Ex post Impact Evaluations of Appliance Standards and Labeling Programs: A Global Review of Current Practices and Lessons Learned

Jennifer Corry Smith, Yang Yu, Ana Maria Carreño
CLASP, Washington, D.C.

Abstract

Energy efficiency standards and labeling (S&L) programs have been proven as a cost-effective and impactful way for policymakers to reduce energy consumption and CO_2 emissions. Developing a plan to assess the impacts of these programs is a key component that needs to be integrated into the program from inception.

Oftentimes an ex ante analysis estimates the potential energy, CO_2, and cost savings as part of the policy development process. This type of analysis can help policymakers to prioritize products and to justify regulations to other stakeholders. However, ex ante studies tend to use conservative assumptions, underestimating the energy savings and cost-effectiveness of S&L policies. Ex post evaluations of the impacts of S&L programs are less common, but these evaluations can assist policymakers in building a case to improve and expand S&L policies and can demonstrate the return on investment of appliance efficiency to constituents and funders. Ex post evaluations aim to measure impacts after a period of implementation and thus rely on observed data rather than forecasts.

This paper reviews the methodologies and approaches employed in ex post impact evaluations of S&L programs in Australia, China, the EU, India, Mexico, and the US. The paper discusses approaches to common challenges including resource constraints, data availability, and setting the baseline. The paper draws out key lessons learned and recommendations for criteria that can be evaluated and data that should be gathered to support the development of a program evaluation when an S&L policy is implemented. These recommendations will help policymakers to establish key indicators that should be measured before and after program implementation, and mechanisms to collect relevant data, in order to facilitate the ex post evaluation of policy impacts.

Introduction

S&L programs are in place in over eighty countries and are a proven policy tool to provide multiple benefits, including reduced energy consumption and CO_2 emissions (IEA 4E 2015). Many of these impacts can be measured, but policy makers and evaluators conducting ex post evaluations can expect some challenges, especially if an evaluation plan was not considered from the onset of the program.

Ex ante evaluations for S&L programs use modeling tools to estimate energy savings and impacts based on forecasted sales and usage data. These evaluations are usually undertaken before a standard is finalized to determine what the impacts will be on consumers, manufacturers, the economy, and the environment. Ex post evaluations are based on actual sales data and usage patterns and can reveal strengths and weaknesses in program implementation and measure actual savings against what was forecasted.

Figure 1 gives a high-level overview of the S&L program evaluation process and demonstrates that evaluation is a cycle that needs to be integrated into a program to continue the feedback loop and improve programs.

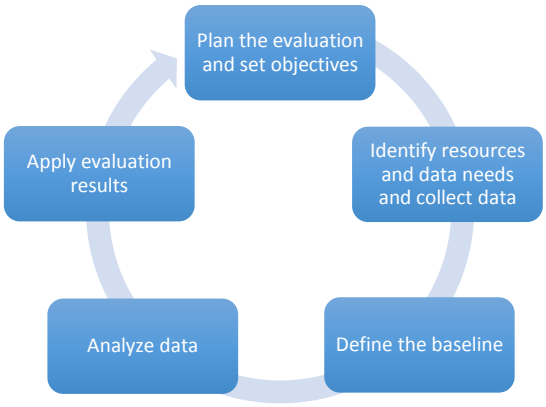

Figure 1. S&L Program Evaluation Process[1]

This paper examines the key considerations (e.g. data collection and baseline definition) for evaluators when designing and executing impact assessments for S&L programs. Comparisons and lessons learned are drawn out through an analysis of ex post evaluations completed in Australia, China, the European Union (EU), India, Mexico, and the United States (US). These case studies were chosen based on publically available information and the need to represent different evaluation approaches and examples from both developing and developed countries. Table 1 lists the case studies that were chosen and select aspects of these studies.

Key considerations when evaluating the impacts of minimum energy performance standards (MEPS) include changes in the efficiency of the products available on the market, which are verifiable as standards remove a portion of (inefficient) products from the market. For labels consideration should be given to market shifts, but also changes on retailer and consumer decisions[2]. In general, the studies (e.g. Australia and the EU) evaluated the impacts of S&L policies as a whole and did not attempt to attribute savings to either standards or labels.

