A GLOBAL REVIEW OF INCENTIVE PROGRAMS TO ACCELERATE ENERGY-EFFICIENT APPLIANCES AND EQUIPMENT

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A Global Review of Incentive Programs to Accelerate Energy-Efficient Appliances and Equipment

SEAD Incentives Working Group

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Abstract

Incentive programs are an essential policy tool to move the market toward energy-efficient products. They offer a favorable complement to mandatory standards and labeling policies by accelerating the market penetration of energy-efficient products above equipment standard requirements and by preparing the market for increased future mandatory requirements. They sway purchase decisions and in some cases production decisions and retail stocking decisions toward energy-efficient products. Incentive programs are structured according to their regulatory environment, the way they are financed, by how the incentive is targeted, and by who administers them. This report categorizes the main elements of incentive programs, using case studies from the Major Economies Forum to illustrate their characteristics. To inform future policy and program design, it seeks to recognize design advantages and disadvantages through a qualitative overview of the variety of programs in use around the globe. Examples range from rebate programs administered by utilities under an Energy-Efficiency Resource Standards (EERS) regulatory framework (California, USA) to the distribution of Eco-Points that reward customers for buying efficient appliances under a government recovery program (Japan). We found that evaluations have demonstrated that financial incentives programs have greater impact when they target highly efficient technologies that have a small market share. We also found that the benefits and drawbacks of different program design aspects depend on the market barriers addressed, the target equipment, and the local market context and that no program design surpasses the others. The key to successful program design and implementation is a thorough understanding of the market and effective identification of the most important local factors hindering the penetration of energy-efficient technologies.

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Executive Summary

The purpose of this study was to review and describe incentive instruments and the regulatory framework that govern their development across major economies to better understand how incentive programs are being implemented globally. The report describes how programs are designed to accelerate the penetration of cost-effective and emerging highly efficient (HE) technologies in the residential sector. HE technologies or products are defined as having significantly higher efficiency as compared to the market average yet lack meaningful market penetration.

Policy Framework

We found that governments typically either directly roll-out incentive programs with money raised through taxes or they set energy-saving goals (also referred to as *obligations*) for utilities (also referred to as *energy providers*) to reduce energy use from their customers. While the first route is the most common approach used across countries, policy makers are increasingly choosing the second route as a way of internalizing energy efficiency in future energy resource planning.

In addition to energy savings, government funded programs have often for goal to foster the penetration of innovative emerging technologies. Programs are then used to stimulate the uptake of new HE technologies, in order to create a larger market that induces economies of scale and learning-by-doing effects. Another goal often pursued by government incentive programs is to boost economic activity in times of economic recessions.

Funding is an essential part of implementing energy-efficiency incentive programs. Governments are seeking new source of funding to secure long term funding for energy efficiency programs. Alternative funding opportunities include constituting a revolving fund, establishing a feebate, or getting credit from programmatic Clean Development Mechanism (CDM) projects. In the case of energy provider obligation schemes, programs are funded through energy rate increase and are often referred as *rate-funded programs.*

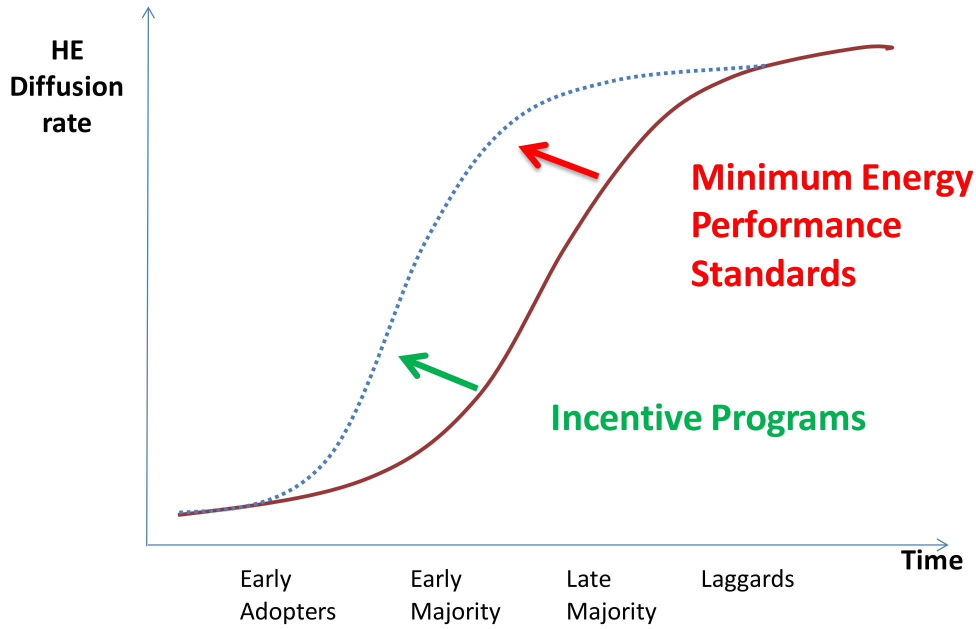
Government programs have the distinct advantage to generally cover a larger geographic scope than utility programs, i.e., nationally. This effectively reduces the number of transactions and potentially increases a program's efficacy. On the other hand, Energy providers have a direct link to energy consumers and access to valuable data on energy usage patterns which are a significant advantage for effective program design. However, energy efficiency is not an obvious business for them to be in, since it requires them to sell less of their product. Beyond setting energy-reduction goals, some U.S. states have developed market regulations to both remove this disincentive to energy conservation and to incentivize investment in efficiency.

Market transformation has been an additional objective of energy efficiency policies and programs after the observation that rate-funded efficiency programs tend to focus on short-term payback periods with quick results and did not explicitly address underlying market barriers to market adoption of energy-efficient products. Market transformation implies that policies and programs be tailored to address the different stages of an energy-efficient product's market diffusion, in order to accelerate its penetration in a sustainable manner for long term solutions.

Market Transformation

Standard and labeling (S&L) programs are generally the first order of policy intervention to transform the market of a specific end-use. S&L programs allow certifying and ranking technologies according to their energy efficiency level and removing inefficient technologies from the market. Incentives programs come next by targeting HE technologies that are above current standards. By increasing their market penetration at an early stage of development, incentives programs help reduce the cost of production of HE technologies. This occurs through streamlined production, economies of scale and learning effects. The efficiency gains achieved through the incentive program can then be cemented by more-ambitious standards, in a virtuous cycle of improvement. This virtuous circle can be repeated indefinitely as innovation continuously brings new opportunities to produce more efficient technologies. Figure ES-1 illustrates how market intervention can help speed the diffusion of HE technologies with permanent effects.

Figure ES- 1. HE Technology Diffusion Rate and Market Interventions



Program Designs

We found that the benefits and drawbacks of different program design generally depend on the market barriers addressed, the target equipment, and the local market context and that no program design surpasses the others. The key to successful program design and implementation is having a thorough understanding of the market and effectively identifying the most important local factors that hinder the penetration of HE technologies.

Program designs are defined by the different elements that compose an incentive program. The form the incentive takes and to whom it is provided are determining elements of program designs. Typically, incentives are implemented through downstream programs, where they are provided directly to the customer, midstream programs, where they directed to distributors or retailers and upstream programs, where they target manufacturers. Each element of program designs are addressing different barriers and have advantages and disadvantages illustrated in Figure ES-2.

Figure ES- 2. Incentive Program Design along the Supply Chain

Manufacturers Upstream Programs	Distributors & Retailers Midstream Programs	Consumers Downstream Programs
Barriers Addressed: -Uncompetive price -Small or non-existant production of SE -Low energy price	**Barriers Addressed:** - Lack of available product - Lack of marketing outreach	**Barriers Addressed:** - Perceived risk of energy-efficiency investments - Lack of information - Limited access to capital
Main Advantages: - Small number of actors - Multiplicative effect on retail price	**Main Advantages:** -Leverage marketing capabilities - Meets customers at point of decision -Give rebate at point of purchasing	**Main Advantages:** - Allows incentive to be directed to specific groups e.g., the low income - Positive Spillover effect*
Main Disadvantages: - Opaque to consumers - Evaluating the right price of manufacturing cost -Picking winners (manufacturing firms)	**Main Disadvantages:** -Chosen firms only supply part of the market -Picking winners (distribution or retail firms)	**Main Disadvantages:** - large number of actors - Need Marketing to reach more participants

**Positive Spillover effect* refers to the increasing adoption of energy-efficient products from program non-participants due to increased knowledge about the benefit of energy efficiency.

Upstream incentives are particularly effective at reducing the up-front cost of technologies that are at an early stage of penetration. Incentives are offered to manufacturers to streamline their production line and increase their production at a lower price. The main advantage of these programs is that they can influence a large portion of the market through fewer actors and therefore have lower transaction cost. Moreover, by reducing the price before products reach the market, the incentive impact on the purchase price increases compared to a downstream incentive. The main disadvantage is that the financial incentives offered to the manufacturers are not seen by the consumer. Another drawback is that it requires estimating how much it will cost to the manufacturer to produce more efficient products to be able to negotiate with them a fair price.

Midstream incentives help address the lack of availability of HE products. This can be particularly impactful in the case of emergency replacement of equipment, when a consumer's purchase decision depends on the product's availability. Midstream programs also educate retailers to promote HE technologies in general, and to use electricity bill savings as a selling point for the products. This helps reduce transaction costs incurred by consumers since they can find all the information they need where they will be making their purchase. Most important, these incentives influence customers at their point of decision. A midstream program can be particularly effective when the program budget is rather small and the price of equipment is high. Since the profit margin for distributors and retailers tends to be thin, a small increase from an incentive can provide a significant motivation to sell more-efficient equipment. Focusing on the midstream point in the supply chain means more transaction costs than an upstream program (although fewer than a downstream focus). An additional inconvenient is that midstream incentives tend to bring in only the largest retailers which contributes to 'picking winners' and to reduce the total affected portion of the market.

Downstream incentives have the advantage of raising consumer awareness of HE products, which has positive spillover effects on other energy efficiency purchases. The existence of a rebate is a signal in itself and may even be more important than the cash amount in some cases. Moreover, downstream programs have the flexibility to be directed to a select population, such as low-income households. A disadvantage of this program design is the transaction costs involved in engaging large numbers of customers on an individual basis to grant rebates.

Market transformation strategies require a multi-year, holistic approach where upstream, midstream, and downstream incentive programs are part of a larger set of market interventions that speed the adoption of more-ambitious standards. This requires an acute understanding of the market conditions and barriers that hinder HE technologies so that these can be addressed.

Measuring Success

Evaluations of policies and programs are far from being systematically and consistently conducted around the world. Governments do not always allocate time and money to evaluate their programs. Evaluation of rate-funded programs tend to be more systematically conducted, as their achievements are a necessary input to future resource planning investment, and impact evaluations are generally part of the program process development.

Accounting for energy savings differs widely from one country to another, and these differences have a significant impact on results which make them difficult to compare. Divergence of accounting savings relates to differences in unit (e.g., life time savings, annual savings, avoided gigawatts (GW), carbon dioxide emissions reduction), in scope (e.g., electricity, oil, natural gas, residential sector, all sectors), time frame, net versus gross savings (e.g., free-ridership, spillover effects).

