption from a whole-building perspective, the participant has to be prepared to incur upfront costs for the Energy Reduction Plan development, installation oversight and post-retrofit M&V activities. Total project costs are also higher since scopes of work include multiple measures. Since the incentives are paid upon approval of each deliverable, the participant has to lay out funds before the incentives are paid.

In an attempt to alleviate some of these obstacles, administrators have advised partners to charge for services in alignment with the incentive payment schedule. They also collaborated with the New Jersey Economic Development Authority to offer low-interest financing for projects participating in the programme.

Uptake challenges

Due to the novelty and complexity of the schemes, participation rates were low during the first 12 months of the programme. Additional marketing and increased partner participation eventually led to a steady flow of submittals.

The programme design results in a lag between work scope approval and installation of energy efficiency measures due to a number of reasons. First, the incentives are not guaranteed until the Energy Reduction Plan is thoroughly reviewed and approved. For example, this approval process exceeded two months for the first project from a partner. Second, most projects involve

five or more measures, resulting in additional time for design, bidding and construction planning and management.

Informal conversations with various programme partners also indicated that lack of participation may be due to the complexity of the management structure in commercial facilities. In the retail and hospitality sectors specifically, partners found it challenging to reach top management to discuss energy savings opportunities and programmes.

Key findings identified from programme implementation are listed below:

- When developing the programme, it was important to assess previous and existing incentive programmes and acknowledge the strengths and weaknesses of each. There was a need in the New Jersey commercial, industrial and multifamily market for a comprehensive, energy-efficiency programme. Many participants and contractors are familiar with existing and previous incentive programmes in New Jersey and have participated in some or all of these programmes in the past. Translating some programmatic aspects of these programmes into P4P immediately created a market of willing participants.
- Integrate existing resources. It is important to leverage existing standards, technologies and service providers to minimise the duplication of efforts. P4P created a large partner network utilising a talented pool of New Jersey energy companies to market and deliver the programme. Since most of the partners are based in New Jersey, the programme also serves to stimulate the state's economy.
- Proper programme and project management is a key factor which drives the success of the programme in reaching its goals. Most importantly, appropriate management of the programme contractors is necessary in order to ensure programme participation levels are high (Rozanova *et al.*, 2012).

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B2 – Energy Trust of Oregon – Pay for Performance Pilot

1. Overview

Responsible entity	Energy Trust of Oregon (ETO)
Summary	The P4P scheme managed by ETO engages energy service providers and the commercial sector, in particular office buildings, healthcare, grocery stores and MUSH buildings. The participant is working with an approved P4P ally, who is responsible for preparing a baseline for the M&V procedure and an energy reduction plan. Once approved by ETO, the plan will identify a minimum of three capital improvements and opportunities for operation and maintenance savings.
Purpose	▪ Deliver deeper savings. ▪ Encourage participants to take a holistic approach to energy efficiency (capital measures, O&M) and retrocommissioning. ▪ Improve realisation rates for programmes. ▪ Supplement energy efficiency programmes with Strategic Energy Management (SEM) offerings.
Start date and duration	▪ Phase I started in October 2014 and ended in 2017. ▪ Phase II was launched in 2017 and is still active. ▪ Phase III will be launched within the year 2020 (Public Utility Commission of Oregon, 2019).
Location	Portland, Oregon, United States
Coverage	▪ For electric savings in Portland General Electric and Pacific Power territories. ▪ For natural gas savings in NW Natural, Cascade Natural Gas and Avista territories.
Driven by regulation?	Yes. ▪ Investor-owned electricity companies (retail) must meet the energy savings goals set by the Oregon Public Utility Commission (OPUC) to be eligible for funding under the obligation (that is, funding from the Energy Trust). ▪ As a result of state legislation, tariffs and other requirements, Energy Trust is funded by customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista.
Website	https://www.energytrust.org/incentives/existing-buildings-custom-incentives/

2. P4P structure

Actors involved

- The Oregon Public Utility Commission (OPUC) oversees Energy Trust's investment of utility customer funds in energy-efficiency and renewable power programmes. Through state legislation passed in 1999, the OPUC was authorised to select a non-profit organisation to invest the majority of a "public purpose charge" (OPUC Partners - Energy Trust of Oregon, n.d.). Energy Trust was selected to receive and invest those funds in cost-effective energy efficiency, new renewable resources and market transformation. Energy Trust of Oregon has to meet cost-effective directives and criteria set by OPUC. OPUC oversees the expenditures through quarterly financial reports and statements.
- Energy Trust of Oregon is an independent non-profit organisation that helps utility customers benefit from efficient energy use and from renewable energy production. It provides comprehensive energy efficiency and renewable energy programmes and is dedicated to helping is 1.6 million utility customers in Oregon and Southwest Washington. ETO is mainly responsible for customer outreach and reviewing the eligibility of the participants in the programme. ETO will review the Energy Reduction Plan developed by the ally and will also perform a documentation review. In addition, ETO will make a post-installation verification and will conclude a model review. Finally, ETO will review the report filed by the ally and, if it passes the quality review, will provide the incentive payment to the participant.
- The P4P ally is responsible for customer recruitment and identification of site and customer attributes. Its role includes the development of an Energy Reduction Plan and the preparation of the application with the customer. Furthermore, the ally will install/implement the energy efficiency measures and will make the necessary model development. Finally, the ally will prepare the final savings report to justify eligibility for incentives (Levin & Belkayat, 2017).
- Utility customers must follow the guidelines of the pilot and act according to the programme's requirements. They must cooperate with the service's companies and contactors to achieve agreements (MetaResource Group, 2016; Energy Trust of Oregon, n.d.).

Measures

The programme was structured to engage commercial, in particular office, buildings, as well as healthcare, grocery stores and MUSH.

The P4P programme pilot (Phase I) included the following design elements:

- Requires that customers work with a selected contractor to an agreed-upon scope that meets ETO programme requirements.
- Includes both O&M and capital savings measures.
- Requires a minimum of three years of customer commitment.
- Requires at least 20,000 square feet of conditioned floor area.
- Requires the maintenance of at least 80% of maximum building occupancy levels for one year prior to project start.

There is not a standard list of eligible energy efficiency measures; the only requirement is the selection of at least three capital improvements. The majority of the energy efficiency measures implemented in the participating facility were operational rather than capital (Levin & Belkayat, 2017; Walker, 2016).

Performance assessment

M&V was completed using the existing utility meters, with a regression model-based approach to normalise for weather and any other building changes that may affect energy performance. Progress is measured continuously based on actual savings. Monthly savings are aggregated at the end of the year to calculate the annual energy savings compared to the baseline. It is required that achieved savings must be greater than 5%.

Reward mechanism

Payment structure Phase I & Phase II pilot:

Participants (buildings' owners) receive an incentive payment at the end of each of the three years.

Energy Trust capped the incentive at 125% of the savings projected in the service provider's proposal to mitigate Energy Trust's risk, while still encouraging more measures. The verified savings exceeded the cap primarily because the service provider implemented additional measures.

There is the option for the participant to assign the payment to the contractor. Regarding the commercial building that participated in 2014, the customer and service provider had their own performance-based contract. The customer purchased savings from the service provider at the end of each year for three years at market cost. This solved the problem of the owner paying for upgrades while the tenants benefitted. In this case, the participating customer bills the service provider's fee to the tenants as part of their lease payment.

There were two options for the P4P Phase II pilot.

Option 1 included:

- O&M and behavioral: $0.05/kWh, $0.60/therm for three years
- Capped annually at 200% of proposed

While Option 2 composed of:

- At least 50% capital retrofits: $0.10/kWh, $1.20/therm for three years
- Capped annually at 150% of proposed

Payment structure Phase III pilot (to be launched):

The basic differences with the previous phases are the duration of the payment agreement, which will last only one year instead of three, and the compensation process. The one-year contract agreement resolves the building's owner change problem. The commercial properties are sold too often and may change one or more owners between the three-year period. Furthermore, the participant will earn cash incentives at the time of installation of $0.15/kWh and $1.80/therm based on 60% of the estimated energy savings. At the end of one year, the energy model will show final energy-saving results, and the remaining 40% of the estimated savings or more can be delivered to the participant. Finally, the energy reduction plan and energy modelling will be provided to the participant/building owner at no cost.

The ETO pilot pursues the aggregation of projects for facility managers to pair smaller projects that are not cost-effective on their own with other projects that generate more savings. Thus, by grouping projects together, facility managers can make more energy-saving upgrades than if they pursued them individually (Levin & Belkayat, 2017; Energy Trust of Oregon, n.d.).

Achievements

Phase 1: Energy Trust issued a Request for Proposals in February 2014, seeking three or more commercial office buildings to participate. In the late spring of 2014, Energy Trust selected two

pilot projects. Ultimately, only one project, a large commercial building in downtown Portland, was selected for the pilot and the three-year contract was completed in 2017. Savings were verified for the building which participated in the Phase I pilot during the period 2015-2016. The overall achievements are listed below (Levin & Belkayat, 2017):

- Energy Star score improved from 80 to 92.
- 16% savings (over 700,000 kWh each year).
- Estimated $65,000 in energy cost savings annually.
- High customer satisfaction.

Phase 2: Following this initial pilot, Energy Trust staff and contractors launched Phase II of the commercial P4P offer in 2017 to achieve deeper persistent savings and expand customer interest and participation. The expanded effort provided additional contractor training on programme requirements, including offering energy modelling tools and standard calculation methodology developed by Energy Trust. The main characteristics and requirements of the pilot remained the same as in pilot Phase I. Phase II of the Commercial P4P pilot received limited engagement from energy service providers eligible to deliver the offering and, to date, has not been successful in identifying P4P project candidates.

Phase 3: Given the limited interest regarding the Phase II pilot, Energy Trust engaged their Conservation Advisory Council and other stakeholders in August 2018 to share lessons learned from a third party evaluation of the Phase II P4P Pilot and to receive feedback. In addition, Energy Trust staff engaged a targeted group of stakeholders to provide their perspective on potential changes for a P4P Phase III pilot.

Next steps

Energy Trust of Oregon will soon launch the Phase III P4P programme incorporating the steps listed below.

To increase participation activity:

- Expand customer and building eligibility to include smaller energy users and revise baseline energy use requirements.
- Reopen the contractor eligibility application process to provide additional time and training to interested contractors.
- Consider alternative approaches to lead generation for P4P projects.

To achieve deeper and persistent savings:

- Revise length of programme engagement.
- Develop alternative payment structures for capital projects.

OPUC staff plans to work closely with Energy Trust as they engage stakeholders on the redesign. Proposed actions will require Commission approval. This redesign will be transparent and open to stakeholder input (OPUC, 2018; MetaResource Group, 2016).

3. Issues of interest for setting P4P schemes

What have the main drivers been?

Since 2002, Energy Trust has implemented energy efficiency incentive programmes for investor-owned electric and gas utilities across all customer sectors (residential, commercial and industrial) resulting in the acquisition of 670 MW and 57.9 million therms of cost-effective energy savings. The majority of the programmes delivered by Energy Trust are designed to encourage customers to choose efficient energy equipment and usage practices.

In 2010, the government of Oregon introduced an energy efficiency obligation for residential, commercial and industrial sectors. The obligation concerns electricity and gas. Obligated parties include investor-owned electricity companies (retail). Measures for buildings must meet Energy Trust energy efficiency specifications. Statute requires independent review of the public purpose charge to develop recommendations for the legislature.

In 2012, various contractors in the market introduced the concept of a P4P pilot offering to OPUC. OPUC and Energy Trust saw potential in the P4P design because it shifts performance risk away from ratepayers to the customer or contractor receiving the incentive by ensuring that savings are realised prior to payment. In 2014, Energy Trust released a request for project proposals under the PUC Docket No. UM 1678. Energy Trust staff worked diligently to create a pilot P4P programme at OPUC's request, and OPUC assisted them (OPUC, 2018).

What were the lessons learned?

The main barrier the Energy Trust of Oregon P4P pilot faced was the limited participation from energy service companies and project candidates. To overcome this hindering barrier, Energy Trust of Oregon engaged their Conservation Advisory Council and other stakeholders in August 2018 to provide feedback on the Phase II pilot. From the consultation analysis, Energy Trust of Oregon received very mixed reviews and realised their programme did not meet all prospect

participants' needs. In addition, in the first quarter of 2019, Energy Trust proposed a more formal consultation engagement process that brought together customers as well as industry representatives to modify the P4P pilot offer in order to increase customer and contractor activity.

Energy Trust staff engaged a targeted group of stakeholders in 2018 to provide their perspective on potential changes to the Phase III pilot.

According to the findings of the evaluation, customers are not interested in the current offering for the following reasons:

- The technical requirements to estimate savings and screen projects for cost-effectiveness before a customer can commit are onerous and limit project eligibility.
- The lack of upfront incentives and the long-term payment structure make it difficult for P4P allies to sell and may not align with typical customer capital budgeting and financing schedules.
- The overlap with existing offers for commercial customers to pursue capital projects with upfront incentives limits applicability.
- Many large commercial customers are already enrolled in the Commercial Strategic Energy Management (SEM) offer that specifically addresses energy savings opportunities related to operations, maintenance and behaviour activities with meter-based energy savings and incentives paid to the customer after the end of an engagement year.

Lessons learned from the P4P pilot regarding the incentive structure (MetaResource Group, 2016).

Participant perspective:

- Timeline of payments. Traditional incentives are typically paid out within weeks of project completion in one lump sum.
- Lack of incentive predictability. Since the incentive is performance-based, it can be difficult to predict in advance, adding uncertainty to participants' investment decisions.