Table 1. Impact Assessments Analyzed

Country (Year)	Data Sources	Impacts Assessed	Products Covered
Australia (2010)	Product registration database; national statistical database	Impacts on key stakeholders including energy savings, energy efficiency spread in market, change in purchase price and product availability. Does not consider evaluation of compliance.	Refrigerators and freezers
China (2004)	Stakeholder survey Retailer Shelf-survey	Impact on key stakeholders including manufacturers, retailers, consumers and quality monitoring agencies - e.g. manufacturers' additional investment on production updates; price increases attributable to improved standards; percentage of models on the market that exceed the standards; consumer awareness, and percentage of tested models that are in compliance to the standards.	Refrigerators and air conditioners
Europe (2015)	Eurostat database, product-specific impact assessments and preparatory studies	Impacts on key stakeholders including manufacturers and consumers: energy savings, environmental impacts (e.g. water use, noise, air pollution), job creation, technology development, and industrial competitiveness.	33 product groups with over 180 products
India (2014)	Stakeholder survey	Impact on consumers, retailers, and manufacturers– e.g., consumer awareness, willingness to pay premium for efficient products, and consideration of efficiency as a	Televisions, refrigerator, air conditioners, washing

1 This process is described in greater detail in Chapter 9 of CLASP's Energy Efficiency Labels and Standards: A guidebook for appliances, equipment, and lighting.
2 Ibid.

	Annual energy savings based on actual sales (BEE's registry) vs. assumed baseline (1 star label)	criteria when purchasing new products/appliances Impact on production and sales of labeled products – Manufacturers' willingness to shift to labeled products, sales and uptake of labeled products Market transformation - market penetration of labeled appliances, growth trends Energy and GHG emissions savings – electricity savings, avoided capacity and GHG abatement potential Does not consider evaluation of compliance.	machines, ceiling fans, electric geysers, TFLs, computers.
Mexico (2015)	Product registration database and stakeholder interviews	Energy savings, monetary savings for consumers, improvements in the average efficiency, changes in average product price Other non-energy benefits: awareness of EE, improvements in conformity assessment infrastructure Does not consider evaluation of compliance	Air conditioners and refrigerators
US (2008)	Census data, industry reports, US Department of Energy (DOE) technical support documents from rulemakings	Energy savings in terms of primary energy; Consumer economic benefits in terms of monetary savings; Environmental benefits in terms of CO2 and NOx reduction.	Refrigerators, freezers, central ACs and heat pumps, room ACs, water heaters, gas furnaces, clothes washers, clothes dryers, dishwashers, fluorescent lamp ballasts, distribution transformers/

Methodologies and Approaches to Impact Assessments

The objectives of an impact evaluation for S&L policies may vary depending on the needs of policy makers and program evaluators. For policy makers, two of the most important questions to address in the impact evaluation are: 1) how well the policies are implemented and received; and 2) what have the policies achieved. In this study we primarily focus on the following objectives common to most impact assessments:

- Assessing the impact of S&L policies on the market and stakeholders;
- Measuring and verifying the impact of S&L policies in terms of energy saved and other benefits.

The first objective addresses how well the policies have been implemented, how the market and stakeholders responded to the policies, and what improvements or revisions are needed for future policy design or revision. The second objective allows policy makers to quantify the achievement of the policies and/or to assess whether the policies have achieved their intended goals.

Based on the objectives, there are two general approaches that were used in the impact assessments analyzed: a survey method and a bottom-up modeling analysis. The first yields more qualitative data that can be useful in recognizing weaknesses in process and program implementation and can help understand how the policy affects consumer, retailer, and manufacturer decisions. The second is a data driven approach that evaluates market shifts, identifying coincidences between policy implementation and changes in the market. Although this approach is more suitable to MEPS, it has also been used to assess impacts from labeling policies[3].

3 See Australia case study.

The evaluation approach might differ depending on the type of program that is being evaluated (e.g. labels vs. standards or voluntary vs. mandatory), and the type of impacts relevant to the program implementer (e.g. energy, economic, environmental, or non-energy impacts). Other factors to consider include resources available, national priorities, and data availability.

Surveys do not require a robust modeling methodology or extensive data sets. Surveys yield qualitative data which may provide policy makers with useful and valuable information about the impact of efficiency policies and strengths and weaknesses in implementation. However, they do not provide quantitative data on energy savings, carbon reductions or cost savings that policymakers can use to measure programs success against national energy use or CO_2 reduction targets.

Unlike a modeling approach which can provide policy makers with a time series of impacts for a given efficiency policy, surveys provide only a snapshot of those impacts. The survey needs to be conducted repeatedly if the policymakers wish to track the progress of policy changes or updates. In the modeling approach, once the model is developed and populated with raw data, assessing the impact of future policy updates would only require updating the model with new data and information. Ideally, evaluators would measure program impacts using surveys, interviews, stock and sales information, and independent test results that verify the energy performance of products on the market.

In the following subsections further detail is provided on key considerations including establishing the baseline and data collection.