Introduction

Numerous studies have demonstrated that the penetration of energy-efficient equipment is far below the level that is cost-effective for energy consumers (IPCC, 2007; McNeil et al., 2008; Letschert et al., 2013). Energy-efficiency (EE) policies seek to close this gap (Golove and Eto, 1996) by identifying and addressing the barriers that prevent consumers from investing in energy efficiency. These barriers are diverse, and include, among others: lack of information; split incentives (e.g., between landlords and renters); high “transaction costs”; lack of technical expertise; and lack of energy-efficient equipment on the market (Eto et al., 1996a; Sathaye and Murtishaw, 2004; Jollands et al., 2010; Murphy and Meier, 2011). One of the most significant market barriers identified by policy makers is the relatively higher up-front costs of efficient products. In many instances, up-front costs deter potential users from investing in EE, even when investments appear to be in their interest, i.e., when they are cost effective over their lifetime. Consumers place a greater value on immediate savings and heavily discount future savings (Hausman, 1979; Houston, 1983). Moreover, future savings are not easily evaluated by consumers and they tend to have a low degree of confidence in their expected payback. Therefore, consumers often prefer to purchase the cheapest options available at the time.

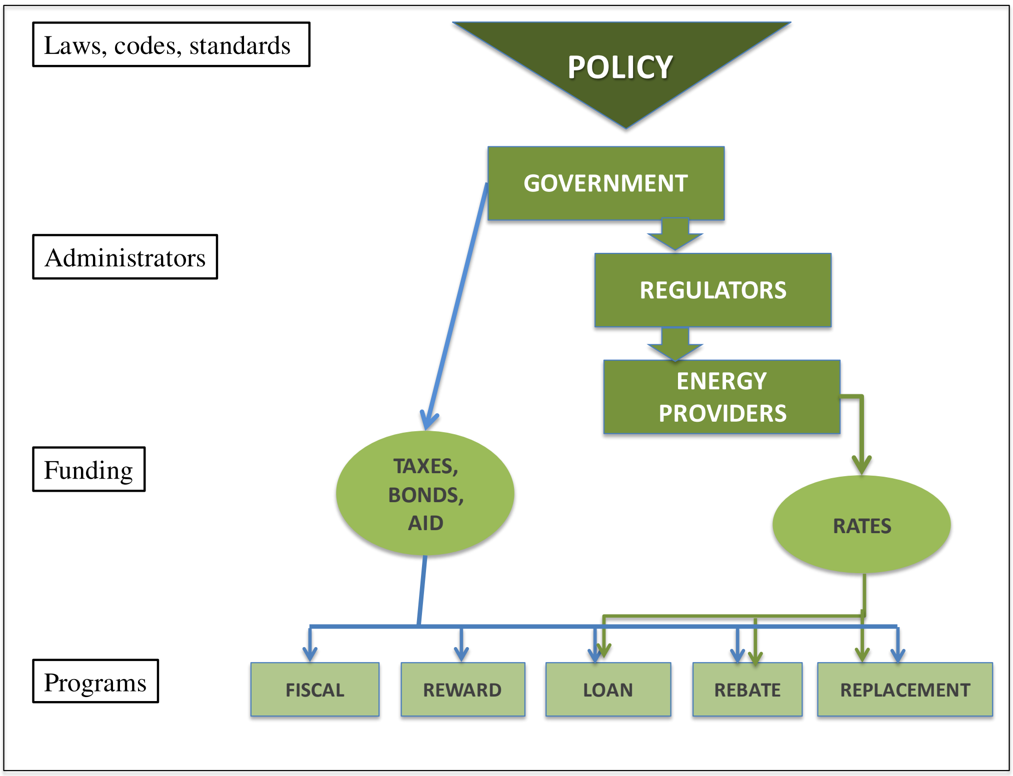
Well-designed incentive programs attempt to address these market barriers and should be complementary to mandatory standards. Incentive programs push market penetration of more-efficient equipment, and appliance standards cement these market improvements by eliminating least efficient models previously sold.

Over the years, a myriad of incentive programs have been developed and designed worldwide. In some instances they are part of national government policies toward energy efficiency; in others, they are part of integrated resource planning strategy of energy utilities. A recent study by the Buildings Performance Institute Europe (BPIE) screened 333 different financial schemes in Europe alone (BPIE, 2011). The DSIRE database records more than 1,300 programs in the US (DSIRE, 2013)

The purpose of this study is to review and describe incentive instruments and the regulatory framework that govern their development across major economies to better understand how incentive programs are being implemented globally. We focused our review on energy-efficiency programs that target residential appliances and equipment, and that encourage the purchase of more-efficient equipment by customers through a combination of information and financial incentives. While energy-efficiency policy has been described generally in the literature (IEA, 2010; WEC, n.d.; Ortiz et al., 2009 and Gellar et al., 2005), the use of incentives and their designs have rarely been covered at a global level. Extensive literature covers the United States (e.g., Nadel, 2003; DSIRE, 2013; Fuller et al., 2010; U.S. EPA, 2010; Eto et al., 1996a). Reports and analysis also exist on incentive programs in Europe (BPIE, 2012; Vine, 1996) and to some extend internationally (Hilke and Ryan, 2012; Sarkar, 2009; Birner and Martinot, 2005). However, literature rarely reports on how programs are designed to accelerate market penetration of residential appliances and equipments. For example, the recent BPIE (2012) and IEA (Hilke and Ryan, 2012) reports cover incentives that target building improvements but do not cover the mechanism employed in program design and programs that target residential appliances. Our focus in this report is to describe the main characteristics of incentive program designs and provide a variety of examples to illustrate how they intend to accelerate market penetration of efficient residential equipment and appliances. The report gives an overall picture of the variety of programs, shows their importance, and identifies design advantages and disadvantages related to their application context. A list of the incentive programs reviewed in this study is provided in Appendixes.

While surveying incentive programs across countries, we found that governments typically either directly roll-out incentive programs with money raised through taxes or they set mandatory savings goals (also referred to as *obligations*) for utilities (also referred to as *energy providers*) to meet to reduce energy use from their customers. While most countries use the first route, the second route is being increasingly chosen by policy makers as a way of internalizing energy efficiency in future energy resource planning. Figure 1 summarizes the two main routes and some of the main program designs identified in this report. The balloons indicate how the programs are funded.

Figure 1. Incentive Programs Flow Chart



This analysis first looks at programs directly developed and implemented by government and describe the typical incentive instrument used. It then reviews program designs implemented to meet an energy-saving obligation imposed on energy providers and funded through an energy rate increase. In each section, description of key characteristics of programs include (1) program goals, (2) the funding source, (3) the type of financial instrument, and (4) the point in the supply chain at which the incentive is used. The last section discusses measures used to determine the success of incentive programs and the advantages and disadvantages of certain program designs over others.

Government Funded Programs

Goals

Incentive programs are commonly used by governments to promulgate energy efficiency. For example, governments provide financial incentives (FI) for equipment at an early stage of commercialization as a way to encourage investment in the development of clean technology. The main goal of these programs is to help fuel long-run growth of a clean products market and to accelerate the technological maturity of those products. Financial incentives are given to emerging highly efficient (HE) technologies to increase production and, by extension, the benefits that come with economies of scale and learning-by-doing effects. HE technologies or products are defined as having significantly higher efficiency as compared to the market average yet lack meaningful market penetration. The overall objective is to lower production costs. Government programs have a distinct advantage in that it is possible to develop and deploy them at a large scale, i.e., nationally. Indeed, as explained by Singh et al. (2012), government programs such as the Indian Super Energy-Efficient Equipment Program (SEEP) have a larger geographic scope than utility programs. This effectively reduces the number of transactions and potentially increases a program's efficacy.

However, an important drawback to consider when subsidizing technologies in their early phase of development is the risk of picking winners while leaving behind technologies that had potential for further improvement. This is a risk that policy makers need to assess when designing incentive programs.

Although one goal of financial incentives is to accelerate the deployment of more energy-efficient technologies, their implementation can also address other goals. For example, governments have implemented incentive programs in times of economic recession as a stimulus tool to boost economic activity. In this case, programs are short term and are designed to motivate consumer spending in clean technology and stimulate job creation.

Incentive Instruments

An incentive instrument can be categorized based on what form the incentive takes and to whom it is provided. Governments have provided incentives in several forms, including fiscal incentives such as income tax credits, allowances, value-added tax (VAT) reductions, cash incentives such as grants and subsidies or low-interest financing. Some innovative programs have used reward points granted to consumers to promote the purchase of efficient equipment, as explained later in this report. The incentives can be provided to several potential actors in the supply chain. Typically, incentives are implemented through downstream programs, where they are provided directly to the customer. Recently, an increasing numbers of programs have targeted manufacturers, to incentivize them to produce more efficient equipment. These programs are referred as *upstream programs.* Table 1 gives examples of programs for different potential combinations of program design and target actors of the supply chain. The table also presents advantages and disadvantages of different program design options. The list is not meant to be exhaustive; rather, the examples illustrate current government program designs and are detailed in the sections following the table. Program examples are organized by whom the incentive is provided and what form it takes.

Table 1. Government Program Examples

	Instruments	Examples	Advantage	Disadvantage
DOWNSTREAM	**Tax credit**	- France's Tax Credit - Italy's Tax Credit - Sweden's Tax Credit	- - Large audience - Acceptance from consumers - Announcement effects	- Only applicable to taxpayers - Lag between purchase and received subsidies - High transaction costs - Targets large investments
	Tax deduction	- Sweden "ROT-avdrag"	- Similar to above	- Similar to those above
	VAT reduction	- UK's VAT reduction	- Reduction directly received	- Not always perceived by the consumer - No announcement effect
	Rebate/ Grants	- Netherland home retrofit	- Acceptance from consumers - Large announcement effect - Announcement effects	- Required to raise funding beforehand - Targets large equipment
	Reward Point	- Japan Eco-point - Korea Cashbag	- Acceptance from consumers - Announcement effect - Encourages energy-efficient behavior	- High transaction cost - Required to find partners
	Low-interest loan	- Germany KfW - U.S. local government PACE	- Remove split incentive	- Targets large investments
	Replacement Program	- Mexican refrigerator and air conditioner replacement program	- Renew the stock - Allow to recycle components - Targets low-income households - Limited rebound effect	- Can be expensive
UPSTREAM	**Tax Credit**	- U.S. manufacturer tax credit	- Low transaction cost - Multiplicative effect of the subsidy due to markup - Prepare manufacturer for more stringent standards	- No announcement effect
	Subsidy	- India SEEP - China	- Low transaction cost - Multiplicative effect of the subsidy due to markup - Develops a local market	- Picks winners

Downstream Programs

Downstream programs—those that offer an incentive to consumers—are a popular form of incentive program. A key advantage of downstream incentive programs is that they are likely to be more acceptable to consumers who directly see the gain. They also increase the adoption of efficient products by program non-participants because they spread information about the benefits of HE products to all consumers. This is referred to as the *announcement effect* (U.S. DOE, 2010; U.S. EPA, 2008). Further, downstream programs allow the possibility of targeting incentives toward a specific category of consumers, such as low-income consumers. The main drawback of downstream programs is that they target a large number of actors: the consumers. Downstream programs also often have high transaction costs.