Programme administrators' perspective:

- For combined capital and O&M projects, programme administrators face some uncertainty in parsing out savings between capital and O&M. Additionally, these combined savings can add uncertainty to measure life claims.

- Potential uncertainty around end of life vs. early replacements. Since the savings are measured at the meter, the savings calculation treats all measures as early replacements.

4. References

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B3 – District of Columbia Sustainable Energy Utility (DCSEU) – Pay for Performance programme

1. Overview

Responsible entity	District of Columbia Sustainable Energy Utility (DCSEU), a sustainable energy utility
Summary	The DCSEU P4P programme offers incentives to large, existing commercial and institutional buildings for energy conservation measures delivering annual savings greater than 10% and based on pre- and post-project metered data. The minimum savings requirement was doubled from 5 to 10% after the launch of the programme.
Purpose	▪ Drive energy efficiency savings for customers ▪ Develop the data analytics vendor community
Start date and duration	▪ Data analysis capabilities and programme design were developed during FY 16-18, with 11 projects closing during that time as part of DCSEU's Custom Retrofit offering. ▪ The programme was officially rolled out in FY19 with projects tracked as part of DCSEU's Custom P4P pilot offering. ▪ In FY20, the programme will no longer be a pilot and is intended to continue as a standard custom incentive offering. The current DCSEU contract runs until end of September 2021.
Location	District of Columbia, United States
Coverage	Commercial and institutional buildings, including hospitals, universities, commercial real estate and hotels larger than 100,000 ft^2 that have completed, or are undergoing, complex, multimeasure, behavioural and/or operational changes.
Driven by regulation?	Yes: ▪ The District's Clean and Affordable Energy Act of 2008 instructed the Department of Energy and Environment (DOEE) to contract the Sustainable Energy Utility to deliver energy savings. ▪ The Clean Energy DC Omnibus Amendment Act of 2018 created a Building Energy Performance Standard (BEPS) for buildings over 50,000 ft2. Owners can choose to improve their energy performance by 20% over the compliance period. P4P is a tool to influence customers to retrocommission/retune their building in their effort to comply, although P4P itself is not mandated.
Website	https://www.dcseu.com/commercial-and-multifamily/pay-for-performance

2. P4P structure

Actors involved

The following actors are involved in the scheme:

- Department of Energy and Environment (DOEE): places obligation on DCSEU to make energy savings, if not through P4P.
- DCSEU: sustainable energy utility implemented by Vermont Energy Investment Corporation (VEIC), winner of the competition to deliver energy savings. DCSEU account managers deal with individual P4P cases.
- Customers: enter into direct agreement with DCSEU and benefit from energy savings.
- Energy efficiency service providers (SP): third party vendors provide energy efficiency services to end customers. They can enter into specific three-party incentive agreements with DCSEU and the customer.
- Preferred contractors: a list of preferred contractors bring potential cases to DCSEU for consideration and are listed as a group on the DCSEU website for access to new potential customers contacting DCSEU for advice.
- Vendors: can receive the incentive payment if the customer agrees and signs a third party agreement transferring the payment.
- Electricity and natural gas ratepayers pay a surcharge that finances the Sustainable Energy Trust Fund, from which DCSEU is funded. Ratepayers benefit from system savings stemming from energy efficiency programmes, with P4P programmes ensuring that ratepayers are getting value for their money, given that their investment is tied to performance.

Measures

Target measures are:

- Complex multimeasure efficiency projects.
- Recommissioning and retrocommissioning of equipment.
- Advanced building controls and upgraded building automation systems, such as thermostats and sensors.
- Use of an energy management information system to identify and implement measures.

The measures implemented so far include mostly HVAC and lighting.

Performance assessment

IVMVP Option C is used to calculate the counterfactual energy consumption against which performance is measured. Baseline data are submitted to DCSEU (at least one year's worth of data). Inspections are possible. Mandatory data updates are provided on work performed during project and upon completion (within one year) (documentation required). Ideally, data are collected for at least one year after project completion, including occupancy rates and non-routine events in order to better model savings.

Target savings per project are 250,000 kWh or 1,000 MMBtu, and savings must be greater than 10%. Savings can only be claimed for a year's lifetime. The process is as follows:

1. Based on a savings estimate (10% of annual use or determined through calculated estimates), an Incentive Agreement (IA) is created with a "not-to-exceed" incentive value at the current $/MWh or $/MMBtu yield.
2. Customer signs the Incentive Agreement and work is performed with evidence provided to DCSEU throughout.
3. Post-project performance is compared to the baseline energy model to determine energy savings.
4. Customer can assign incentive to a third party via a third party release form.
5. Inspection is completed (could be based on data or screenshots, etc.).
6. Check request is processed.

Reward mechanism

Incentives vary based on factors such as project cost, scope of project, duration of project, total energy saved and funding availability. The DCSEU pays a yield that varies by project and remains confidential. Programme incentives are paid after a period of performance through verified savings. The yield is clearly communicated to the customer and set in the Incentive Agreement.

Achievements

Since FY 2016, using the P4P method of savings analysis (regression), 8,780 MWh and 879 MMBtu of energy savings at 14 sites have been claimed.

Next steps

Minimum performance standards for commercial and institutional buildings will drive uptake from 2020. Twelve projects are lined up for 2020 and another 20 are in the pipeline, so the programme is ramping up.

There is not enough DCSEU budget to do aggregated P4P in the residential sector at the moment.

3. Issues of interest for setting P4P schemes

What have the main drivers been?

- Legislative drivers for energy savings.
- Cost reductions and improved access to data collection and analysis — simpler than doing engineering calculations.
- Performance incentive should lead to better quality.

What were the lessons learned?

- Communication is key: With different offerings from DCSEU, there was some initial confusion over whether traditional incentive calculations or the P4P method of savings analysis was appropriate. DCSEU ensured that it is clear that P4P is appropriate for complex, multimeasure, behavioural and/or operational changes.
- Attribution of savings can be difficult: There may be two vendors active at a site or multiple simultaneous efforts (ex., an ASHRAE audit performed by one and EMIS effort by another vendor). The P4P method cannot easily separate how much savings is allocated to each effort. DCSEU communicated that it is the total savings that is the key and that the DCSEU incentive is based on continuous energy improvement. This may, however, increase the complexity of agreements between vendors on how to allocate rewards between them.
- Internal data analysis capability needed to be ramped up: Training and investment in internal tools made each analysis easier and take less time. This is an internal staffing issue.
- At least one year of performance data is needed: some vendors asked for less than one year of energy data, in order to recover their costs more quickly. However, one cannot exclude a summer/winter month as performance under extremes is needed to have an

accurate analysis. There is an added complication that DCSEU operates on a Fiscal Year cycle and will sometimes make exceptions to the full year performance period (extrapolating weather data) in order to meet its goals, as long as the full summer is included.

- Behavioural measures can take advantage of P4P: Successful behavioural measures benefit from P4P as they would not get taken into account in an engineering calculation.

4. References

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B4 – Seattle City Light – Deep Retrofit Pay for Performance (P4P) programme

1. Overview

Responsible entity	Seattle City Light (SCL), the public utility providing electrical power to Seattle, Washington (U.S.), and parts of its metropolitan area
Summary	Seattle City Light started a three-year pilot P4P programme in 2013 with three medium-large commercial buildings. The savings were measured at the meter in P4P and participants received a set incentive rate for energy savings achieved over the course of a defined performance period (either three or five years). Incentive payments were made at the end of each year of the performance period (SCL, 2018a; SCL, 2018b). After the successful conclusion of the P4P pilot programme, in 2018 SCL launched the Deep Retrofit P4P programme. Seattle City Light administers the programme and a contractor implements the measures in commercial buildings.
Purpose	To enable customers to achieve energy efficiency through incentive payments, which are made over time and based on energy savings measured at the electric meter.
Start date and duration	▪ Pilot started in 2013 and completed in 2016 (Rocky Mountain Institute, 2013). ▪ The Deep Retrofit P4P programme was launched in October 2018. Three large buildings have participated and several more are considering participation.
Location	Seattle, Washington, United States
Coverage	SCL medium-large commercial facilities' owners in SCL areas with interval meters, each with at least 50,000 square feet of conditioned floor area and energy use over the past year that is stable enough to allow the baseline model to meet the M&V quality requirements.
Driven by regulation?	Yes. The state's Energy Efficiency Resource Standard (EERS) requires electric utilities (*i.e.*, investor-owned utilities, municipal utilities, rural electric cooperatives and public utility districts) to consistently meet targets for energy conservation and renewable energy (Washington Department of Commerce Energy Division, 2018).
Website	https://energysolutions.seattle.gov/your-business/pay-for-performance/ (not available outside U.S.)

2. P4P structure

Actors involved

The following actors are involved in the scheme:

- Seattle City Light is a publicly owned utility dedicated to exceeding its customers' expectations in producing and delivering environmentally responsible, safe, low-cost and reliable power utilising the City Budget to develop and implement conservation programmes. Seattle City Light is responsible for the administration of the programmes to address issues and make necessary updates. Conservation programmes of SCL are funded by a charge on the utility customers' bills.
- Service providers/contractors will work with building owners to find an energy efficiency solution customised to each building, with support from Seattle City Light. Such service providers can include energy service companies (ESCOs), which often embrace the type of whole-systems, deep-savings efficiencies compatible with P4P programmes.
- Customers/participants will cooperate with energy service providers and any eligible savings — once verified — will qualify the owner for a rebate paid annually over the course of the three-year or five-year performance period. Participant must ensure that at least one member of the P4P team brings technical background and experience related to performance-based projects and has sufficient knowledge and expertise in M&V. Participants are also solely responsible for all aspects related to selecting the energy efficiency measures / equipment, selecting contractors to perform any project work, inspecting the project work and the equipment and that they are safely and properly installed and suitable for participant's purposes (SCL, 2018a).

Measures

The programme intends to engage medium-large commercial buildings. Also, MUSH market buildings are eligible and have shown a lot of interest. The first building participating in the programme was a very large hospital facility with estimated savings around 9,000,000 kWh. Industrial customers are only eligible for any buildings they may have without industrial processes. Potential building types could be offices, hospitals, hotels, warehouses and large retail/grocery stores, senior care facilities and schools.

The programme encourages deep retrofits that result in significant energy savings of at least 15 % of the building's baseline electric consumption from capital equipment upgrades with measure lifetimes over 10 years. As such, savings should primarily be from building retrofits and

equipment upgrades, but behavioural, operational and maintenance (O&M), and retro-commissioning activities will also be accepted if enough savings come from retrofits and upgrades (Moen & Rodenhizer, 2016).

Performance assessment

Savings for the SCL P4P programme are estimated utilising meter-based measurement. Specifically, M&V procedure is achieved in accordance with International Performance Measurement & Verification Protocol (IPMVP) Option C or other normalised metering. Baseline is estimated taking into account normalised pre-implementation meter data. Baseline is calculated (ECAM software) on one year of previous energy use (unless there are valid reasons to incorporate more data in the baseline).

Seattle City Light Energy Management Analysts (EMAs) will independently develop and maintain models for each P4P project. The EMAs will use these models to monitor performance, comparing them to expected outcomes during each quarterly performance period, and to verify savings estimates provided by participants at the end of each annual performance period. The EMA will accept the participant-submitted savings estimate if the difference between the participant-submitted savings estimate falls within the EMA's Uncertainty Interval; the interval encompasses the values of EMA's savings estimate + and – the normalised savings relative precision value. If the participant's-submitted savings do not fall within the EMA Uncertainty Interval, then he/she can choose to redo their estimate or accept Seattle City Light's estimate.

Hourly or 15-minute interval data is required for the building's electricity consumption. AMI billing/meter data are used for savings calculations. Participants have to submit quarterly reports summarising the status of energy conservation measures and log any significant changes in the building (non-routine events) once every three months.

An annual report must also be submitted to Seattle City Light about the baseline and annual performance periods, and must provide all supporting documentation regarding the M&V procedure. The annual report will also include the modelling techniques used and demonstrate how the reported savings are associated with efficiency and conservation measures.

Reward mechanism

Payments are all performance-based and are delivered directly to the participating customers. Customers can assign payments to service providers, but they have to do so for each payment (annually).

The incentive rate of the P4P programme differs depending on the programme path option selected by the customer. There are two available options for participants:

1. The three-year contract (Persistence Path) is suitable for participants who have a sufficient initial budget to make all energy efficiency measures upfront in year one. It offers an incentive rate of $0.08/kWh. Incentive payments are made on the normalised cumulative savings achieved over the baseline at the end of each year.
2. The five-year contract (Tiered Path) is designed for customers who lack initial capital or prefer to implement the energy efficiency retrofits gradually during the five-year period, or for those participants who prefer to have the incentive payment reflect the total value of the new savings of the previous year. Under the five-year contract, a new baseline is estimated each year. The five-year path pays $0.18/kWh on the normalised incremental (new) savings achieved year-over-year for each year of the performance period, with the baseline "resetting" each year. The baseline will be reset at the prior year consumption level and then future incentives are paid out only on incremental savings above this new baseline. Projects are eligible for a bonus incentive rate once cumulative electricity savings for the project exceed 15% of the initial baseline. Specifically, a $0.02/kWh additional incentive is paid on every 5% of incremental savings.

For both options, funding is capped at 70% of the total project cost (capital investment and invoiced professional services related to energy conservation measures (SCL, 2018a).

Achievements

Three existing commercial buildings participated in the pilot in total and all completed deep retrofits which achieved between 13% and 20% savings during their P4P period (Rocky Mountain Institute, 2013).

