A Retrospective Look at Federal Energy Efficiency Tax Incentives: How Do Cost and Performance-Based Incentives Compare in Their Ability to Transform Markets?

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ABSTRACT

Several energy efficiency tax incentives were enacted as part of the Energy Policy Act of 2005 to encourage the implementation of efficiency in buildings and appliances. These include the Energy Efficient Commercial Buildings Deduction (26 USC 179D), the New Energy Efficient Homes Credit (26 USC 45L), the Nonbusiness Energy Property Tax Credit (26 USC 25C) and the Energy Efficient Appliance Credit (26 USC 45M). With over five years of often sporadic data and experience implementing these incentives, this paper examines the effectiveness of each at transforming the market for energy efficiency. In particular, this paper examines whether performance based incentives were more effective – resulted in greater levels of energy savings at a lower cost, with less free-ridership – than cost based incentives. Past research has shown that in the limited cases where they have been evaluated, cost-based incentives have not been effective at transforming markets and tended to overpay for efficiency; some were found to have produced statistically insignificant levels of energy savings. The paper presents data on the use and effectiveness of each incentive, collected from a variety of sources including manufacturer and retailer sales data, the Energy Information Administration, the US Department of the Treasury, tax attorneys, consultants, and the Government Accountability Office. The paper analyzes how the various incentives have been used: what measures were implemented, what effect they had on the Treasury, and whether energy savings were additional or the result of free riders.

Introduction

Federal tax incentives are considered a key component to transforming the long-term market for energy efficiency by increasing the market share for or encouraging the development and deployment of highly efficient technologies and practices. (Nadel et al. 2006) In particular, those tax credits in which the government sets efficiency standards that manufacturers must meet through whichever technology means they see fit are thought to be most effective. (Mann 2010) Past research has identified several different types of efficiency incentives:

- *Cost-based incentives* where the amount of the incentive is determined by the cost or incremental cost of the measure, regardless of performance.
- *Performance-based incentives* where the amount of the incentive is based on the level of efficiency achieved rather than cost (either on a sliding scale for incremental energy savings or as a single minimum standard).
- *Managed incentives* which are actively administered and the incentive levels and criteria are modified as necessary to maximize energy savings within a set program budget.

- *Long-term incentives* which are fixed at a given level for a multi-year period in order to give manufacturers and other stakeholders the certainty to plan to meet the incentive.

The Energy Policy Act of 2005 (EPACT) included several tax incentives intended to encourage efficiency improvements in new and existing residential and commercial buildings. These incentives were the Energy Efficient Commercial Buildings Deduction (26 USC 179D), the New Energy Efficient Homes Credit (26 USC 45L), the Nonbusiness Energy Property Tax Credit (26 USC 25c), and the Energy Efficient Appliance Credit (26 USC 45M).

Prior to the enactment of these incentives, there was limited experience with federal tax incentives for energy efficiency in the United States. This experience included a federal tax credit for residential conservation expenditures from 1978 to 1983 and for business purchases of efficiency measures in the 1970s. Both of these incentives were cost-, rather than performance-based. The residential conservation tax incentives of the 1970s and 80s offered homeowners an incentive of 15 percent of expenditures on conservation measures up to $2000 and the business credit of the 1970s offered a credit of 10 percent of costs for business purchases of energy efficiency measures.

Retrospective analysis of both incentives indicated that most measures would have been implemented regardless of the presence of the incentive. (Hirst et al 1982; Quinland et al. 2001; Goldstein & Fairey 2006) Analysis of the residential incentive found that the incentive was claimed 4 million times per year and cost the US Treasury a total of $2.3 billion, most of which was spent on free riders – those consumers who would have implemented measures regardless of the incentive. (Gold & Nadel 2011) Oak Ridge National Laboratory found that while the incentive appeared to induce more efficiency than would have occurred otherwise, the results were not statistically significant. Furthermore, a survey of homeowners found that close to 90 percent of those qualifying for the incentive said they would have purchased the measures anyway. (Hirst et al 1982)

This past research has shown that purely cost based incentives, when they have been evaluated, have generally not been effective at transforming markets for energy efficiency and tend to pay mostly for free riders. This research has also postulated based on anecdotal evidence that performance based incentives would be more effective at encouraging market transformation and increased implementation of efficiency measures. (Goldstein & Fairey 2006)

Another aspect of tax incentive design is the recipient of the incentive, namely, whether it is a consumer-facing or producer-facing incentive. While this is another important element of tax incentive design, it is beyond the scope of this paper.