Grants

Grants from national governments are rarely distributed for the purchase of small appliances but rather are offered to cover major house retrofits or the replacement of older equipment, as in replacement programs. Appliance upgrades are frequently included in EE building retrofit programs. For example, in the Netherlands, the national government made

€15 million available for the implementation of the National Grant Scheme, which offers homeowners grants of €300 or €750 to implement energy-saving measures to make their homes more energy-efficient. Grants from the federal government can also be allocated to the local government, such as the state, county, or cities to develop their own energy-efficiency programs. This is the case in the United States, where the federal government offers grants through the Weatherization Assistance Program (WAP). WAP offers home energy upgrades — sometimes called "weatherization" — to about 100,000 low-income families annually.

Fiscal Instruments

Fiscal instruments are a popular form of financial incentives implemented by governments across countries. Fiscal instruments refer to incentives that directly use government revenue collection, i.e. taxation. In a 2012 survey of financial instruments in European Member States, BPIE found that (BPIE, 2012). In total, 14 countries out of 29 Member States reported one or more fiscal incentives. However, most of the incentives cover home improvements—the main focus of this study.

The difference between a *tax credit* and a *tax deduction* is in the amount reduced. A tax credit directly reduces the taxes the consumer pays; whereas a tax deduction lowers the consumer's taxable income. Both are used to reduce the expense of purchasing energy-efficient equipment by taxpayers. The inconvenience is that the taxpayer must bear the efficient equipment's up-front cost, part of which is only later recovered through tax deductions or a tax credit. This deters customers from taking advantage of this instrument, especially for consumers highly sensitive to up-front costs. Transaction costs are incurred by both the taxpayer (to apply for the tax reduction) and by the government (to verify and process individual tax reduction). This type of program design tends to be more attractive to those making a larger investment in residential equipment because it justifies the time invested and the additional fiscal burden incurred by the taxpayer. The main advantage is that since most people pay taxes, the incentive can be used by a large number of consumers. However, the downside is that not everybody pays taxes, especially low-income households, and therefore either they cannot participate.

Since 2005, France has had a tax credit scheme that allows personal income tax credits to be claimed for the purchase of efficient boilers, heat pumps, and windows. In 2009, more than 1.5 million French households benefited from the scheme, amounting to 2.6 billion euros of lost revenue to the government (French Ministry of Sustainable Development, 2011). Since 2007, Italy's government has been offering a tax credit of 50 percent of the price of similar efficient equipment, as well as for home insulation measures (Pistochini and Valentini, 2011). Examples of tax deductions generally cover larger expenses. For example, the Swedish government offers a tax deduction of 50 percent of the cost of the building work for energy-efficiency improvements under its repairs, maintenance, or conversion and extension work program ("ROT-avdrag" program, Sweden NEAAP, 2011).

A VAT reduction on energy-saving products reduces the transaction costs for the consumer by eliminating the need to file for an income tax rebate and provides an up-front discount to cover part of the incremental costs. The UK government offers a reduced VAT rate of 5 percent on insulation material, heating control systems, heat pumps, and wood-fueled boilers (UK HMRC, 2012). The VAT incentive lowers the price of efficient models compared to less-efficient models. Thus the cost barrier to efficiency is reduced for building professionals who can offer their customers energy-saving products for a competitive price.

Consumer Reward Points

Recently, two countries—Japan and South Korea—have implemented consumer reward programs to encourage consumers to select HE technologies. This form of program is an innovative tool aimed at promoting low-carbon lifestyles by raising consumer responsibility and awareness. The system awards carbon points to consumers for every energy-efficient electronic and electrical appliance they buy. These points can then be redeemed for price discounts or cash. On top of encouraging consumers to buy HE products, the reward points are often only exchangeable for the purchase of local products and services that also encourage energy-efficient behavior, such as traveling via public transport, for example.

The Japanese government ran the Eco-Point System from May 2009 to March 2011 as part of Japan's stimulus package. The goals of the scheme were threefold: stimulate the economy, accelerate high-energy-saving products, and assisting the transition to digital television. This program granted "eco-points" for the purchase of consumer products that rated four or more stars in the national system of energy-efficiency standards. Consumers earned Eco-Points by buying three kinds of government-designated HE products: air conditioners (ACs), refrigerators, and televisions. The points, worth ¥1 each, could then be exchanged for three types of goods: coupons and prepaid cards, HE products, or products that promoted regional economies. There were 271 designated "green goods and services" listed in a catalog sponsored by the government. These ranged from local travel coupons to gift cards. In December 2009, the government added light-emitting diode (LED) lamps to the list of redeemable products, and from January 2011, only five-star appliances were eligible. The total budget amounted to ¥693 billion ($8.7 bill)[1] (METI, 2010). The program was evaluated by the Ministry of Economy, Trade and Industry (METI) and was found to be very successful. The share of shipped products with four or more stars increased from 20 percent to 96 percent for ACs, from 30 percent to 98 percent for refrigerators, and from about 84 percent to 99 percent for televisions. Estimates are that this resulted in a savings of 2.7 million tons of carbon dioxide (CO_2) per year. In 2012, Japan reinstated the Eco-Point program adding awards for post-disaster reconstruction and the wider diffusion of earthquake-proof and energy-efficient housing.

South Korea launched the "Carbon Cashbag" program in October 2008, operated by Ministry of Knowledge Economy (MKE) and Korean Energy Management Corporation (KEMCO). Consumers who purchase low-carbon products get carbon credits from manufacturers, retailers, or banks that participate in the *Carbon Cashbag* program. Points are then stored on a Carbon Cashbag card and can be used for discounts on public transportation, basic utilities charges, purchases of other efficient appliances, or tickets to cultural events. It is a voluntary program, where companies that register benefit from reductions in advertising fees and other public incentives. As of October 2011, 33 companies had been participating in the program with 18 products, 333 sub-products (McNeil et al., 2012).

[1] The 2011 exchange rate of 79.8 yen per US$ (OECD, 2012)

Replacement Programs

Early retirement and direct installment programs involve the replacement of inefficient residential appliances before the end of their useful lives with significantly more efficient appliances. This reduces electricity use by both encouraging the deployment of more efficient appliances and ensuring that older, less-efficient appliances are removed from the stock. By removing the old appliance from the households, they have the added advantage to minimize the potential for rebound effect. The economic feasibility of early replacement depends on the vintage of the unit being replaced, the installed cost of the new unit, and the energy savings. These programs are often directed at low-income households, which tend to have older, less-efficient appliances than the average household. Besides the energy-efficiency benefits, programs that replace old equipment are also attractive because they provide an opportunity to recycle old appliances in accordance with the appropriate environmental regulations and practices. In the case of old refrigerators that use chlorofluorocarbons (CFCs), a further benefit is compliance with the Montreal Protocol for removing CFCs. A disadvantage of this type of program is that they tend to be expensive, as often effective programs include the total cost of replacing the unit (Gertsman and Kyllo, 2012).

Mexico’s Programa Nacional para la Sustitución de Equipos Electrodomésticos (Salaverría and Patricia 2010; SENER 2010; Lucas et al., 2012) is an example of a replacement program that has been successful in replacing large numbers of old appliances. The program offers government-funded subsidies to consumers to replace their old refrigerators and ACs with new, more-efficient models. The subsidies cover a portion of the price of the new appliance and the costs for the transportation, storage, and disposal involved in removing and replacing the old appliance. To receive the subsidy, consumers are required to surrender their old, functioning refrigerators and room air conditioners, which must be 10 years old or older. Participating retailers are able to sell refrigerators and ACs at the subsidized price and receive the difference from the utility upon verification that the appliance is sold to a subsidy-eligible customer. Recycling and destruction of the old machines are done in specialized centers in compliance with Mexican environmental law and international protocol for CFC-intensive Freon. The program has replaced over one million units (90 percent of which are refrigerators).[2] In addition to ensuring environmentally sound removal of refrigerators from the national stock, the program has resulted in the recovery of copper (170,000 kilograms) and aluminum (300,000 kilograms) from returned appliances. Furthermore, program administrators plan to sell carbon credits from the recovered CFCs on the Clean Development Mechanism (CDM) market. The Federal Electricity Commission (CFE), the National Development Bank (NAIFIN) and the Trust Fund for Energy Savings (FIDE) operate the program. PNSEE has been running since 2010 with a budget of approximately $107 million per year.[3]

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[2] Davis, L., A. Fuchs and P. Gertler. March 2012. “Cash for Coolers: How Appliance Replacement Programs Affect Energy Use.” UC Berkeley, Haas School of Business, Energy Institute at Haas.

[3] See: World Bank. *Project Appraisal Document*. Report No: 54303-MX. October 25, 2010.

Upstream Programs

Upstream incentives are provided directly to appliance manufacturers for producing more-efficient units. The relatively small number of producers compared to the number of potential consumers means that upstream programs can dramatically reduce transaction costs. Furthermore, incentives offered to manufacturers can have a proportionally larger impact since the subsidy is provided before the markup of the retailer is applied. This results in a larger markdown for the consumer.[4] On the other hand, upstream incentives are not directly perceived by consumers, and so do not have an "announcement effect" that can increase energy-efficiency awareness to the consumers. Evaluation, monitoring, and verification of upstream programs are also more challenging because no cross-sectional methods[5] can be used, as the program applies to all sales (Friedmann, 2011). The two most common forms of upstream programs implemented by governments—fiscal instruments and subsidies—are described below.

Fiscal Instruments

In 2005, the U.S. Congress passed the Energy Policy Act of 2005 and designed a tax credit to incentivize the production of the most energy-efficient refrigerator units. The Internal Revenue Service (IRS), the U.S. government agency responsible for tax collection, administered the program, and the goal was to influence manufacturers to produce increasingly energy-efficient appliances in order to transform the market. According to a white paper from Gold and Nadel (2011), the tax credits have been largely successful for several reasons, among which are robust stakeholder involvement and education and the link with standard programs: each successful extension of the tax credit program pushed the efficiency standard forward so that the next set of incentives would "achieve higher levels of energy savings cost-effectively." The white paper also points out the importance of targeting advanced technologies and practices that currently have a low market share with a defined period of time—usually around five years—so that the technologies' market share can grow and prosper on their own after the tax incentives end. However, policy maker incentivizing at an early stage of technology development has the drawback of picking a winner.

Subsidy

Two recent examples of large-scale incentive programs implemented by governments offer a subsidy to manufacturers of HE products: the Promotion Products Program in China and the Super Energy-Efficient Equipment Program (SEEP) in India.

China's upstream subsidy program began with a compact fluorescent lamp (CFL) promotion program launched in 2008. Subsidies were offered to suppliers to provide a 30 percent discount on wholesale purchases and a 50 percent discount on retail sales. A total of

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[4] For example, if a light bulb is marked up 40 percent, a $1 incentive to the consumer will discount the price of the bulb by $1, while the same $1 incentive to the manufacturer will discount the customer price of the bulb by $1.40 because the price is reduced before the markup. This is the multiplier effect of an upstream program.

[5] Cross-sectional methods compare regions with no active energy energy-efficiency programs, to establish a baseline for comparison.

