Energy Policy 72 (2014) 56–66

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Design of incentive programs for accelerating penetration of energy-efficient appliances

Stephane de la Rue du Can *, Greg Leventis, Amol Phadke, Anand Gopal

International Energy Studies Group, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Mail Stop 90R2002, Berkeley, CA 94720, USA

HIGHLIGHTS

- We researched incentive programs design and implementation worldwide.
- This paper seeks to inform future policy and program design.
- We identify design and identify advantages and disadvantages.
- We find that incentive programs have greater impact when they target highly efficient products.
- Program designs depend on the market barriers addressed and the local market context.

ARTICLE INFO

Article history:
Received 26 November 2013
Received in revised form
22 April 2014
Accepted 25 April 2014
Available online 24 May 2014

Keywords:
Energy efficiency
Incentive
Program design
Energy saving obligations
DSM

ABSTRACT

Incentives are policy tools that sway purchase, retail stocking, and production decisions toward energy-efficient products. Incentives complement mandatory standards and labeling policies by accelerating market penetration of products that are more energy efficient than required by existing standards and by preparing the market for more stringent future mandatory requirements. Incentives can be directed at different points in the appliance's supply chain; one point may be more effective than another depending on the technology's maturity and market penetration. This paper seeks to inform future policy and program design by categorizing the main elements of incentive programs from around the world. We identify advantages and disadvantages of program designs through a qualitative overview of incentive programs worldwide. We find that financial incentive programs have greater impact when they target highly efficient technologies with a small market share, and that program designs depend on the market barriers addressed, the target equipment, and the local market context. No program design is inherently superior to another. The key to successful program design and implementation is a thorough understanding of the market and identification of the most important local obstacles to the penetration of energy-efficient technologies.

1. 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., 2012). Energy-efficiency policies seek to close this gap (Golove and Eto, 1996) by identifying and addressing the barriers that prevent consumers from investing in energy-efficient equipment. These barriers are diverse, including lack of information, split incentives (e.g., between landlords and renters), high transaction costs (costs of participating in a market), lack of technical expertise, and lack of energy-efficient equipment on the market (Eto et al., 1996; Sathaye and Murtishaw, 2004; Jollands et al., 2010; Murphy and Meier, 2011). One of the most significant barriers that policy makers identify to the purchase of energy-efficient equipment is the relatively higher up-front costs of efficient products. In many instances, these costs deter potential purchasers even when investments appear to be in consumers' interest (i.e., when investments are cost effective over the equipment lifetime). Consumers place great value on immediate savings and heavily discount future savings (Hausman, 1979; Houston, 1983). Moreover, because they may not be able to easily evaluate future savings, consumers tend to have a low degree of confidence in expected paybacks. As a result, consumers often purchase the cheapest options available.

* Corresponding author. Tel.: +1 510 486 7762; fax: +1 510 486 8996.
E-mail address: sadelarueducan@lbl.gov (S. de la Rue du Can).

http://dx.doi.org/10.1016/j.enpol.2014.04.035

Numerous incentive programs have been developed worldwide to address these barriers and accelerate the penetration of more efficient equipment. 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 1300 programs in the United States. (DSIRE, 2013). In some instances, these programs are part of national government energy-efficiency policies; in others, the programs are part of utilities' integrated resource planning strategies.

Although the literature describes energy-efficiency policy general (IEA, 2010; WEC, n.d.; Ortiz et al., 2009; Geller and Attali, 2005), the design and use of incentives worldwide has not been comprehensively studied. The literature addresses incentives in the United States (e.g., Nadel et al., 2003; DSIRE, 2013; Fuller et al., 2010; U.S. EPA, 2010; Eto et al., 1996), in Europe (BPIE, 2012; Vine, 1996), and, to some extent, internationally (Hilke and Ryan, 2012; Sarkar and Singh, 2010; Birner and Martinot, 2005). However, it rarely reports on the specific design or mechanisms by which programs aim to accelerate market penetration of residential appliances and equipment. For example, the recent BPIE (Maio et al., 2012) and IEA reports (Hilke and Ryan, 2012) address incentives that target building improvements but do not address the mechanisms that target residential appliances.

This paper attempts to remedy this gap in the literature by describing the main design characteristics of incentive programs that encourage consumers to purchase highly efficient residential appliances and equipment. The paper's objective is to provide those policy makers and program administrators considering implementing incentive programs an understanding of what these key characteristics are and what tradeoffs are involved with them. We first describe the regulatory frameworks that govern development of incentive programs in major economies, to characterize how incentives are being implemented globally. We then categorize the main elements of incentive program designs and analyze advantages and disadvantages of a variety of program designs. Finally, we provide a variety of examples to illustrate how programs in several major economies attempt to accelerate market penetration of efficient residential equipment and appliances.