The energy efficiency tax incentives in EPACT included pure performance-based incentives (45M, 179D and 45L) and incentives that were a combination of performance and cost-based incentives (25C). While there is not good consistent data on each of these incentives for the whole five-year period, this paper compiles the market share, tax claim, anecdotal and other data available to date to analyze how these incentives have actually performed. Why have some performed better than others? Have these incentives resulted in actual energy savings and transformed markets for energy efficient products? What led to success in some cases and failures in others?

The Energy Efficient Commercial Buildings Deduction

Background

Since its enactment in 2005, there have been significant challenges to the implementation of Section 179D, which is summarized in Table 1. Some of these challenges are due to the structure of the incentive and some are due to the way it has been implemented. While the Energy Efficient Commercial Buildings Deduction was designed to be a long-term incentive that set a very high, but achievable efficiency bar (at the time of enactment, only 100 buildings had been documented as having reached the 50 percent target), it was originally enacted for just two years, despite the fact that the stand-alone legislation on which this section was based would have applied to buildings designed within five years and placed in service within 7 years. (Goldstein and Fairey 2006; Nadel et al 2006) This two-year time frame did not align with the construction cycle or provide owners and designers adequate time or certainty to invest in designs that would meet the energy savings targets and therefore prevented uptake of the incentive. (Nadel et al 2006) Additionally, the incentive is not available to any private building owner who does not have tax liability and these owners make up a large share of commercial real estate owners (although this outcome was not predicted at the time).

Table 1. Summary of Section 179D

Incentive Type	Performance-based.
Building Type	New and existing commercial buildings.
Expiration Date	Originally would have expired on 12/31/08, but the Emergency Economic Stabilization Act (EESA) of 2008 extended until 12/31/13.
Amount	$1.80/SF of building for full deduction; $0.60/SF for partial deduction.
Criteria	Improvements to the interior lighting, HVAC or hot water, or building envelope designed to reduce total annual energy costs by 50 percent compared to ASHRAE Standard 90.1-2001; partial deduction for a reduction in any one of the three systems (lighting, HVAC and hot water, and envelope).
Recipient	Commercial building owner; can be assigned to designer for government-owned building.

In addition to these structural challenges, there has been a lack of clear guidance from the IRS and DOE on how to certify compliance with the incentive, particularly on how to certify compliance with either the envelope or HVAC partial deductions. (Gold and Nadel 2011) While the IRS has issued several sets of guidance on the deduction, it has not clearly specified how a third-party should certify compliance, as required by the law. Additionally, although the guidance has specified targets for the partial deduction, it has not offered guidance on how to show that these targets have been met. (Ibid) Despite the fact that software standards have now been developed by the Commercial Energy Services Network (COMNET) that could be used to comply with the deduction, the IRS has yet to endorse these standards.

For the partial deductions other than lighting (which was specified prescriptively in the legislation) the IRS failed to follow legislative guidance to base the calculation on the California energy code procedures, which had been used to certify single-system compliance for almost two decades. Instead it established percent savings requirements for the whole building that had to be achieved by changes made to only one system. This was problematic for a number of reasons. Among the most troublesome was that the percentage for the envelope was set at 15%, while analysis of energy use showed that even a perfectly insulating shell could not meet this goal for many buildings.