210 million subsidized CFLs were sold to consumers between 2008 and 2009, resulting in an estimated savings of 8.8 billion kilowatt-hours (kWh) of electricity each year. In June 2009, the Chinese government extended the incentive program to air conditioners. The central government offers subsidies of 500–850 renminbi (RMB) ($72 to $122) per unit for efficient products, rated as grade 1 in the Chinese label system[6] and 300–650 RMB ($45 to $95) per unit for grade 2 products. Local governments were encouraged to provide additional subsidies. By early February 2010, about 5 million subsidized HE ACs had been sold, leading to a reduction of 1.5 billion kWh of electricity (Wang, 2010; Yu, 2010). In June 2012, the Chinese government extended the program to include other products: TVs, refrigerators, washing machines, and water heaters. The budget is RMB 26.5 billion ($4.1B) and the time frame is one year (China Daily, 2012). The main goal is to promote energy-saving home appliances and stimulate the economy to offset the impact of the international economic crisis. The new program includes new rules to ensure the impact; the process of distributing the subsidy requires that manufacturers prove shipment of the products with a retailers' sales receipt.

India's Market Transformation for Energy Efficiency (MTEE) National Mission on Enhanced Energy Efficiency (NMEEE) includes a program called SEEP (Super Energy-Efficient Equipment Program) which envisages developing equipment that is 50 percent more efficient than five-star appliances[7]. The first product chosen for this program was ceiling fans, with a goal of producing fans that consume 35 watts of power, instead of the 50 watts that the five-star rating fans consume (Singh et al., 2012, Chunekar et al., 2011). It is planned that an incentive would be payable for every SEEP fan sold by the manufacturers. This could then be further extended to other products like room air conditioners, frost-free refrigerators, and televisions. A recent report from the Prayas Energy Group (Singh et al., 2012) describes the group's experience assisting the Bureau of Energy Efficiency (BEE) in the development of SEEP from its conception to the design of the program and the framework for its implementation. Many interesting details on the design aspects of the program can be learned from Prayas report; for example, how the technical specification for the eligible product has been established in close collaboration with the manufacturing industry and retail sector to take into consideration local industry conditions and consumer preferences. An original distinction of the SEEP program is that it gives manufacturers an opportunity to design and market products suited for Indian conditions.

Funding Sources

Many form of funding are feasible for government programs. In most cases, government programs are funded through general government budgets (also referred to as central budgets), which are financed by taxpayers. In the case of stimulus packages, funding is generally financed by exceptional stimulus funds, such as the American Recovery and Reinvestment Act of 2009 in the United States.[8] Governments from developing countries or

[6] In the Chinese Label system, grade 1 is the highest efficiency level and level 5 represents the standards.

[7] Five-star ratings are the highest rating available

[8] Ultimately, these stimulus funds will be paid for either through borrowing or currency devaluation, creating financial burdens ultimately borne by taxpayers.

economies in transition can seek out for financial support from various international financial institutions such as the World Bank, the Clean Technology Fund, and the Global Environmental Facility. For example, the Mexican replacement of refrigerators and ACs is co-funded by loans from the International Bank for Reconstruction and Development and the Clean Technology Fund (World Bank, 2009).

Table 2 summarizes the main funding approaches in the government programs described in this subsection.

Table 2. Source of Government Funding for Incentive Programs

Source of Funding	Examples
Government Budget	Most tax and subsidy incentive programs
Stimulus Fund	-U.S.'s ARRA -Japan's Eco-point
International financial institution	-Mexico -India's SEEP
Revolving Fund	-Germany's KfW loans -U.S.'s local Property-Assessed Clean Energy (PACE)
Feebate	-South Korea's Promotion of Energy-Efficient Goods
Programmatic CDM	-India's Bachat Lamp Yojana (BLY) program

Although funding from general budget sources is traditionally the most common source of funding for national energy efficiency programs, policy makers are becoming interested in finding alternative sources of funding as their budgets shrink in time of recession (Hilke and Ryan, 2012). During times of financial crisis, governments readjust their budgets and can reallocate funding to other areas that are considered a higher priority. Moreover, general government funding is subject to political forces, and therefore can be vulnerable to sudden instability. The next paragraph reviews alternative funding mechanisms that provide examples of original government funding that helps to constitute a sustained flow of funding for energy efficiency over a longer term.

A *Revolving fund,* in which installment payments replenish the principal, is another innovative alternative mechanism for financing efficiency measures. One prominent example is the Kreditanstalt für Wiederaufbau (KfW) fund created by the German government. This fund, originally created for the reconstruction of the country after the second World War, now helps the country to become more energy efficient. The KfW institution partners with private banks to offer advantageous loan conditions to consumers wishing to invest in energy-efficiency improvements (KfW, 2011). In the United States, revolving funds have been used by local governments to offer low-interest loans to building owners through a program called Property-Assessed Clean Energy (PACE). Under PACE, the loan is paid off through a special tax on the property triggered by the installation of efficient devices. The loan is attached to the house, and therefore allows the remaining balance to be transferred to the new property owner when the property is sold. The city of Berkeley and Palm Desert in California were the first cities to implement this program (DSIRE, 2012). In less than three years (2008 to 2010), 25 U.S. states had passed legislation enabling local governments to create PACE programs (DSIRE, 2012). However, many of the residential PACE programs have been on hold since the U.S. Federal Housing Financing Agency (FHFA) expressed concerns regarding the senior lien status of PACE loans over other obligations like home mortgages, which means they must be paid off first in the event of foreclosure (Zimring, 2010).

Earmarked taxes are an alternative way to raise funding. Under this budget practice, a tax is raised for financing a specific energy-efficiency program. These taxes are even more powerful when they are used to serve the same goal of energy efficiency. For example, South Korea introduced a 5 to 6.5 percent tax on energy-consuming home appliances; the revenues were used to subsidize low-income families to purchase goods with high energy efficiency (IEA, 2010). The tax was effective from April 2010 to December 2012 and has been extended to December 2015. Its purpose is to promote HE goods. This type of policy is sometime referred as *feebate,* where a tax or “fee” on less-efficient equipment is coupled with a rebate on more- efficient equipment. If designed and monitored carefully, this financing mechanism provides a revenue-neutral policy and can be independent of government general budgets. Most examples of implementation of this policy are found in the transport sector, such as the “bonus-malus” in France (German and Meszler, 2010). However, the main drawback of a feebate policy is the need to continually revise the program to keep revenue and expenditure balanced. In the French case, the program turns out to be much more costly for the government than expected. This can be a considerable burden for governments that do not have the capacity to meticulously and constantly monitor the program.

The proportion of *Clean Development Mechanism (CDM)* projects in the area of energy efficiency has generally been small and focused on the industrial sector. The diffuse nature of end-use energy-efficiency savings opportunities in the residential and commercial sectors has hindered the development of CDM projects in these sectors, despite offering significant greenhouse gas (GHG) mitigation potential. The recent introduction of “Programmatic CDM” as a new approach that ties together projects can potentially enable more energy-efficiency projects from these sectors. The government of India, for example, has taken advantage of this opportunity with the Bachat Lamp Yojana (BLY) program, which provides an interesting applied example. The scheme works on a voluntary basis; is a public-private partnership between the Government of India, CFL suppliers and state-level electricity Distribution Companies (DISCOMs); and leverages the CDM market. The BLY program uses a deemed savings approach in which CO_2 savings per CFL sold are fixed at a certain assumed value. The state utility receives CDM revenues based on the number of CFLs sold, which in turn is passed on to the consumer in the form of rebates on CFLs to reduce or eliminate the cost difference between the price of a CFL and an incandescent bulb. Several utility companies in India have implemented the BLY program (BEE, n.d.).

Funding is an essential part of implementing energy-efficiency incentive programs. Shared experiences across governments can help governments develop their own dedicated source of funding for energy efficiency.

Rate-Funded Programs

An increasing number of governments have created regulatory frameworks to compel energy providers (also referred as *utilities*) to deliver energy savings as part of their activities. In some case the savings targets are conferred to a third party or governmental agency that implements the programs to achieve the energy-saving goals. These programs are typically funded through an energy rate increase and are often referred as *rate-funded programs.* This section reviews the regulatory framework and program designs implemented to meet the energy supplier obligation.

Utility energy-efficiency programs in the United States began with the idea that efficiency should be considered on an equivalent basis to generation, and as such should be integrated into planning decisions for future energy resource acquisition (Eto, et al. 1996b; Nadel and Kushler 2000). The main rationale is that future investment should prioritize conservation as long as saving one kilowatt-hour of electricity (or one gigajoule of fuel) is cheaper than procuring one additional kilowatt-hour. Energy providers were chosen as program administrators because of their direct link to energy consumers and their access to valuable data on energy usage patterns. Energy customers are vast and diffuse, which makes it hard for EE programs to reach them. Energy providers are a natural gateway to this market. However, energy efficiency is not an obvious business for energy providers to be in, since it requires them to sell less energy. Beyond setting the obligation, some states have developed market regulations to both remove this disincentive to conserve energy and to incentivize investment in efficiency, such as decoupling revenue and electricity sales and implementing shareholder incentives to achieve energy efficiency beyond targets (U.S. EPA, 2007b; EEWG, 2008; Schultz and Eto, 2002; Satchwell et al., 2011). Moreover, regulators are also developing regulatory frameworks to move beyond a focus on short-term energy-efficiency activities that reply to a strict resource acquisition objective to a more sustained long-term, market transformation strategic focus (Rosenberg and Hoefgen, 2009; Nadel and Latham, 1998; Eto et al., 1996).

Regulatory Framework

A significant number of countries have implemented regulatory frameworks that require energy providers to work with consumers to help them reduce their energy consumption (Heffner, 2013). Table 3 provides examples of countries or U.S. states that have set obligations on their providers, with detail on the saving targets, the budget, and the scope of the obligations.

Appendix 3 provides a list of countries with a policy framework in place that mandate energy saving from energy providers' sales.

Goals, also referred to as *obligations* or *targets*, are expressed in different units across countries. The required reduction can be expressed in annual energy usage and coincident peak demand or life time savings, primary or final energy units, or avoided emissions of carbon dioxide. In other cases, targets require energy providers to spend a predetermined share of their annual revenue on efficiency measures, as is the case in Brazil.

Table 3. Examples of Regulatory Energy Provider Obligations

Examples	Massachu -setts	California	UK	France	Brazil	South Africa	Europe Union
Current Cycle	2010–12	2010–12	2008–12	2011–13	Since 1998	2011–13	TBD
Savings Target	Elec: 2.4%/yr Gas: 1.15%/yr	7,000 GWh 3460 MW, 150 MTherms	2.0%/yr	345 TWh cumac	None	4,055 GWh (~0.7%/yr)	1.5%/yr
Savings Units	first year final energy	first year final energy	lifetime CO_2	lifetime final energy	first year final energy	first year final energy	TBD
Budget B/year	$0.7	$1.0	$1.65	NA	0.5% revenue	$0.2	TBD
Sectors	All	All	Res.	All	All	All	All
Fuel	Electricity & Nat Gas	Electricity & Nat Gas	Electricity & Nat Gas	Electricit y, Nat Gas & Gasoline	Electricity	Electricity	All

GWh: gigawatt-hours, MW: megawatt, TWh: terawatt-hours
TWhcumac: specific unit to the French program that means final energy savings CUMulated over the lifespan of an action or measure.
NA: Not available, TBD: to be determined.

