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Energy Efficiency Feed-in-Tariffs: Key Policy and Design Considerations

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Acronym List

EM&V	Evaluation, Measurement & Verification
ESCOs	Energy Service Companies
FiTs	Feed-in-Tariffs
ISO	Independent System Operator
kWh	Kilowatt Hour
PSE&G	Public Service Electric and Gas
RHI	Renewable Heat Initiative

1. Introduction

Numerous studies over the past several decades have demonstrated that the level of investment in the energy efficiency of the buildings in which we live and work is well below economically optimal levels given current energy prices. It is even further behind levels necessary to economically meet long-term carbon emission reduction goals. One reason for the persistent underinvestment in efficiency is the fact that the markets in which families and businesses make efficiency investments are separate and fundamentally different from the markets in which power suppliers make investment decisions for power plants, transmission lines, and distribution substations.

Energy efficiency FiTs are the obverse of energy savings obligations. Instead of establishing the quantity of savings desired and letting the market determine their price, FiTs establish a price and let the market determine the quantity that will be delivered.

For building owners, energy needs are just one – and usually not the most important – of the many concerns in their daily lives. Moreover, efficiency is just one – and often not the most important – of the many attributes of the energy products that they buy. This complicated co-mingling of features, with efficiency usually being the least “visible,” also leads lenders, appraisers, and prospective buyers and renters of buildings to undervalue efficiency. As a result, building owners typically have both much less information about, and much less focus on, the energy implications of their investment decisions than do those who make investments in the energy supply infrastructure.

In addition, building owners typically have much shorter investment horizons than those who make investments in energy supply infrastructure. Building owners typically have no idea whether they will still own and pay energy bills in a specific building even five or seven years in the future, whereas public policy-makers and power system managers know that on average, these buildings will require energy services for decades to come. Public policies and power system rules require plans and investments for generation and delivery to be made with that longer time frame in mind. In economic terms, the building owners in each city and nation implicitly expect or require much higher returns on efficiency investments than those investing in energy supply infrastructure expect of their investments.

Many jurisdictions across Europe and North America have endeavored to address these and other market barriers to efficiency investments by imposing energy efficiency obligations on energy distributors or retail energy sales companies. Under such schemes, the obligated parties are required to help their customers to achieve, in aggregate, specific savings targets, usually expressed as incremental annual savings. A number of jurisdictions have achieved relatively high levels of new annual savings under such policies – savings which in some cases span a number of years. In many of these schemes, energy suppliers or distribution companies play a dominant role in designing, delivering, paying for, and raising funds for large-scale efficiency programmes. Energy efficiency feed-in-tariffs (FiTs) are a potential alternative approach to striking a better balance between efficiency and energy supply markets. In a way, they are the obverse of energy savings obligations. Instead of establishing the *quantity* of energy savings desired and letting the market (i.e., via the obligated energy companies, or otherwise) determine the price of achieving them, they establish a *price* that will be paid for efficiency savings and let the market determine the quantity of savings that will be delivered.

A comparison to policies used to promote renewable power generation is appropriate here. Across the globe, many nations, provinces, and states have used a number of policies to accelerate the uptake of renewable electricity. Usually the centerpiece of those policies is either a Renewables Obligation (specifying the quantity of renewables generation desired and leaving price to competitive market forces) or a FiT (specifying a price for additional renewables supply, but leaving quantity to the market). There is a great deal of experience globally with both of these approaches to promoting renewables generation and integration, experience which includes the merits of using them for different purposes in different circumstances, and even using them in combination. With respect to efficiency, on the other hand, the overwhelming experience to date is with efficiency obligations (like Renewables Obligations, setting the quantity only); there is very little experience with Efficiency FiTs.

Considering that many readily available efficiency resources are less expensive than conventional generation, and much less expensive than the usual FiTs for renewables generation, it seems that system efficiency and social welfare would be well served by programmes that would defer supply-side investments in favor of cost-effective demand-side alternatives. Just as FiTs for renewable power have opened doors to new providers of distributed energy by bypassing industry inertia and opposition to new technology, energy efficiency FiTs could offer the potential to create new markets and enable new market entrants to uncover and deliver energy efficiency resources that are currently not being reached.

No jurisdiction to date has created an explicit energy efficiency FiT. Thus, as with any new or innovative concept, the development of an energy efficiency FiT that is intended to be a major element in a policy framework for promoting efficiency will require very careful consideration of a variety of structural issues if it is to be successful.