The IRS did recently issue a new set of guidance that would reduce the percentage needed to qualify for the HVAC and hot water system partial deduction by 5 percent and increase the lighting deduction by 5 percent. An owner would be able to choose whether to follow the percentage targets under this new guidance or the previous targets. (IRS 2012b) While this may help in some circumstances, it is not likely to greatly increase the use of 179D. Without guidance on what those percentages mean and exactly how to calculate them, the new options are still highly uncertain to the taxpayer.

Additionally, DOE has developed an online tool that can be used for IRS compliance for pre-determined, basic building types which should be available later this year.[1]

When the targets of Section 179D were established, the choice was guided by a study of what levels of building efficiency were being constructed in California, the state with the most stringent energy code and the strongest utility-run new construction programs. The level chosen represented about 5-10% of all new buildings in the state. So it is evident that on a national basis, far less than 5% of buildings were being constructed to these targets. Indeed the primary criticism of the provision prior to adoption was that the target was so ambitious that no one could achieve it. The lighting targets, in particular, were considered by lighting experts in both the advocacy community and the industry to be at the bleeding edge of what could be achieved.[2] So based on the best available data at the time, free ridership was sure to be trivial.

Data on Uptake and Implementation

There is limited data on the use of Section 179D due to the fact that there is no IRS form for the deduction and that it is not claimed as an individual line item on a business' tax returns. Past anecdotal data have found that use of the deduction has been limited overall and primarily for the lighting partial deduction, which does not require modeling. (Gold and Nadel 2011) Whereas EIA originally projected that 179D would cost the US Treasury $198 million in FY 2007, it reduced its projection to $60 million for FY 2010. (EIA 2011)

[1] A beta version of the site is available at:
http://apps1.eere.energy.gov/buildings/commercial_initiative/179d/disclaimer.cfm

[2] Negotiators working on the bill compared the requirements in Section 179D's lighting section with the levels of performance required in the Advanced Lighting Guidelines published by the New Buildings Institute, which defined state-of-the-art efficient lighting, and with California's energy code, relying on personal discussions with the authors of these documents, and found that the requirements in Section 179D were more stringent, or in some cases, much more stringent, than even the most ambitious voluntary guidelines. In some cases, the lighting designers argued that the Section 179D levels could not be achieved at all.

Table 2. Summary of Collected Data from Two Firms on Use of Section 179D

		Firm 1	Firm 2
Total Square Feet Reported		3,636,740	9,180,239
Number of Projects Reported		8	68
Time Period (Years)		2011	2007-2011
New Construction (SF)		1,708,502	4,094,709
Mixed Project (Both NC and R; SF)		928,238	0
Retrofit (SF)		1,000,000	5,085,530
Publically Owned Building (SF)		3,636,740	6,249,802
Privately Owned Building (SF)		0	2,930,437
Partial Deduction Claimed (SF)	**Lighting**	1,814,285	9,180,239
	HVAC	693,238	
Full Deduction Claimed (SF)		1,129,217	0

For this paper, we interviewed several tax consulting firms and obtained data on the use of the deduction from two firms (referred to as "Firm 1" and "Firm 2" below), which is summarized in Table 2. The authors are aware of at least eight consulting firms that have helped building owners claim the deduction and there are likely at least several more of which the authors are not aware.

Firm 1 reported data from 8 projects comprising 3.6 million square feet for which the deduction has been claimed. While Firm 1 only reported data on 8 projects, many of these projects included multiple buildings for the same client, all of which were government clients. Firm 2 reported data for 68 projects comprising 9.2 million square feet for which the deduction has been claimed, of which 68% (by total square footage) were publically owned. For Firm 1, all projects were from 2011, whereas for Firm 2, 79 percent of projects were from 2010 and 2011, while the other 21% were from 2007 through 2009. All of the projects reported by Firm 2 were for the partial deduction (information on the type of partial deduction was not available). For Firm 1, the lighting deduction was most common, but the full deduction and the HVAC partial deduction were also utilized. Common building types that the deduction has been claimed for include university campus buildings (e.g. residence halls, gyms, alumni and arts centers, classrooms), parking garages, office buildings, and manufacturing facilities.