The United States has the longest experience in carrying out utility energy-efficiency programs, with about three decades of program implementation. However, the scope and intensity vary significantly among states. Today, many rate-funded incentive programs are regulated through Energy-Efficiency Resource Standards (EERS). Table 3 shows examples of the two most aggressive U.S. EERS, requiring that 2.4 percent of annual sales are met with EE programs in Massachusetts and about 1.3percent[9] in California. About 27 U.S. states have passed EERS or have set goals for their electric energy providers; only 12 also include goals for natural gas (DSIRE, 2012). According to the annual report of the Consortium for Energy Efficiency (CEE, 2012), a total of US$8 billion was budgeted for gas and electric efficiency programs in 2011 in the United States, representing an increase of 20 percent over the previous year. Of this funding, a third is allocated to efficiency measures in the

[9] This is an annualized target compared to 2010 electricity sales from investor-owned utilities in California (CEC, 2012).

residential sector, about 40 percent is allocated to the commercial and industry sectors, and the rest is in other sectors and for load management (CEE, 2012). California represents by far the largest source of rate-funded programs, with a budget of US$3.1 billion over three years.

In Europe, the UK was the first country to implement an obligation scheme, in 1994. The scheme, called the Carbon Emissions Reduction Target (CERT), has evolved over the years and is now targeting lifetime carbon dioxide savings. The previous obligation requires domestic energy suppliers to avoid the emission of 293 megatonnes of CO_2 from 2008 to 2012 (DECC, 2011). This amount represents annual savings, at the end of the scheme, equivalent to 2 percent of current household emissions. It is expected that suppliers will need to invest around £5.5 billion in energy-efficiency measures to meet this target (DECC, 2012). The British scheme only covers the residential sector, and it is accompanied by specific requirements. For example, 40 percent of the target must come from energy savings measures carried out in low-income households, and at least 68 percent of the target must be delivered through professionally installed insulation measures (DEEC, 2012).

Other European countries have since also implemented energy-saving obligation schemes. This is the case in Denmark, the Flemish region of Belgium, Italy, France, and more recently, Poland (Lees, 2012; Staniaszek and Lees, 2012). More European Union (EU) countries will need to do so, as a EE directive has been recently signed by the EU Commission, the European Parliament, and the EU Presidency. The directive requires Member States to implement utility energy savings obligation equivalent to 1.5 percent of annual sales. However, under the principle of subsidiarity,[10] each EU Member State may meet their obligation by implementing a regulatory framework that best suits local circumstances (E.C., 2011).

In France and Italy, the efficiency targets have already been implemented since 2005, and they are accompanied by trading markets where white certificates represent a unit of energy savings and can be either sold or purchased. Moreover, the coverage of sectors is broad. In its second phase, France extended its white certificate scheme to cover the transport sector. This second phase spans from 2011 to 2013 and has a target of 345 TWh of cumulative energy savings from gasoline, gas, and electricity. During the first phase (2006–2009), two-thirds of the savings achieved came from installation of HE heating systems, about 15 percent were achieved through building envelope improvements, and only 3.4 percent were achieved from installation of efficient electrical equipment (mainly variable-speed drives and low-energy lighting) (French Ministry of Sustainable Development, 2009).

There are other examples of savings obligation schemes dispersed around the globe, notably in Australian states, Brazil, South Africa, China, and India (Balawant and RAP, 2012; Lees, 2012). The state of New South Wales in Australia implemented the first mandatory GHG emissions trading scheme in the world in 2003. Greenhouse gas emissions associated with electricity sales were capped every year, and electricity retailers had to submit certificates to partially offset the emissions associated with their electricity sales (IPART 2008, 2010). Today other Australian states have implemented GHG-reduction targets which can be met only through energy-efficiency activities in the residential sector.

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[10] *Subsidiarity* is a principle of the European Union law that ensures that actions are taken as closely as possible to the citizen (Article 5 of the Treaty on European Union).

In Brazil, the power regulatory authority, ANEEL, has since 1998 mandated utilities to invest at least 0.5 percent of their net revenues in energy-efficiency programs (Taylor et al., 2008). Program costs are funded through a wire charge. The Brazilian Congress mandates that about half of these funds must be spent on energy-efficiency measures targeted at low-income households. According to Taylor et al. (2008) investments of the wire charge funds are about five times greater than investments by PROCEL, the government program for efficiency in the electricity sector.

In South Africa, the government introduced the Standard Offer Scheme in 2010. The scheme sets an energy-savings target of 4,055 GWh (and 1,037 MW) by 2013. Eskom, the sole South African utility, has been allocated a budget of 5,445M (US$651 million) for these programs.

In China and India, utility programs are still at an early stage, but their role could increase rapidly. In November 2010, China adopted national energy-efficiency regulations that require China's power grid companies to save the equivalent of at least 0.3 percent of their sales volume and 0.3 percent of maximum load compared with the previous year (Finamore, Yew, and Ho, 2010). The new regulations came into effect on January 1, 2011, with possible sources of funding coming from a rate surcharge applicable to all, a rate surcharge differentiated by customer categories, and/or government budget allocations (Finamore, Yew, and Ho, 2010). These new regulations are in part the outcome of tight collaboration between the State of California energy-efficiency experts and a few provinces in China. China uses the term Efficiency Power Plant (EPP) rather than Demand Side Management (DSM) to describe a virtual power plant that delivers "negawatts" through a portfolio of DSM or energy-efficiency projects. In India, the Maharashtra Electricity Regulatory Commission (MERC) instituted a public-benefits type of electricity charge on utilities—funds which can be used to finance renewable-energy and energy-efficiency programs in the state. MERC ordered utility companies in the state to use these resources to start CFL programs in the residential sector in Mumbai and in the Nasik District in late 2005 (Sathaye et al., 2006).

Cost Recovery

Programs implemented by utilities are referred as *ratepayer-funded*, since they are either explicitly or implicitly paid for by ratepayers.

Explicit mechanisms charge a defined amount as part of the consumer electricity rate. In the United States, South Africa, and Brazil, the budget for EE programs are generally funded with the installment of a small levy or charge—a fraction of a cent per kilowatt-hour—on electricity sales. This levy finances a common public fund that is used to recover the cost of implementing programs (Eto, Goldman, and Nadel, 1998). In the United States, the value of the charges ranges from US$0.00003 to $0.003 per kilowatt-hour, with a median value of about US$0.0011 per kilowatt-hour (Kushner, York, and Witte, 2004).

In implicit mechanisms, the cost of the EE programs are included as part of the rate base used to determine the retail energy prices. This is the case in the UK, where the energy market is liberalized and utilities recover their costs through their tariffs. Price impacts in the UK have been estimated at approximately 1.5 percent (Eyre et al., 2009). In the case of France, the cost recovery mechanism remains imprecise. Even though the French law stipulates that implementation costs are taken into account in price changes regulated by the government, no increase has been earmarked to the French white certificate market. Moreover, the energy savings during the first phase of the French program have been largely met by measures that benefited from the government tax credits, which has lowered the program cost for the energy providers.

Incentive Instruments

Utilities have developed a wide variety of programs to meet their energy-saving targets. Gradually, they have expanded the number of stakeholders to whom they direct their programs in order to better overcome specific market barriers. For example, retailers and distributors have increasingly been targeted for incentive programs when product availability presents a barrier to market penetration of more-efficient equipment. Figure 2 shows the points in a product delivery chain at which incentives can be directed.

Figure 2. Points in the HE Product Delivery Chain Where FI Can Be Applied

Upstream incentive programs are targeted as early as the production stage, encouraging manufacturers to produce more-efficient equipment at a lower price. Incentive initiatives directed to distributors or retailers are referred to as *midstream programs.* The final link in the product chain delivery mechanism is the actual purchase of the product at the retail level. Programs focused on this stage are considered downstream and are intended to influence consumers' purchasing decisions. The following sections discuss each of these incentive types in more detail. Table 4 provides examples of incentive instruments used in rate-funded programs.

Table 4. Rate-Funded Program Examples

	Instruments	Examples	Advantage	Disadvantage
DOWNSTREAM	Consumer Rebates	- Numerous examples in DSIRE database	- Reduce up-front cost - Announcement effect	- High transaction costs
	On-Bill Financing	- This design is available in 20 U.S. states	- Spread out the up-front cost - Offset installment with energy savings - Address split incentive barrier	- High transaction cost for utilities - Target large investments
	Direct Install Program	- South Africa residential mass roll-out	- Low-income households - Hard-to-reach households - High energy savings per participant	- Expensive program
MID-STREAM	Retailer or Distributor Rebate	- Houston central AC - California water heating	- Increase product availability - Increase retailers knowledge of EE products	- Most efficient for product with small mark up
UP-STREAM	Manufacturer's Rebate	- California Upstream Lighting Program	- Reduce production cost - Increase product availability - Lower transaction costs	- Lost tax revenue

Downstream

Consumer Rebates

Consumer rebate programs are a very popular incentive instrument among U.S. utilities. Of more than 1,390 FI programs reported in the Database of State Incentives for Renewable Energy (DSIRE), 76 percent are rebate programs, most of which are consumer rebates. Rebate programs reduce the price that consumers pay when purchasing new HE appliances. In Europe, rebates are more often called *grant subsidies* and are also implemented as a means to spur the penetration of high-efficiency appliances.

On-Bill Financing

On-bill financing programs allow consumers to spread out the up-front cost of buying energy-efficient appliances by paying them off on their monthly electricity bills, and to offset the monthly cost with the energy savings. The utility pays the up-front cost and then recoups the cost gradually over time through the customer's monthly bill. On-bill financing also offers the possibility to link the loans to the meter, meaning that whoever lives at the house or owns the business pays the fee. This tariff approach has the advantage of encouraging short-term owners and renters to participate because they only pay for energy-saving measures while they benefit from them (Brown, 2009). The downside of such a program is that it complicates the utility's billing and requires new skills in risk management and financing. Currently, this program design is available in 20 U.S. states (Bell et al., 2011). Ratepayer funds constitute generally the source of funding for these programs. However, new program developments indicate a trend toward leveraging ratepayer funds to bring in additional private capital to pay for a larger investment in efficiency. Ratepayer funds are then used as a loan loss reserve and to cover program implementation costs while up-front investment comes from financial institutions like banks, credit unions, or foundations (Brown and Braithwaite, 2011; Brown et al., 2012). The loan reserve reduces risks for participating financial institutions, which then can offer an advantageous interest rate.

Direct Installation Programs

Direct Installation Programs or mass roll-out programs involved an initial home visit, completed either by a utility employee or an approved contractor, followed by arrangements for HE equipment installation and often financial assistance.

This type of program has been used in the United States to reach out to low-income households and other hard-to-reach consumers, as these programs tend to result in significantly higher costs to the utility than those from financial incentive programs such as rebates. However, direct installation programs do achieve higher energy savings per participant than other programs (Nadel and Geller, 1996). In South Africa, Eskom is currently launching the Residential Mass Roll-out (RMR) program to replace inefficient lighting and to install water heater timers and blankets, pool timers, and low-flow showerheads. The RMR is a replacement program offered free of charge to the consumer. Its implementation is intended to start in spring of 2013 and is targeted at the middle income sector.

