Innovative Approaches for Reducing GHG Emissions: Feebates for Appliances and Buildings

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ABSTRACT

A feebate is a market-based policy that can encourage greater energy efficiency and associated greenhouse gas emission reductions by levying surcharges on low-efficiency/high-emitting products and refunding the revenue generated to purchasers of high-efficiency/low-emitting products through a rebate. Feebates, which can be designed to be revenue neutral, can be used to create incentives that shift markets toward lower emission products by influencing purchasing decisions. This paper provides an overview of feebate design considerations and implementation options for programs that target appliances and buildings in California.

A significant energy savings opportunity exists in bridging existing voluntary and involuntary market interventions. Well designed incentive programs are effective at motivating customers to purchase energy efficient products and services in a specific targeted market, but their effectiveness is usually limited to a small fraction of that market. Regulations for buildings and appliances are extremely cost effective at improving efficiency for an entire market, but codes and standards are blunt instruments that usually leave a lot of potential savings "on the table." Feebates can be used to bridge gaps between California's incentive programs and codes and standards as well as the gap between state and federal regulations. In particular, feebates could allow California to achieve additional energy and greenhouse gas emissions savings from appliances that are federally preempted from state-level codes and standards. From a policy perspective, federal regulations for buildings and appliances are effective at moving the entire nation towards a more sustainable future, but they are less effective than state policies at developing innovative regulations suitable for individual climate and economic conditions.

Introduction

There are a variety of market barriers and failures that prevent consumers from adopting seemingly economical energy-efficient measures (Brown 2001). While energy-efficiency programs such as codes and standards, financial incentives, and local government programs have all been successful in helping to bridge the "energy-efficiency gap," these traditional approaches also have certain limitations. Feebates for appliance and building could complement existing programs and regulations, enabling states to achieve even greater energy savings and associated emission reductions. A feebate is a market-based, technology-neutral policy that can be used to levy surcharges ("fee-") on less-efficient products and provide rebates ("-bate") for higher-efficient products. Through this system of surcharges and rebates, feebates create incentives that shift the market towards higher energy-efficiency and lower-emissions.

Feebates can be designed to achieve a number of objectives such as reducing energy or fuel consumption, or reducing emissions of criteria pollutants or greenhouse gas (GHG) emissions. This paper discusses two new applications of the feebate model – feebates for appliances and existing buildings implemented at the state level, that aim to reduce GHG emissions.[1]

The next section discusses some traditional approaches to improve the efficiency of appliances and buildings, some of their limitations, and how feebates could complement and bridge gaps between these traditional mechanisms. The paper then provides a brief background on feebates, including examples of feebate programs that have been discussed and/or implemented, and lessons learned in feebate design. Drawing from these findings and lessons learned, we conceptualize feebate programs for appliances and existing buildings in California. The paper addresses key design and implementation considerations for the proposed feebates. It also presents specific examples of an appliance and a building feebate. The paper concludes with a recommendation that California pursue pilot scale programs for both appliances and existing buildings.

The Opportunity

Through energy-efficiency programs such as incentive programs, federal and state regulations, and various local government programs, California has curbed growth in energy use and reduced GHG emissions. These existing programs have generated significant economic and environmental benefits for the State. Going forward, the California Air Resources Board (CARB) Assembly Bill (AB) 32 Scoping Plan, which outlines how the state will meet the aggressive AB 32 GHG emission targets, specifies that energy efficiency and conservation measures will account for about 19 million metric tons of carbon dioxide equivalents ($MMTCO_2e$) or about 11% of the needed GHG reductions. To achieve 19 $MMTCO_2e$ of reductions, the plan asserts that "California must enhance existing efficiency programs and institute new policies and programs to achieve unprecedented levels of energy savings" (CARB 2008). Feebates could be one of these new programs that would help the state of California achieve record levels of GHG savings. In this way, feebates for appliances and buildings could complement existing programs and policies by targeting areas where these traditional approaches fall short.

Minimum energy efficiency standards, for example, have been an extremely successful and cost-effective means for improving the efficiency of an entire market (Neubauer et al. 2009). Appliance standards and building codes provide end users with a minimum level of efficiency performance. Performance-based standards usually also reduce the cost of efficiency measures required to meet the standard through economies of scale and learning effects, leading to even more affordable and widely available high-efficiency products (Neubauer et al. 2009). In the 1990s and the early 2000s, however, the federal government failed to review and update appliance standards on a timely basis. As a result, many appliance standards were not updated for a decade or even longer.[2] Further compounding this problem, states are limited in most cases from pursing stronger standards because of federal preemption rules. Under the framework of federal appliance standards that Congress enacted through the 1975 Energy Policy and

[1] A majority of the GHG emissions from appliances and buildings are attributed to energy use, but the feebate could also address GHG emissions from other sources (e.g. refrigerants).
[2] However, the U.S. Energy Independence and Security Act of 2007 addressed this issue by setting new requirements for the federal appliance standards program; DOE is now required to review a standard every 6 years.

Conservation Act (EPCA), once an appliance standard becomes part of federal law, states are preempted from setting a higher efficiency standard for that product. Because of this preemption, states have been severely limited from pursing more aggressive, yet cost-effective, standards that are specifically tailored to the state's economic landscape, climate, and environmental priorities.[3] Federal preemption has significantly limited California's ability to develop and enforce more stringent energy efficiency codes and standards. Consequently, the potential emissions reductions that could be achieved through new state-level codes and standards are dwindling. Our preliminary analysis suggests that much greater emission reductions (on the order of 50% more by 2020) could be achieved in California if the State was not subject to federal preemption.