Discussion

While still anecdotal, data from the two firms presented above in addition to conversations with tax consultants indicate that the use of the incentive has increased over the past two years and that while the majority of claims are still for the lighting deduction, the HVAC partial incentive and the full deduction have been utilized. This is in contrast to past anecdotal data which suggested that the deduction was only used for the lighting deduction. The data provided by the two firms also indicates that the 179D deduction has been claimed more frequently for publically-owned buildings, although given the limited number of firms it is drawn from, no definitive conclusions can be made; interviews with tax consultants indicated additional use of the incentive for both publically-owned and privately-owned buildings. While use of 179D is still limited, the data presented above and additional interviews indicate that uptake of the deduction has increased since its enactment and its utilization is not as limited as past anecdotal evidence suggested. While 179D has not yet transformed the market for buildings that

meet its efficiency criteria, this is largely due to the various barriers to implementation discussed above, and the recent data presented indicates that the deduction is beginning to work as intended. Furthermore, the lower than predicted uptake of 179D has consequently kept the cost of the incentive very low.

Table 3. Summary of Section 45L

Incentive Type	Performance-based
Building Type	New single family and manufactured homes.
Expiration Date	Originally would have expired on 12/31/08, but EESA extended through 12/31/09. Lapsed in 2010, but was retroactively extended for 2010 through 12/31/11 by the Middle Class Tax Relief Act (MCTRA) of 2010.
Amount	$2000 for each qualified single family home; $1000 for manufactured homes.
Criteria	For single family homes, a 50% reduction in heating and cooling energy compared to the 2004 International Energy Conservation Code. At least one-fifth of savings from envelope improvements. For manufactured homes, 30% improvement compared with 2004 IECC or meets ENERGY STAR requirements.
Recipient	Builder.

New Energy Efficient Home Credit

Background

When Section 45L was first enacted in 2005 there were many perceived barriers to its implementation. Specifically, many homebuilders thought that the 50 percent savings target was out of reach, that there would be a resistance to increased upfront cost of more efficient homes, that homebuyers would not value efficiency in their home purchasing decisions, and that the lifetime of the credit was too short. (Nadel et al. 2006) Supporting that point of view was the observation that DOE's Building America program, which required a savings target somewhat lower than the 45L level, had a cumulative subscription of less than 1000 homes.

There were several key factors that have allowed 45L to be utilized. Unlike Section 179D, for 45L the IRS issued guidance in 2006 which clearly specified how a homebuilder could claim the deduction using the RESNET methodology. (IRS 2006) The performance-based nature of the credit allowed homebuilders to meet the savings target in whatever way they saw fit, giving them flexibility and likely leading to more homes complying with the credit. Additionally, the credit was coupled with the less stringent ENERGY STAR criteria, which also relied on the RESNET methodology and increased homebuilders' familiarity with the Home Energy Rating System (HERS).

Data on Uptake and Implementation

Both the total number and percentage of new homes meeting the credit's efficiency criteria have grown significantly since the credit was enacted. Before the credit, almost no new site built homes met the credit's efficiency criteria. As shown in Table 4, the number of homes meeting the credit's criteria grew steadily between 2006 and 2009, with both the total number and percentage increasing, despite an overall decrease in new home sales. The credit expired at the end of 2009 and was only retroactively extended for homes built in 2010 at the end of that year. For 2010, the number of homes meeting the credit fell to 21,000, while the percentage of

qualified new homes fell to 6.5%. In 2011, the number of homes meeting the credit increased back to 32,000 (for 2011, the credit was in effect at the beginning of the year).