This white paper identifies likely policy issues and options and offers initial insights into how to address some of the most important of those issues. In doing so, it draws on well-developed experience in the United States with related programmes and policies. Chief among these are "standard offer" programmes[1] that have been offered by distribution utilities and/or other obligated entities in New Jersey, New York, California, Texas, and several other states over the past two decades. Such programmes essentially offer a specific price per kilowatt hour (kWh) for every unit of energy savings that customers or energy service companies (ESCOs) can document as having been achieved. These programmes differ from an efficiency FiT primarily in that they are offered as part of a portfolio of programmes designed to collectively meet an energy savings obligation, not as the fundamental policy construct for achieving savings. As a result, there is no long-term commitment to continue to offer them (although in many cases they have been offered in different forms for many consecutive years). Also, the prices they offer for energy savings are usually well below the market clearing price for energy[2] because they are designed to optimise the amount of savings per dollar spent. They do not aim to treat efficiency and energy supply resources equally; nor do they aim to optimise – relative to the cost of energy supply – the amount of savings achieved. Nevertheless, they provide valuable insight into how markets react to offers of fixed price payments per unit of energy savings.

The experience in the northeastern US states with allowing efficiency resources to compete with generators in forward capacity markets also provides some valuable perspective. In some ways, they are a peak capacity savings analogue to an energy savings FiT. They also have a number of well-established and documented rules that guide the participation of efficiency and other demand resources in the market. As such, they provide valuable insights into the issues a grid operator has to address when creating market mechanisms for such resources.

Broadly speaking, we see the most important questions to be addressed in considering and designing an energy efficiency FiT as:

- What is the target market?
- How should pricing be structured?
- How should payment be structured?
- How will savings be evaluated, measured, and verified (EM&V)?
- How will the initiative be administered? And, finally
- In broad terms, what advantages or disadvantages do energy efficiency FiTs offer, compared to the other approaches commonly used – Efficiency Obligations, levies on energy providers to create a fund for efficiency programmes, preferential financing, government support, codes and standards, etc.?

We address each of these issues in some detail below.

1 "Standard offer" is just one of many names given to these programmes. Others include "performance contracting" and "pay-for-performance."

2 Sometimes they also have "caps" on the amount that can be paid for any given project.

II. Target Market

The first fundamental question that policy-makers must consider is whether an efficiency FiT would be intended to acquire savings from all customers or just a subset of end-use sectors – for example, just larger commercial and industrial customers. Participation in a FiT will impose non-trivial transaction costs – to document that qualifications are met, to address EM&V requirements, and so forth (these are discussed further below). Thus, residential and small commercial customers could only realistically participate through aggregators such as ESCOs. However, ESCOs have historically had little to no interest in contracting with small customers. Indeed, almost all of the savings from standard-offer programmes in the United States have come from larger commercial and industrial customers; virtually none has come from residential customers and very little has come from small commercial customers.[3]

There are several interrelated reasons for ESCOs lack of interest in small customers. First, ESCOs get their savings from retrofit projects. That is, they assess efficiency opportunities in an existing building and help their customer make changes to that building. Other than the potential to reduce heating loads through treatment of the thermal envelope of the building, the cost-effective *retrofit* savings potential[4] in individual residential buildings and, to a lesser extent individual small commercial buildings, is usually quite modest in absolute (e.g., kWh) terms. Because many homes and businesses are heated with gas, retrofits to address heating efficiency would only be possible under a FiT that addresses more than electricity savings (see discussion on multiple fuels below). Thus, although there is substantial electric efficiency savings potential in the residential and small commercial markets, it cannot be affordably accessed through the building-by-building retrofit approach typically taken by ESCOs. Instead, it must be acquired by simultaneously influencing many efficiency investment decisions by many customers at the time new appliances and other energy consuming products are being purchased. Even some measures that can be cost-effective in a retrofit context – for example, replacing incandescent light bulbs with CFLs – can be much more cost-effectively delivered through initiatives designed to influence retail sales. As a result, if policy-makers want the FiT to effectively address all market segments, they must structure it to allow for payment for mass market programmes as well as individual building retrofit projects (see discussion on projects vs. programmes below).

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3 The one notable exception to this rule has been the Texas programme, which has succeeded in annually achieving some residential savings. However, the magnitude of those savings has been quite small (at least relative to the magnitude of the savings being achieved, planned, or debated in leading jurisdictions in North America and Europe).

4 Here we must distinguish between retrofit programmes, which seek to initiate efficiency investments, and appliance and equipment replacement programs, which focus on investments customers are already planning to make. It is rarely cost-effective to replace an energy-consuming appliance such as a refrigerator or water heater before it would naturally be replaced. The costs are just too large relative to the energy savings. Thus, aside from thermal envelope improvements to increase space heating efficiency, the only cost-effective retrofit savings in many homes are those associated with installing CFLs and hot water conservation devices such as low-flow showerheads. There are substantial potential savings in the residential sector from well-designed appliance and equipment replacement programmes, and these savings could be rewarded via an efficiency FiT. These are not, however, the kinds of programmes typically run by ESCOs.

Individual Projects and Mass Market Programmes?