Due to the decoupling of energy sales and utility profits, California's investor owned utilities (IOUs) have a significant financial incentive to improve energy efficiency within their service areas. Utilities undertake a number of initiatives that result in energy savings, including advocating for more stringent statewide codes and standards and designing and implementing voluntary financial incentive programs. Incentive programs are usually designed to provide rebates for appliances or buildings that meet some predetermined efficiency level or levels. The programs usually offer one or two distinct rebate amounts, but they do not typically provide any additional incentives for products that substantially exceed these predetermined efficiency levels. Since new, super-efficient products are expensive to develop, the traditional rebates are not always high enough to entice manufacturers to develop and commercialize such technologies or to bring the cost of new products down to competitive levels. Feebates could address these shortcomings by offering incentives that are proportional to the product's energy or GHG performance, so super-efficient products would receive a larger rebate, in proportion to expected savings, thereby providing a high enough incentive for break-through innovations.

Rebates provide consumers with positive feedback, or a "carrot," if they select an efficient product but they do not provide any negative feedback, or a "stick," that may discourage an end-user from purchasing an inefficient product. As discussed later in this paper, research in psychology has shown that people experience losses and gains differently and as a result, "sticks" or fees in combination with "carrots" or rebates may provide more motivation than a "carrot" alone.

The existing building stock presents a significant opportunity for cost-effective energy savings; however this is a difficult market sector to reach. A majority of the projected 2020 GHG emissions associated with buildings are attributed to buildings that already exist today. As new buildings become more efficient, older buildings that were not subject to strict building standards are consuming a disproportionally large amount of electricity and natural gas, and there is significant potential in making existing buildings more efficient. As an example, the technical savings potential in the residential sector in California is about 26,000 GWh (Itron 2006).

Several new programs, including building rating programs and local energy conservation ordinances have begun to tap into this hard-to-reach existing building market. Discussed later in the paper, a building feebate could also dovetail with energy efficiency financing programs like the property assessed clean energy (PACE) programs, which became available to all California cities and counties through AB 811. PACE programs make it possible for local governments to finance energy efficiency and renewable energy upgrades on private buildings by linking loan repayments to property taxes.

[3] Under EPCA, states are permitted to file a waiver to gain an exemption from preemption, although so far, none of the waiver petitions filed have been granted.

As mentioned above, a key strength of feebates is that rebates and surcharges are proportional to the product's efficiency or GHG emissions level, thus products that achieve breakthrough GHG savings will be awarded a significantly large rebate. This structure provides manufacturers with a financial incentive to develop super-efficient technologies. A second attractive feature of feebates, especially for state and local governments, is that they can be designed to be revenue neutral. In a revenue neutral program, the fees collected are used to pay for rebates and any administrative costs associated with the program.

Feebates provide consumers with both positive feedback (i.e., rebate) and negative feedback (i.e., fee) depending on their purchasing decisions. Psychologists Daniel Kahneman and Amos Tversky (1979) found evidence that people often make decisions that cannot be explained by the rational choice theory of traditional economics. Rather, people exhibit loss aversion; that is, they strongly prefer avoiding losses to acquiring gains of the same nominal amount. Psychologically, losses are a more powerful motivating factor than rewards. One potential implication of this for feebates is that the "stick," if clearly communicated to the customer, will provide more motivation than a "carrot" alone.

A significant potential drawback to a feebate is that some stakeholders will likely perceive it as a new tax. However, since the fees collected are used to fund rebates, feebates are still likely to be more palatable to consumers and more politically viable than an un-refunded tax. Feebates may also be more appealing than a traditional sales tax because consumers would have the option to avoid the fee (e.g., purchasing an efficient appliance or improving the efficiency of the building). Another challenge with feebates is that making adjustments to the feebate program (discussed below) on a regular basis to maintain the program's revenue neutrality can make it difficult for manufacturers to predict the fee or rebate a product will receive, which is crucial information for manufacturers to consider when making investment decisions during the design phase of product development.

Background on Feebates

Basics of Feebate Design

There are many different ways to design a feebate system. In the simplest feebate structure, the fee or rebate amount would be proportional to the product's GHG emissions that are emitted per some function unit. For example, for an air conditioner, the fee and rebate could be proportion to the GHG emissions per Watt.[4] The *rate* and *pivot point,* shown in Figure 1, are two key elements to a feebate's structure. The rate is represented by the slope of the function. A constant rate (i.e., linear function) is not only the simplest structure, but is also economically efficient in the sense that it values every ton of GHG mitigated equally. This structure is also the best example of a feebate's capability to provide fees and rebates that are proportional to emissions. The value of the rebates or surcharges levied on products is equal to the rate times the distance between the pivot point emission level and the product's emission level. As demonstrated in the building example at the end of this paper, it may be necessary to use a scaling factor to ensure that fees and rebates are large enough to encourage changes in consumer behavior.