Midstream

Midstream incentives consist of rebates directed to retailers who sell qualifying high-efficiency appliances. The rationale is that these programs influence a large portion of the market by accelerating the introduction, stock, and sale of efficient equipment models. These incentives can impact the percent of HE products in a specific category. An added advantage of midstream programs is that they educate and incentivize retailers to promote HE products in general, and to use the energy and cost savings benefits to convince customers to purchase the products. A midstream program can be particularly effective when the program budget is rather small and the price of equipment is high. Since the profit margin on products that distributors and retailers sell tends to be thin, a small increase from an incentive can provide a significant motivation to distributors or retailers to sell more-efficient equipment.

Targeting programs to midstream actors can also be particularly advantageous in situations that present a principal-agent problem. For example, in the case of central air conditioners, the decision on what product to purchase is generally made by the installer, who has no stake in the costs of energy consumption. Targeting a rebate to installers can help mitigate this problem. This approach was used with success in Reliant Energy HL&P's 2001–2004 AC Distributor program in Houston, Texas. The program offered incentives to heating, ventilation and air conditioning (HVAC) distributors, with a goal of promoting the sale of at least 7,500 tons of central air conditioners with a Seasonal Energy Efficiency Ratio (SEER) of ≥14 (with a minimum eligibility of 13). In 2002, 79 percent of the weight goal was met with an average SEER of 13 (Garland et al., n.d.).

Another example of a midstream incentive program is the California Commercial Water Heater Distributor Incentive Program administered by Pacific Gas and Electric Company (PG&E). The program's goals are twofold: (1) to encourage distributors to increase their inventory of high-efficiency commercial water heating equipment; and (2) to encourage distributors to increase their sales of more-efficient equipment by explaining to their customers the technical and financial benefits. Incentives in the form of cash rebates are offered to distributors for selling qualifying high-efficiency water heaters installed at commercial and multifamily PG&E gas customers' facilities. (PG&E, n.d.).

Upstream

Upstream incentives provide an effective way to motivate manufacturers to produce more HE models and to reduce production costs. Upstream programs also aim to increase product availability at the retail level, and can influence manufacturers to improve product quality. As explained in the government program section, upstream programs have lower transaction costs, since the only interactions needed are with a few producers instead of with thousands or even hundreds of thousands of consumers, and there is a "multiplier" effect, whereby a rebate is multiplied by the appliance markup, thus giving consumers a larger discount than if the rebate were given directly to them. Upstream strategies also have disadvantages, however: lost tax revenue (since a percentage sales tax is applied to a smaller final price) and a constrained ability to target subsidies to specific consumer groups, which can result in high rates of free riders, among other drawbacks.

One example of an upstream incentive is the California Upstream Lighting Program implemented by California's three largest investor-owned-utilities. An evaluation of the 2006–2008 program conducted by KEMA (2010) estimates statewide annual net savings to be about 1,325 GWh, with net peak savings estimated to be approximately 134 MW. California utilities provided incentives to manufacturers averaging US$1.57 per bulb on nearly 100 million CFLs, while the average consumer discount at the register was US$2.70 per bulb, resulting in a multiplier of 172 percent (KEMA, 2010). The multiplier effect happens when a rebate given upstream is increased by the product markup, thus giving consumers a larger discount than if the rebate were given directly to them[11].

Other types of programs directed to customers exist. As market transformation is increasingly being integrated into energy-efficiency goals, new programs have been designed to further reduce market barriers to the adoption of energy-efficient products. For example, York et al. (2013) have noted a clear trend toward behavior-based programs. These programs provide energy use feedback, as well as contextual information to incentivize customers to reduce energy use.

Measuring Success

The success of a policy can be measured by determining if the initial intended goal has been met and by evaluating how effectively it has been met. Additionally, spillover effects or other unintended consequences, such as environmental consequences or equity issues, need to be considered (Harmelink, 2008).

Evaluations of policies and programs are far from being systematically and consistently conducted around the world. Governments do not always allocate time and money to evaluate their programs in detail. Moreover, a particular program may have multiple goals, and these goals can be broad, especially when they encompass research and development elements. Evaluation of rate-funded programs tends to be conducted more systematically, as their achievement is a necessary input to future resource planning investment, and impact evaluations are generally part of the program development (U.S. EPA, 2007a). According to the 2012 CEE report (CEE, 2012), evaluation, measurement, and verification (EM&V) averaged 3.6 percent of the total amount budgeted for rate-funded energy-efficiency programs in the United States. In California, the Public Utilities Commission (CPUC) approved a budget of US$125 million (4 percent of the overall portfolio budget) for EM&V from 2010 through 2012 (CPUC, 2009).

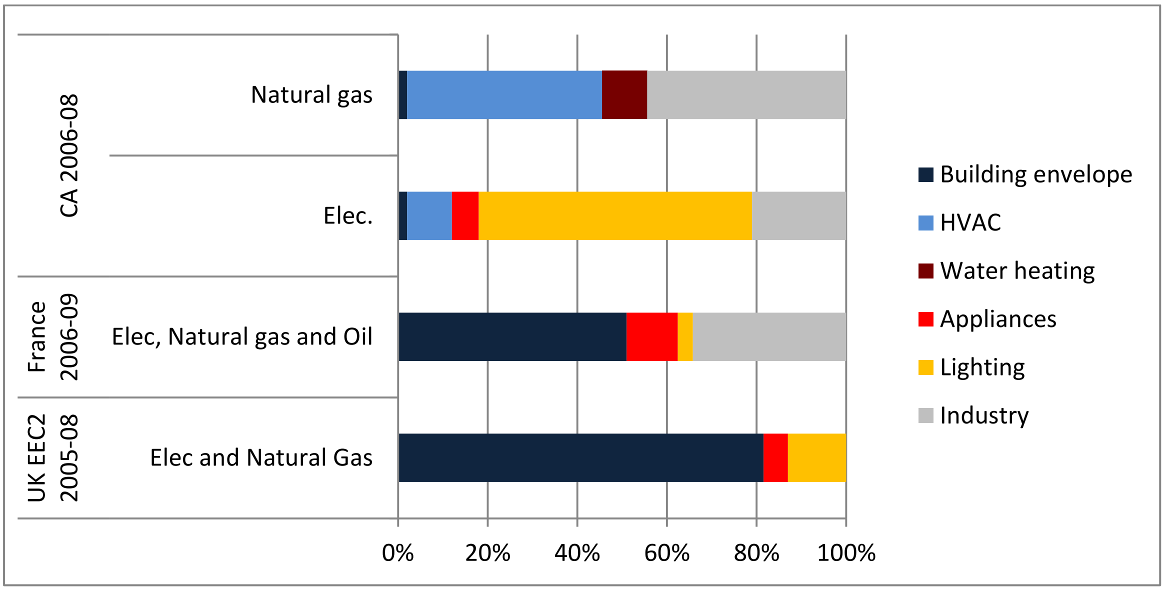
Energy-Saving Goals

Methods of accounting for energy savings differ widely from one country to another and have a significant impact on the results. For example, in California, the CPUC goal is expressed in annual savings accumulated during the three-year program period. In Europe, the target is generally expressed in lifetime savings, which includes aggregated savings accrued over the expected life of a measure installed during the program period. The advantage of setting a goal in terms of lifetime savings is that the measure may save only a little in the short term but achieve large savings over the long term, and that approach encompasses those long-term savings. The inconvenient is that it adds uncertainties as measure-life estimate becomes a determinant parameter for the energy savings estimate.

[11] For example, if a light bulb is marked up 40 percent, a $1 incentive to the consumer will discount the price of the bulb by $1, while the same $1 incentive to the manufacturer will discount the customer price of the bulb by $1.40 because the price is reduced before the markup is applied. This is the multiplier effect of an upstream program.

Figure 3 provides a summary of the energy-savings breakdowns from some energy provider programs that were identified for this review and for which data from evaluation reports were available.

Figure 3. Energy Savings per Program Cycle



Due to variations in energy units, time frame, and insufficient information, it is not possible to compare energy savings among countries and to harmonize results. Therefore, Figure 4 is more indicative of the scope of schemes in each country and the type of measures developed to meet the goals. It shows that short-term measures, such as lighting, have been a large source of energy savings for utilities in California. The proportion of savings from lighting efficiency are minimized when lifetime savings are used, as in the UK and French systems, so measures with longer lives produce the majority of savings (for example, insulation in the UK and condensing boilers in France). In the UK, the proportions are also driven by the policy itself, which requires a certain percentage of savings to be met by insulation measures. In France, the type of savings realized in the white certificates scheme is influenced by the tax credit scheme (in this case, measures that receive a tax credit are also eligible for white certificate credits).

Divergence of accounting savings across countries, as well as across states in the United States, also stem from the evaluation methods of calculating net savings. Net savings impacts are the percentage of energy savings strictly attributable to the policy being considered. They exclude savings from program participants that would have undertaken the energy-efficiency activities in the absence of the program (free riders) and include savings from nonparticipant programs that resulted from the influence of the program (spillovers). Net savings also exclude the demand-reduction effects of other programs such as standards and labeling, building codes, and other FI policies; and of other impacts like recession or accelerated economic growth. This can be particularly difficult when, for example, different entities (such as utilities, national governments, and even local governments) offer FIs to the same set of consumers for the same appliance. Other considerations include the “rebound” effect, i.e., the possibility that reductions in energy costs may encourage customers to use more energy and therefore lower the impact of the energy savings achieved.

Evaluation studies also assess how effective a particular policy has been in achieving the original goal (Gillingham et al., 2006; Goulder and Parry, 2008); that is, whether or not the policy in place is achieving its goal with the lowest possible cost-benefit ratio. Cost-benefit ratio and cost-per-unit energy saved are common metrics used to evaluate success. However, the use of such metrics requires that evaluators have access to detailed information on savings and a sound and consistent method of quantifying the value of the benefits and the costs of programs implemented. A 2009 report from ACEEE examined efficiency programs in 14 states and found that the utility cost of saved electricity ranged from US$0.016 to $0.033 per kilowatt-hour saved and averaged US$0.025 per kilowatt-hour saved (Friedrich et al., 2009). The cost of natural gas savings ranged from US$0.27 to $0.55 per therm saved, with an average of US$0.37 per therm.[12] In Europe, a study by Giraudet and Finon (2011) provides detailed analysis of the white certificate schemes in the UK, Italy, and France, and calculates net social benefits from each scheme. Cost estimates reached €0.009 per kilowatt-hour saved in the UK and €0.037 per kilowatt-hour in France.[13] In both regions, the cost of saving energy is well below the cost of delivering it. However it is important to note that many parameters enter into the cost-benefit analysis equation; for example, the discount rate, lifetime of equipment, and usage assumptions.

In an evaluation assessment, it is also essential to assess possible side effects (both positive and negative) that may result from the implementation of a policy so that decision-makers have adequate information to determine whether to expand, limit, adapt, or continue the program or policy. For example, evaluations can assess impacts on peak electricity load (e.g., in the case of air conditioners), GHG emissions, jobs, public health (e.g., mercury from CFLs), water usage, and social equity. A recent IEA publication (Ryan and Campbell, 2012) describes co-benefits of energy efficiency programs. Evaluations of side effects are rarely conducted, as they generally do not relate to the policy's goals and require significant time and resources. Some interesting results from such studies are given as examples. A study in France estimates that for every €1 million of investment in building thermal renovation, 14.2 jobs are created (EC, 2012). Another study of the German KfW program shows that for every euro spent by the government, €2–€5 is returned to the government in the form of additional tax revenue, social security contributions, and a reduction in unemployment costs (EC, 2012).