The three active projects have not completed a performance year, so no savings have yet been recorded. However, the three projects that participated in the pilot phase saved a total of 8,145,909 kWh.

In 2017, stakeholder consultation was implemented to gather input on various programme design elements (*e.g.*, the design of incentives, application and reports). SCL conducted four to five workshops with relevant stakeholders (*e.g.*, energy service providers). Stakeholders were also informed prior to the official launch of the programme about its design and processes, and as soon as the programme officially launched customers had already been engaged.

Next steps

SCL aims to make the programme truly measure-blind. Currently, participants are not allowed to purchase equipment through another programme (e.g., HVAC system through an HVAC rebate program). This is going away soon as the goals of the programmes are not in competition.

Seattle City Light is considering an aggregation P4P model for small business customers, *i.e.*, through an RFP process to contract with an implementor to install energy efficiency measures in small businesses and pay them based on actual first year savings of the entire portfolio of small businesses.

3. Issues of interest for setting P4P schemes

What have the been main drivers?

Seattle City Light is under Washington state jurisdiction. In Washington, under the state's Energy Efficiency Resource Standard (EERS), later enacted into law as the Energy Independence Act, utilities can set targets based on their share of regional conservation potential identified by the Council's regional power plan or on their own Conservation Potential Assessments (CPAs). SCL's Conservation targets are set based on their CPA, an analysis of the amount of energy savings that either exists, is cost-effective, or could be realised through the implementation of energy efficiency programmes and policies. A substantially higher clean energy standard appears feasible if it includes flexibility to accommodate variations in the state's hydroelectric generation. Seattle City's Light conservation target for 2018-2019 was 214,620 MWh.

According to the 2019 Commerce Biennal Energy Report, future efficiency efforts need to continue to sustain and expand investments in new electricity efficiency through meeting electric utility Energy Independence Act conservation obligations, investing in public-sector efficiency projects, strengthening building energy codes and deploying new approaches such as P4P contracting.

The P4P programme was also a community request mainly formed by the energy market (*e.g.*, ESCOs). The need for a whole-building, performance-based programme has been communicated by stakeholders for the past 8-10 years.

What were the lessons learned

Lessons learned from the pilot implementation as reported from Seattle City Light are listed below:

- Regular engagement with programme participants is valuable and helps maintain savings. In case something goes wrong in the building and savings start to disappear, it can be caught quickly in the data and corrections can be made.
- It takes a long time to land projects as they are large and complex. Participants and administrators must be prepared for the time-consuming process.
- Not overanalysing what is being done in the building and keeping the processes as simple as possible is very important. The proof of installation and meter data is key. Requiring engineering calculations or other time-intensive paperwork leads the benefits of the performance-based approach to vanish very quickly.
- The P4P approach does not work for everyone or every project. There must be different alternatives for customers, who should not be pushed into this if it is not right for them.

The lessons learned and the consultation processes facilitated Seattle City Light's launch of the official P4P programme in 2018. The programme is still at an early stage, but administrators highlighted that implementing very large projects, even in one year, may be very difficult and time-pressuring. Having the option of installing energy efficiency measures progressively during a longer period attracts more participants who would otherwise hesitate due to time and capital constraints.

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B5 – Puget Sound Energy – Pay for Performance pilot

1. Overview

Responsible entity	Puget Sound Energy (PSE) - Washington state (U.S.) energy utility
Summary	In 2018, PSE launched a commercial P4P programme with the goal of enlisting five existing buildings. The pilot intends to maximise energy savings through capital, operational and maintenance improvements, and behavioural opportunities. All proposals require a 15% minimum energy reduction target from capital measures, with an incentive structure that rewards a total building approach to managing the facility's resources. PSE pays based on how well the building performs after installing the proposed measures.
Purpose	▪ Determine whether certain strategies and measures are cost-effective in the long run ▪ Test cost-effective ways to demonstrate market opportunities for energy efficiency
Start date and duration	▪ The pilot started in 2018. It has been in place for two years. Two facilities have participated and are under contract, while two more are considering participation. ▪ The commercial P4P pilot is currently treated as a regular programme and the goal is to enlist at least five buildings in the years 2020 and 2021, respectively.
Location	Puget Sound, an area located along the northwestern coast of the U.S. state of Washington.
Coverage	PSE utility serves electricity to more than 1.1 million customers in the Island, King, Kitsap, Kittitas, Pierce, Skagit, Thurston and Whatcom counties of Washington. The pilot targets customers with buildings of at least 50,000 square feet with large savings potentials.
Driven by regulation?	Yes. The state's Energy Efficiency Resource Standard (EERS) requires electric utilities (*i.e.*, investor-owned utilities, municipal utilities, rural electric cooperatives and public utility districts) to consistently meet targets for energy conservation and renewable energy (UTC, 2019).
Website	https://www.pse.com/rebates/business-incentives/commercial-retrofit-grants/pay-for-performance

2. P4P structure

Actors involved

The following actors are involved in the scheme:

- The Washington Utilities and Transportation Commission (WUTC) is the state agency that regulates private, investor-owned electric and natural gas utilities in Washington. It is the Commission's responsibility to ensure regulated companies provide safe and reliable service to customers at reasonable rates, while allowing them the opportunity to earn a fair profit. WUTC oversees the conservation services offered by the regulated energy utilities (IOUs) in Washington State.
- PSE provides initiatives and activities and employs adaptive management steps to be responsive to the expectations of customers and to meet the savings goals of energy efficiency programmes funded. Since 1997, PSE has funded its conservation programmes through a separate surcharge on customer bills.
- The energy consumer of PSE and participant of the programme must comply with the requirements of the programme and inform the administrator or the recommended energy professionals (REPs), the energy experts responsible for delivering the projects, for changes which effect energy use (*e.g.*, occupancy, schedule, tenant, thermal instability, etc.). Also, the energy customer has to arrange with the contractor how the payments are going to be implemented as the incentive rates are paid directly to the customer.

Measures

The programme aims to assist commercial and MUSH (*e.g.*, schools, universities) buildings to reduce their energy needs. To be eligible, these buildings must have ≥ 50,000 conditioned square footage or use significantly more energy than a typical office building (*e.g.*, 24/7 facility, museum, medical facility). The two buildings currently participating are a school and a commercial building composed of offices and laboratories.

Eligible measures for savings under the PSE P4P programme are:

- Capital improvements.
- Maintenance and operational improvements.
- Behavioural energy-savings opportunities.

There is not a specific list of all eligible measures. All capital improvements are accepted, but a combination of two or more measures must be selected.

Performance assessment

The PSE utilises the International Performance Measurement and Verification Protocol (IPMVP) to verify savings. Baseline is estimated based on previous year's (12-month period) electric usage and weather data, and comparing with actual usage. If there are valid reasons to incorporate more data, baseline will be calculated based on a longer period.

Data are collected using standard electric and gas interval meters and a web-based, proprietary software application for tracking energy, weather, building occupancy or other variables to develop a model of predicted resource usage.

Reward mechanism

Incentives are paid directly to the programme participants through a hybrid payment structure. The following are in place for the incentive amounts:

- Up to 50% of incentive according to estimated project cost and estimated/deemed project savings can be paid out after implementation of measures (end of year one).
- Remaining incentive is paid out annually for years two through five. Incentives are shaped as $0.35/kWh and $5.00/therm. Furthermore, performance incentives are also offered of $0.05/kWh and $0.50/therm for savings above the proposed target. In order to qualify for the incentives, the consumer must achieve a minimum of 15% savings from capital improvements.

Energy professionals/contractors have to agree with consumers regarding their compensation. PSE signs an agreement only with the customers so participants are able to choose a different energy service provider in the five-year contract duration if they wish.

Project savings are mainly calculated individually, but up to three buildings of similar usage (*e.g.*, three office buildings) can be aggregated (PSE Pay for Performance, n.d.).

Achievements

The programme has just recently started; thus, savings have not been claimed or enlisted yet. The 2020 savings goals are 700,000 kWh and 2,500 therms, and the P4P programme targets five projects annually (PSE, 2019).

Next steps

The programme must be further developed in a way that the needs of all relevant stakeholders are fulfilled in order to attract more participants and implement more projects.

3. Issues of interest for setting P4P schemes

What have the main drivers been?

- Puget Sound Energy is under the Washington state jurisdiction and consequently acts according to the Energy efficiency resource standard (WAC 480-109-100) and Energy Independence Act conservation obligations (RCW 19.285.040). Puget Sound Energy had a conservation target of 520,456 MWh for the years 2018-2019. According to the aforementioned standard, a utility is obligated to:
  - Identify potential. Identify the cost-effective, reliable and feasible potential of possible technologies and conservation measures in the utility's service territory.
  - Develop portfolio. A utility must develop programmes to acquire available conservation from all of the types of conservation identified.
  - Implement programmes. Implementation methods shall not unnecessarily limit the acquisition of all available conservation that is cost-effective, reliable and feasible.
  - Adaptively manage. A utility must research emerging conservation technologies and assess the potential of such technologies for implementation in its service territory.
- Types of conservation include but are not limited to: (i) End use efficiency; (ii) Behavioral programmes; (iii) High-efficiency cogeneration; (iv) Production efficiency; (v) Distribution efficiency; and (vi) Market transformation. (vii) Pilots. A utility must implement pilot projects when appropriate and expected to produce cost-effective savings within the current or immediately subsequent biennium, as long as the overall portfolio remains cost-effective.
- By January 1, 2010 and every two years thereafter, a utility must project its cumulative 10-year conservation potential. The biennial conservation target must identify, and quantify in megawatt-hours, all available conservation that is cost-effective, reliable and feasible (Washington State Legislature, 2019).

Besides regulation, ESCO's requested a performance-based programme structured with a long-term agreement and incentive stream with the customers.

What were the lessons learned?

- Administrators need to do supplementary activities (*e.g.*, presentations, webinars, etc.) to inform customers about the programme structure and procedures, since it may be more difficult for building owners to understand and trust the P4P programme concept compared to experienced contractors and energy service companies. It takes effort to convince customers to go for P4P programme, especially when a lot of other incentive programmes are also available.
- While having a longer-term revenue stream is typically desired by contractors, customers may not be as willing to accept such a long contract period, especially since the incentive is not guaranteed.

4. References

Washington Utilities and Transportation Commission (UTC). (2019). *Clean Energy in Washington State.* https://www.utc.wa.gov/regulatedIndustries/utilities/Documents/5116 Fact Sheet.pdf

PSE. (2019). *2018 Annual Report of Energy Conservation Accomplishments.* ~~Retrieved from~~ https://www.pse.com/-/media/Project/PSE/Portal/Rate-documents/EES/ees_2018_annual_rpt_energy_conservation_accomplishments.pdf

PSE. (n.d). *Pay for Performance.* https://www.pse.com/rebates/business-incentives/commercial-retrofit-grants/pay-for-performance

WAC 480-109-100 (2019). https://apps.leg.wa.gov/WAC/default.aspx?cite=480-109-100

B6 – Efficiency Vermont – Continuous Energy Improvement

1. Overview

Responsible entity	Efficiency Vermont, an Energy Efficiency Utility (EEU), which delivers energy savings based on a plan agreed upon with the Vermont Public Utility Commission. Efficiency Vermont is administered by the Vermont Energy Investment Corporation (VEIC).
Summary	Continuous Energy Improvement (CEI) is a holistic programme that applies a data-driven approach to ▪ Understand how businesses and industries use energy. ▪ Set up a strategy to reduce energy use through a mix of behavioural, operational and technical measures. ▪ Measure the performance against a baseline to track improvements.
Purpose	Reach demand-side management savings goals with data-driven long-term systems approach to energy management
Start date and duration	Pilot from 2014 (R&D), evaluated in 2015 and 2018 Programme started in 2018
Location	Vermont, United States
Coverage	U.S. state level (Vermont) Large commercial and industrial consumers
Driven by regulation?	Yes. In Vermont, dedicated energy efficiency utilities were created by the regulator to deliver savings. Efficiency Vermont is one of these energy efficiency utilities.
Website	www.efficiencyvermont.com/services/project-support/strategic-energy-management

2. P4P structure

Actors involved

The following actors are involved in the scheme:

- The Vermont Public Utility Commission (PUC), as the regulator, appoints and sets targets and budgets for Energy Efficiency Utilities (EEUs), including Efficiency Vermont.
- Efficiency Vermont is an Energy Efficiency Utility, which delivers energy savings based on a plan agreed upon with the PUC. Efficiency Vermont is administered by the Vermont Energy Investment Corporation (VEIC).
- Participating companies (industrial and commercial sector) commit to dedicate resources to the Continuous Energy Improvement programme and benefit from advanced technical support from Efficiency Vermont.
- Energy consumers in Vermont contribute to these programmes by paying a volumetric charge on customers' bills, known as the Energy Efficiency Charge (EEC). The EEC rates are expressed in terms related to customers' consumption and are set by the PUC each year. Consumers benefit from system savings stemming from energy efficiency programmes.

Measures

The programme was designed to reach the largest commercial and industrial energy consumers in Vermont. It helps commercial and industrial businesses take a comprehensive, ongoing approach to using less energy. As a result of the programme, companies undertake behavioural changes and investments such as:

- Process improvements in the office and in operational spaces (including software tools and metering equipment, and assessments of energy-saving opportunities).
- Employee engagement to foster best practices in saving energy (including trainings).
- Regular maintenance of equipment.
- Capital upgrades for equipment that is out of date or reaching end of life.