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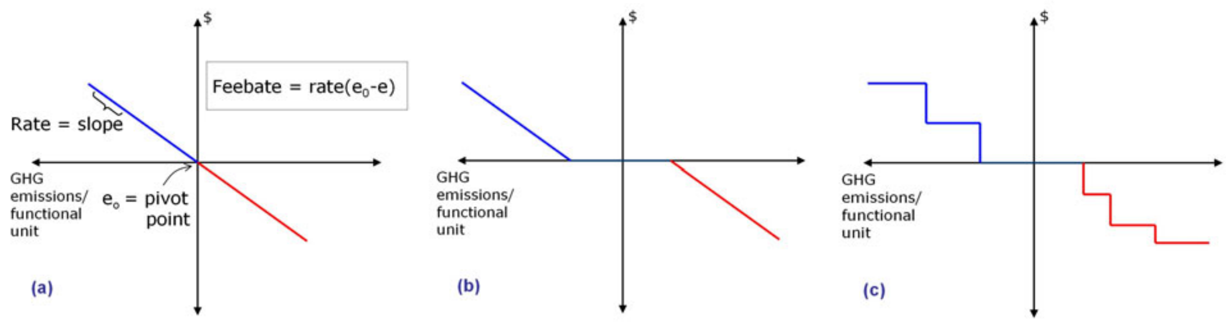
[4] Capacity in Btu/h divided by Energy Efficiency Ratio (EER) in units of Btu/Watt-hr yields Watts. GHG emissions are based on an assumed hours of full load operation.

The pivot point is the separation point between products that receive surcharges and products that receive rebates. To achieve revenue neutrality, the pivot point needs to be carefully established so that the all revenues generated can pay for all rebates issued, plus program administration costs. To set the pivot point, the program administrators consider the current and planned product distribution and the elasticity of the market (i.e., anticipated shifts in purchasing behavior from feebate price signals). As the market shifts towards more efficient products, the pivot point will need to be adjusted to maintain the program's revenue neutrality. Since the feebate value is calculated based on the pivot point, adjusting the pivot point will also result in updated incentive levels for every product on the market. For example, a product that receives a small rebate before the readjustment may be subject to a small surcharge after adjustment. This is another way the feebate program encourages the market to move in the direction of higher efficiency / lower emissions products.

Figure 1. Examples of Feebate Structures



(a) a constant-rate feebate; (b) a feebate with a dead-band zone; and (c) a tiered feebate.

There are many different possible variations on this simple feebate structure, two of which are also illustrated in Figure 1. Ideally, every ton of emission reductions should be valued equally, but some variations that are less economically efficient may be desirable if they allow policymakers to achieve other objectives such as minimizing administrative costs, increasing consumer understanding of the feebate, reducing disparate impacts on different manufacturers, other equity considerations, etc. Instead of having a single pivot point, the program could be devised with a "dead-band zone," or a range of emission levels where no fees or rebates are imposed (see Figure 1b). Since this approach removes some percentage of the market from being affected by the feebate, it will reduce the number of transactions involving feebates and may help minimize resistance to the program, but it could also reduce the effectiveness of the feebate. Policymakers may also consider a feebate program that specifies different schedules (pivot points and rates) for different types or classes of products to help preserve consumer choice (Mims and Hauenstein 2008). For instance, there could be separate feebate schedules for electric and gas water heaters. This may also be politically advantageous if it helps mitigate disparate impacts on manufacturers and building owners. One drawback of multiple pivot points is that it could lead to scenarios where higher-emitting products in one class receive rebates while lower-emitting products in a different class receive a surcharge, thus creating a perverse incentive to purchase the higher-emitting product.

Policymakers could also decide to cap feebate values at either end of the emissions spectrum to avoid overly onerous fees or overly generous rebates. Another variation would be to set feebate rates that are multipliers of an excise tax; with this approach, the fee or rebate could be determined by both the emissions rate and product's price. Still another variation is where the rate is structured in steps, or tiers, instead of as a continuous line (see Figure 1c). This feebate structure can lead to undesirable boundary effects (e.g., an appliance's emissions only needs to improve slightly to qualify for a significantly higher rebate, leading to a clustering at the edge of the step). On the other hand, some research has suggested that the tiered feebate structure such as the one recently implemented in France for vehicles, can have a more influential impact on consumers' purchase decisions, since they can help identify specific vehicles as "the right choice" (Peters et al., 2008).

How Feebates Move Markets

Relatively few feebate programs have been implemented and none of these have been comprehensively evaluated, so there is a lack of empirical data on feebate programs' actual impact on consumer and manufacturer decision-making. However researchers have analyzed the impact of vehicle feebates by modeling anticipated manufacturer and consumer responses (e.g., Greene et al. 2005; Davis et al. 1995). Two of the findings from these studies are applicable to a state appliance feebate program. First, a majority of the impacts (on the order of 90%) of a national feebate policy would come from its effect on manufacturer decision making (redesigning products, technological innovation), rather than from a shift in sales caused by consumers making different purchase decisions based on the feebate (Davis et al. 1995; Greene et al. 2005). However, studies have also assumed that this same response is not guaranteed for a state level feebate since manufacturers would likely be less responsive to a feebate program that affects a smaller portion of their market (Langer 2005). With a state feebate program, the relative impact attributed to consumer response vis-à-vis manufacturer response is likely to be more significant. This suggests that to maximize impact, a state feebate program should be visible and clearly communicated to consumers.

Second, a feebate policy is likely to be more effective when it is applied to a larger jurisdiction or market since, as mentioned above, manufacturers have less of an incentive to redesign models for a smaller market. For example, an HLB Decision Economics, Inc. study of an Ontario feebate for vehicles found that a coordinated feebate policy across the U.S. and Canada is likely to be more effective than a Canada-only policy (Greene et al. 2005). Similarly, a 2002 California Energy Commission (CEC) analysis of feebates as a means to reduce petroleum demand found that a California-only feebate would bring about a response that was 30% as large as a national feebate program of the same magnitude (Langer 2005). In spite of this, the state-level approach is likely to be advantageous because it provides a venue to pilot the policy on a smaller scale and around specific environmental, climate and economic conditions. It is also worth noting that California market is still a significant portion total U.S. market, with California's economy making up about 13% of the U.S. economy (as measured by Gross Domestic Product).