The experience of numerous distribution utilities and other obligated parties suggests that substantial savings can be acquired from residential and small commercial customers, at levelised costs that are well below even today's energy prices, through programmes designed to influence customers' decisions during natural equipment replacement and/or other purchasing cycles. Such programmes typically combine customer rebates for efficient products with both marketing support and related efforts to recruit and train retail sales staff and business equipment vendors on how to sell efficient equipment. The range of products for which such programmes have been and are currently being delivered include CFLs, heat pump clothes dryers, commercial refrigeration and air conditioning equipment, motors, LED lighting fixtures, and numerous others. Although critical for reaching residential and small commercial customers, these programme approaches can be and often have been applied effectively to larger commercial and industrial customers as well.

Thus, as noted above, it is important that an efficiency FiT be designed to allow for payment for documented savings from programmatic as well as project-specific initiatives. There are some challenges, however, that need to be addressed in such a design. For example, allowing both mass market programmes and individual efficiency projects in specific buildings to participate creates a potential for two different parties – the party providing a programme rebate for the measure and the party installing or arranging for the installation of the measure through a specific building project – to claim credit for the same savings. It will be necessary to develop rules for determining "ownership of savings" and to conduct careful monitoring to ensure such rules are followed, so that there is no double-counting of and paying for savings. This is an eminently addressable challenge. Indeed, the New England Independent System Operator (ISO) in the northeastern United States has been effectively administering implementation of its Forward Capacity Market with such rules and systems for several years. Distribution utilities and other organisations that run efficiency programmes have developed a simple adaptation to these rules: any customer accepting a rebate legally signs over the rights to the market value of its energy savings to the programme administrator. Thus, those customers who are approached by independent ESCOs who want to acquire peak capacity savings must either (1) accept the programme rebate and reject the ESCO's offer, or (2) work with the ESCO and turn down the programme rebate.

Which Energy Sectors – Electric Only?

In general, FiTs have historically been considered primarily in the context of electricity markets, as they were initially conceived as a means to increase the amount of electricity produced by wind, solar, and other clean renewable energy sources. Although production incentives for transportation biofuels are well known, there has been much less development of renewable energy FiT equivalents in the gas sector[5], and the concept of a FiT has not often been seen to be relevant to gas markets. However, that changes when the FiT concept is expanded to encompass energy savings from efficiency investments in buildings. There is no reason an efficiency FiT could not apply equally to both electricity and gas markets.[6]

There are important reasons to consider establishing efficiency FiTs for both electricity and gas. First, many efficiency measures save both fuels in the same building. For example, adding insulation, replacing inefficient windows, and reducing air infiltration into buildings reduces both winter gas heating loads and summer

5 One programme cutting across transportation and non-transport end-uses is the Bioenergy Producer Credit Program in the Province of Alberta, Canada, which pays different premiums for the production of second-generation ethanol and biodiesel as liquid fuels, and for biogas used in electric generation, as well as for direct biomass combustion for electricity. See http://www.energy.gov.ab.ca/BioEnergy/1826.asp.

6 One close analogue is the recently adopted Renewable Heat Initiative (RHI) in the United Kingdom. Under the RHI, the Government requires payment of a price premium – essentially a FiT – to various systems deriving heat from renewable sources, including biogas and methane recovery, ground-source heat pumps, geothermal heat, solar thermal heat, and biomass boilers. However, energy efficiency investments that would avoid fossil fuels and provide equivalent environmental benefits at lower cost are not eligible for these premium payments. See http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/incentive/incentive.aspx

electric cooling loads. An electric-only FiT would therefore lead to underinvestment in cost-effective efficiency by valuing only a portion of the benefits of some efficiency measures. Second, comprehensive energy roadmaps and policy models suggest that economically meeting long-term carbon emission reduction goals (i.e., 80 percent emission reductions by 2050) may require making significant investments in the thermal efficiency of buildings and then fuel-switching most building space heating (as well as water heating and perhaps other end-uses served by gas) to electricity from a de-carbonised electric grid.[7] Thus, in the long run, all building efficiency investments may ultimately be saving electricity. For individual building owners, an electricity-only FiT might create an inefficient incentive, encouraging some consumers to fuel-switch to standard electric heat before making thermal efficiency improvements,[8] "locking in" some inefficiency[9] and adding undesirable levels of demand to the power grid.

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7 European Climate Foundation, Roadmap 2050: Practical Guide to a Prosperous, Low-Carbon Europe, Volume 1, April 2010. See www.roadmap2050.eu

8 This might occur because customers with gas heating, for example, would not be able to access incentives from an electric-only FiT unless they fuel-switched.

9 If fuel-switching occurs before the thermal envelope of the building is retrofitted to economically optimal levels of efficiency, the new electric heating systems will be over-sized, with both adverse economic consequences (larger systems cost more) and potentially adverse impacts on efficiency (some over-sized systems do not operate as efficiently).

III. Pricing and Payment

What Price Should Programmes Pay for Proven Savings?