Baseline Selection

The selection of the baseline is a key step in any quantitative impact assessment of S&L policies, as energy savings estimates are a result of the comparison between the observed trend (i.e., product market behavior after policy implementation) vs. the baseline (assumed product market behavior without policy implementation). The baseline is often times referred to as business as usual (BAU) scenario or counterfactual, and it is based on extrapolations of observed past trends and other assumptions. The quality of any modeling exercise depends on the quality of these assumptions, and thus they should be strongly rooted in evidence. The case studies analyzed in this paper have followed various approaches for their baseline selection:

- Dependent on efficiency improvements: a flat baseline which does not consider efficiency improvements over time (Mexico and India) vs. a dynamic baseline with efficiency improvements over time (Australia, EU, and US)
- Dependent on data available showing past trends: extrapolation of past trends (Australia, Mexico, US) vs. a snapshot in time (India)

The selection of the baseline relies on a good understanding of past trends, as such, data availability becomes a key input in the process. This is often a major challenge faced by programs developing an impact assessment for the first time, and for countries that do not have access to product registration databases.

Another approach for baseline selection that was not used in any of the case studies from this paper is to consider as a counterfactual what has happened in other jurisdictions (i.e., comparable economies with similar markets) where the policy under evaluation has not been implemented. There are additional challenges in this approach including selecting a comparable jurisdiction and the finding data.

Data Collection

Collecting accurate data, specifically on product sales and/or shipments, unit energy consumption, and the rate of energy efficiency improvement can be very resource intensive, if not

impossible, when doing a retroactive impact assessment. Various methods are employed to collect data: sales data can be purchased from market research firms such as GfK or Euromonitor and data on appliance ownership and other macroeconomic parameters may be available in government statistical databases. Product registration and certification databases that support S&L programs can be one of the most cost-effective and reliable sources for appliance specific data (e.g. product types and energy performance, among others.).

If a country has a robust product registration system this makes it much easier to track industry's response to policies. These databases are generally used to verify compliance and certification, but they can also track the evolution of the market and give regulators access to data points that are needed for a robust impact assessment (e.g. product energy consumption and relative efficiency). Data from national appliance registration systems were used in four of the impact assessments covered in this analysis: Australia, India, Mexico, and the US.

More recently, software programs have been used to collect real-time appliance model level price and efficiency data from websites, but sales data cannot be obtained using this software. This approach was recently used in Sweden to estimate policy impacts by analyzing the corrections between policy implementation and historical and real-time trends in price, energy efficiency improvement trends, and life-cycle cost trends (Enervee 2014). The use of web scraping and application programming interfaces (APIs) presents a new opportunity to gather data at a relatively low cost. In China, web scraping tools were used to collect product data from online shopping websites. The data were used to analyze the home appliance market and estimate the energy savings from China's S&L policies. (CLASP 2013) Further research is needed to identify how this data can be most useful to policymakers when assessing impacts.

When collecting and analyzing data, careful consideration should be paid to the assumptions made regarding end-user behavior. For example, estimates are made regarding the number or hours of day a product is used, which can vary significantly depending on climate, culture, energy price, and other factors. The product lifetime can also vary significantly across products and countries.

In addition to the quantitative data that is collected, qualitative data should be collected from manufacturers and consumers to determine the impact that S&L programs had on the deployment and adoption of more energy efficient technologies.

Review of International Impact Evaluations

Case Study: Australia

Goals and General Approach

The 2010 Energy Efficiency Strategies Impact Assessment looks at both the ex post and ex ante impacts from refrigerator MEPS and labels that came into effect in Australia from 1986-2010. The evaluation uses a bottom-up stock model. The attributes of the refrigerators in the model are sales weighted for the ten different refrigerator/freezer product groups. The model also uses adjustment factors to account for real world use rather than rely on results from product testing.

Data Sources and Needs

Australia's energy labeling registration database has been collecting data on approved models on the market since 1987 and is now one of the most comprehensive databases of its kind. All regulated products must be registered before entering the Australian market; the data collected includes size, energy consumption, star rating, and life cycle energy cost. Having access to this data facilitated the evaluation process. In addition to the information from the registration database, the consultants used sales data purchased from GfK and data on household appliance ownership, saturation, and penetration from Australia's Bureau of Statistics.

Definition of the Baseline

This study considers various baseline scenarios or counterfactuals. The first baseline, before any policies had been implemented, considers a fixed efficiency improvement that declines over time; the authors proposed two ranges, a low range (with a small increase in efficiency) and a high range (with a higher rate of efficiency improvement). Subsequent policy scenarios are used as baselines following the implementation of a revised MEPS or label (in this case, after policies were implemented in 1986, 1999, 2005, and 2010); these baselines consider market trends of previous years, and a fixed efficiency improvement that declines over time.