Lessons Learned from Prior Feebate Implementation

The majority of feebate discussion, research and implementation to date has centered on passenger vehicles. Washington D.C. and a number of states, including Connecticut, Massachusetts, Maryland, and California, have considered feebate programs for vehicles (Langer

2005).[5] Vehicle feebates have also been considered and implemented in Canada and France. The Province of Ontario, Canada implemented a vehicle feebate in 1991. Canada also instituted a national feebate program known as the Vehicle Efficiency Initiative in 2007. France introduced a new feebate in 2007; their “Bonus-Malus” program for vehicles is based on carbon dioxide (CO_2) emissions.

There has been limited work on feebates for appliances. Mark K. Jaccard Associates, Inc. (Rivers and Peter 2007) studied a possible Canadian feebate program for home appliances. In this study, ENERGY STAR-qualified appliances received a rebate and non-ENERGY STAR qualified appliances were subjected to a fee (based on a % of purchase price). To the best of our knowledge, feebates targeting *existing* buildings have not been discussed or studied. However, the City of Portland, Oregon is currently in the process of developing a new High Performance Green Building Policy that would create a feebate program for newly constructed buildings (commercial and multifamily projects only).

Despite the limited information on feebates for appliances and existing buildings, a number of “lessons-learned” from vehicle feebates are expected to translate to appliances and buildings. Six of these lesions are:

1. **Design feebate programs that are visible to consumers.** Most studies model manufacturers’ motivation to improve products based on the argument that feebates make expensive technology upgrades more cost-effective and thus manufacturers find it is worthwhile to redesign products. The events that transpired after Canada launched its feebate program in 2007 indicated that the marketing and public relations elements of the feebate can also be driving factors in manufacturers’ decisions to alter product designs.[6] Had the consumers not been aware of the rebates issued to each model, the program may not have inspired manufacturers to react as strongly. Also, one of the cited shortcomings of Ontario’s feebate in the early 1990s was that it was invisible to consumers (Langer 2005).

2. **State feebate policy for appliances should be carefully designed to avoid preemption.** In the early 1990s, the U.S. Department of Transportation opined that Maryland’s proposed feebate law for new vehicles conflicted with the federal government’s authority to regulate fuel economy and was therefore federally preempted. In hindsight, it appears likely that only the labeling requirement of Maryland’s law would have actually been preempted (Chanin 2003). Regardless, this case highlights the importance of carefully designing a feebate policy to minimize preemption concerns.

3. **Rebates and fees need to be large enough to matter**. Another shortcoming of Ontario’s feebate was that most vehicles received $75 fee to $100 rebates. These amounts were too small to influence purchasing decisions on cars that cost tens of thousands of dollars (Langer 2005).

4. **Provide opportunity for adequate stakeholder input to feebate policy development.** One problem with Canada’s 2007 Vehicle Efficiency Initiative was

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[5] Currently, the California Air Resources Board (CARB) is funding research on a potential feebate program for new passenger vehicles (Greene and Bunch 2008), either as a complement or alternative to Pavley regulations.

[6] The Honda Fit missed the cut-off for receiving a $1,000 rebate by one-tenth of a liter per 100 kilometers. This sent a loud message to consumers that the Honda Fit was not a high environmental performer, which threatened to mar Honda’s reputation as an environmentally responsible manufacturer. Honda responded by launching an advertising campaign that emphasized Honda’s commitment to the environment.

policymakers did not consult industry adequately before the program was approved (Banerjee 2007). Using a transparent process that provides industry and other stakeholders with sufficient opportunity to provide input is critical.

5. **Introduce feebate policy by laying out a clear timetable for phase-in.** The Vehicle Efficiency Initiative became effective immediately, instead of laying out a phase-in period (Banerjee 2007). Since a substantial portion of the feebate's impact is expected to come from manufacturers redesigning products, it is important to provide enough lead-time so they can adapt products prior to the effective date.
6. **Minimize exclusions/exemptions and minimize the dead-band zone that could undermine the goals of the program.** Ontario's feebate program excluded high-emitting vehicles (Langer 2005), and the Vehicle Efficiency Initiative exempted pick-up trucks and included a large dead-band zone that effectively exempted most vehicles sold (Banerjee 2007). While the notion of excluding certain vehicles to preserve consumers' ability to choose high-emitting vehicles or vehicles not regulated under the program is justified, exempting vehicles – particularly high-emitting vehicles – makes the program less effective at reducing emissions.

Feebate for Appliances

Design Considerations

Target market. A California feebate appliance program could target one or more types of appliances sold in the state. The feebate would provide incentive for manufacturers to identify, develop and integrate new technologies that improve an appliance's efficiency, creating a greater market pull for innovative products. In particular, a feebate program for appliances could be designed to provide a "carrot" to accelerate the introduction of super efficient appliances (e.g., LED lamps).[7] Feebates targeted at more innovative technologies could be used to augment existing utility programs. As discussed earlier, it may be necessary to create separate feebate schedules for different classes of an appliance to preserve consumer choice.[8]

Preemption considerations. The framework of federal preemption under EPCA, discussed earlier, preempts states from setting appliance standards for federally covered products. Specifically, the language states that, "for any covered product, no State regulation, or revision thereof, concerning the energy efficiency, energy use, or water use of the covered product shall be effective with respect to such cover product….", with several specific exceptions to this enumerated for certain products. Based on this language, it appears an appliance feebate would be preempted if it was 1) considered a State "regulation" and 2) if it "concerns" the energy efficiency or energy use of a covered product.