These measures are different for each participant, but all participants are engaged as a cohort to encourage peer-to-peer learnings.

Performance assessment

The Continuous Energy Improvement programme follows the International Performance Measurement and Verification Protocol (IPMVP). A baseline regression model is developed

taking into account a number of factors including previous year's electric usage and weather, among others.

Progress is measured continuously, enabling the capture of actual savings. Daily savings are aggregated at the end of the year to calculate the annual energy savings against the baseline. Dedicated meters in electric panels and an energy management information system are used for that purpose.

Reward mechanism

The participant (industrial and commercial consumer) is incentivised by Efficiency Vermont's enhanced technical engineering and consulting support, and not rewarded based on performance.

Efficiency Vermont and the participating companies sign a Memorandum of Understanding. The MOU captures a shared agreement between Efficiency Vermont and the customer for estimated savings results anticipated with full commitment by the customer for programme participation. Efficiency Vermont pays for some related programme costs such as installation of submeters. There is no obligation for results for participating companies, but Efficiency Vermont aims to cut consumption by 10–15% in the first three years across the portfolio of companies involved in the programme.

Savings are delivered and monitored and can then be claimed by Efficiency Vermont as part of its energy savings goals, which are negotiated with the Vermont Public Utility Commission for two-year periods. Efficiency Vermont's compensation is based on three components: (1) actual incurred costs; (2) performance compensation upon attainment of EEU three-year performance targets; and (3) operations fees. The performance-based element of the remuneration is not proportional to the savings achieved. Its amount is a percentage of the other elements (3.15% for current period) that is added to the remuneration if a number of indicators, including energy savings, are achieved.

Achievements

Efficiency Vermont claimed savings for its hospital cohort ending in 2019. This is the first cohort in which savings have been formally claimed for the CEI programme. Individual customer savings ranged from 2% to 8%.

Next steps

Every three years the PUC conducts a Demand Resources Plan (DRP) proceeding to identify short- and long-term energy efficiency budgets and savings goals, as well as other compensation matters related to the delivery of energy efficiency services by Vermont's EEUs. Efficiency Vermont is currently working on a 2021-2023 triennial plan.

Efficiency Vermont is focusing on strengthening the CEI programme by improving its modelling, increasing remote support structures, and enhancing planning structures around future cohorts.

3. Issues of interest for setting P4P schemes

What have the main drivers been?

- Utility energy saving programme

Before 1999, Vermont had been requiring electric utilities to deliver comprehensive energy efficiency programmes to their customers. In 1999, the PUC decided to appoint dedicated Energy Efficiency Utilities (EEUs). Efficiency Vermont is responsible for a share of the Energy Efficiency Utility savings. Burlington Electric Department (BED), and Vermont Gas Systems, Inc. (VGS) also contribute.

The Continuous Energy Improvement programme was first set as a pilot, using dedicated research and development funding provided to Efficiency Vermont

- Moving to a holistic strategic approach to energy management

Large commercial and industrial consumers have been identified as a segment with untapped energy efficiency potential. It has also been identified that moving from a project-by-project energy management approach to a strategic energy management planning approach can lead to more cost-effective savings and brings more value to customers (technical and organisational support).

What were the lessons learned?

- Setting an appropriate baseline

To claim the savings related to the programme towards their objective, Efficiency Vermont has to comply with the state's expectations related to setting an appropriate baseline. This is particularly challenging for programmes which have a behavioural aspect. This could be done once the pilot phase was concluded and the programme evaluated.

- Data availability

In 2017, the CEI Lite project was launched targeting small- and medium-sized businesses. Despite a strong initial response, actual participation was low. Data availability was identified among the barriers to the program. In general, access to data is a challenge, and the requirements have to be clear to the participant from the start. As data sharing allow for AMI, Efficiency Vermont will have a greater opportunity to improve engagement and focus on areas of most impact for the SMB sector.

- Responding to customers' needs

The programme managers have chosen not to pay the final beneficiary for performance, but to provide the benefits in exchange for access to data. There is still a lot of value for the participant in terms of getting support through the process, which is resource intensive for Efficiency Vermont. It is also interesting to note that the name of the programme was chosen to fit with the corporate culture in Vermont.

- Communicate clearly about what is expected from the customer

Ensuring that the final beneficiary is fully aware of the program's requirements is very important. In this case, it can be challenging for companies to ensure that the right amount of time was dedicated to the program.

4. References

Efficiency Vermont. (n.d.) *Continuous Energy Improvement*. www.efficiencyvermont.com/services/project-support/strategic-energy-management

State of Vermont PUC. (n.d.). *Energy efficiency – EEU budgets, performance goals, and annual plans.* https://puc.vermont.gov/energy-efficiency-utility-program/eeu-budgets-performance-goals-and-annual-plans

State of Vermont PUC. (n.d.). *Energy efficiency – History and structure*. https://puc.vermont.gov/energy-efficiency-utility-program/history-and-structure

B7 – Ontario Save on Energy – Energy Performance Program

1. Overview

Responsible entity	Independent Electricity System Operator (IESO)
Summary	The Energy Performance Program (EPP) encourages whole-building energy performance improvements in the commercial sector through an incentive that provides four cents per kilowatt-hour of savings per year for up to two and a half years. This model encourages participants who are able to make behavioural and operational changes alongside capital investment projects to achieve and grow energy savings over multiple years (Energy Performance Program, Save on Energy, n.d., a).
Purpose	▪ reduce the cost of programme delivery, while ensuring the availability of energy efficiency to support consumers and the electricity system. ▪ serve as a more holistic approach to energy management, moving from incentivising projects to incentivising energy management.
Start date and duration	▪ A pilot named Results Based Performance Optimization (RBPO) started in 2013 and enrolled 18 grocery stores across Ontario. ▪ A performance programme launched by IESO December 21, 2016. ▪ IESO launched the Save on Energy programmes suite, which contains the EPP programme, in April 1, 2019. Incentives are available for site applications – with terms lasting up to 31 December, 2022 (IESO, 2017b).
Location	Ontario, Canada
Coverage	Participants must have a minimum annual consumption of 1,500,000 kWh per building (or group of up to five buildings aggregated into a single baseline energy model) (Save on Energy, n.d., a).
Driven by regulation?	Yes. In Ontario, licensed electricity distributors (connected to the IESO-controlled grid) have allocated conservation and demand management (CDM) targets for savings in peak electricity demand and electricity consumption. IESO is responsible for offering a suite of centrally-delivered conservation and demand management programmes. The required electricity consumption reduction is based on each electricity distributor's share of total annual energy consumption by customer account type (Eyre *et al.*, 2015).
Website	https://saveonenergy.ca/For-Business-and-Industry/Programs-and-incentives/Energy-Performance-Program

3. P4P structure

Actors involved

- The Independent Electricity System Operator (IESO) is responsible for operating the electricity market and directing the operation of the bulk electrical system in the province of Ontario, Canada. It is one of seven Independent System Operators in North America. Save on Energy Business programmes are delivered by the IESO and provide support and tools to invest in energy-saving techniques, projects and capabilities. IESO created the IESO Conservation Fund to provide support for significant advances in new conservation and demand management programmes, practices and technologies that impact Ontario's initiative to reduce electricity consumption and achieve electricity bill savings for Ontario ratepayers.
- Local distribution companies have to achieve specific conservation and demand management targets. (LDCs are licensed electricity distributors connected to the IESO-controlled grid and whose rates are regulated by Ontario Energy Board.) The province of Ontario saw a considerable amount of energy savings in 2016 and in 2017 under the 2015-2020 Conservation First Framework (CFF). The CFF establishes a partnership between the Independent Electricity System Operator (IESO) and Ontario's 68 LDCs to design and deliver electricity conservation programmes to the customers of LDCs (*i.e.*, almost all Ontario electricity users, with the major exception of some large, primarily industrial, companies connected to the high-voltage transmission grid) (IESO, 2016).
- Participants must comply with the requirements of the programme (Save on Energy, n.d., a):
  - Commit buildings to participate for at least two years and plan to realise at least 5% energy savings per building.
  - Have hourly meter data available for the building for at least 12 months.
  - Implement eligible measures.
  - Provide savings reports.

Measures

The Energy Performance Program enrols commercial buildings that are not utilised for any industrial process. Eligible measures are any measures implemented in a facility, including

equipment retrofits, controls installation, and system, recommissioning and behavioural initiatives, but specifically excluding:

- any measures that are behind-the-meter generation projects that do not meet the requirements of the IESO's Behind-the-Meter Generation Project Rules.
- any measures involving fuel-switching that do not meet the IESO's Fuel Switching Guidelines.
- projects through the IESO Feed-in Tariff (FIT) programme and micro-FIT programme (*e.g.*, behind-the-meter renewable generation).

Performance assessment

Raw data requirements

Hourly, or sub-hourly, interval data from Measurement Canada certified meters is required, starting with at least 12 months of baseline history accompanied by the overlapping 24 months of monthly utility data. Variable data must be independently verifiable. Rules governing treatment of outliers/gaps are provided.

Baseline Model Requirements

The form of the baseline model is not dictated, but suggestions are provided. Third party modelling software can be used to derive the models. Statistical specifications are provided, and a post-baseline model validation procedure is defined. Allowable modifications to baseline data to reflect known changes in electricity usage shall be clearly explained and defined. Historically, most applicants have submitted their baseline energy models using Microsoft Excel's Data Analysis pack. Also, baseline models created using RETScreen are acceptable.

IESO Baseline Validation Methodology (Pre-Approval)

The baseline model will be screened by the IESO or its Technical Reviewer prior to being accepted into the programme.

Savings Calculation Procedures

Savings will be calculated and evaluated on an annual basis. Guidelines with respect to the eligibility of Baseline Adjustments resulting from changes to building electricity consumption during the P4P Period are provided. For this programme, IPMVP method Option C (Whole Building Analysis Approach) is used. Savings calculations will be prepared based on the

difference between actual consumption during the P4P Period and baseline model output for the same period (Save on Energy, n.d., b).

Reward mechanism

The payment structure of the Energy Performance Program is not all performance-based. In addition to the annual performance payments, customers are entitled to receive a Modelling Incentive of $1,500 for each enrolled facility to set up the energy model, up to a maximum of $15,000 for 10 approved facilities. After setting up the energy model, incentives are provided at four cents per kilowatt hour ($0.04/kWh) of achieved savings per year, for up to two and a half years. Negative savings will not be zeroed out. For each P4P period, negative savings will offset positive savings.

Customers have choice and flexibility in implementing capital and non-capital energy efficiency measures, and they are rewarded for energy savings at the same rate regardless of the types of projects/activities that have been implemented. Performance payments are paid annually and are limited to maximum savings equal to 20% of the annual electricity consumption for the period used to establish the facility's baseline energy model.

The consumer may aggregate up to five buildings into one single baseline model, and the aggregated sites would constitute one facility for the purposes of the programme (with annual consumption ≥ 1,500,000 kWh). Such buildings should be close enough to each other so that they can use the same weather data source. The facility's hourly energy consumption would be the sum of the hourly energy consumption of each of the aggregated buildings (Save on Energy, n.d., a).

Achievements

The pilot programme (2014-1016) achieved 10% savings from 18 buildings participating in the program.

The Energy Performance Program claimed 4% savings from the buildings participating since the programme launched in 2016.

3. Issues of interest for setting P4P schemes

What have the main drivers been?

- The Energy Efficiency Obligation Scheme for electricity distributors in Ontario was introduced through a Directive adopted by the Minister on 31 March 2010. The Directive

authorised the Ontario Energy Board to amend the licences of all electricity distributors so they are obliged to implement energy conservation measures. The Ontario Energy Board developed the Conservation and Demand Management (CDM) Code, finally approved on 12 November 2010, initiating the obligation scheme. The CDM Code established the framework clarifying all the conditions and rules to be followed by the obligated electricity distributors. The Ontario Energy Board proposed updated guidelines in 2012 for the implementation of the obligation scheme for the period 2012-2024.

- In December 2013, Government adopted a policy of Conservation First with respect to electricity and natural gas, which means investing in all cost-effective and achievable energy efficiency resources before investing in new supply. All licensed electricity distributors with a CDM requirement are obligated parties. Electricity distributors not connected to the Independent Electricity System Operator-controlled grid are excluded from the obligation (Eyre *et al.*, 2015).
- On 10 June, 2016, the Minister of Energy directed IESO to centrally design, fund and deliver a new province-wide P4P programme with implementation commencing by the end of fall 2016. The programme will support the provincial Conservation and Demand Management (CDM) savings target of 30 terawatt-hours (TWh) by 2032 — 7 TWh of which would be achieved through Local Distribution Company (LDC) CDM programmes (IESO, 2016).
- A new Interim Framework for provincially delivered energy efficiency programmes was established 1 April 2019 by ministerial directive. According to the newly launched directive, the Minister of Energy is committed to ensuring that Ontario has an affordable and reliable electricity system, while continuing to find efficiencies in the electricity sector. An interim electricity conservation and demand management framework was established aiming to offer a suite of programmes centrally-delivered by the IESO.

What were the lessons learned?

Implementing the pilot and the Energy Performance Program led administrators to key findings regarding opportunities and obstacles of performance-based structure.

Advantages:

- Multiyear, whole-building approach enables the full capture and incentivisation of savings from O&M measures.
- Centralised application administration and review processes.

- Single incentive application and M&V process for multiple projects vs. multiple retrofit applications.
- Higher overall incentive if savings are maintained; performance will be assessed annually relative to an original established baseline.
- Customers are compensated for energy savings at the same rate regardless of which initiatives are pursued, and the incentive is not capped by the project costs.