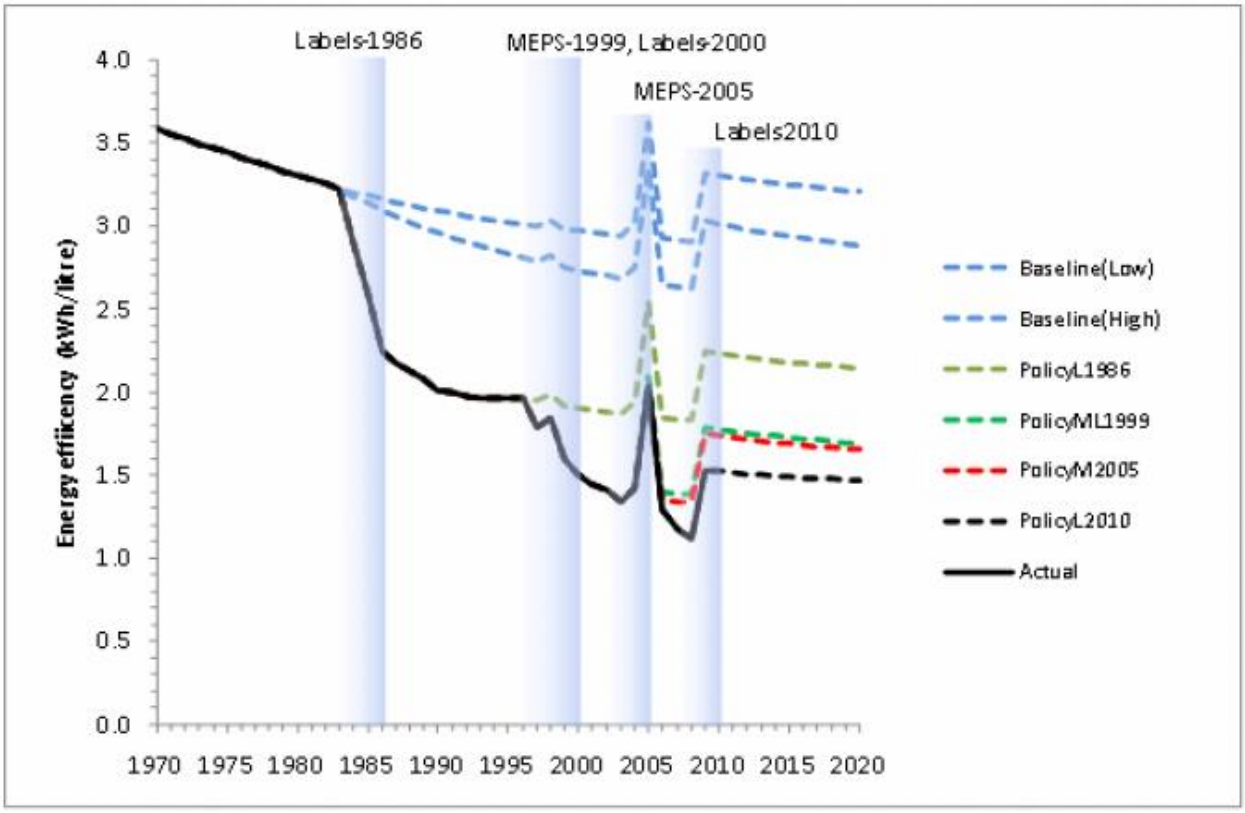

Figure 2. Baseline and policy scenarios for the evaluation of energy efficiency policy measures for household refrigeration in Australia[4]

Case Study: China

China's S&L program has expanded rapidly in recent years and now covers the majority of household appliances and products. Since the 1980s, China has implemented 48 (MEPS) for energy-using products and the China Energy Label (CEL) program covers 29 product types. The program covers majority of the household appliances and products. Even though the Chinese government does not have a framework in place to evaluate the savings of these standards, labeling, and incentive programs (Romankiewicz et. al. 2013), many independent civil society groups and industry associations have made efforts to assess the impacts from appliance efficiency policies.

China's first MEPS program was implemented in 1989 and the first impact assessment was not conducted until 2004 when the China Household Electric Appliances Association (CHEAA), in collaboration with American Council for an Energy-Efficient Economy (ACEEE), initiated an impact assessment to examine the impacts of refrigerator and air conditioner standards on product technology, efficiency, sales, costs and manufacturing. We focus on analyzing this impact

4 The spike in 2005 according to the authors is "an artefact of rapid decrease in average volume (size) for this particular product group",

assessment since this first assessment of S&L impacts in China and the assessment covered a wide range of stakeholders including manufacturers, retailers, consumers and quality monitoring agencies.