Pricing will be the most critical aspect of any FiT. At first blush, it may appear easy – just set the price equal to the price for electric supply and the market will determine how much efficiency should be pursued. At a high level of generality, this could well lead to larger, societally efficient results.[10] However, that approach would lead to significant overpayment for relatively inexpensive efficiency savings – both because ESCOs aim to maximise rates of return on their efficiency investments and because there are substantial levels of relatively inexpensive savings still available in the economy.

Indeed, this has been the experience with markets for efficiency resources in which there was a single price paid for all such resources, regardless of how difficult or expensive they were to acquire. Consider the "standard offer" programme offered by Public Service Electric and Gas (PSE&G) in New Jersey in the 1990s. That programme – one of the biggest, if not the biggest programme of its kind to date (PSE&G spent over $1 billion on it) – offered ESCOs a fixed price per kWh saved (differentiated by the season and time of the savings) for any measures that they caused to have installed. A detailed evaluation of the programme was completed in 1998.[11] The evaluation concluded that 83 percent of the efficiency savings produced were due to lighting retrofits in large commercial buildings. The programme was far less successful in capturing savings from non-lighting measures such as HVAC and motors (which together accounted for less than 6 percent of efficiency savings).[12] Moreover, the programme paid an average levelised cost of 3.9 cents/kWh for those large lighting retrofits.[13] The 3.9-cent cost of savings was, of course, lower than the full cost of power supply and delivery, and thus saved consumers significant sums. But at the same time, it might have been possible to acquire those savings *at even lower cost*. For example, utility-run rebate programmes for commercial lighting retrofits in other jurisdictions at the time typically cost ratepayers roughly 2 cents/kWh (or less).

The "problem," if we can call it that, is that there is a very large gap between the cost to deliver the cheapest large-scale efficiency measures, and the cost of power supply and delivery that those cheap measures displace. How much of the net savings should be (a) reserved to participating end-use customers, (b) paid to ESCOs, installers, utilities, and other efficiency prospectors, or (c) invested in delivering greater quantities of higher-cost efficiency or renewables resources?

10 Economists and consumers alike understand that in competitive markets, oil from low-cost wells receives the same market price as oil from high-cost wells, and power from low-cost generators receives the same market price as power from high-cost generators. The same principle could be applied to energy efficiency savings delivered to a power system, with the same market-clearing price offered for all savings that are less expensive than supply-side resources. However, considering that an energy efficient FiT is itself a market intervention designed to overcome market failures, policy-makers do have an opportunity to design the energy efficient FiT to deliver maximum societal savings at even lower cost to final consumers, and should be mindful of that opportunity.

11 Edgar, George, Martin Kushler and Don Schultz (all on behalf of the Wisconsin Energy Conservation Corporation). "Evaluation of Public Service Electric and Gas Company's Standard Offer Program." Prepared for PSE&G, October 14, 1998.

12 Ibid. Note that fuel-switching measures were also eligible to participate and were the second largest source of savings after lighting measures. Lighting measures accounted for 60 percent, fuel-switching accounted for 27 percent, and HVAC and motors accounted for five percent of total (efficiency plus fuel-switching) savings.

13 Ibid.

Designers of energy efficient FiTs will need to balance competing objectives in setting the FiT rates. On the one hand, there is a need to provide an adequate profit margin for efficiency providers, to encourage their growth, strengthen their ability to attract staff and capital, and to innovate and test new programme designs. On the other hand, there is the common problem of "cream-skimming," in which efficiency entrepreneurs actively promote only the largest, least expensive measures with the largest short-run payoffs, leaving "stranded efficiency" opportunities in the buildings initially served.

Just as a renewable energy FiT should not pay the same price for wind energy as for solar – or for systems of different sizes or scales – because the same price is not needed to drive investments in those technologies, an efficiency FiT should not pay the same price for the easiest and cheapest savings as it does for the most difficult and expensive savings.

Without conscious attention, "cream-skimming" could be a lasting consequence of badly designed energy efficiency FiTs. Although the degree of such "cream-skimming" under a single price FiT might change over time, as the "well" of cheap savings begins to "dry up," the ability to capture other, more expensive (but still societally cost-effective) savings will likely have been diminished in the process. This is because customers incur transaction costs in making efficiency improvements, particularly retrofit improvements. Thus, it may become difficult to convince at least some customers to invest the time and disruption required to deal with a second or third retrofit treatment. Moreover, participation in an initial efficiency project may lead some customers to inaccurately conclude that they have fully addressed their efficiency issues.