Table 4. Number of Homes Verified to Meet the Tax Credit Criteria

Year	Number of Homes Verified for Tax Credit	Total Number of New Homes Sold in the U.S.	% of New Homes Sold Verified for Tax Credit
2011	32,000	306,000	10.5%
2010	21,000	323,000	6.5%
2009	37,506	374,000	10.0%
2008	21,939	485,000	4.6%
2007	23,102	776,000	3.0%
2006	7,110	1,051,000	0.7%

(Baden 2012; Census 2012)

The number of ENERGY STAR qualified homes built each year during this time period stayed relatively constant. The number of ENERGY STAR built homes had increased annually between 2000 and 2006, and then dropped in 2007 and remained at over 100,000 homes per year through 2010. ENERGY STAR attributes the decrease in ENERGY STAR homes built in these years to the overall decrease in new housing starts. (EPA 2011) But this reasoning did not seem to retard the growth of tax credit homes. Also relevant is the fact that the total number of homes receiving a HERS rating increased over this period. In both 2010 and 2011, 120,000 homes received ratings. Additionally, all of the nation's largest production home builders have signed memoranda of understanding with RESNET to rate all of their homes. (Baden 2012)

Discussion

The data presented in addition to anecdotal evidence strongly indicates that the 45L credit has been a significant factor in driving the construction of new homes the meet the credit's efficiency criteria. Other complementary factors, such as the ENERGY STAR program, the implementation of the credit and, possibly, the recession in the new homes market have most likely also contributed to the credit's success (although it is arguable that the credit succeeded despite the recession). As described above, before the credit's enactment, almost no homes met its efficiency criteria. This number has increased steadily every year since the credit's enactment, except for the drop in 2010, when the credit was only extended retroactively. The fact that the number of ENERGY STAR new homes did not see a similar drop in 2010 (in fact, the number increased) indicates that the credit was indeed driving the substantial additional efficiency in tax credit qualified homes.

While the IECC did increase its efficiency requirements by roughly 15% in 2009, due to the time lag in adoption and implementation by states, the code would not likely have affected new construction before 2011 at best. This, combined with the fact that the savings achieved by the 2009 IECC are only a small fraction of the 50% required to achieve the tax credit, lead to the conclusion that this improvement in the code did not likely influence the number of homes complying with the tax credit.

In sum, while other policies may have increased the market for homes saving about 25% (ENERGY STAR) or 15% (2009 IECC or California Title 24), there is no evidence suggesting that the 50% savings would have been achieved at all absent the 45L credit. No other popular

programs even targeted that level, and prior thinking in the industry had been that the level was impossible to meet in mass markets.

It is also noteworthy that the credit achieved this market transformation at a relatively low cost to the Treasury; with a credit amount of $2000 per home, the annual cost of the credit is in the tens of millions.

Certainly, the existence of the ENERGY STAR program and the Builders Challenge and their use of the HERS rating system for at least one compliance mechanism is likely a factor in the credit's success as they complemented the credit's program, but these programs cannot explain the increase in number of homes that meet the 45L targets (only 12,000 homes have met the builders challenge since 2008). Additionally, there is some indication that the downturn in the housing market has led builders to use energy efficiency as a way to market new homes, evidenced by anecdotes from builders and the fact that all major home builders have now signed MOUs with RESNET to rate and market their new homes' HERS Index. (Easley)

The Nonbusiness Energy Property Tax Credit

Background

Section 25C provides a tax credit to homeowners for implementing energy efficiency measures, as described in Table 5. This paper presents data on both the overall use of the credit as well as available market data for three of the eligible efficiency measures: windows, heat pumps, and central air conditioners.

Data on the Use and Implementation

While there are only sporadic data available on the use of 25C, the data available indicate that the most common use of the credit has been for envelope measures (insulation, windows, and doors). (GAO 2012; Gold and Nadel 2011; JCT 2008) Table 6 summarizes GAO data on the number of claimants, consumer expenditures, and total amount of the credit claimed for 2006, 2007, and 2009. It is important to note that for 2006 and 2007, consumers could only report spending on their tax forms up to certain limitations, whereas reported spending was unconstrained in 2009, meaning that actual consumer spending was likely higher than reported in Table 6 for the first two years. (GAO 2012)