Considerations (IESO, 2017a):

- Must have ability to maintain the savings over multiple years.
- Unable to participate in other Save on Energy programmes (with exception of Energy Manager incentives).
- Incentive paid annually.

4. References

Eyre, N., Fawcett, T., Spyridaki, N. A., Oikonomou, V., Tourkolias, C., & Vega Barbero, J. (2015, August). *Energy saving policies and energy efficiency obligation scheme.* http://enspol.eu/sites/default/files/results/D2.2.%20Report%20on%20existing%20EEOs%20outside%20the%20EU.pdf

IESO. (2016). *Pay-for-Performance program engagement plan.* http://www.ieso.ca/en/Sector-Participants/Engagement-Initiatives/Engagements/Completed/Province-wide-Pay-for-Performance-Engagement

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IESO. (2017b). *Implementation of a Pay For Performance Program in Ontario.* Presentation. https://www.aceee.org/sites/default/files/pdf/conferences/mt/2017/Lundhild_SessionD1_MT17_4.3.17.pdf

Save on Energy. (n.d., a). *Energy Performance Program: Business and industry incentives.* https://saveonenergy.ca/For-Business-and-Industry/Programs-and-incentives/Energy-Performance-Program

Save on Energy. (n.d., b). *M&V Procedures – Energy Performance Program v3.0.* http://www.ieso.ca/en/Sector-Participants/Engagement-Initiatives/Engagements/Completed/Province-wide-Pay-for-Performance-Engagement

B8 – New York State Energy Research and Development Authority (NYSERDA) – Business Energy Pro

1. Overview

Responsible entity	New York State Energy Research and Development Authority (NYSERDA) is a New York State public-benefit corporation promoting energy efficiency and the use of renewable energy sources.
Summary	Business Energy Pro is a commercial P4P programme administered by NYSERDA and utility Consolidated Edison, Inc. (Con Edison). In 2019, the first request for proposals (RFP) was launched. NYSERDA and Con Edison will select one or several Portfolio Managers based on their bids. Portfolio Manager(s) will be compensated over a performance period of three years. Portfolio Manager(s) will engage with small and medium-sized businesses (SMB) to deliver energy savings. These savings will be measured and aggregated on an ongoing basis to calculate the Portfolio Manager's performance.
Purpose	▪ Enhance use of energy efficiency as a grid resource ▪ Develop the energy efficiency services market
Start date and duration	RPP launched in 2019 The five-year pilot features a two-year implementation period, starting in 2020, during which the Portfolio Manager may enrol new participants. Each annual cycle is followed by a three-year performance period, during which metered results from enrolled projects are monitored. The second Performance Period extends through 2024.
Location	State of New York, United States
Coverage	▪ Staten Island (electricity) and Westchester County (electricity and gas) ▪ Small to medium businesses. This means approximately 40,000 eligible customers for 5,000-15,000 projects.
Driven by regulation?	Yes, pilot scheme as part of utility energy savings programme
Website	www.nyserda.ny.gov/All-Programs/Programs/Business-Energy-Pro

2. P4P structure

Actors involved

The following actors are involved in the scheme:

- The New York State Department of Public Service (DPS) approves the NYSERDA investment plan, which covers the P4P pilot scheme. The Public Service Commission (PSC) oversees the energy utilities such as Con Edison and sets energy savings goals for these utilities.
- NYSERDA is a public-benefit corporation that promotes energy efficiency and the use of renewable energy sources in New York State. It administers the Business Energy Pro pilot programme and provides funding for it thanks to the Clean Energy Fund.
- Con Edison is the programme utility partner. It is in charge of creating customer eligibility lists. It will also manage performance and contractual relationships with Portfolio Manager(s), including the delivery of payments upon performance.
- Portfolio Manager(s) (PMs) are selected via an RFP issued by NYSERDA and Con Edison. They will engage with SMB to implement energy efficiency solutions.
- Participating customers (SMB) will implement energy efficiency solutions with support from Portfolio Manager(s). Energy savings will be measured and aggregated on an ongoing basis to calculate the Portfolio Manager's performance and remuneration.
- Energy consumers in the State of New York contribute to the Clean Energy Fund. They benefit from system benefits related to energy efficiency programmes.

Measures

The pilot is "measure-agnostic" to provide the opportunity for flexibility and innovation. PMs were required to explain in their bids how they intend to provide services to customers. Energy savings can happen with special financing, free services, discounted pricing, etc. Proposals may include behavioural, retrocommissioning, and operational and maintenance measure savings.

The condition is that proposals and respective project Interventions must go beyond a single measure, and they shall aim to achieve a minimum of 5% portfolio energy reduction for either electric or natural gas. This means that the minimum performance is assessed for the whole portfolio, and not for single projects.

The targeted customers are those with an average annual electric peak demand of less than 300 kW. Con Edison will provide contracted PMs with a list of eligible customers.

Performance assessment

PMs will be awarded a five-year contract including an implementation period of two years and a performance period of three years.

The competitively selected Advanced Measurement & Verification (AMV) Solution Provider, Recurve Analytics, Inc., will develop a baseline for each project and conduct all energy data and related savings analysis using the CalTRACK methodology. Smart meters will provide real-time data on consumption. PMs will have access to individual customer and aggregated portfolio data, providing analytics and insights into realised savings and opportunities.

Reward mechanism

The payment/energy unit (kWh or therm) rate is not available yet. It will vary depending on the bid presented by PMs. It will therefore be different for each PM, but a ceiling for levelised costs of $12/MMBtu[29] has been established. The price paid per MMBtu is adjusted to reflect the lifecycle value of the metered savings. According to the programme managers, a portfolio that bids in at the ceiling price and offers a portfolio that delivers 20 years of savings would get paid $8.00 per annual therm and $0.27 per annual kWh saved.

Con Edison will pay the PMs for metered savings upon NYSERDA's approval. Payments will be done quarterly starting from the performance period initial date. Every year each project will get one initial payment, based on predicted annual savings, and three adjusted payments.

All payments are performance-based, and PMs are not entitled to receive their entire contract value if savings are not delivered. Adjustments to the contract amount or payment/energy unit rates may occur if PMs do not deliver projects in line with their proposals. PMs can pass that value on to customers depending on the business model they have developed.

A performance period of three years was chosen based on the following issues:

- PMs Cashflow – typical private sector (ESCO) P4P models have a 5 to 25-year term, but this market largely focuses on large C&I, not residential and SMB sectors. To support this new market, shorter terms are needed to limit cashflow uncertainty.

[29] 1 MMBtu = approximately 293 kWh

- Non-Routine Events (NREs): having a performance period of three years reduces the likelihood of NREs (*e.g.*, change in occupancy/building remodel).
- Pricing: the price paid per MMBtu is adjusted to reflect the lifecycle value of the metered savings so the term of the project makes no difference to the total amount a bidder may end up receiving. The price competition was tied to bidders' Levelised Cost of Energy Savings per MMBtu, accounting for the full expected lifecycle savings from bidders' proposed project portfolios. This approach thus rewarded bidders who proposed portfolios that achieve deeper savings over a longer lifetime.
- Rate cases: A three-year period is also preferred by utilities as it aligns with three-year rate cases.
- It also reduces the risk for both NYSERDA and PMs during early pilot phases as design is still being testing and refined.

Achievements

The pilot has a target of installing projects that result in 34,000 MMBtus of annual natural gas reductions in Westchester County and 14,000 MWh of annual electric reductions in both Staten Island and Westchester County. Approximately $10 million is available from the Clean Energy Fund to support payments to Portfolio Managers. This does not cover pilot administration activities provided by NYSERDA or pilot/contract administration costs incurred by ConEd.

Next steps

- There are no plans to expand the current ConEd BEP Pilot at this time, *e.g.*, to launch another Request for Proposal.
- A residential P4P pilot programme is foreseen in partnership with the utility National Grid. It should target single-family houses for 2,500-10,000 projects. NYSERDA and National Grid plan on releasing the RFP in 2020.
- NYSERDA is also focused on supporting additional discussions with other prospective utility partners interested in understanding how P4P might benefit their specific goals.

3. Issues of interest for setting P4P schemes

What have the main drivers been?

- Reaching greenhouse gas targets cost-effectively requires market innovation

In 2014, New York State launched "Reforming the Energy Vision" (REV), the state's energy strategy, highlighting the need to stimulate market innovation and promote private investment in energy efficiency. In 2018, NYSERDA and DPS released a white paper entitled "New Efficiency: New York" which establishes an energy efficiency target for 2025 and proposes a comprehensive initiative to be funded through the Clean Energy Fund. Among the innovative approaches to energy efficiency, utilities are encouraged to launch P4Ps in partnership with NYSERDA.

- Improving the value proposition for customers and the risks of underperformance for ratepayer-funded programmes

The "New Efficiency: New York" white paper states that P4P models are designed to respond to the fact that customers would find highly compelling a value proposition where a comprehensive energy service contract guarantees lower cost of energy with little or no money down, with the risk of non- or underperformance borne by the service provider. The white paper also notes that one of the most "public-interest-aligned contract structures" for ratepayer-funded approaches is a performance-based structure, where the risk of underperformance is borne by the service provider.

- Balancing certainty and flexibility for providers

The white paper notes that stability and certainty allow service providers to invest in their business systems and in their project pipelines, while flexibility allows them to adapt approaches and offerings in response to learning and to market evolution.

What were the lessons learned?

The pilot scheme is still at an early stage, but lessons can already be learned from the process. Among these:

- Programme design should pay attention to the depth of the measures foreseen

As noted in the "New Efficiency: New York" white paper, the design of a P4P programme should put in place mechanics to prevent excess attention to low-hanging fruits, such as lighting measures. The bidding rules should be carefully written to that purpose.

- Design cash flow carefully

While the draft pilot payment scheme only sought to pay out on metered results, the establishment of one upfront payment/project and following adjusted payments in the RFP was put forward as a means to reduce concerns over cashflow.

- Engage all key stakeholders during pilot planning process

During the process, it was important to illustrate to utilities the P4P value proposition compared to their traditional programme models. There was also a need to increase private sector comfort in partnering with utilities under P4P contracts vs. more traditional, safe and cashflow-certain arrangements. To increase confidence in the scheme and make adjustments if needed, programme managers can, for example, offer a draft RFP review period.

- Need for additional project finance

Private sector companies need to get better at packaging customer-facing offers versus responding to the often misaligned utility incentive model. They have shown a hesitancy to competitively bid on P4P RFPs. Other business opportunities offer more lucrative financial terms and lower risks to implementers. Early bidders must show success with reasonably low business risks and commensurately high rewards in order to attract more competition for future RFPs. In order to attract new market players (beyond typical large mature ESCOs), NYSERDA and utility partners need to support additional project finance and insurance tools to reduce payment and performance risk. This will create cashflow stability for companies that do not have large credit reserves to float this type of model with.

- Need for marketing support and customer protection

P4P schemes also shift customer acquisition risks to the implementer. In addition to the direct impacts on revenues, the ability to generate a project pipeline is an essential precondition for attracting third party capital to underwrite project finance and manage performance risks. Programme sponsors should prioritise marketing support to help implementers mitigate customer acquisition risks. The implementer's ability to manage both customer acquisition risks and performance risks hinges on the ability to gain timely access to granular customer data, including energy consumption data. This need must be balanced with imperatives to protect customer privacy.

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B9 – Bay Area Regional Energy Network (BayREN) – Small and Medium Commercial Buildings Pay-for-Performance Program

1. Overview

Responsible entity	Bay Area Regional Energy Network (BayREN)
Summary	The BayREN SMB P4P works with SMB owners and managers to install energy improvements that will pay for themselves over time and provides incentives for long-term behaviour and performance. Through 2025, the programme aims to provide incentives for upgrades to deliver combined annual energy savings of more than 12,000 MWh and more than 136,000 therms of natural gas.
Purpose	Empower the small and medium business (SMB) sector across the San Francisco Bay Area by removing barriers to installing energy efficiency upgrades, thereby reducing business expenses while improving equipment reliability, productivity and business services, to ensure continued growth and prosperity (BayREN, n.d.).
Start date and duration	Implementation and administration ramp-up started in 2018 and is currently in a soft-launch phase. During this phase, a limited number of projects are enrolled to stress-test the process and data infrastructure.
Location	San Francisco Bay Area, United States
Coverage	Nine Counties of the Bay Area: Alameda, Contra Costa, Marin, Napa, San Mateo, Santa Clara, Solano, Sonoma, and San Francisco The programme is available to PG&E small and medium commercial consumers in the area receiving natural gas and/or electric distribution service.
Driven by regulation?	Yes. In California, Investor-owned Utilities (IOUs), Regional Energy Networks (RENS) and other programme administrators deliver energy savings under the auspices of the California Public Utilities Commission (CPUC). BayREN is one of the three RENs which provide regional-scale energy efficiency programmes, services and resources and is funded by utility ratepayer funds through the CPUC. By definition, RENs are local government collaborations (Doss, Harbs, & Kuhnert, 2019).
Website	https://www.bayren.org/commercial

2. P4P structure

Prior to implementation, BayREN prepared a detailed Business Plan for years 2018-2025. For the Business Plan, BayREN conducted a lot of research to identify the hindering barriers and structured strategies to overcome them. After delivering the Business Plan, BayREN conducted a market characterisation study (*e.g.*, interviews with energy service companies, other programme administrators, etc.) in order to uncover the drivers for a business to participate in an energy efficiency programme (*i.e.*, rebates, lower utility costs, reduced maintenance, etc.), and types of equipment best suited for the SMB sector. The findings of this study were the key inputs to form the programme design (City and County of San Francisco, 2018).