Finally, and perhaps most importantly, the installation of some inexpensive "basic" efficiency measures can render the installation of more advanced measures with greater savings uneconomic for many years. For example, once a decision is made to replace T12 commercial lighting fixtures with standard T8s or even high performance T8s, the opportunity to install even more efficient LED fixtures may be lost for 15 years or more (i.e., until the new T8s need to be replaced) because the customer will have to bear (a) the full cost of the new LED fixtures (rather than just the incremental cost relative to the T8s that would have been incurred had the LEDs been installed the first time), (b) a second set of installation costs (first for the T8s and again for the LEDs), and (c) the cost that an ESCO or vendor will charge to cover its transaction cost of recruiting the customer for a second round of retrofits.

How can good design address this problem? Put simply, an efficiency FiT will impose fewer costs on consumers and be most effective in generating savings – particularly in the long-term – if its pricing structure differentiates between different types of savings, and rewards more comprehensive treatment of efficiency opportunities. Just as a renewable energy FiT should not pay the same price for wind energy as for solar – or for systems of different sizes or scales – because the same price is not needed to drive investments in those technologies, an efficiency FiT should not pay the same price for the easiest and cheapest savings as it does for the most difficult and expensive savings. Thus, FiT pricing should ideally be differentiated in one or more of the following ways:

- **By measure.** Pay less for basic measures (e.g., CFLs and standard T8s) than for advanced measures with much lower market penetrations (e.g., LEDs).
- **By end-use or value of savings.** Pay more for end-uses whose efficiency measures are less commonly pursued in the market and/or that drive peak demands and therefore will have greater benefits by reducing stresses on the grid. For example, California's programme in the late 1990s offered incentives per unit of first-year savings of $0.05/kWh for lighting, $0.08/kWh for motors and other measures, and higher amounts ($0.165/kWh) for air conditioning and refrigeration measures, which would deliver high-value demand reductions in peak power periods.[14]
- **By market segment.** Pay more for savings from hard-to-reach markets such as residential and small commercial customers; savings from low-income and fuel-poor customers may be paid the highest premium.
- **By depth of savings.** Consider paying bonuses for depth of savings. For example, the current

14 Schiller, Steven, Charles Goldman and Brian Henderson. *"Public Benefit Charge Funded Performance Contracting Programs – Survey and Guidelines"*, in Proceedings of the 2000 ACEEE Summer Study on Energy Efficiency in Buildings.

New Jersey Pay-for-Performance programme offers a payment of $0.18/kWh and $1.80/therm of first-year savings for projects that just meet the minimum requirement of 15 percent savings. For every one percentage point greater savings, however, the payment for all savings increases by $0.01/kWh (with a cap of $0.22/kWh) and $0.10/therm (with a cap of $2.50/therm).[15] That means the marginal payment for the 16th percentage point of savings is $0.34/kWh and $3.40/therm – or roughly double the payment for each of the first 15 percentage points of savings.[16] This obviously encourages deeper savings, but even with these higher marginal rates, both the marginal and overall efficiency investments are still quite cost-effective.[17]

What Savings Life Should be Recognised?

In addition to establishing the initial price(s) paid per kWh, an efficiency FiT must be clear about the number of years of savings for which it will pay. If efficiency resources are to be fully valued, *it is critical that they receive payment that recognises all of the savings produced over their useful lives.* Arbitrary caps on the lives of measure savings – which some US initiatives have put in place[18] – will inherently undervalue longer-lived measures and lead to less than optimal levels of investment in such measures.

In that context, it would likely make sense to initially establish deemed measure life assumptions, at least for common measures. Such assumptions could be updated over time as new information becomes available. Ideally such updates would only apply to any new savings brought to the market after the update, and would not pose a financial recovery risk to customers or ESCOs with respect to efficiency investments already committed.

Measure life assumptions for less common or custom measures would need to be established through documentation provided by the parties bringing the savings to the market, with review and approval by the system operator or other designated party.

When Should Payments be Made?

An efficiency FiT policy must also establish when payments for efficiency savings will be made. Options range from a full up-front or first-year payment for the projected lifetime savings, to paying each year for only that year's savings (e.g., 10 separate payments – one each year – for a measure or project with a 10-year life).

In general, the greater the fraction that is paid up front, the more attractive the offer will be to prospective market participants. Up-front payments reduce transaction costs for market participants (as well as for the FiT administrator), reduce real or perceived risks associated with future payment streams, and diminish or eliminate the need to raise long-term capital to finance efficiency projects. To the extent that there is significant enough uncertainty about the magnitude of savings, there will be some advantage and even need to defer some payments until savings can be better documented through EM&V (see Section IV). However, that is likely to be the case only for more complex, custom commercial and

15 These are the combined second and third (final) payments per kWh and therm. The first payment is a payment per square foot of building space to offset part of the cost of an efficiency assessment and plan. Note that the caps only provide additional marginal incentives to increase electric savings to 19 percent and to increase gas savings to 22 percent. That is not an ideal structure, as savings well above 22 percent are often cost-effective (for more details see: http://www.njcleanenergy.com/files/file/Pay%20for%20Performance%202011%20Forms%20and%20Applications/P4P%20EB%20Incentive%20Structure%20002-10-11.pdf)