Table 5. Overview of Section 25C

Incentive Type	Performance criteria, but primarily cost-based for envelope and windows.[3]
Building Type	Owner-occupied residential buildings.
Expiration Date	Originally expired on 12/31/07. Lapsed in 2008, but then EESA extended for 2009. Extended again by American Recovery and Reinvestment Act (ARRA) through 12/31/2010. MCTRA extended again through 12/31/2011.
Incentive Amount	For 2006-2007, 2011: 10% of cost for envelope measures, no more than $200 for windows. $50 for a main air circulating fan, $150 for a furnace or boiler, and $300 for other HVAC equipment. Total cap of $500 for all measures. For 2009-2010: 30% of costs up to $1500.
Criteria	Efficiency criteria vary by measure and some have been modified over time. Eligible measures include envelope improvements and equipment upgrades.
Recipient	Home-owner.

Table 6. Number of Claimants, Homeowner Spending, and Amount Claimed

Year	Number of Claimants (millions)	Total Spending (millions of dollars)	Total Credit Claimed (millions of dollars)
2006	4.3	$7,947	$956
2007	4.3	$7,484	$938
2009	6.8	$25,567	$5,288

(Source: GAO 2012)

As discussed above, one of the primary uses of 25C was for envelope measures and in particular windows. Unlike the efficiency criteria established in 45L and 179D, when 25C was first enacted, the efficiency criteria for windows, which were tied to ENERGY STAR requirements, already represented a significant share of the total windows market (both new construction and replacement), as shown in Table 7. Despite the credit, this percentage did not increase significantly between 2005 and 2007 (the credit lapsed in 2008). By August 2008, the market share for ENERGY STAR replacement windows was over 90 percent and consequently the ENERGY STAR windows criteria were strengthened in 2009. As shown in Table 7, total shipments of replacement windows decreased over the lifetime of the credit.

Table 7. Windows ENERGY STAR Market Share and Replacement Shipments

	ENERGY STAR Market Share	Annual Shipments Replacement Windows (millions of units)
2005	49%	36.4
2006	52%	34.5
2007	53%	34.3
2008	57%	30.2
2009	93%[4]	27.5
2010	89%	29.6

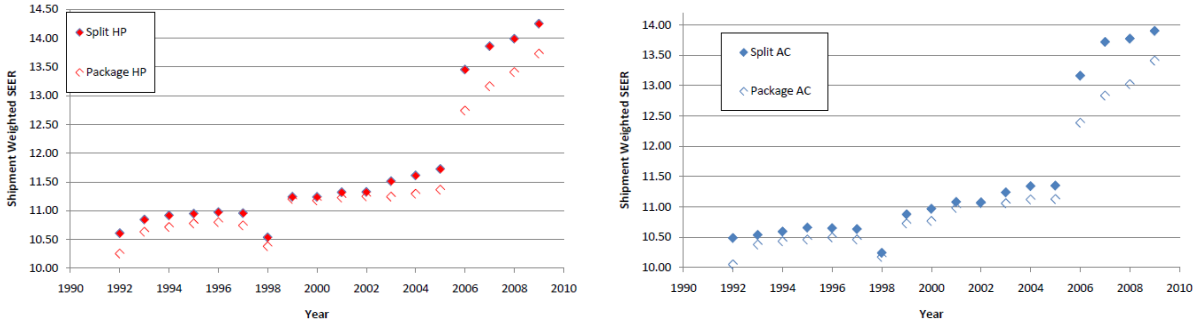
(Source: ACEEE and ASE 2011; W&D)

[3] The distinction is that for envelope measures, most of the markets for new homes already met the performance criterion, so cost was the binding constraint. For the HVAC measures, the market share of the complying product was less than 1% as the tax incentive began, and the incremental cost was far higher than the incentive, so the performance level was the binding constraint

[4] Market share data from 2009 and 2010 are based on a survey conducted of replacement windows suppliers conducted by ACEEE and ASE and so is not directly comparable to the data for 2005 through 2008 which is for the entire windows market.