Actors involved

The following actors are involved in the scheme:

- The CPUC administers and allocates the California utility ratepayers fund and reviews and approves the Energy Efficiency Business Plans of programme administrators, which consist of the three RENs, five investor-owned utilities (IOUs), and two community choice aggregators.
- BayREN is a collaboration of the nine local government counties that make up the San Francisco Bay Area. Led by the Association of Bay Area Governments (ABAG), BayREN delivers energy savings based on the Business Plan approved by the CPUC.
- Participants (SMB property and business owners/managers) comply with requirements of applications and arrangements (*e.g.*, are required to provide access to their utility data) and are rewarded from BayREN for savings achievements.
- The project implementation partners, such as the "program ally" and the M&V provider, are crucial to programme success. The program ally is the primary source for energy savings, and its knowledge and expertise allow participants to make their businesses more energy efficient. The program ally is mainly responsible for financial planning assistance, energy assessment, energy model/simulation, the energy management plan and construction management services. The M&V provider an independent third-party that collects the data, identifies any anomalies, and using the data, calculates the compensation to the program ally for BayREN.
- The nine Bay Area counties are also important partners. They provide general marketing and outreach support, particularly to those that are hard to reach or sited in a socio-

economically disadvantaged area, and guidance to deploy strategies best suited for their local conditions.

- Energy consumers, also known as ratepayers, in California contribute to these programmes by paying a small portion of electricity and gas rates included in their utility bills. Energy efficiency programmes are regulated by the CPUC. Together with programme administrators, RENs and IOUs, the CPUC facilitates the development of the economy and the energy market by creating job opportunities and helping California residents and business owners lower their monthly utility bills. They also save money by avoiding the need to build additional expensive power plants and transmission lines.

Measures

BayREN contracts with an energy service company (ESCO), also known as the program ally, at a fixed price per unit of energy savings delivered to the programme. The program ally decides the appropriate mix of measures, or equipment. The program ally strikes a balance between three elements: 1) a measure mix that yields the highest return on investment, 2) a measure mix that yields the least risk of not achieving forecasted energy savings, and 3) a measure mix that successfully accommodates the customers' needs. Energy savings are eligible when resulting from the installation of equipment required for modifications to existing buildings to exceed the requirements of Title 24 of the California Code of Regulations, as well as operational, behavioural and retrocommissioning activities reasonably expected to produce multiyear savings.

All nonresidential sites with no more than 50,000 sq. ft. of conditioned space meeting either of the following criteria — annual electricity consumption less than 500,000 kWh or annual gas consumption less than 250,000 therms —are eligible. As the programme has recently started, there is not yet a list of energy efficiency equipment actually implemented during the programme. But there is a list of the main measures eligible under the programme; these are: boiler plant improvements, building envelope modifications, electrical peak shaving/load shifting, electric motors and drives, electric and daylighting modifications, HVAC, appliance and plug-load reductions, refrigeration and food service equipment.

Performance assessment

The M&V plan is adapted from the International Performance Measurement and Verification Protocol (IPMVP) and particularly Option C, Whole Facility approach is followed. The M&V plan also incorporates CalTRACK 2.0 standards, which provides transparent and peer-reviewed

protocols for Option C implementation. Baseline is estimated taking into account normalised meter energy consumption and a minimum of 12 months of baseline energy consumption data is required.

In general, for 24 months, the programme relies on its M&V provider to compare the performance of projects against a 12-month baseline period. Constant measurement of energy savings is performed based on meter data. Daily savings are aggregated at the end of each quarter to calculate the resultant energy savings against the baseline period. This is achieved using dedicated smart meters technology, using AMI *(BayREN, 2019).*

Reward mechanism

The BayREN budget, approved annually by the CPUC, is broken into percentages/portions for the different programmes and tasks (*e.g.*, marketing, incentives, etc.). Afterwards, regarding the P4P programme, it is decided how many projects can be implemented based on the price the ESCOs have bidden in.

To better manage performance risks for both ratepayers and participants in the programme, BayREN recruited an ESCO, via a competitive solicitation, to act as program ally to sell and install energy efficiency projects. The contract will have an original term of two years, with an option to extend. Fifty percent of the compensation to the program ally will be based on approved forecasted savings calculations and payable upon project completion (Year 0). This infusion of cash reduces the project's upfront cost and helps program allies manage cash flow. The programme will then disburse the balance of the incentive after Year 1's metered performance is measured and verified using CalTRACK 2.0 methods; the final incentive disbursement will follow after Year 2.

Year 1 and Year 2 performance payments will be calculated as true-up payments, representing the performance-based balance after accounting for the Year 0 payment. In this way, total compensation to program ally is tied to actual performance results as long as metered savings exceeds at least 50% of forecasted predictions. By truing up incentive payments with realised performance, ratepayers will be shielded from paying for nonexistent energy savings. This realigned approach also serves to foster long-term relationships between the participant, programme staff, and implementation partners (allies) which will support longer term energy management and savings persistence.

Year 1 and Year 2 progress payments will be calculated based on metered savings at the ally portfolio level and paid to the ally. The ally's contractual relationship with the customer will

determine if and how improvement incentives flow through to finance improvements. Incentives will be as follows:

Year 0: Project Completion, based on ex-ante Calculated Savings Prediction	=50% of Total Price
Year 1: Based on ex-post Metered Energy Savings	=75% of Total Price x metered savings – Year 0 payment
Year 2: Based on ex-post Metered Energy Savings	=100% of Total Price x metered savings – (Year 0 payment + Year 1 payment)

If a project portfolio underperforms:

Ally's portfolio will receive ongoing monitoring by the M&V provider. Large anomalies, such as those listed under "Non-Routine Event Adjustments" will be immediately flagged for investigation and possible baseline adjustments. If the portfolio underperforms relative to predicted savings, then the corresponding P4P incentive will be devalued relative to predicted ally revenue. Ally portfolio savings must exceed 50% of predicted savings before the ally becomes eligible for a Year 1 or Year 2 progress payment.

If a project portfolio overperforms:

The ally may deliver measured and verified savings that exceed its portfolio goals (kWh and therms of natural gas), either by delivering project savings that exceed total predicted savings or by delivering a greater number of projects. The programme will pay for the increased performance up to 200% of the goal. For ally portfolio savings in excess of 110% of goal, BayREN will pay for savings at a discounted price that declines as a function of overperformance. This mechanism limits the programme's liability for savings that exceed the incentive budget.

Savings calculations will follow CPUC guidance for population-based metered savings programmes, as detailed in the Draft Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption. Individual project savings are only estimated for Year 0 after the end of each project completion and estimate the up-front payment for each project Due to the population-based method for estimating savings, the savings from a project that underperforms can be mixed up with the savings of a project that overperforms, thus underperforming projects are not excluded from the project (BayREN, 2018).

Achievements

- The programme is amongst the first in the U.S. to provide energy efficiency services to the SMB-sector using a P4P programme design. The programme serves as a model for other U.S. utilities' energy efficiency programming.
- As mentioned previously, the programme is in the soft-launch phase, thus the targets of 2019 were allocated into the 2020 programme cycle. From the beginning of 2020 to the onset of the statewide COVID19 shelter-in-place order in mid-March, the program ally has over 20 projects awaiting equipment installation.

Next Steps

Many utilities in the area (*i.e.*, PG&E and Marin Clean Energy) have already started turning most of their programmes to P4P. BayREN also plans to implement more P4P programmes for the future. New standards and protocols must be developed in order for ESCOs to be willing to invest in residential as well.

3. Issues of interest for setting P4P schemes

What have been the main drivers?

California has been a front runner for energy efficiency programmes since the 1970s. Due to the state's efficiency programmes, per capita energy use has remained flat, while the rest of the U.S. has increased by about 33%. In the 1970s, California established the California Energy Commission (CEC) with a mandate to make power station siting decisions, make energy demand projections and to look at energy efficiency policy in the state. The principal measures adopted were codes and standards, but included utility programmes, initially voluntary, but now under the oversight of the CPUC.

Since 2012, the CPUC and state energy policy is to make energy efficiency and demand response the IOUs' highest priority procurement resource. After cost-effective efficiency and demand response, the CPUC relies on renewable sources of power and distributed generation, such as combined heat and power applications. In order to promote the resource procurement policies articulated in the Energy Action Plan and by this CPUC, energy efficiency activities funded by ratepayers should offer programmes that serve as alternatives to more costly supply-side resource options (resource programmes). Focusing energy efficiency efforts in this way is the most equitable way to distribute programme benefits. By keeping energy resource procurement

costs as low as possible through the deployment of a cost-effective portfolio of resource programmes, over time all customers will share in the resource savings from energy efficiency.

Also, in 2012 the CPUC authorised the formation of Regional Energy Networks (RENs) to enable local government entities to plan and administer energy efficiency programmes independently from the IOUs. RENs are regional, representing several local government entities, and are selected by the CPUC instead of by the IOUs. REN territories should not overlap. The RENs have the independent ability, within the confines of the approvals of their proposals granted by the CPUC, to manage, deliver and oversee their own programmes independently, without utility interference or direction as it relates to the design and delivery of their programmes. The IOUs serve as fiscal managers responsible for all usual fiscal and management functions including fiscal oversight and monitoring, such as providing the day-to-day contract management functions and disbursement of ratepayer funds. The CPUC retains the authority to direct changes to the REN energy efficiency programmes. RENs and the IOUs coordinate and cooperate for seamless programme offerings and to avoid customer confusion (Doss, Harbs, and Kuhnert, 2019; Eyre *et al.*, 2015).

The CPUC requested BayREN to develop their Business Plans in order to focus on high-level intervention and to fill gaps in IOU portfolios, serve hard-to-reach customers, and leverage special expertise or relationships with customers that other administrators do not possess. BayREN developed the SMCB P4P programme to engage participants who were excluded from PG&E's performance-based programmes. Another important driver was the programme's promising cost-effectiveness since payment is awarded for achieved savings.

What were the lessons learned?

Barriers identified so far:

- Extremely difficult to get access to metered data. This barrier was removed with the improvement and expansion of AMI since 2006, energy benchmarking requirements, and other supportive legislation such as Assembly Bill 802. The conditions are now prime for energy efficiency programmes serving the SMB sector to expand beyond deemed and calculated savings estimation to include meter-based methodologies.
- Owners of SMB buildings and real estate brokers have limited awareness of energy savings opportunities and the benefits of green buildings. Programme marketing and outreach messages emphasise the full array of nonenergy benefits that can accrue to business owners from energy-efficient building operations.

- Split incentive problem: The split incentive refers to the divergent needs of a landlord and tenant: the decision-maker for efficiency investment does not pay the energy bills and has little incentive to reduce them. When the owner pays the utilities, they generally wait until a space is vacant to make improvements. The ESCO business model supports energy savings agreements, which can be structured to bridge split incentives between landlords and tenants.
- Owners of SMB may not have the credit needed for capital-intensive system upgrades. Owners need proof that savings will outweigh costs. The programme provides access to no-cost project assessments via in-kind technical assistance. Assessments will quantify project savings opportunities before business owners are asked to invest resources.

BayREN leverages local government relationships with local business improvement districts, business community leaders, and other trusted messengers to connect with hard to reach participants. Most of the participants find it easier to trust their local governments rather than a utility. Based on the success of other programmes, BayREN found that this approach was very successful for the engagement process.

The programme is in a soft-launch phase and more lessons will be pointed out in the future. BayREN is in close consultation with CPUC Energy Division staff, and will submit a detailed plan for process evaluation. The evaluation efforts will advance the programme's management of key issues including those identified in the description of the programme's objective and strategies.

BayREN will constantly identify challenges and barriers and make improvements (continuous improvement) to the programme with input from Allies.

4. References

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B10 – Pacific Gas and Electric Company (PG&E) – Residential Pay-for-Performance Programmes

1. Overview

Responsible entity	Pacific Gas and Electric (PG&E)
Summary	PG&E contract with third party providers to design and implement two-year pilot P4P programmes in the residential sector. Contractors are paid on a monthly basis for energy savings calculated using the CalTRACK method. Programme evaluations will determine whether P4P is a sustainable model for energy efficiency programmes and its potential application in allowing energy efficiency to act as a reliable grid resource.
Purpose	▪ Demonstrate that the P4P programme is a sustainable model for energy efficiency programme portfolios ▪ Create a supportive data ecosystem ▪ Allow energy efficiency to emerge as a reliable grid resource
Start date and duration	One programme began in 2018; three further programmes began in 2019. Each programme runs for two years before being evaluated.
Location	California, United States
Coverage	▪ U.S. state level (California) PG&E service area ▪ Households that are not expecting a reduction in occupancy or other factors expected to reduce energy savings for reasons unrelated to an aggregator's intervention, *e.g.*, purchasing an electric vehicle, solar panels or storage
Driven by regulation?	Yes. The California Public Utilities Commission (CPUC) requires utilities to procure third party designed and implemented energy efficiency programmes.
Website	https://www.pge.com/en_US/residential/save-energy-money/resources/energy-efficiency-resources/third-party-energy-efficiency-programs.page

2. P4P structure

Actors involved

The following actors are involved in the scheme:

- The California Senate sets energy efficiency goals (Senate Bill 350).
- The California Assembly requires that real-time energy usage data are made available to consumers (Assembly Bill 793) and asks that weather-normalised, meter-based savings be prioritised (Assembly Bill 802).
- The California Public Utilities Commission (CPUC, regulator) requires utilities to procure third party designed and implemented energy efficiency programmes (Decision 16-08-019).
- PG&E, an energy utility, procures third-party programmes, rewards contractors and evaluates (sometimes with the CPUC) samples of up to 10% of participating customers or completed projects each quarter.
- Third party aggregators — three contractors with four programme contracts — deliver energy savings (Franklin Energy, who has two programme contracts; ICF; and Richard Heath and Associates) using data-driven feedback to inform future programme interventions.
- Customers benefit from energy efficiency measures and co-finance investments where applicable.
- Electricity and natural gas consumers pay a surcharge on their bills to fund the energy efficiency programme portfolio. Consumers benefit from system savings stemming from energy efficiency programmes, with P4P programmes ensuring that ratepayers are getting value for money, given that their investment is tied to performance.