16 Although the increase in payment is only about five percent higher (i.e., 0.19/kWh for 16 percent savings vs. 0.18/kWh for 15 percent savings), the increased payment applies to all 16 percent of the savings, not just the increment above 15 percent. For example, a building consuming one million kWh/year that achieved 15 percent savings would receive a payment of $27,000 (i.e., $0.18/kWh * 150,000 kWh). If the same building achieved 16 percent savings, it would receive a payment of $30,400 (i.e., $0.19/kWh * 160,000 kWh). Thus, the marginal incentive for the additional one percent savings would be $0.34 (i.e., $3,400/10,000 kWh) – or roughly double the incentive per kWh for the first 15 percent savings.

17 The premiums paid are just for the "first year" savings; because the efficiency measures will deliver savings for many years (typically 10 to 15 years or more), the premium paid is much lower than the system avoided cost when calculated on a lifetime basis.

18 For example, under the PJM Reliability Pricing Model (the Mid-Atlantic states' forward capacity market), efficiency measures are allowed to receive payments for a maximum of only four years.

industrial efficiency projects. Moreover, even in such cases, it should not take more than a year or two after installation to establish a reasonable estimate of annual savings.

For those reasons, standard offer type programmes in the United States have evolved from making annual payments for annual savings to significantly accelerating payments for delivered measures in anticipation of their long-term savings. For example, PSE&G's standard offer programme in New Jersey in the 1990s offered contracts to participating customers or ESCOs in which it committed to payments over a 5- to 15-year time horizon, depending on the types of measures being installed. In contrast, the current "pay-for-performance" programme in the state makes three separate payments: one for completion of an energy reduction plan, a second for installation of measures based on projected energy savings, and a third, typically a year later, based on actual measured reductions in consumption.[19] New York's performance-based incentive programme paid out incentives "over a two-year measured performance period."[20]

One could argue that paying for the full lifetime savings of efficiency measures or projects immediately after the measures are installed or the projects are completed would be treating efficiency resources differently, indeed more favorably, than the way supply resources are treated. However, efficiency resources and supply resources are different in ways that suggest different payment approaches may be appropriate. In particular, nonrenewable supply resources are both dispatchable and incur significant variable costs (primarily fuel costs) when they are dispatched. Their production cost and power market revenues thus vary considerably from year to year. Moreover, they incur significant variable costs (primarily fuel costs) when they are dispatched, so paying them in full for a lifetime of electricity production would eliminate any incentive to actually run when they are needed. Many renewable supply resources, including wind and solar, are non-dispatchable. Their production can still vary considerably from year to year, however, and support schemes are designed to encourage maintenance and operational decisions that will maximise production from these high-capital-cost facilities.

In contrast, the savings from most efficiency measures are both non-dispatchable, very predictable (at least on average), and for the most part do not require continuing incentives to make sure they are "dispatched" to the grid. Moreover, as discussed above, there are significant market barriers to their installation, which can be overcome by revealing their values to investors and building owners at the time their capital costs are being borne.

19 The current programme is different from the 1990s standard offer in several other ways as well: (1) it is targeted to only medium and large commercial and industrial customers (there must be a minimum baseline demand of 200 kW), whereas the 1990s program was open to customers of all sizes; (2) it requires that a minimum facility savings of 15 percent be achieved in order to receive any payments, whereas the 1990s program had no minimum; (3) its payment per kWh of electricity saved and per therm of gas saved increases as the savings percentage increases (see discussion above); and (4) its M&V requirements are much less onerous (see discussion below).

20 Schiller et al.

IV. Evaluation, Measurement, and Verification

Balancing Precision and Cost

If all consumers are to pay for delivered energy savings, and if power and gas systems are to rely on them for energy security and grid stability, then it is imperative that the delivered savings be "real." That is true regardless of whether savings are delivered through a binding savings obligation, an efficiency FiT, or any other policy mechanism. Evaluation, Measurement & Verification (EM&V) however will likely be more complicated under an efficiency FiT primarily because the number of parties participating and delivering savings is likely to be greater than under a savings obligation scheme imposed on a discrete number of energy suppliers. Under a savings obligation scheme, it is usually enough to assess the accuracy of savings estimates from an appropriately sized representative sample of customer efficiency projects, and apply any resulting "correction factors" to the portfolio of savings reported by the obligated party to determine whether it met its targets. Under an efficiency FiT, it will be necessary to ensure that any party contemplating participation in the market expects savings claims to be carefully scrutinised before payments are made.