Evaluation studies must consider the effects of cross subsidies and recommend remedies where desirable and possible.

Market Transformation

Market transformation has rapidly become an additional objective of many utility- and government-supported energy-efficiency programs. The concept of market transformation emerged in the early 1990s in the United States and Europe (Eckman et al., 1992). In the United States, it resulted from the observation that rate-funded efficiency programs focused on short-term payback periods with quick results and did not explicitly address underlying market barriers to market adoption of HE products. Energy-efficiency programs did not necessarily impact the market over the long term, and in some cases, market effects observed during the intervention of a program stopped when the program was discontinued (Birner and Martinot, 2005; Rosenberg and Hoefgen, 2009). In Sweden, the National Energy

[12] A discount rate of 5 percent was used.

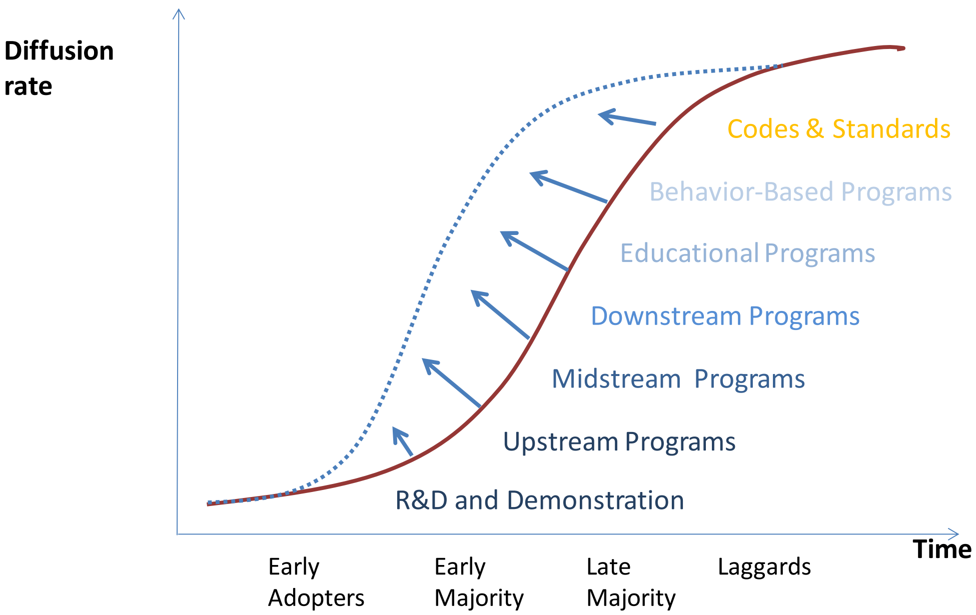
[13] A discount rate of 4 percent was used.

Administration (NUTEK) has been developing programs that integrate a market transformation strategy focus, based on technology procurement in a first phase and supporting measures in a second phase to affect the market in a sustainable manner (Neij, 2001).

Standard and labeling (S&L) programs are generally the first order of policy intervention to transform the market of a specific end-use. S&L programs allow certifying and ranking technologies according to their energy efficiency level and removing inefficient technologies from the market. Incentives programs come next and target HE technologies, i.e. technologies with the best energy rating identified by the labeling program.

The diffusion of HE technologies generally follows an S curve (Rogers, 1962 and 2003). At first, only a few early adopters are willing to risk investing in the new more expensive technology, and market penetration is small. After some time, when the technology has proven itself, the technology's market penetration rates increase more quickly. Then market penetration of the technology levels off, and only "laggards" are still resistant to adopt the new technology. Figure 4 illustrates this concept and shows how different market interventions can help move the diffusion of HE equipment faster.

Figure 4. Super Efficient Technology Diffusion Rate and Market Interventions



Market transformation policies and programs have been designed to address the different stages of a technology's market diffusion, to accelerate the sustainable penetration of HE products. This approach requires an acute understanding of the market conditions and the barriers that hinder efficient technology to be adopted earlier in the process.

Evaluations have tended to show that financial incentive programs are often most effective when they target efficiency specifications that still have a small market share. Lees' evaluation of previous British schemes, Energy Efficiency Commitment (EEC) 1 and 2, shows that share of free ridership (or deadweight) increases as the market share of efficient product increases (Lees, 2008). The analysis suggests that technologies with a market penetration greater than 30–40 percent do not need to be financially incentivized. Gold and Nadel (2011) find similar results and also point out that incentive programs should be of a limited time period, usually around five years, as they become less effective over time.

Market transformation policies and programs combine measures necessary to address barriers to the point at which cost-effective efficient technologies become normal practice (Eto et al., 1996a). Technology push efforts, under the form of upstream programs, are suitable in early stages to stimulate the introduction of new technologies. Midstream and downstream programs can then strategically increase market penetration until the product penetration takes off. Consumer education and behavior-based programs help expand market share by reaching out to "laggers." Finally, mandatory performance standards complete the transformation process by "locking in" the efficient technology. In addition, replacement programs can help renew the remained stock of old appliances more rapidly. This virtuous circle can be repeated indefinitely as innovation continuously brings new opportunities to produce more efficient technologies. The type of intervention and the timeline needed can differ among products.

According to a June 2011 ACEEE white paper (Gold and Nadel, 2011), the US refrigerator tax credit upstream program has been largely successful as each extension of the program pushed the efficiency standard forward so that the next set of incentives would achieve even higher levels of energy savings. One of the reasons of this success was the robust stakeholder involvement and their education as to how to participate in the program. As pointed out by Nadel et al. (2003) in a review of market transformation initiatives in the United States, successful initiatives enlist the input, participation, and support of major market players and involve multi-prolonged efforts such as training, incentives, and promotion. Furthermore, Rosenberg and Hoefgen (2009) notes that multiple coordinated market interventions over an extended period are more likely to affect the behavior of market actors than programs that include a single intervention in a short period of time. In countries with slow-moving S&L programs or weak standards, incentive programs can help jumpstart the negotiation to achieve higher efficiencies. They can be brought in to make ambitious standards politically palatable and to ensure they are acceptable to local manufacturers and the public.

Program Design

Program designs are defined by the elements that constitute a program. Some of these elements are shown in Figure 5.

Figure 5. Elements of Program Design

Efficiency criteria	• What is the efficiency level targeted by the incentive program?
Incentive amount	• What is the amount offered?
Incentive recipient	• Who is the target participant of the program?
Form of Incentive	• What is the form of the incentive offered (is it a tax credit, cash rebate, a low interest loan, ect.)?
Eligibility requirements	• Is there any eligibility criteria to participate to the program?
Recycling	• Is the program include a recycling component (most often in the case of replacement programs)?

The key elements are the program's target beneficiary and the incentive's form. The target beneficiary refers to the point in a target appliance's supply chain where the incentive will focus. An incentive can be directed upstream, e.g., a buy-down gives funds directly to the manufacturer to discount the price on a certain number of units, midstream, e.g., funds aimed at participating retailers or distributors to motivate them to increase the available stock of higher efficiency units, or downstream, e.g., a rebate voucher offered to individual consumers to motivate them to chose high efficiency models.

An incentive's form is the mechanism or vehicle by which the incentive funds reach the beneficiary. For example, tax credits, Value Added Tax (VAT) reductions, rebate vouchers, product price buy-downs, consumer rewards and loans are all incentive forms.

No one single program design surpasses all others in increasing the penetration of energy-efficient products; program designs are most successful when they address specific market barriers. Therefore, the key to successful program design and implementation is having a thorough understanding of the market and effectively identifying the most important local factors that hinder the penetration of HE technologies (Rosenberg and Hoefgen, 2009). This process is often referred as *program theory,* and it helps program administrators to identify the key market actors involved (e.g., manufacturers, distributors, customers), the market barriers each of these players faces, and the strategies that can be used to best influence them (Frank et al., 2012; U.S. EPA, 2010).

Table 5 provides examples of programs whose instruments are designed to help address specific market barriers to energy efficiency.

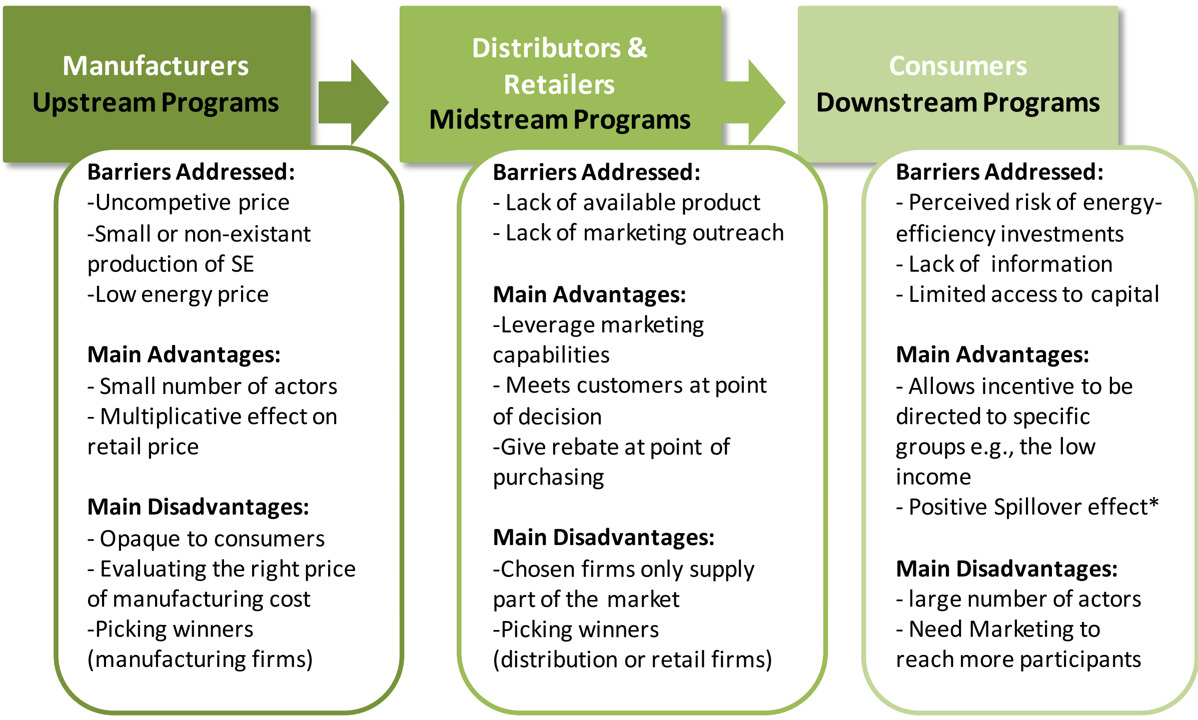
Table 5. Examples of Barriers Addressed by Incentive Programs

Barriers	Effect	Examples of Program Design Used in Incentive Programs
Uncertainty of savings	Consumers do not have a high degree of confidence in expected savings.	Consumer Rebates: - Help to assure consumers that they are making cost-effective decisions - Provide a financial impetus to invest and reduce the risk in energy-efficiency investment
Lack of information	Information on current and future technological is not easily available or accessible at the time of investment.	Individualized Energy Reports: - Provide information on energy usage compared with peers - Offer recommendations on how to save energy - Promote energy conservation
Transaction cost	The *transaction cost* refers to the time and effort required to identify and implement efficiency improvements. Even if consumers are interested in a particular product, they may face high hassle costs to acquire and install it.	Reward programs: behavioral programs that seek to motivate consumers' engagement by setting individual and community goals and offering rewards and recognition. - Provide challenge to motivate people to get over the hump of hassle costs - Reward good behavior
Limited access to capital	Limited access to capital prevents investment in equipment that is more efficient but has more expensive up-front costs (Golove and Eto, 1996).	Replacement Programs: install the measures at no (or reduced) cost; for example, by replacing inefficient residential appliances before the end of their useful lives with significantly more efficient appliances - Reduce electricity use by encouraging the deployment of more-efficient appliances - Ensure that older, less-efficient appliances are removed from the market - Recycle old appliances in accordance with the appropriate environmental regulations and practices
Lack of HE equipment on the market	Restricted selection of higher-energy-efficiency equipment may dissuade consumers.	Midstream Programs: incentives are offered to retailers to engage them in increasing their stock and promoting the value of energy-efficient investment to consumers.