CLASP has conducted several assessments on China's S&L program in recent years, but these studies were more focused on assessing how S&L policies impact the consumer awareness in China (See Zeng et. al. 2011; Zeng 2014; Yu 2015) and therefore will not be discussed in detail in this paper. The Lawrence Berkley National Laboratory (LBNL) has also conducted several impact assessments of China's S&L program. (See Zhou 2013 and Fridley 2007) These assessments were not considered because the methodology used is similar to the case studies for Mexico and the US that are already discussed in this paper.

Goals and General Approach

The goal of the study was to examine and assess the impacts of standards for ACs and refrigerators on product technology, efficiency, sales, costs, and manufacturing. Key stakeholders were interviewed and in-store shelf surveys were conducted to gather additional product specific data. Recommendations were developed based on the assessment to improve China's S&L program.

The objective of this S&L impact assessment is to measure the impact on stakeholders and the market, differing from many studies that focus on energy savings and other quantifiable benefits. Nevertheless, this study provided valuable information on the standards setting process and the impact of standards on the appliance market.

Data Sources and Needs

Unlike the modeling approach, this evaluation does not require extensive data. Data used in this assessment were mostly acquired through questionnaires and interviews with manufacturers, retailers, consumers, and quality monitoring agencies. In store shelf surveys were also conducted to gain insights on the energy performance of products available on the market. A total of 650 refrigerators and 649 air conditioners from 21 retailer stores were surveyed. To measure the level of compliance of S&L policies, representatives from two test laboratories and seven municipal Quality Supervision and Inspection Bureaus were surveyed. In addition, tests results from 52 refrigerators and 50 air conditioners were collected and analyzed.

Case Study: European Union

Goal and General Approach

Ecodesign requirements are the EU's regulatory tools to specify (MEPS) for appliances and equipment. The first step in developing or revising Ecodesign requirements is to undertake a preparatory study and ex ante impact assessment. These reports are developed by outside consultants and then delivered to the Commission who can then propose policy options to a group of stakeholders. The Ecodesign Impact Accounting report (Kemna and Wierda 2015) was commissioned to review past preparatory studies and ex ante impact assessments and develop a methodology to systematically report on the impacts from S&L programs.

The objective of the study is to isolate the impacts of Ecodesign and Labelling policies on energy use, environmental impacts (e.g. water use, noise, air pollution), job creation, technology development, and industrial competitiveness.

Defining the Baseline

According to the study, the BAU scenario is not a 'freeze' scenario (as can be seen in Figure 3); it is derived from extrapolating historical trends at the time of the first preparatory study analysis[5],

5 Preparatory studies are developed for each product group before it is regulated by Ecodesign and labeling requirements. These preparatory studies inform the development of appropriate requirements.

including ongoing market trends in energy efficiency improvement. In this case, the policy scenario (ECO scenario) is also modeled and no real market data was collected to validate assumptions at the time of the preparatory studies. The authors mentioned that the transition between BAU and ECO scenario in most studies is smooth, mostly because manufacturers anticipate that there will be performance requirements 2 to 3 years before the standards are implemented (i.e. the preparatory studies send a signal of the upcoming regulations). The curves are smooth as the data modeled does not consider abrupt changes in performance of products available on the market.