This issue of preemption warrants further legal consideration. However, our initial review suggests that if a feebate is framed in terms of environmental protection, i.e., reducing GHG emissions, it would be more likely to fall outside the scope of the EPCA preemption language.

[7] France's "Bonus-Malus" feebate program for new passenger vehicles includes this element by providing very high rebates for cars with extremely high fuel efficiency (97.5 miles per gallon (mpg) or better) in order to encourage future market introduction and growth of electric vehicles.

[8] For example, to account for inherent differences in energy-use between different configurations of residential refrigerators (e.g., side-by-side, top-mount, etc.)

On the other hand, if the EPCA language is construed broadly, even a feebate program that targets GHG emissions may run into preemption challenges because energy efficiency is a main determinant of the appliance's GHG emissions during its use. An additional consideration is whether or not a feebate program is a "regulation." On one hand, "feebates" have been described in other venues as a "consumer incentive program" (Chanin 2003) in which the main objective is to alter consumer incentives rather than mandate that industry take certain actions. In this sense, a feebate may not be considered a "regulation." A feebate policy would not mandate which appliances could or could not be sold in the state, nor would it require manufacturers to take any actions.

Who implements. From a program design perspective, if the objective is to reduce GHG emissions then, under the authority it has from AB 32, CARB would likely be the most logical lead agency to oversee a state appliance feebate effort in California. Despite the proposed focus on GHG emissions, the energy efficiency of appliances would be a central element in this feebate policy. Therefore, it would be important to involve the utilities, the CEC and the California Public Utilities Commission (CPUC), all of which have extensive experience in energy efficiency program and policy design and implementation. A joint proceeding between CARB and one of the other state agencies may be an effective means to establish a feebate policy. The utilities, in a role similar to the one they play in the process to establish new state codes and standards, could provide program design and analytical support within the rulemaking process. The lead agency, again possibly in coordination with other agencies, would be responsible for reviewing (perhaps annually) the feebate program and making needed adjustments.

From a program administration perspective, the IOUs—who have program infrastructure and significant experience and expertise in designing and implementing incentive programs—could also distribute rebates. The California State Board of Equalization—the agency responsible for collecting state sales and use tax, as well as fuel, alcohol and tobacco taxes and other fees—could collect fees. This model, which divides fee collections and rebate distribution between two entities, may be necessary because no single entity has the experience or authority to both collect fees and distribute rebates. The State Board has the expertise to collect fees, but it does not have an existing model to administer rebates. Likewise, IOUs have the infrastructure and experience to administering rebate programs, but they do not have the infrastructure or the authority to collect fees levied on appliances at the time-of-sale. Thus, the State Board–IOU team could be the ideal implementer of the feebate.

Collection of fees/distribution of rebates. The State Board–IOU team would collaboratively develop a streamlined system for collecting fees and distributing rebates. Ideally, the system would be similar to an instant rebate program where the customer has immediate access to the financial incentives. To minimize program administration costs, the feebate should take advantage of existing infrastructure. The State Board could collect fees on all appliances within a particular product class. Much like California's eWaste fees, retailers could collect the fee at the point-of-sale.[9] The rebates, administered by the IOUs, could be distributed in several ways: they could be distributed directly to the consumer, ideally though not necessarily through an instant

[9] The eWaste fee is imposed on the purchase of certain video display devices. Revenues generated from the fee are used to cover the cost of safe and convenient collection and recycling of the electronic devices, which contain hazardous materials.

rebate at the cash register. Alternatively, they could be administered upstream in the distribution channel. In many cases, the most cost effective way for a utility to administer rebates is to interact with market actors near the top of the distribution channel (e.g., distributors or manufacturers). The manufacture or distributer that receives the rebate would incorporate the rebate value into the wholesale price of the appliance. Upstream programs typically require interaction with far fewer market actors than downstream programs, so the administrative costs are relatively lower. On the other hand, distributing rebates upstream could reduce the visibility of the program to consumers; as previously mentioned the program is likely to be more effective if the feebate is visible. However this shortcoming could be remedied with in-store information and other marketing strategies, developed by or in coordination with the IOUs.

Establishing fee and rebate schedules. The value of a metric ton of carbon dioxide equivalent avoided ($/MTCO$_2$e) provides an approach to setting the values of fees and rebates. As discussed earlier, it is also critical that the value of the fees and rebates make sense relative to the purchase price and lifetime of the appliance, and be large enough to have some influence on consumers' purchase decisions and manufacturers' production decisions.

Appliances Feebate Example

The following figure demonstrates how a feebate might be applied to residential gas storage water heaters. This example demonstrates how the value proposition to the customer would change with a feebate, a utility incentive, and with both a feebate and utility incentive.

For a typical 50-gallon gas storage water heater, three efficiencies (expressed in terms of Energy Factor, or EF) are considered: an efficiency that just complies with the current federal standard (0.60 EF), an intermediate efficiency (0.65 EF), and a high efficiency (condensing) water heater (0.86 EF). In this example, the pivot point is set at the medium efficiency level (see Figure 2); in actuality, sales data must be collected and a model developed for the appliance under question. One would identify the appropriate pivot point that results in enough fees collected to support the payment of rebates plus the costs of administration with the current distribution of sales with respect to efficiency.[10] For this example, CO_2 reductions are valued at $60 per ton of CO_2. This was based on a review of several sources where a social cost of carbon has been estimated to be in the range of $5-67/ton (DOE 2010) and $80/ton (Biesalds et al 2009) in 2009$.[11]