On the other hand, the efficiency criteria in 25C for residential HVAC equipment have represented a much smaller section of the market. The shipment weighted average efficiencies for both central air conditioners and heat pumps have grown steadily since 2006, as shown in Figure 1. Clearly the jump in 2006 was primarily the result of the standard for split system air conditioners increasing from SEER 10 to 13, but the slope of the curves in the years following adoption of the standard is higher after this change than it was in 1992 and continues to be positive for the next three years, unlike the curves after 1992. Additionally, past research has found that 25C likely influenced the market for high efficiency residential furnaces, with one survey finding that 37 percent of consumers chose the more efficient model due to the tax credit when coupled with a broader rebate program. (Gold & Nadel 2011)

Figure 1. Historical Shipment Weighted Average Efficiencies for HPs and CAC



(Source: DOE 2011)

Discussion

The data in Table 6 indicate that the increased amount of 25C in 2009 did not drive proportionately greater levels of energy efficiency investment. The number of returns filed grew by only 50% from the 2006-2007 period to the 2009, but the cost of the credit grew by a factor of 5.6. Whereas for 2006 and 2007, the ratio of lost government revenue to private investment was $1 to $8 (and likely even higher, given the under reporting issue discussed above), this ratio fell to $1 to $4.8 in 2009. Since the incentive is cost-based, consumers could claim a larger tax credit during this time period for the same efficiency measures, leading to wasted government spending on free riders. Furthermore, at least in the case of windows which accounted for 34 percent of consumer spending on eligible measures reported by taxpayers, this spending did not lead to substantial increase in energy savings. The market share of ENERGY STAR windows quickly jumped back to over 90 percent after the criteria were strengthened in 2009, while the total number of replacement windows sold actually decreased. While the quick increase back to 90 percent market share was probably partially aided by the tax credit, it came at a significant cost to the Treasury without corresponding public benefit. [5] This example shows that with a cost-based credit (without appropriate performance criteria) cost to the Treasury can be significant.

[5] One might argue that there would have been an even bigger drop in window sales without the credit and therefore the credit increased the replacement of old single pane windows with new low e windows, thus saving additional energy, but that argument has two flaws. First, the credit is so small compared to the cost of replacing windows that it is implausible to assume it increased retrofit jobs by more than a few percent. Second, since the replacement windows were not state of the art, one can argue that every window replaced with a U value of .30 in the years 2007-9 foreclosed the possibility of using a U=.20 window a few years later.

Energy Efficient Appliance Credit

Background

Table 8 provides a summary of Section 45M which provides a tax credit to manufacturers of energy efficient appliances. In 2010, the Association of Home Appliance Manufacturers (AHAM), energy efficiency groups and consumer advocates signed a consensus agreement specifying new minimum efficiency standards as well as specific levels and amounts for the 45M tax incentive for specific years, which have largely been enacted to date.

Table 8. Summary of Section 45M

Incentive Type	Performance-based.
Equipment Type	Clothes washers, dishwashers, and refrigerators.
Expiration Date	Originally would have expired 12/31/2007. EESA extended through 12/31/2010. MCTRA extended again through 12/31/11
Incentive Amount	Has varied over time and depending on criteria but ranges from $25 to $225 per appliance. Cap on the total amount that any individual manufacturer can claim, which has also varied over time.
Criteria	Includes several efficiency tiers which correspond to different incentives amounts for each product that have applied to different years. Have generally been harmonized with ENERGY STAR and Consortium for Energy Efficiency (CEE) levels.
Incentive Recipient	Manufacturer.