		- Motivate retailers to sell HE products by advertising signage or other marketing attractions - Increase stock of HE products - Can provide field education support of the retailer sales force.
Split incentives	Split incentives occur when the investor does not receive the benefits of improved efficiency. Ex: rental property where owners lack incentives to invest in efficiency improvements because the tenant pays the utility bill and benefits from the savings.	On-bill Financing Programs: spreads out the up-front cost by charging monthly installments on electricity bills, generally offset by energy savings. - Link the loans to the meter, meaning that whoever lives at the house pays the fee and stops paying when they move. - Encourage renters and short-term owners
Uncompetitive market price	Scale economies and learning benefits have not yet been realized due to new low-volume products.	Upstream Programs: incentives are offered to manufacturers to increase production of HE products. - Accelerate the market introduction and scale production of more-efficient equipment - Accelerate the S-curve penetration of iSE products - Influence a large portion of the market through fewer actors

However, it is important to note that program design elements described in the table may address more than one barrier, and conversely, one barrier may need several program instruments to be addressed the most effectively. Therefore, there is no single answer to each barrier identified, but multiple program design elements are often necessary to accelerate the penetration of more-efficient equipment. Barriers tend to be interdependent and may vary between the market sectors, technologies and organizations. Figure 5 characterizes what we found to be the main barriers addressed and the main advantages of upstream, midstream, and downstream programs.

Figure 6. Incentive Program Design along the Supply Chain



Positive Spillover effect refers to the increasing adoption of energy-efficient products from program non-participants due to increased knowledge about the benefit of energy efficiency.

Upstream incentives are particularly effective at reducing the up-front cost of technologies that are at an early stage of penetration. Incentives are offered to manufacturers to streamline their production line and increase their production at a lower price. The main advantage of these programs is that they can influence a large portion of the market through fewer actors and therefore have lower transaction cost. Moreover, by reducing the price before products reach the market, the incentive impact on the purchase price increases compared to a downstream incentive. The main disadvantage is that the financial incentives offered to the manufacturers are not seen by the consumer. Another drawback is that it requires estimating how much it will cost to the manufacturer to produce more efficient products to be able to negotiate with them a fair price.

Midstream incentives help address the lack of availability of HE products. This can be particularly impactful in the case of emergency replacement of equipment, when a consumer's purchase decision depends on the product's availability. Midstream programs also educate retailers to promote HE technologies in general, and to use electricity bill savings as a selling point for the products. This helps reduce transaction costs incurred by consumers since they can find all the information they need inside the store. Most important, these incentives influence customers at their point of decision. A midstream program can be particularly effective when the program budget is rather small and the price of equipment is high. Since the profit margin for distributors and retailers tends to be thin, a small increase from an incentive can provide a significant motivation to sell more-efficient equipment. Focusing on the midstream point in the supply chain means more transaction costs than an upstream program (although fewer than a downstream focus) and larger costs for each transaction than for a downstream program. For example, in a downstream program, to complete reach each participant the administrator could simply send a rebate voucher but in a midstream program, a full contract must be agreed to with each stakeholder. Unlike an upstream incentive program, midstream incentives will only affect the portion of the market that is reached by participating retailers and/or distributors (practically a program will probably not be able to reach every distributor and/or retailer in a market). Furthermore, it could be argues that choosing which retailer or distributor participates is effectively 'picking winners.'

Downstream incentives have the advantage of raising consumer awareness of HE products, which has positive spillover effects on other energy efficiency purchases. The existence of a rebate is a signal in itself and may even be more important than the cash amount in some cases. Moreover, downstream programs have the flexibility to be directed to a select population, such as low-income households. A disadvantage of this program design is the transaction costs involved in engaging large numbers of customers on an individual basis to grant rebates.

This figure is not exhaustive, and more research is needed to complete the universe of characteristics of programs and the effect of upstream and downstream programs designs on each of them. However, the figure gives a primary overview of the most important characteristics that program administrators should consider in program design.

Conclusion

There is no silver bullet for accelerating the penetration of energy efficient products in the market; policy must be developed on a case-by-case basis to respond to local market barriers, and it must embrace local conditions. However, to induce the development of new policy and programs, and to leapfrog mere trial-and-error learning, it is critical to share experiences of innovative and successful program designs among policy makers and program administrators.

The greatest challenge for incentive programs is to identify market barriers and design programs that are successful in overcoming them. The second challenge is to mobilize funds for energy efficiency incentive programs over the long term. The third challenge is to develop a successful policy framework that will allow energy-efficiency measures to lead to durable market transformation. Finally, program evaluations are essential and adequate resources should be allocated to provide confidence in savings estimates and data to use for program improvement.

Program administrators and policy makers have continuously innovated in terms of program designs. The choice between different types of programs—such as downstream, midstream, or upstream programs—should be driven by a careful analysis of market conditions. Factors like market barriers to energy efficiency, market concentration, and supply-chain profit margins should be addressed to determine where incentives will most impact accelerated penetration of more HE equipment. Program administrators should adopt an evidence-based approach toward implementing energy-efficiency programs.

Incentive programs often involve a payment of the up-front cost of more-efficient equipment, and therefore require that capital be raised to cover the cost. Rate-funded programs have a sustained funding mechanism that ensures a constant renewal of investment in energy efficiency. Moreover, it incorporates energy efficiency as a resource in a nation or state future resource planning. Other sources of funding exist, and in many cases, such as feebates or revolving funds, co-exist. Experience should be shared among policy makers to inspire the development of further funding mechanisms or new mechanisms that best fit local circumstances.

Incentive programs favorably complement mandatory policies by promoting energy-efficiency improvements beyond standards requirements and by preparing the market for increased future mandatory requirements. By increasing the market penetration of the HE products, incentive programs help reduce their production cost. The efficiency gains achieved through incentive programs can then be cemented by more-ambitious standards that capture the newly cost-effective efficiency savings, in a virtuous cycle of improvement.

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APPENDICES

Appendix 1: Incentive Programs Referenced in this Report

Country	Program	Time Frame	Government /Utility	Program Design	Funding	Energy Efficient Product
Japan	Eco-points	2009 to present	Government	Consumer reward program	General Budget	271 goods and services deemed "green"
France	Bonus-malus	2007 to present	Government	Feebate	General Budget	cars
S. Korea	Feebate	April 2010 to Dec 2012	Government	Feebate: 6.5% tax penalizes less-efficient models	General Budget	TV, refrigerator, AC, fans, washers
Germany	Kreditanstalt für Wiederaufbau (KfW) Energy Conservation	Since 1990	Government	Revolving fund for EE		home insulation, water heating, HVAC, windows
UK	Green Investment Bank	In development	Government	Low interest loan	Revolving fund	
U.S.	Property Assessed Clean Energy (PACE)	Various	Local Government	Low interest loan	Revolving fund	home insulation, water heating, HVAC, windows
India	Bachat Lamp Yojana (BLY)	2009 to present	Government	Rebates	CDM income	CFLs
France	Income Tax credit	2005 to present	Government	Tax credit	General Budget	home insulation, water heating, HVAC, heat pump, windows
Italy	Income Tax credit	2007 to present	Government	Tax credit	General Budget	efficient equipment, home insulation
UK	Reduced VAT	2000 to present	Government	VAT reduced by 5% on certain EE measures	General Budget	insulation material, heating control systems, heat pumps, and wood-fueled boilers
S. Korea	Carbon Cashbag	October 2008	Local Government	Consumer reward program	General and Local Budget	home electronics and appliances

Appendix 2: (continued)

Country	Program	Time Frame	Government/Utility	Program Design	Funding	Energy Efficient Product
Mexico	PNSEE (Programa Nacional de Sustitución de Equipos Electrodomésticos)	2009-Ongoing	Government	Rebate (Voucher) On-bill financing Replacement	International Institution	refrigerators, air conditioners
U.S.	Federal Energy Efficiency tax incentives for Manufacturers	2005 to 2011	Government	Upstream Tax Credit	General Budget	residential refrigerators, clothes washers, and dishwashers
China	Promotion Products Program	2008 to present	Government	Subsidies for 30% wholesale and 50% retail discounts	General Budget	CFL, AC, TV, Water Heater, washing machine, refrigerator
India	Super Energy-Efficient Equipment Program (SEEP)	In Development	Government	Upstream Incentive	International Institution	Ceiling fans
U.S. (TX)	Reliant Energy HLP AC Distributors program	2001 to 2004	Utility	Midstream rebate	Rate funded	Central AC units
U.S. (CA)	California Commercial Water Heater program	2010 to 2012	Utility	Cash rebates offered by distributors	Rate Funded	High-efficiency water heaters
U.S. (CA)	California Upstream Lighting program	2006 to 2008	Utility	Buydown to CFL manufacturers	Rate Funded	CFLs

Appendix 3: Energy Efficiency Policy Framework Referenced in this Report

Country	Policy	Time Frame	Obligation
U.S. (CA)	Utility-sector customer energy efficiency programs and now Energy Efficiency Resource Standard	Since 1970	Electricity and Natural Gas
U.S. (MA)	Energy Efficiency First Fuel Requirement	Since 1997	Electricity and Natural Gas
Brazil	The Wire Charge (PEE)	Since 1998	Electricity
South Africa	The Standard Offer Program	Since 2011	Electricity
France	White Certificates	Since 2006	Electricity, Natural Gas, and Gasoline
Australia (New South Wales)	Mandatory greenhouse gas emissions trading scheme	Since 2003	Electricity
UK	Energy Efficiency Standards of Performance (EESoP), which became the Energy Efficiency Commitment (EEC), which then became the Carbon Emissions Reduction Target (CERT).	Since 1998	Electricity and Natural Gas
Italy	White Certificates	Since 2005	Electricity and Natural Gas
Poland	Energy saving obligation scheme	Since 2011	Electricity, Natural Gas And Heat Providers
Denmark	Demand Side Management Scheme	Since 1995	Electricity, District Heating, Natural Gas & Oil For Heating
Belgium–Flanders	Energy saving obligation scheme	Since 1995	Electricity
EU	Directive for Energy Saving Obligations for Member Countries	TBD	TBD
China	National energy efficiency regulations	2011 to present	Electricity
India	Maharashtra Public Benefits-type charge	2005 to present	Electricity

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