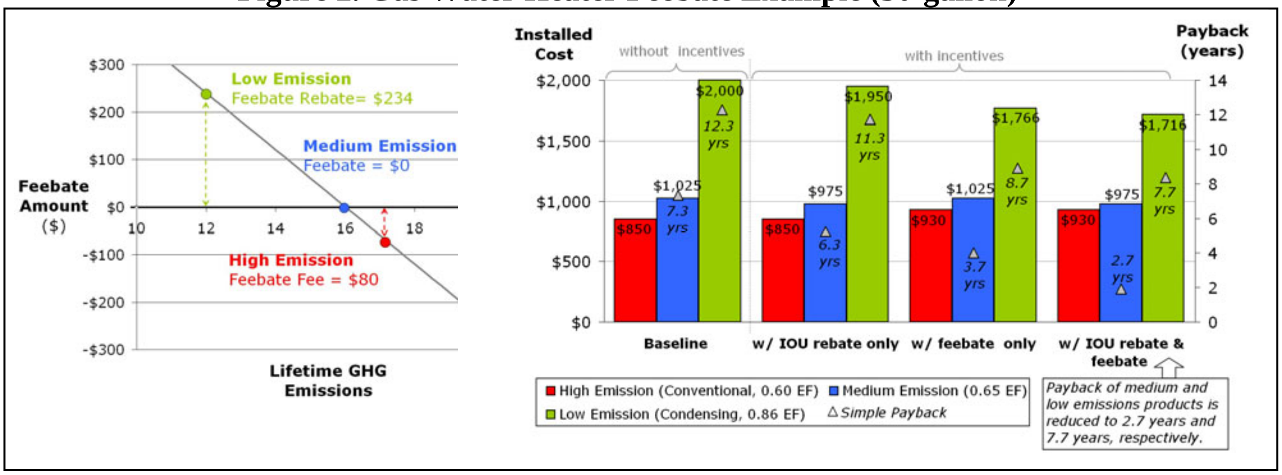
Under a feebate, a high-efficiency (low emission) water heater would receive a rebate of $234 (about 12% of the original installed price), while a low-efficiency (high emission) water heater would be subject to a fee of $80 (about 9% of original installed price) (Figure 2). Figure 2 also summarizes the economics from a feebate, an IOU rebate program, and an IOU rebate plus a feebate. The feebate reduces the incremental installed price by both increasing the price of the high emission water heater and reducing the price of the low emission water heater. The combination of feebate and utility incentive can further reduce the price differential and

[10] Cost of administration would be negligible if IOUs support development of rebate structure and implementation of rebates.

[11] Note these estimates are based on two different approaches. DOE (2010) valuation is based estimates of the monetized damages worldwide from climate change. In contrast, Biesalds et al. (2009) estimates the marginal cost of achieving a given emission target (stabilizing the concentrations to around 400 parts per million CO_2e) based on the cost of emissions abatement.

significantly shorten payback from 7.3 to 2.7 years for medium-emission water heaters, and from 12.3 to 7.7 years for the low-emission condensing water heater. CO_2 reductions per water heater would range from 1.3 to 5.2 tons over the lifetime of the water heater for a consumer switching from high to medium emission and high to low emission, respectively. Making a rough assumption that a feebate would influence 25% of California customers to purchase a lower emission water heater, total lifetime emission reductions from three years worth of water heater sales would range from 0.6 to 2.4 $MMTCO_2$.[12]

Figure 2. Gas Water Heater Feebate Example (50-gallon)



(left) Feebate structure for water heaters; and (right) feebate economics under four scenarios.
Assumptions: Annual energy use for three models shown above is 174, 231, and 250 therms, based on ACEEE analysis for a typical gas water heater servicing a family of 4. Feebate calculated based on water heater's GHG emissions at point-of-use (site) over lifetime of water heater (assumed 13 years), using $60 per ton of CO_2. Utility rebate based on 2010-2012 PG&E rebate of $50 for new gas water heaters with EF ≥0.65. Simple payback is calculated as ratio of the incremental installed price to the incremental annual energy savings (using $1.24/therm), relative to the high emission water heater.

Feebate for Existing Buildings

Design Considerations for Building Feebate

As mentioned earlier, we are not aware of any existing models for feebates applied to existing buildings. The conceptual building feebate presented below incorporates the fundamental attributes of feebate policy. However, the technicalities and implementation strategies of an existing building feebate differ quite a bit from feebates applied to vehicles, appliances, or newly constructed buildings. Several design considerations, such as whether the feebate would be levied annually or as a one-time event, have not yet been resolved. It is anticipated that some of these unresolved issues would be addressed as more stakeholders contribute to program development.

[12] Based on assumed annual sales of approximately 615,000 in CA, that was calculated assuming a stock of 8 million gas storage water heaters in CA with average lifetime of 13 years. Upper end of range represents 25% of purchasers switching from high-to-low emission; lower end of range represents this shift assuming 25% of purchasers switch from high-to-medium emission.

Target market. The proposed building feebate could target any type of existing building. New construction is subject to increasingly stringent Title 24 energy performance standards; however, new construction only adds a small percentage of new buildings to California's building stock each year. Hence, there is a significant opportunity to use feebates to significantly improve the efficiency of and reduce emissions associated with existing building stock. As discussed earlier, to preserve consumer choice, separate feebate schedules could be established for different building types (offices, retail, multi-family residential, single family residential, etc.), building vintages (constructed 50+ years ago, constructed 35-49 years ago, etc.), and perhaps building square footage. The feebate schedule would also depend on geographic and economic conditions. The feebate could target owner occupied buildings or buildings that are occupied by tenants.