Data on Uptake and Implementation

It is difficult to disaggregate the effects of the 45M tax credit with those of utility, local and state programs as these programs tend to rely on the ENERGY STAR and/or CEE criteria, which are generally aligned with the tax credit levels. Even though it is difficult to quantify how much is due to the tax credit or these other factors, the number of high efficiency models available for all three products that meet the 45M criteria has increased over the past 5 years. (Gold & Nadel 2011) For example, when the 2009 ENERGY STAR criteria for dishwashers were proposed in August 2008, which aligned with those in the 45M tax credit, 35 percent of dishwasher models available met the specification. (EPA 2008) By 2010, the percentage of available models had grown to 81 percent. (EPA 2010) While the tax credit was not the only driving force, it is likely one of the driving factors in this dramatic increase in available models. Dishwashers and refrigerators have seen similar increases in high-efficiency model availability. At the same time, the cost of the credit to the Treasury has been relatively modest. For example, the Joint Committee on Taxation estimated the cost would be $200 million in 2010. (JCT 2010)

Discussion

When a number of actors collaborate on market transformation, which is a condition that almost defines the term “market transformation,” it is impossible to allocate credit to a particular program. (Keating et al 1998) But the evidence indicates that the combination of programs, of which the tax credit was a major part, changed the availability of compliant models significantly without a significant cost to the Treasury.

Conclusions

The new data and observations in this report corroborate previous studies that suggested performance-based incentives would be most effective at transforming markets for energy efficiency. New data and interview information provide no examples that refute this hypothesis and considerable results that are consistent with it. In general, the successful incentives discussed above—measured in terms of low free ridership, success in changing the highest levels of efficiency available in the market, and moderate or low cost to the Treasury—are all fully or primarily performance-based. The less successful incentives—in terms of high cost and free ridership—were primarily cost-based. The performance-based 179D incentive, which was not a success, failed softly in that it had low influence but commensurately low cost and no evidence of free ridership.

The clearest success story is the performance-based 45L which, not surprisingly, is the incentive for which the most consistent data are available. 45L has shifted the market share of efficient new homes that meet the credit's efficiency criteria from far less than one percent to over ten percent. This success was likely due to the availability of a clear and useable compliance mechanism through the HERS rating system and an appropriate target (very low market share, yet achievable). Also, apparently, the lead time for adding efficiency to new home design was shorter than the initial 2-year duration of the credit.

While it is difficult to disaggregate the effect of the performance-based energy efficient appliance credit, the market shares for appliances meeting the credit's efficiency criteria have increased since the enactment of the credit and the credit is likely at least one driver in this increase in availability. At the same time the cost of the credit to the Treasury was modest.

Section 179D, while performance-based, has seen rather limited uptake. This lack of uptake has been primarily due to the difficulties in claiming the incentive. Section 179D has seen some success in driving the market for lighting retrofits as evidenced by anecdotal data. This is most likely due to the clear compliance mechanism and the stringent but achievable targets. It is also notable that the cost of the deduction to the Treasury has been low, so despite the fact that the deduction has not been utilized to the extent intended, it did not suffer the alternate fate of performance criteria that were set too low and subsequent high cost.

Finally, the available data indicate that for Section 25c when efficiency criteria were set at a low market share, the credit helped drive increased availability of efficient models; whereas when the criteria were set at levels that already saw high market share, the cost of the credit was high and the additional energy savings were likely small. As discussed above, the market share for high-efficiency HVAC equipment has increased since the enactment of 25c and the credit is likely at least one factor in this growth. On the other hand, the available data indicate that the credit had little effect on the market share of windows meeting the ENERGY STAR criteria in 2006 and 2007, which was already over 50 percent when the credit was enacted. When the credit amount was increased and the ENERGY STAR criteria strengthened for 2009 and 2010, the credit likely drove the quick jump back to a 90 percent share of the replacement market, but this came at a high cost to the Treasury, and a potential lost energy savings opportunity as windows with even higher efficiency could have been installed. Furthermore, while the number of replacement windows sold actually decreased in 2009 and 2010, the cost to the Treasury grew disproportionately compared to consumer spending on eligible measures.

Overall, these conclusions are consistent with the hypothesis that performance-based incentives, with stringent yet achievable efficiency targets, clear compliance mechanisms, and an

appropriately long period of enactment can transform markets for energy efficiency. The conclusions also suggest that purely cost-based incentives, without appropriate performance criteria can result in significant cost to the Treasury and are less effective at transforming markets for efficiency.

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