2. Overview of policy frameworks and program designs

2.1. Policy frameworks

The typical policy frameworks in which incentive programs develop are either (1) direct government roll-outs with money raised through taxes or (2) mandatory savings goals (also referred as *obligations*) set for energy providers (also referred as *utilities*) to reduce their customers' energy use. This is illustrated in Fig. 1.

Incentive programs have been principally implemented by governments to fuel long-run growth of domestic clean product markets. By increasing production of efficient products that are at an early stage of development, incentive programs help technology (and thus the market) mature and spur private-sector investment. Implementation of incentive programs can also be motivated by the need to boost an economy in times of recession; governments deploy incentive programs to stimulate economic activity while also promoting clean technology development.

Governments have also created regulatory frameworks that compel energy providers to deliver energy savings. Energy providers often then become the administrators of energy-efficiency programs. Utilities' direct link to energy consumers and access to valuable data on energy usage patterns are a significant advantage in designing effective programs. However, energy efficiency is not an obvious business for utilities to undertake because when consumers save energy, utilities sell less of their product. Some

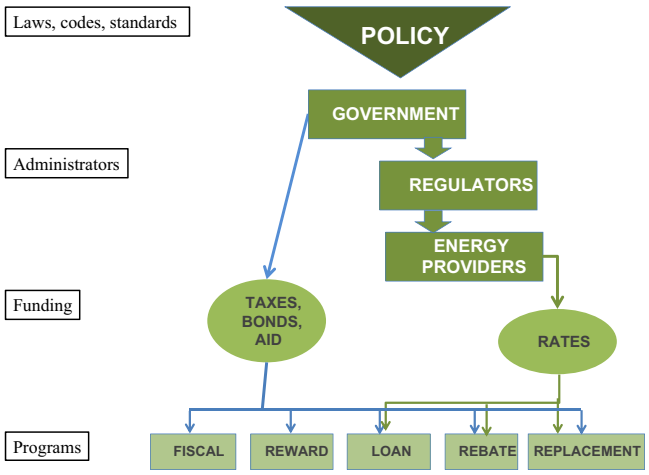

Fig. 1. Incentive program policy framework.

U.S. states have developed market regulations to remove utilities' disincentive to conserve energy and to incentivize utilities to invest in efficiency. These include regulations that decouple revenue and electricity sales and shareholder incentives to achieve energy efficiency beyond targets (Satchwell et al., 2011; EEWG, 2008; U.S. EPA, 2007; Schultz and Eto, 1990). In some cases, the responsibility for meeting savings goals is delegated to a third party or government agency that implements the programs.

Table 1 lists countries that have policy frameworks mandating that energy providers save energy.

Utilities in the United States have the longest experience – more than three decades – in executing energy-efficiency programs. However, the scope and intensity of these programs vary significantly among states. Twenty-seven U.S. states have set efficiency goals for their electric energy providers, and 12 also have goals for natural gas providers (DSIRE, 2012). According to the Consortium for Energy Efficiency's 2012 annual report (CEE, 2012), a total of US $8 billion was budgeted for gas and electric efficiency programs in 2011, a 20-percent increase over the previous year. Of this funding, one-third is allocated to residential-sector efficiency measures. California has by far the largest share of rate-funded programs, with a budget of US$3.1 billion over three years and a requirement that about 1.3 percent of annual sales be met with energy-efficiency programs. Massachusetts has one of the most aggressive targets, 2.4 percent of annual sales.

In Europe, the UK was the first country to implement an obligation scheme in 1994, the Energy Companies Obligation (ECO). ECO has evolved and is now combined with another scheme called the Green Deal (DECC, 2011).

Other European countries—Denmark, the Flemish region of Belgium, Italy, France, and recently, Poland—have also implemented energy-saving obligation schemes (Lees, 2012; Staniaszek and Lees, 2012; Heffner et al., 2013). In France and Italy, the efficiency targets are accompanied by trading markets where a unit of energy savings known as a "white certificate" can be either sold or purchased. Energy saved in any sector counts toward meeting an obligation. A new EU directive on energy efficiency requires that all EU Member States implement utility energy savings obligations equivalent to 1.5 percent of annual sales (EC, 2012), so other European countries are expected to follow the example of those that have already adopted these schemes.

Other examples of savings obligation schemes around the globe include those in some Australian states, Brazil, South Korea, South Africa, China, and India (Balawant, 2012; Lees, 2012). The Australian state of New South Wales implemented the world's first mandatory greenhouse gas (GHG) emissions trading scheme in