Measures

Each programme has different offers for customers, with contractors having the flexibility to choose from a wide variety of measures and approaches including retrofits, operational measures and behavioural measures, including variable pricing. The programmes are:

- The Home Energy Optimisation programme (ICF) offers smart thermostats, tuning and optimisation of equipment, such as air conditioners and water heaters, lighting and monthly energy efficiency progress reports.

- Home Energy Rewards (Franklin Energy) offers home energy use analysis with recommendations, energy savings kits and discounted energy efficient products, as well as the possibility of full-home energy retrofits (HVAC equipment and fabric improvements).
- The WatterSaver Package and Residential Energy Fitness Program (Richard Heath and Associates) offers rebates on high efficiency, hybrid electric and heat pump water heaters, as well as free in-home assessments and upgrades to smart thermostats and enhanced time delay relay. Some no-cost water consumption reduction measures are also offered.
- Comfortable Home Rebates (Franklin Energy) offers home maintenance and fabric improvements, as well as upgrades to more efficient lighting, HVAC, water heating and pool pumps.

Performance assessment

The CalTRACK method is used to calculate a counterfactual against which observed energy consumption is compared (similar to IVMVP Method 3). The method accounts for weather variation and time of the week. Hourly electric meter reads are needed, which are available daily through Green Button Connect with a 24-hour delay. Customers can agree to share their data with any of the contracted third parties through the Share My Data platform.

Reward mechanism

Household participants are not rewarded on a P4P basis. The third-party aggregators are rewarded on the basis of the performance of their portfolio of households.

Compensation is provided to third-party aggregators on a monthly basis over the two-year period based on the expected lifetimes of the measures. Payment was initially scheduled to be annual, but the frequency of payments was increased to more closely align with contractor investment outgoings and the associated risks being taken.

Compensation rates per kWh and therm agreed upon are commercially sensitive.

Achievements

It’s too early to say at the moment, with only two programmes fully launched and only one of the programmes mature. Programmes are also quite small (less than $10 million dollars spent to date, compared to an annual spend of $270-280 million on the programme portfolio).

Next steps

The programmes will be evaluated once enrolment has reached critical mass, after which an educated judgement can be made about whether to go forward with these sorts of programmes in the future.

PG&E is looking to control for other distributed energy resources (DERs), such as storage, solar panels and electric vehicles in their modelling, given their proliferation in California; this would also enable greater participation.

3. Issues of interest for setting P4P schemes

What have the main drivers been?

- Policy and regulatory drivers for ambitious energy efficiency programmes, third-party contracting and the use of real-time data.
- Policy and regulation driven by climate goals, the increasing variation in the value of energy savings by time of day and year, and the need to improve the cost-effectiveness of programmes funded by ratepayers.

What were the lessons learned?

It is too early to draw definitive lessons; however, the following points have emerged from the operation of the programmes so far:

- The need to get the compensation structure right

PG&E needed to change the frequency of compensation from annual to monthly given the risks that aggregators were being asked to take on.

- If energy efficiency measures are to be rewarded through P4P programmes, there is a need to account for DERs in the modelling framework used for measuring energy savings.

Many Californian households have invested, or are likely to invest, in electric vehicles, solar panels and storage options. Excluding participants with these DERs, or who are about to invest in these technologies, excludes a significant number of potential programme participants.

4. References

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B11 – Germany – Energy Savings Meter

1. Overview

Responsible entity	Programme launched by the German Federal Ministry for Economic Affairs and Energy (BMWi) and managed by the Federal Office for Economic Affairs and Export Control (BAFA)
Summary	The Energy Savings Meter aims at leveraging digitalisation for the benefit of energy efficiency improvements. Public funding is provided to businesses (large companies and SMEs) which promote digitally-enabled energy efficiency solutions to their customers. These companies apply for funding. The level of funding depends for a large part on the amount of energy saved.
Purpose	Develop energy efficiency services markets through digitalisation
Start date and duration	2016-2018 pilot phase. The programme has been extended until 2022.
Location	Germany
Coverage	▪ Geographical coverage: National level ▪ Target sectors: residential, commercial and industrial
Driven by regulation?	▪ No, it is a Government-funded programme but does not stem from an obligation scheme.
Website	https://www.bafa.de/DE/Energie/Energieeffizienz/Einsparzaehler/einsparzaehler_node.html

2. P4P structure

Actors involved

The following actors are involved in the scheme:

- BMWi launched the pilot programme in 2016 and has extended it to 2022. Its role is funding and supervising the programme. BAFA administers the programme — selecting projects, evaluating performance and paying the subsidies to the companies.
- Participating companies are selected on the basis of a project proposal. They provide digitally-enabled energy efficiency services to their clients. They receive public funding to support the development of these services. Part of this subsidy is based on the amount of energy savings achieved.
- Participating customers are clients of participating companies. They realise energy savings thanks to the new digitally-enabled service developed by those companies. The energy savings can be achieved through various ways: behavioural changes, maintenance or optimisation of energy-consuming appliances, or investment in more efficient products.
- Taxpayers ultimately bear the costs for the federal programme. Like for all energy savings programmes, they eventually benefit from lower energy system costs (due to the energy saved). The market digital energy efficiency services will also be more mature as a result of the programme, which could benefit all citizens.

Measures

The programme was designed to allow for a high degree of flexibility, in terms of sectors, eligible companies and projects.

The applicant is free to choose the end customers to whom he will address its offer: households, public bodies, companies or other end customers. Projects have been funded in a variety of settings, including offices and retail stores, hospitals, swimming pools, hotels, restaurants and industrial sites (IEA, n.d.).

The applicants shall develop and propose innovative digital solutions to save energy for their end customers. The savings can be realised as a result of improving access to energy-related information, but also by installing automatic control devices. These services can be combined with other offers, including support to investments.

The subsidy, however, only covers the costs related to the development of the digital service. This covers the purchase of hardware. There is also additional funding for commercialisation of the digital service, which is subject to EU de-minimis-aid rules.

According to the IEA (n.d.), funded projects include those that provide individualised energy advice to consumers in real-time, automatic "energy-saving assistants" or innovative building and heating technologies that integrate weather forecasts and leverage some form of artificial intelligence, *e.g.*, self-learning algorithms.

Performance assessment

The energy consumption data must be recorded with the use of digital tools to allow for measuring the energy savings against a baseline. For the residential sector, the baseline takes into account the last three annual energy bills as well as a weather adjustment if sensible.[30] In other sectors, more factors are taken into account.

Reward mechanism

The second programme phase, which will run until 2022, has €100 million allocated to it, compared to €62 million for the first phase. The maximum allocation per project is €2 million. This was increased compared to the first phase of the project, where the maximum allocation per project was €1 million.

The funding rate is between 25% and 50% of project costs.[31]

Twenty-five percent of the funding is not performance-related. It is based on the costs that the beneficiary can prove to BAFA, before the savings are established. These costs shall be related to the development of the digital service. The costs of additional energy savings measures (*e.g.*, device replacement, building refurbishment) are not eligible under this programme.[32]

The remaining 75% are paid out according to a fixed remuneration key based on the proven savings over the five-year funding period. The idea is to remunerate projects on a yearly basis, once the savings are established (companies have to submit evidence). The price paid per unit rewarded is as follows: 1) electricity savings: 28 cents/kWh for residential customers and 15

[30] *E.g.*, there is no weather adjustment for electricity savings that are unrelated to heating.
[31] 25% general rate; 10% points in addition for SMEs; 15% points in addition for open source bonus (BAFA, n.d.).

[32] They may be eligible under other programmes, *e.g.*, the end customer could apply for funding when planning these measures.

cents/kWh for other customers; 2) natural gas, heating and cooling savings: 5 cents/kWh; 3) primary energy savings: 4 cents/kWh. Additional remuneration options are possible, for example if the project is "load management-ready" or developed in an "open source" way, with up to 2 cents/kWh.[33] The companies do not have the obligation to pass the subsidy to the final beneficiary.

The programme project is a "hybrid project" (Weiß *et al.*, 2017), as it combines the funding of a digital energy service (cost of the development, production and deployment) with a remuneration based on energy savings achieved.

Achievements

As of mid 2019, BAFA had approved more than 50 projects, and the programme has, according to the German government, helped to stimulate a "lively start-up culture" (IEA, n.d.). Further evaluations are needed to understand its impact on the energy services markets.

Next steps

The programme is ongoing.

3. Issues of interest for setting P4P schemes

What have the main drivers been?

- Digital tools in support of climate and energy targets

Energy efficiency plays a key role in achieving the German Energiewende primary energy use reduction goal of 50% by 2050.

In 2014, the BMWi's National Plan for Energy Efficiency (NAPE) included a number of measures to achieve this goal, including the launch of the programme aimed at stimulating innovation, making the best of digitalisation and promoting new business models to deliver energy efficiency solutions.

[33] Unlike the open source bonus, the load management-ready remuneration does not increase the overall cap on the funding rate. There is also a special smart meter gateway bonus that follows the same principle.

What were the lessons learned?

- Programme flexibility versus administrative costs?

The variety of the projects submitted has created complexity in managing the programme, from project selection to energy savings verification. This resulted in increased administrative costs. The process is continuously being streamlined including, for example, by updating funding documents and requirements (IEA, n.d.).

- Innovation versus results?

An evaluation would be needed to understand how the programme has succeeded in creating both innovation and results. One can expect that it takes time to develop a convincing offer, and there could be a trade-off between incubating a truly innovative project and achieving large energy savings immediately.

4. References

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Appendices C – Capacity mechanisms fact sheets

C1 – ISO New England Capacity Market

1. Overview

Responsible entity	ISO New England, the regional transmission organisation, serving six states in the U.S.
Summary	The Forward Capacity Market in New England ensures that the New England power system has sufficient resources to meet the future demand for electricity, particularly during peak periods. Resources compete in the auctions to obtain a commitment to supply capacity in exchange for a market-priced capacity payment. ISO-NE invites customer-based demand-side resources to compete against conventional generation resources. These demand-side resources fall into several categories: demand response, end use energy efficiency and load management, and behind-the-meter distributed generation.
Purpose	Procure future capacity through auctions
Start date and duration	2008 through the present (12 years of operation); energy efficiency eligible from the beginning
Location	Holyoke, Massachusetts
Coverage	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont
Driven by regulation?	Yes. ▪ FERC is the federal agency that regulates ISO New England. Many actions that the ISO takes require approval from FERC, such as proposed changes to market rules or other aspects of the ISO tariff. ▪ Many of the energy efficiency projects bidding into the capacity market are driven by EEOs at state level.
Website	http://www.iso-ne.com

2. P4P structure

Actors involved

The following actors are involved in the scheme:

- ISO New England Inc. is in charge of managing the capacity market auctions and sets the rules for participation.
- Obligated utilities (those with an Energy Efficiency Obligation, called Energy Efficiency Resource Standard in the U.S.) participate in the capacity market by bidding in energy efficiency.
- Aggregators bid in energy efficiency measures.
- State regulators set Energy Efficiency Obligation.
- FERC can issue orders and must approve changes to the market rules.
- Final customers, including domestic and non-domestic, receive energy efficiency measures at a subsidised rate.

Measures

The ISO NE capacity market was established to ensure system reliability in the future. Energy efficiency has participated in the ISO NE capacity market from the market's outset. Companies bidding into the capacity markets offering capacity resources through energy efficiency include utilities and aggregators.

Once a bid successfully clears the auction, payments for each kW of capacity per month are made (currently $2/kW/month), assuming that the utility or aggregator demonstrates that it has installed sufficient energy efficiency measures to meet its capacity obligation. These payments are being used to part-finance a wide variety of energy efficiency measures including, but not limited to, lighting, HVAC and motors.

The ISO NE capacity market is technologically neutral as long as bidders can prove capacity savings and energy efficiency measures need to permanently reduce load. In some cases, demand response is also being delivered with the same technology (*e.g.*, a HVAC system that is more efficient that also gets switched off for several minutes during peak hours).

Performance assessment

A baseline is established for each measure which serves as the counterfactual. Many factors are accounted for in the capacity savings calculations, including the hours the measure is operating,

the power usage of the equipment being replaced as well as that of the newly installed efficient equipment, the estimated usage and time of use, as well as the lifetime. Often such data is obtained through detailed surveys.

Bidders in the ISO-NE capacity market use an M&V manual which is based on the International Performance Measurement and Verification Protocols (IPMVP).

Reward mechanism

ISO-NE provides capacity payments to successful bidders. Bidders, in turn, finance programmes and projects providing an incentive for end users to adopt energy efficiency measures.

In principle, capacity payments to supply-side resources and demand response are based on real-time data. If capacity has cleared, it gets paid the clearing price (currently $2/kW/month). If the capacity resource does not deliver when called during a capacity scarcity period (*i.e.*, intervals during which the electric system is short of resources to meet its energy and reserve requirements), it needs to pay a penalty for each MWh not delivered of up to $5,000 /MWh. If other capacity resources delivered more capacity relative to their cleared capacity obligation, they get compensation from the penalty proceeds obtained from capacity resources that did not deliver.