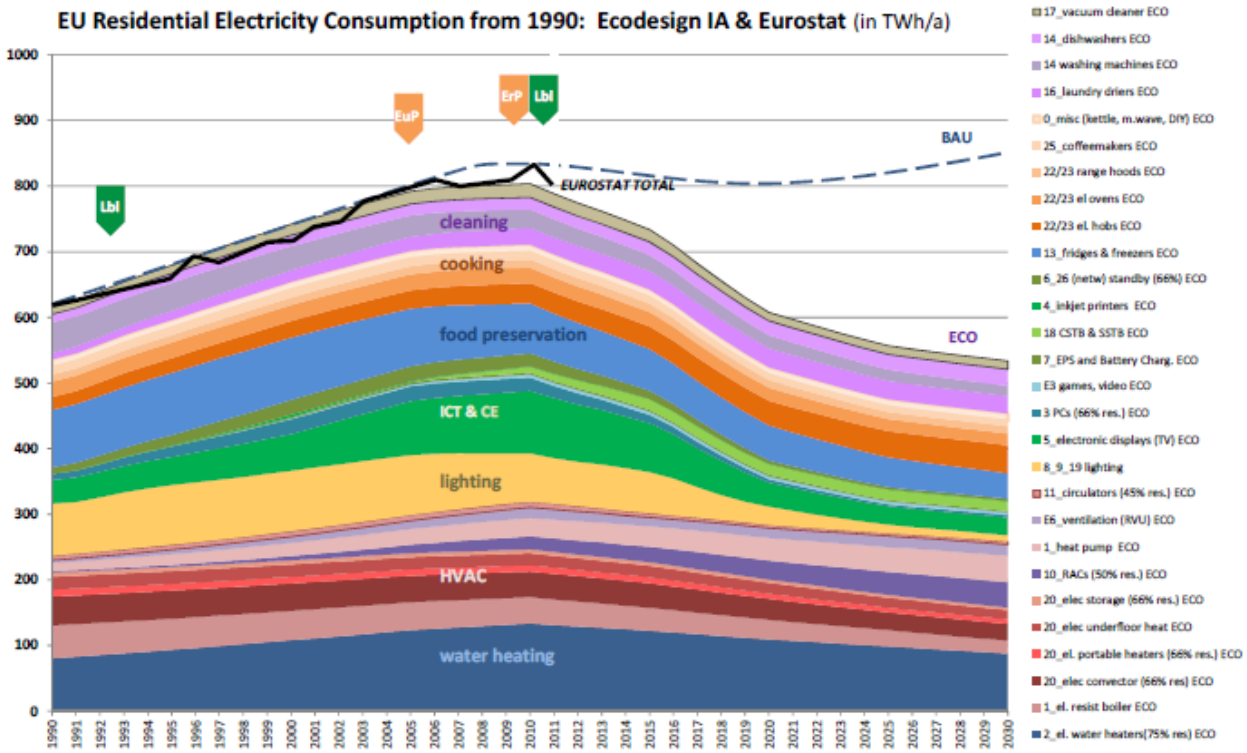

Figure 3. BAU and ECO scenarios in the Ecodesign Impact Accounting

Data Sources and Needs

The data utilized in the analysis is from Eurostat—the statistical office in the EU. The report also pulls from the underlying analysis and data found in the preparatory studies and impact assessments completed for each of the products analyzed.

The data points that underpin the impact accounting are: sales, product lifetime, eco-impacts per product (e.g. energy use), price, improvements in eco-impacts (e.g. efficiency), and associated costs and benefits from improvements (e.g. change in consumer price). The first four data points are used in both the business as usual (BAU) and policy scenarios, the last two data points are only used to calculate the impacts in the policy (ECO) scenario.

Case Study: India

Goals and general approach

The Impact Assessment of BEE's Standard & Labeling Program in India (Market Xcel Forthcoming), aimed to identify and measure impacts on consumers, retailers and manufacturers. The assessment included products under both the mandatory and voluntary regimes.

The methodology had two components: a quantitative assessment aimed at measuring shifts in

awareness and behavior of stakeholders, and a qualitative assessment to measure impacts on market transformation and penetration of labeled appliances.

The analysis was developed by conducting a comprehensive national stakeholder survey in order to assess consumer awareness and understanding of the labeling program, changes in stakeholders' attitudes towards energy efficiency, and to measure market transformation. Some of the specific impacts include:

- Impact on key stakeholders (consumers/retailers/manufacturers) – Consumer awareness, willingness to pay a premium for efficient products, and consideration of efficiency as a criteria when purchasing new products/appliances.
- Impact on production and sales of labeled products – Manufacturers' willingness to shift to labeled products, manufacturers' sales and uptake of labeled products.
- Market transformation - Market penetration of labeled appliances and growth trends.
- Energy and GHG emissions savings – Electricity savings, avoided capacity, and GHG abatement potential.

Data sources and data needs

The primary source was the national stakeholder survey of the labeling program conducted across India. In addition, data of the models registered with BEE were used in order to estimate energy savings and GHG emissions abatement.

Definition of the base line

In order to estimate energy savings and GHG emissions savings, it was assumed that the base line energy consumption was at the 1 star label (the de facto MEPS) for most products[6].

Case Study: Mexico

Goals and general approach

The impact assessment aimed to quantify the impacts of MEPS for refrigerators and window air conditioners that were revised or updated in the period 2000 – 2014, and the impacts of a new standard for mini split units.