Who implements. Local governments are the most logical entity to implement a feebate program for existing buildings. From a program design perspective, local governments are familiar with the distinctive physical characteristics of the building stock as well as local economic drivers. From a program administration perspective, local governments levy property taxes and oversee local building transactions including permitting and Title 24 compliance certification. Because local governments control substantive interactions between building owners and the government, they should play an active role in the feebate administration.

Even though it is recommended that the building feebate be implemented on the local level, it would be advantageous for a single regional administrator to assume a leadership role in program design, and potentially offer program implementation services to municipalities. The Oakland-based company, Renewable Funding, is currently testing this single administrator model for local governments wishing to implement PACE programs. Through the CaliforniaFirst program, Renewable Funding is offering local governments turnkey design-to-implementation services. Having a single administrator would reduce program design costs and make it easier to track program effectiveness. Utilities could assume the role as the regional program administer by encouraging local governments to participate in feebate programs, developing model programs, or offering technical assistance to jurisdictions.

Collection of fees/distribution of rebates. Under the proposed feebate design, fees and rebates could be collected and distributed in one of two ways. The first alternative is to levy a one-time fee or rebate at the time-of-sale. Under this design scheme, the feebate could apply to the seller, the buyer, or both. One drawback of the time-of-sale model is that the real estate industry is likely to strongly oppose a measure that would add steps and costs to the closing process.

Another option is to link the feebate to property taxes; the owner of a low-emitting building would collect the "rebate" by means of a deduction to their property taxes, whereas the owner of a high-emitting building would pay the surcharge when they pay their property taxes.[13] With this approach, the fee or rebate would be issued on an annual basis, thereby reminding the building owner about the opportunity to invest in efficiency retrofits on a regular basis. This feebate design would include all existing buildings within a specific district, which means all

[13] Pursuant to Proposition 13, local governments may need to seek voter approval for the feebate if it is determined that the program is a "special tax." However, since the feebate program would not require local governments to raise capital (via a bond or other means), and the program is revenue-neutral (i.e. local government is not generating revenue from the program), a voter approval may not be required. Further, a property owner that is subject to a fee could elect to retrofit their building to avoid the fee; in this respect the feebate differs from a tax, which imposes a fee for all constituents.

buildings would need to receive an emissions rating. It would take time and capital to rate all the buildings within a jurisdiction, so the program would probably need to be phased in over time. Some drawbacks of the annual feebates is that administrative costs may be higher than the time-of-sale feebate, and the smaller annual rebates and surcharges may not be as effective at motivating change as a larger one-time surcharge or rebate.

As mentioned above, the feebate could dovetail with energy efficiency financing programs. The feebate would encourage building owners and/or renters to upgrade buildings, which would likely lead to increased participation in financing programs such as on-bill financing or PACE financing. On-bill financing is particularly attractive for renter-occupied buildings. When the utility provides funds to pay for the retrofit, the building owner is largely removed from funding model, thereby addressing the split incentive between the building owner who usually pays for the upgrades and the renter who benefits from lower utility bills and any increased comfort associated with energy efficiency upgrades.

Establishing fee and rebate schedules. The rate of a building feebate could be established through a process similar to that discussed earlier for appliance feebates. The fees and rebates could be proportional to the building's GHG emissions, but should also make sense relative to the cost of common efficiency retrofits and should be large enough so it is economically advantageous for a building owner to invest in a retrofit.

GHG emissions levels, which are needed to determine the feebate amount, could be estimated using utility energy use data and energy emissions factors (as shown in the example below). Alternatively, program administrators could rely on standardized third-party ratings in which energy use and GHG emissions are implicit. For residential buildings, using the state run California Home Energy Rating System (HERS), which some cities are already planning to require, is a recommended rating system. LEED (Leadership in Energy and Environmental Design) and GreenPoint Rated are two prominent third-party ratings that could be used for nonresidential buildings. If a building rating is used, the methodology should to be consistent across all buildings that are subject to the feebate.

Existing Building Example

The following example demonstrates the economic impacts of a feebate for a single-family home located in Pacific Gas and Electric Company (PG&E) territory. As in the water heater example, the feebate value is proportional to GHG emissions; however in this example, the feebate is based on the annual GHG emissions to demonstrate how an annual building feebate could be designed. If the feebate was levied as a one-time transaction, it would make sense for feebate to be based on emissions from multiple years. However, purchasers rarely plan to occupy a building until the end of the building's life, so it does not make sense to base feebate values on lifetime GHG emissions. GHG emissions were determined based on electricity and natural gas use data collected through the CEC Residential Appliance Saturation Survey (RASS) and ARB emission factors for California.[14] GHG reductions were originally valued at $60 per ton of CO_2. However, using this price of carbon did not result in feebate values that were large enough to effect changes in consumer behavior, nor did the values make sense relative to the cost of building retrofits or the assessed value of the property. Thus, the feebate values were scaled so

[14] Emissions factors of 4.37x10-7 $MMTCO_2e$/MWh and 5.32x10-8 $MMTCO_2e$/MMBTU used in the AB 32 Scoping Plan were used to calculate GHG emissions from electricity generation and natural gas combustion, respectively.

that a building that does not emit any GHG emissions would receive a rebate of approximately $2,000 per year.

The pivot point was set at 6.0 metric tons of CO_2e, the calculated average annual emissions for single-family homes built between 1997 and 2003 in PG&E territory based on RASS energy use data. Projected electricity prices are based on CEC forecasts (CEC 2007). Projected natural gas prices are from the Energy Information Administration's 2010 Annual Energy Outlook.