This is different for energy efficiency and most energy efficiency programmes, which use deemed savings rather than metered savings. Some projects use meter data both before and after the installation of the energy efficiency measures to estimate savings (whether at facility or component level). Initially, the intention was to establish a use profile of savings across all hours to determine capacity savings for the reported measures installed. But aggregators struggled to provide the detailed hourly profile and were made exempt from the requirement to provide a detailed breakdown of savings for each hour. As a result, aggregators estimate only peak-period savings produced by their energy efficiency projects. Energy efficiency resources are subjected to a penalty only during capacity scarcity periods that occur during peak periods if bidders under-installed measures; but if bidders over-installed measures (which is often the case as most energy efficiency bidders are conservative in their estimates), they receive additional compensation for the measures installed.

Achievements

The system operator serving New England has substantial experience enrolling efficiency resources in their capacity auctions. Experience has led to an increasing role for efficiency in

these markets over time, with 2,224 MW of efficiency clearing the market for delivery beginning in 2019 (Liu, 2017).

Next steps

ISO-NE will make two changes in 2020 concerning how energy efficiency is integrated into the capacity market.

The first change concerns a process called "reconstitution." To determine the amount of capacity needed to meet the resource adequacy requirement, ISO-NE must project what future electricity demand will be. Electricity demand is forecasted by projecting historical load data as a function of certain independent variables such as economic growth and trends in the use of certain end-use devices (*e.g.*, electric vehicles, heat pumps). Observed historical load is net of any energy efficiency measures that have been installed. Because the region has been running energy efficiency programmes for many years, the impact of energy efficiency is embedded in the historical data so any projection of that data will naturally include the future impact of energy efficiency. But because ISO-NE also treats energy efficiency like any other supply-side resource, using existing energy efficiency resources to meet the future capacity needs could result in an underprocurement of capacity by double-counting the energy efficiency – once as a reduction for forecasted demand, and once again as an increase to capacity supply. Thus, unlike other supply-side resources, the ISO must "reconstitute" (*i.e.*, add back) the demand savings achieved by energy efficiency into historical loads used in developing the long-term demand forecast to avoid this double-counting effect.

At the outset of the capacity market, the ISO performed reconstitution using energy efficiency performance (*i.e.*, amount of energy efficiency installed), expecting that the amount of installed energy efficiency would be commensurate with the amount of energy efficiency clearing the market as a supply-side resource. Over time, however, the ISO observed that energy efficiency programme administrators install and report energy efficiency quantities in excess of the amount participating in the capacity market as a supply resource. In response to this trend, the ISO has determined that its existing reconstitution practices need revisiting, and will be proposing a new methodology that ties reconstitution more directly to the amount of energy efficiency that participates in the capacity auction as a supply resource. The proposed change will reduce the amount of energy efficiency reconstituted into historical loads, which will decrease the long-term demand forecast and the amount of capacity needed to meet the resource adequacy requirement.

The second change concerns the capacity market qualification rules for energy efficiency. The proposed modifications will better account for what are referred to as "expiring measures." An energy efficiency resource comprises installed energy efficiency measures, with each such measure having a discrete life. As measures expire, they must be removed from the Qualified Capacity of the energy-efficiency resource, which reduces the amount of energy efficiency participating as a supply resource in the capacity market over time. The ISO has determined that the methodology it currently employs for this purpose overcounts expiring measures. The current method determines expiring measures based on the total amount of energy efficiency installed and not on the amount of energy efficiency that participates as a supply resource in the capacity market; again, note that the amount installed tends to be significantly higher than the amount participating as a supply resource in the market. In correcting this problem, less expiring measures will be applied to an energy efficiency resource going forward, which will increase the Qualified Capacity of these resources relative to the current approach (*i.e.*, the capacity of an energy efficiency resource will tend to increase).

3. Issues of interest for setting P4P schemes

What have the main drivers been?

- A desire to reduce system cost.
- To better ensure that capacity resources procured on a forward basis are actually delivered by the year of need so that regional resource adequacy is maintained.
- To provide a substantial financial incentive for resources to produce in real-time when capacity is in short supply, which helps maintain system reliability.

What were the lessons learned?

- Energy efficiency can lower peak demand and reduce system cost

By driving investments in end use efficiency, energy efficiency programmes demonstrably contribute to lowering peak demands on power systems, and those reductions can lower both the total quantity of supply-side capacity needed to provide reliable service, and the clearing price that is paid to all resources through the capacity auction, lowering the cost of resource adequacy to consumers. The main purpose of capacity auctions is to use a market mechanism to drive down the cost of providing projected system capacity needs. By opening the auction to energy demand-side resources, the cost of meeting system adequacy goals can be substantially

lower than it would have been if only supply-side resources were permitted to compete. For example, in the first capacity auction held in ISO New England in which demand-side resources were permitted to bid, it was estimated that demand-side resources lowered total costs by USD 280 million, with energy efficiency alone responsible for approximately one third of the demand-side savings (Jenkins, Neme & Enterline, 2009).

- Prices paid in capacity markets are by themselves insufficient to cover the full costs of energy efficiency incentives

Resources that clear in a capacity auction are paid only for the capacity (or capacity reduction) that they deliver, not the amount of cost savings that they confer on end use customers by reducing their energy requirements and lowering clearing prices. Indeed, neither demand- nor supply-side resources rely solely on capacity payments. Efficiency Vermont estimates that it receives less than 10% of the cost of energy efficiency programmes in Vermont, U.S. back from the ISO New England capacity market.

- Align incentives

Aligning the payment for efficiency services with the beneficiaries, in this case the system operator, better aligns market incentives, as well as makes it more likely that efficiency gains will be supported in the long-term, providing a predictable stream of payments to efficiency aggregators.

- Including energy efficiency in capacity market auctions provides a partial answer to the question “Is efficiency reliable?”

The system operators who administer capacity mechanisms are highly focused on system reliability, and have high standards for resources that will be cleared for payment in a capacity market. Efficiency resources are paid only for demonstrating that they will reliably reduce load during system peak periods. Measurement and verification protocols for capacity programmes are stringent, but efficiency programmes have met these standards and have demonstrated that they deliver capacity savings as well as energy savings in wholesale power markets.[34]

[34] For example, after ex-post analysis of performance, the New England system operator concluded that for planning purposes efficiency resources will be available on a 100% basis, while real-time demand response is rated at 89% and generation availability is rated at 94.1% on average (Neme and Cowart, 2014).

The requirements for demonstrating successful delivery of calculated capacity reductions are substantial. For example, Efficiency Vermont reports that up to 30% of the revenue received in the ISO-NE capacity auctions is taken up in the administrative costs of participating in the auctions and demonstrating compliance (Gottstein & Schwartz, 2010). However, it should be noted that revenues from the capacity auctions can be used as complementary funding to strengthen energy efficiency activities (*e.g.*, for thermal measures mainly affecting natural gas use) or to reduce the levy on customer energy bills.

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C2 – UK Electricity Demand Reduction Pilot

1. Overview

Responsible entity	Department for Business, Energy & Industrial Strategy (BEIS)
Summary	The UK Electricity Demand Reduction Pilot (UK EDR) offered funding to organisations through an auction for projects that reduce peak demand by installing electric energy efficiency measures. Customers needed to propose projects to install electric efficiency measures and are paid based on their peak savings. These projects were required to deliver verifiable peak savings between 4-8pm on work days, November-February.
Purpose	Mirror elements of the capacity mechanism to test whether projects delivering lasting electricity savings at peak could, in the future, compete for revenue streams in the capacity mechanism against generation, demand-side response (DSR) and storage technologies (UK Department for Business, Energy and Industrial Strategy, 2019).
Start date and duration	2014-2018 5 years duration
Location	United Kingdom
Coverage	Great Britain (England, Scotland and Wales) 42 organisations (18 in Phase I and 24 in Phase II) bid into the auction, but only 22 of these went on to fully participate in the EDR pilot (11 from each Phase).
Driven by regulation?	Yes. The Energy Act 2013 enabled the Secretary of State to spend money on an electricity demand reduction pilot programme.
Website	https://www.gov.uk/guidance/electricity-demand-reduction-pilot

2. P4P structure

Actors involved

The following actors were involved in the scheme:

- BEIS was the public authority in charge of managing the auctions.
- Organisations from all sectors were invited to participate in the EDR Pilot. This includes organisations from the private, public and voluntary sectors.
- The successful bidders were in charge of finding contractors to carry out the projects they received payments for.
- Final customers receive energy efficiency measures at a subsidised rate.

Measures

99% of all savings were from non-residential lighting projects. The remaining auction payments were made for motors and centrifugal fans (UK Department of Energy and Climate Change, 2016).

In the auction for 2015-16, 86% of the procured peak savings came from commercial and industry organisations and aggregation companies, with the remaining 14% coming from local authorities. In the auction for 2016-18, only 1% of allocated funding went to local authority projects (Liu, 2017).

The price paid in the UK EDR was £203/kW/year (UK Department of Energy and Climate Change, 2016).

Performance assessment

There was a requirement to follow the EDR M&V Manual. Bidders had the option to use deemed savings for standardised technologies or metered savings for more complex projects using IPMVP methods.

Where seasonal variables had been used to calculate adjustments, a full winter peak period needed to elapse before savings could be measured and reported for the peak months. Where other variables were used, shorter periods were acceptable provided that a range of typical operating conditions was captured. The length of a full cycle of operation was determined by the amount of time that needed to elapse for a full range of operating modes to be experienced. At the total site level, buildings such as offices, hospitals or retail sites, a full cycle was taken as a calendar year if there were seasonal variations. For individual technologies, it may be shorter,

for example, motors used in an industrial process or lighting in a retail site with a weekly cycle. Where there is no seasonal variation (*i.e.*, operating cycles are the same throughout the year) then the cycle of operation did not have to coincide with winter peak as use of the equipment would confidently not be expected to be any different over this period. However, the operating cycle had to be representative of the full range of normal equipment operation.

Reward mechanism

BEIS provided capacity payments to successful bidders. Bidders, in turn, financed programmes and projects providing an incentive for end users to adopt energy efficiency measures.

Total payment was based on a calculation of the number of kW bid into the auction and the price of the highest accepted bid in the auction, rather than the bid. Payments were phased, with 20% payable following installation, 60% following the Winter Capacity Savings Report and a final 20% following the Final Report and participation in evaluation.

For each 1% of savings not delivered, successful bidders lost 2% of total funding.

Projects and programmes already supported by other government policies such as EEOs were explicitly disallowed from participating in the EDR in order to support additional savings.

Achievements

The total winter peak kW reduction delivered through projects supported by the EDR pilot was 18,870 kW, and 13% and 78% of the budget was allocated in auctions for 2015-16 (£1.3m of £10m) and 2016-18 (£4.7m of £6m) (UK Department for Business, Energy and Industrial Strategy, 2019).

Next steps

The findings have provided key learning for a public Call for Evidence on facilitating energy efficiency in the electricity system (UK Department for Business, Energy & Industrial Strategy, n.d.). The government invited responses to learn more about market barriers to energy efficiency in the UK and how to create new markets for energy efficiency, securing its role in the wider energy market, contributing to flexibility and becoming a reliable alternative to increased generation and network reinforcement.

3. Issues of interest for setting P4P schemes

What have the main drivers been?

- Attempt to mirror elements of the UK Capacity Market.
- Test whether projects delivering lasting electricity savings at peak could, in the future, compete for revenue streams in the Capacity Market against generation, demand-side response and storage technologies.
- Provide lessons for government and wider stakeholders on the delivery of related schemes.
- The 2013 Energy Act made provisions for the Secretary of State to establish the EDR pilot.

What were the lessons learned?

- Participants chose deemed savings over metered savings.

Lighting dominated the bids because it was a straightforward measure and enabled deemed calculation of predicted impact. Participants felt this was much easier than sourcing metered data. There was also a reduced chance of predicted savings not being delivered, as these are fairly easily guaranteed based upon hours of use and not subject to a wider number of variables.

- Value stacking is vital to enable competition of energy efficiency with supply-side.

The Capacity Market had significantly lower clearing prices and a lower maximum bid than the EDR pilot auctions. This is partly because the EDR did not allow projects already supported by other policies to bid. The final evaluation noted that it is possible EDR participation could be higher (or required £/kW levels lower) if participants were able to access multiple sources of revenue. But participation of EDR in the capacity market would also need to consider the State Aid regime. Under the State Aid regime, support to EDR projects would be capped at a set level to avoid an over-accumulation of aid (the capacity market counts as aid).

- Complexity of participation.

Perceived level of effort of participation outweighed the limited reward. Whilst complexity was somewhat reduced for Phase II, participants continued to comment that the scheme had required a substantial time investment.

- Challenging timelines prevented bidders from bidding.

One of the key factors in organisations choosing not to participate was the limited window available to express interest and apply for the EDR pilot, as well as that there were only two such windows. The scheme set out some rigidity for rules and deadlines which discouraged some potential applicants and proved to be difficult to administer in practice. Giving a longer lead time – and guaranteeing year-on-year funding – could give organisations the space (and certainty) to develop projects, and potentially more ambitious projects, involving technologies other than lighting.

- If penalties are too high, they can act as a barrier to delivery.

The penalty for being under the target was seen as being a further risk in the initial cost-benefit calculation made by target organisations.

4. References

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