The analysis uses a bottom up approach to evaluate changes in average energy consumption due to products regulations. The impacts modelled include:

- Energy savings and GHG emissions mitigated
- Efficiency improvements in the regulated products
- Monetary savings to Mexican consumers

Data sources and data needs

The analysis makes use of the standards program's certification database in order to determine the evolution of market-average efficiency, a critical input to the calculation of impacts. The database includes information of all products registered, including date of registration, the efficiency metric according to the corresponding test procedure, and other product-specific technical parameters.
Other parameters needed in the analysis include:

- Financial variables: interest rates, discount rates

6 The 3 star energy consumption was selected as a base line for a few products

- Power sector variables: Marginal electricity cost, marginal demand cost, transmission and distribution losses, capacity losses in peak period
- Product market variables: lifetime, annual sales, market growth rate
- Product energy variables: use factor, coincidence factor, unit energy consumption
- Product financial variables: price, manufacturing costs, certification costs

An additional source of information were interviews with representatives from the largest certification body in Mexico and an appliance manufacturer.

Definition of the base line

This study considers market trends before MEPS were revised (i.e., average efficiency of the models available on the market in previous years); this data was available for products where there was a previous MEPS requiring certification and registration in Mexico's product registration database (ANCE).

The market trend in two of the products analyzed did not show any significant improvements in energy performance over the years before the standard so it was assumed that the efficiency was constant, represented by a flat line (see Figure 4 below). The energy performance after the standard was passed also showed that same trend (no significant improvement overtime), however, the average efficiency was off set to a higher efficiency level after the standard's implementation.

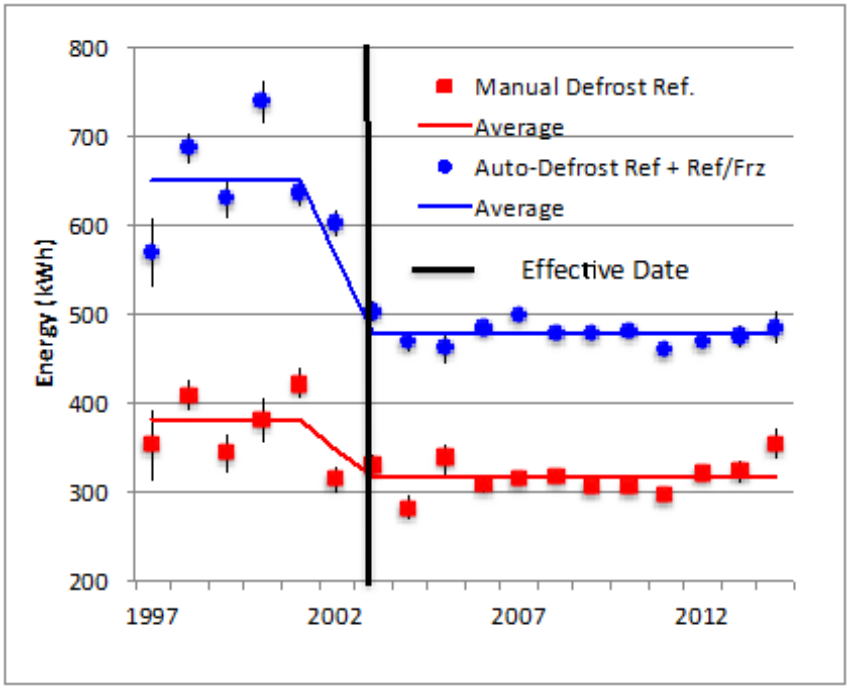

Figure 4. Market average efficiency of refrigerators in Mexico.

Case Study: United States

Impact assessments for standards have been carried out regularly on the federal level. Ex ante impact assessment is included in the US DOE Technical Support Documentation as part of the rulemaking process. LBNL has conducted a number of ex post impact assessments for federal standards. Most of these studies used similar methodology which involved bottom-up modeling analysis using dynamic business as usual scenarios. In this case study we focus on one of the ex post impact assessments which examined the energy, environmental and consumer economic impacts of

US federal residential energy efficiency standards that became effective in the 1988-2006 period (Meyers 2008). More recent impact assessments are also available (Meyers 2012, 2013, 2014, 2015), and the methodologies used are very similar to this case study.

Goals and General Approach

The scope of the study included federal energy efficiency standards for nine residential appliances that became effective between 1988-2006 or would take effect by the end of 2007. The same study also covered two commercial product categories: fluorescent lamp ballasts and electrical distribution transformers. Three key indicators analyzed in this study are:

- Energy savings, in terms of primary energy;
- Consumer economic benefits in terms of monetary savings; and
- Environmental benefits in terms of CO_2 and NO_x reduction

This study employed a bottom-up accounting model which uses historical and projected data on annual shipments and subtracts units retired from the stock based on an assumed product lifetime. Average energy efficiency was assigned to each product category. Energy savings of energy efficiency standards were measured against a baseline scenario which assumed no standards were implemented. Environmental impacts and consumer economic benefits were calculated based on energy savings.