That was the case when the initial standard offer programmes were launched in New Jersey in the early and mid 1990s. Under PSE&G's programme, each FiT project had to have a preapproved M&V plan. Standardised M&V protocols made available by the programme typically involved continuous metering of hours of operation of efficiency measures for many years, even though most of the measures installed involved "constant load, constant operating hour, non-weather sensitive end uses such as lighting system retrofits and constant load motors."[21] These requirements imposed significant costs on prospective programme participants and were cited by a number of ESCOs as a significant barrier to participation.[22]

TXU Electric (serving parts of Texas) took a different approach to M&V requirements for its standard offer programme in order to ensure that the benefits of M&V (in the form of increased precision of savings estimates) were commensurate with the costs. Thus, in contrast with PSE&G's extensive, "one-size-fits-all" requirements, TXU's programme had a three-tiered M&V structure: (1) deemed savings;[23] (2) simple M&V;[24] and (3) full M&V.[25] The method chosen for particular types of investments and customer types depended on the availability of data from past studies on usage data and/or savings, the predictability of equipment operation, and/or precision vs. cost trade-offs.[26] This approach is still used in the current Texas standard offer programmes, with almost all

21 Edgar et al., p. 2-12.

22 Kushler, Martin and George Edgar, "Lessons from Granddaddy: Observations from the Evaluation of the New Jersey PSE&G Standard Offer Program", in Proceedings of the International Energy Program Evaluation Conference, Denver, Colorado, 1999.

23 Savings assumptions for measures that are stipulated in advance of their installation. Numerous jurisdictions in the United States now have extensive (i.e., hundreds of pages long) Technical Reference Manuals that document deemed savings assumptions, any calculations or formulae underlying them, and the sources of all assumptions.

24 For example, conducting short-term testing to develop inputs to pre-set savings calculations.

25 For example, whole building analysis, calibrated simulation modeling, or extensive metering of end-use equipment or systems.

26 Schiller et al.

participants using the deemed savings option.

Texas' more balanced approach is a better one almost regardless of which markets are targeted by an efficiency FiT. However, it is particularly important in the context of a FiT that aims to address savings opportunities in all sectors, including residential customers.

Evaluation Independence

A second key EM&V consideration relates to who is responsible for conducting EM&V reviews. Obviously those entities seeking payment for efficiency savings need to be prepared to clearly document and report on the savings they believe they have achieved. Such savings claims, however, also need to undergo some level of independent assessment.

At a minimum, the independent assessment will involve a review of any EM&V data collected and submitted as part of the savings claim. Ideally it would also involve the FiT administrator in conducting its own EM&V (or at least directing the conduct of the EM&V), rather than allowing project sponsors who have a vested stake in the outcome to manage the M&V process.

V. FiT Administration

As with any policy instrument, an efficiency FiT would require some administrative rules and processes in order to function efficiently. Based in part on the experience of the New England ISO's management of its forward capacity market, we have identified the following issues as among those that should be addressed by such rules and processes:

- **Programme policy, design, and continuous improvement.** As noted in this paper, there are a number of foundational design choices in setting up any efficiency FiT. Aside from broad policy decisions, most of these design details are appropriate for administrative, rather than legislative, decision-making. Energy regulators, energy ministries, or special-purpose efficiency agencies should be given the responsibility to supervise an efficiency FiT, to set and update deemed savings values, to ensure quality control and protect consumers, and to make forward-looking adjustments that will lower costs and raise savings levels.

- **Pre-qualification process.** The efficiency FiT administrator will need some assurance that businesses that are delivering energy savings are reputable and trustworthy, so that the prospects for fraud or even difficulties with data tracking and reporting are minimised. One option would be to create a pre-qualification process in which businesses interested in participating in the market must demonstrate that they meet minimum requirements for participation.

- **Minimum size requirements to participate.** The efficiency FiT administrator will incur transaction costs – to manage the transfer of savings data, to police against double-counting of savings, to assess the reasonableness of the savings claims, to periodically audit savings claims, to manage the transfer of payments for verified savings, and so on – for each participant bringing energy savings to the market. To keep administrative costs at a reasonable level, it will thus likely be necessary to require a minimum level of savings in order to participate in the market. The minimum threshold should balance the desire to minimise administrative costs with the desire to spur entrepreneurial efforts to acquire savings. As a point of reference, the New England ISO has set a minimum of 100 kW for bidding into its capacity market. That is equivalent to the peak savings of approximately 20,000 CFLs or between 500 and 1,000 annual MWh of energy savings. With that cutoff, the ISO had fewer than 70 different efficiency resource "projects" (from approximately 25 different companies) clear the market in its first year.

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- **Expressions of intent to participate.** It will be important for the FiT administrator to be able to forecast, within some reasonable margin of error, how much savings are expected to be brought to the market. That would allow for planning regarding how much revenue should be collected in rates to cover the costs of acquiring the energy savings, as well as planning for system transmission and distribution upgrades, power supply needs, and the like. One way to do that would be to require prospective market participants to file a notice that they intend to participate in the energy efficiency FiT programme, including a forecast of how much savings they expect to deliver, several months before the start of a programme period. There may need to be limitations on how much a provider's actual savings in that year can deviate from its forecast.