Table 1 shows ten years of costs and cost savings for a single-family home subject to the feebate program described above. We assume this home has about 10% higher emissions than the average PG&E territory single- family home built between 1997 and 2003 described above, i.e., the pivot point. Case 1 assumes that the home is not retrofitted. Case 2 assumes that the same home undergoes a $5,000 (assumed cost after tax credits and other incentives) retrofit during the first year that results in 20% energy savings.

Table 1. Economic Impacts of a Feebate for a Single-Family Home (2010 dollars)

	Annual Costs							**Annual Cost Savings**			
	Feebate - Case 1 no retrofit [(a)]			**Feebate - Case 2** retrofit completed during first year [(b)]				**Case 2 Savings Relative to Case 1**			
Year	Feebate *(fee)* [(c)]	Energy Costs	Total Cost	Feebate *(rebate)* [(c)]	Energy Cost	Retrofit Cost [(d)]	Total Cost	Feebate Savings [(e)]	Energy Savings	Retrofit Cost [(d)]	Total Cost Savings [(f)]
1	-$175	-$2,071	-$2,246	$260	-$1,697	-$805	-$2,243	$435	$374	-$805	$4
2	-$180	-$2,048	-$2,228	$255	-$1,677	-$774	-$2,196	$435	$371	-$774	$32
3	-$185	-$2,015	-$2,200	$250	-$1,653	-$744	-$2,148	$435	$362	-$744	$52
4	-$190	-$2,011	-$2,201	$245	-$1,650	-$716	-$2,121	$435	$360	-$716	$80
5	-$195	-$2,020	-$2,215	$240	-$1,657	-$688	-$2,106	$435	$363	-$688	$110
6	-$200	-$2,054	-$2,254	$235	-$1,685	-$662	-$2,112	$435	$369	-$662	$142
7	-$205	-$2,060	-$2,265	$230	-$1,689	-$636	-$2,096	$435	$371	-$636	$169
8	-$210	-$2,058	-$2,268	$225	-$1,687	-$612	-$2,074	$435	$371	-$612	$194
9	-$215	-$2,053	-$2,268	$220	-$1,682	$0	-$1,462	$435	$371	$0	$806
10	-$220	-$2,053	-$2,273	$215	-$1,681	$0	-$1,466	$435	$373	$0	$808
Total ***(One-Time Feebate)***	***-$1,977***	**-$20,444**	**-$22,421**	***$2,374***	**-$16,760**	**-$5,638**	**-$20,024**	**$4,351**	**$3,684**	**-$5,638**	**$2,397**

a. *Single family home; built between 1997 and 2003; located in PG&E service area; 6.5 tons CO_2/yr; no retrofit*

b. *Same building as in Case 1, but building is retrofitted at the beginning of the first year; retrofit cost = $5,000; 20% GHG savings; post-retrofit emissions = 5.2 tons CO_2/yr*

c. *Negative feebate = fees; positive feebates= rebates; feebate rate = $60/ton; pivot point during year 1 is 5.98 tonsCO_2/yr; Feebate values change over time since pivot point is reduced by 0.25% per year to account for adjustments to maintain revenue neutrality; feebate value is scaled so that a building that achieves zero-emissions would receive an annual rebate of $2,000*

d. *Retrofit cost repayment amortized over 8 years; assumes a loan interest rate of 7%.*

e. *Feebate savings = avoided fee + rebate*

Under Case 1, the building owner would pay a $175-$220 surcharge every year (all values in 2010$). Under Case 2, the building owner would receive a rebate of $215-$260. After the loan is repaid, the building owner would be saving around $800 per year, relative to the no-retrofit case (Case 1). Cost savings are attributed to the feebate and to energy cost savings. In this example, the building owner would be leaving up to about $800 per year on the table by not retrofitting the building.

Another way to administer the program is to roll up the anticipated annual surcharges or rebates for some pre-determined length of time, and issue the feebate as a one-time surcharge or rebate at the point-of-sale. If the feebate was one-time feebate that rolled the first ten years of surcharges or rebates into one payment (see bottom row of Table 1), the surcharge for Case 1 (no retrofit) would be $1,977 and the rebate for Case 2 (retrofit during first year) would be $2,374, a difference of $4,351. Assuming the home has an assessed value of $221,500 (based on U.S. Census data for an average California home), the surcharge or rebate would be roughly equivalent to one year of property taxes

Conclusions and Next Steps

The feebate is a market-based, technology-neutral policy instrument that can complement existing efficiency programs by providing greater support to newer, more expensive but highly efficient technologies, as well as by providing a new mechanism to tap into savings potential in hard-to-reach market segments such as the existing building stock. Feebates can spur innovation by providing an incentive structure that encourages continual improvements in energy efficiency. Feebate programs for appliances and buildings would provide consumers with both information and an economic incentive, helping them choose to purchase lower emission products and spurring them to make energy-efficiency retrofits to buildings they own or occupy.

To begin to gather information and experience on feebates for appliance and building sectors, we recommend California, long considered the leading "policy laboratory" for new environmental and energy policies in the United States, develop two pilot scale feebate programs - one for appliances and one for buildings. These pilot programs will provide policy makers and program administers the opportunity test whether feebates can, in practice, generate significant emission reductions and efficiency improvements in the appliance and building sectors. Pilot programs would also allow administrators to address specific program design and implementation issues on a smaller scale where corrections are more manageable. The pilot programs will also inform any future plans to expand the scope of the feebate programs to additional segments of the appliance or building sectors and possibly to the national scale.

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