Data sources and data needs

A wide range of data was used in this study, including shipments, average annual energy consumption, annual average energy efficiency, and product prices. However, due to the complexity of the model, there is no single data source which can provide all the data required. Data have to be gathered from various sources including industry associations, research institutes, census reports, and past literature. In some cases, where actual data did not exist, derivation or projection based on historical trend had to be made.

Definition of the baseline

A dynamic baseline was used, which assumed that product efficiency would improve over time in the absence of standards. For each product, historical trend and subjective judgment were used to construct the baseline which predicted what might have occurred as a result of market forces without policy intervention.

Key Findings and Recommendations

This review of global impact assessments shows that regardless of the approach used there are some key considerations that should be taken into account.

Data collection

Evaluators and policymakers must carefully balance the need for data with the feasibility of data collection and resources available. Requiring manufacturers to register products to participate in an S&L program can make it much easier to collect data. However, product registration or certification databases do not usually include sales data and generally rely on self-reported data from manufacturers. For example, Mexico's certification database does not capture sales data for each model, and thus the market average energy consumption used for the baseline is not a sales weighted average, but a model weighted average. On the other hand, India's labeling scheme makes it possible for policy makers to have access to sales data, as the label is issued to each product placed on the market, keeping a registry.

Sales data can be purchased from a market research firm or collected from internet using a computer program. If real sales data is used, a stronger case can be made for attribution as changes in

the speed of efficiency improvement can be linked to the time of policy development and implementation.

In some cases, a survey or in-store data collection can be used to collect market data while projections on sales can be made from the survey data. The use of web scraping tools and APIs may be a less expensive method to gather sales data at the unit level.

Baseline definition

It can be useful to have multiple scenarios for the counterfactual to present a more conservative approach or a range of potential impacts, as discussed in the Australian case study. Ongoing trends should be used to extrapolate future energy use. For example, the EU study accounted for the trend towards more and often bigger appliances, lamps, computers, etc. in households and extrapolated trends in efficiency improvements for each product area.

Multiple Benefits

Evaluators should quantify impacts beyond energy and CO_2 savings whenever possible, considering if these are relevant to policy makers in government agencies dealing with trade, finance, health, etc. These impacts may include job creation, cost savings for consumers, improvements in industrial competitiveness, among others.

Surveys

A survey approach can be used to assess impacts to stakeholders and evaluate changes in behavior from a labeling program. If baseline data, such as stock, sales, production, and other macroeconomic data are not available to quantify savings from an S&L program, a survey could also be used to provide an initial qualitative assessment. This is particularly important for countries that are just starting an S&L program and do not have historical data. The Mexico case study surveys manufacturers to complement the bottom-up analysis, providing a qualitative component to strengthen the data driven analysis. When surveying different types of stakeholders it is important to customize questionnaires to reflect these target groups. Surveys can provide useful information for policymakers, but they will not yield quantitative data on key success factors such as energy, cost, and carbon emission savings.

Isolate Impacts from S&L

Take measures to avoid double counting of savings for products that are regulated at both a component and system level. This is particularly true for more well established programs. Other effects to be isolated are supply side efficiency gains, and changes in electricity tariffs. The EU study deals with this issue by using a fixed rate of efficiency gain for power generation and distribution, and a constant increase in electricity tariffs.

Assess Compliance

Very few of the assessments reviewed accounted for weaknesses in market surveillance or compliance regimes. This is a broader question that deserves further research as a lack of policy compliance can lead to a much lower rate of energy savings than estimated. The China case study surveyed test laboratories and local Quality Supervision and Inspection Bureaus to gain insights on the compliance. This approach may not be able to quantitatively assess compliance, but it offers a simple and quick way to understand the level of compliance for S&L policies.

Select Target Date

Consider the implications of target dates when extrapolating impacts. For example, in the EU the scenarios run through 2050, but most of the product stock will be replaced by 2030 and no new policy options are considered. Thus, there are no visible policy effects after 2030.

Resource Allocation

It is important to allocate resources for an evaluation and begin collecting data before a program is implemented. Even though it might require some up front investment it is particularly important for programs operating in resource constrained environments to demonstrate programmatic impacts to receive support and resources from taxpayers, donors, and other stakeholders.

Value of combining methods

Policymakers can use either a survey method, modeling method, or a combination of both to evaluate the impacts of S&L programs. This really depends on the goals of policy makers, resources available, and the questions they are trying to answer. Ultimately, it would be ideal to have both.

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