- **EM&V manuals.** The FiT administrator will need to develop and maintain a set of rules regarding how savings are estimated and claimed. This would likely include a "Technical Reference Manual" in which deemed savings values and deemed savings algorithms are clearly articulated. It would also include guidance on how custom assessments of savings (e.g., for larger commercial and industrial retrofits) can be conducted. Further, there will need to be a transparent process governing how such assumptions and guidelines are periodically updated.

- **Auditing of savings claims.** As noted above, the FiT administrator will need to conduct periodic audits of participants' savings claims to make sure savings are real and accurate. Protocols for how such audits are conducted and how they are paid for will need to be developed.

VI. Conclusions and Recommendations

Efficiency FiTs are an intriguing new concept for accelerating investment in end-use energy efficiency. Efficiency FiTs offer the potential to overcome much of the inertia on end-use efficiency that has characterised most power and natural gas systems across the globe. Many jurisdictions have seen an explosion in interest in PV installations, in biofuels, and in wind power following creation of FiTs. By inviting many businesses (rather than just energy suppliers) to participate in generating energy savings, efficiency FiTs have the potential to unearth and harness innovations in delivering cost-effective energy savings that have not been seen to date.[27] That potential could be critical to minimising the costs of meeting long-term greenhouse gas emission reduction obligations, while maintaining 21st-century reliability standards and lowering the fossil fuel burden on modern economies.

There are, however, substantial challenges to effectively implement efficiency FiTs. Unlike savings obligations imposed on energy suppliers, they do not necessarily ensure that a prescribed level of savings will be achieved; if a jurisdiction wishes to ensure that particular savings targets are met, programme administrators must retain a certain amount of administrative flexibility and the ability to change FiT prices over time. Moreover, badly designed FiTs could be complicated to administer, could result in "cream-skimming," or could raise the average cost of energy saved, as compared with a more straightforward energy supplier obligation.

These challenges are not in themselves reasons to avoid creating an efficiency FiT. As with many other innovations in energy policy – including Renewables Obligations, competitive retail power markets, demand response programmes, "smart" metering, and others – experience on the ground is needed in order to test the idea and learn. Until an efficiency FiT is tested on a large scale, it is difficult to make definitive determinations as to how it compares to energy savings obligations and/or other policy mechanisms for generating energy savings. Indeed, whether it is the best approach in any jurisdiction may well depend in large part on local conditions, including whether it is politically possible to establish a system-benefits charge funding mechanism; the degree to which there are obvious parties to "obligate" to meet savings targets; the degree to which those parties are trusted; the degree to which there are prospects for a well-functioning, competitive, and high-quality ESCO industry; evidence as to the ability and willingness of incumbent utilities, distribution companies, and energy service providers to promote deep, sustained savings; and the political and practical history of energy-savings programmes in that jurisdiction.

One thing that is clear is that the *design* of any efficiency FiT will be critically important to its prospects for success. As discussed above, experience with similar or related mechanisms leads us to a number of conclusions regarding design:

- It should be structured to allow both mass market programmes and individual retrofit projects to participate;
- It must establish "ownership" rules to encourage efficiency investments and ensure no double-counting of savings results;
- It will be most effective if simultaneously established for both electric and gas savings;
- It must be supported by a viable, long-term source

27 To give but two examples, we simply do not know whether customer aggregation via new "social media" sales techniques would enable a more rapid penetration of new efficiency measures across thousands or tens of thousands of households and small businesses; or whether an efficiency FiT could be combined with a rooftop solar FiT to lower the costs and raise the penetration rate of both. But we do know that both the potential for efficiency savings and the potential for innovation in programme design remain quite large.

of revenues to support private investments by customers, ESCOs, and other potential market participants;

- The price paid for energy savings should vary by both (1) expected costs of different kinds of measures/projects and (2) the depth of savings achieved, and may vary to reflect other important values, such as addressing energy poverty, addressing peak load costs, improving reliability in congested load pockets, and so forth;
- Payment should be made for the full estimated quantity of lifetime savings of measures/projects (although not necessarily the full value of the savings to the power system as a whole);
- Payments should be made up-front for any measures with deemed savings (or that use deemed savings algorithms), but can be made across appropriate time periods for larger, individualised projects as needed to accurately "true up" estimated savings for those measures and/or programmes requiring EM&V investments;
- Savings claims by market participants should be validated by independent third parties and periodically audited by the FiT administrator; and
- Administrative systems that will need to be put in place should be developed through a process that engages a range of potential stakeholders, with the final products being as clear and transparent as possible.

Finally, because efficiency FiTs have not yet been widely tested, they will almost certainly require fine-tuning as experience with their implementation is gained. Perhaps most importantly, pricing structures will need to be refined once the market response sheds light on which prices may be too high or too low to optimise investment in different types of efficiency measures and programmes.

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