3. Deciding Whether and How to Implement Energy-Efficiency Labels and Standards

Guidebook Prescriptions for Deciding About Labels and Standards

1. **Review existing legislation and establish framework legislation to develop a legal basis for labels and standards.**
2. **Assess existing institutional capacity for developing, implementing, and maintaining a labeling and standards-setting program.**
3. **Develop an overall labeling and standards-setting plan and assign one government agency primary responsibility for driving the program.**
4. **Harmonize energy-performance test procedures with international protocols to facilitate testing and reduce barriers to trade.**
5. **Establish minimum data needs and develop a plan for collecting the data necessary to conduct analysis to support the program. It is better to rely on simple forecasts based on limited but reliable data than on detailed forecasts from end-use models that are based on unreliable proxy data. If you need more data to decide whether or not to proceed, take the time to collect it.**
6. **Use cost-effectiveness analysis to screen the products to be included in the program, in order of priority.**
7. **Plan to periodically review and update the labels and standards every few years.**

3.1 Step D-1: Assess Political, Institutional, and Cultural Factors

A government's decision whether or not to develop an energy-efficiency labeling or standards-setting program is complex and difficult. Once it has been established that there are significant energy-efficiency differences between existing and potential product models, there are many actors and many factors to consider. The first step is to assess how local cultural, institutional, and political factors are likely to influence the adoption and effectiveness of such programs. This assessment can determine which programs, if any, to pursue and can identify factors likely to facilitate or hinder the effort. For example, in countries with a strong central government tradition, it may be relatively easy to reach political consensus that a sweeping set of minimum energy-efficiency standards will provide consumer benefits that are not being captured by the private market. In other countries, there may be greater resistance from influential stakeholders to mandatory regulations, and time and education may be required for people to accept the

benefits claimed for energy-efficiency standards, as well as to accept that standards are economically beneficial to the consumer and do not decrease consumers' choice of products or reduce the number of consumers who can afford quality-of-life improvements such as air conditioners. In countries where there is strong resistance to mandatory standards, a voluntary or mandatory energy-labeling program and/or voluntary standards program may be more saleable.

International experience to date has shown that, in the case of energy labeling, cultural differences are often not as important as cultural similarities, and much of what works in one region is often transferable to another (as described in Chapter 5). In all cases where the decision is made to proceed with labels or standards, it is important to develop support for labeling and standards-setting programs not only within the government but in the private and non-governmental organization (NGO) sectors as well. In addition, impartial and credible labeling and standards-setting institutions need to be in place to ensure effective results. These institutions need to have a mandate, an adequate budget, and enough staff to effectively oversee the development and implementation of the programs.

Figure 3-1 schematically illustrates a five-step process for deciding to implement a labeling and standards-setting program.

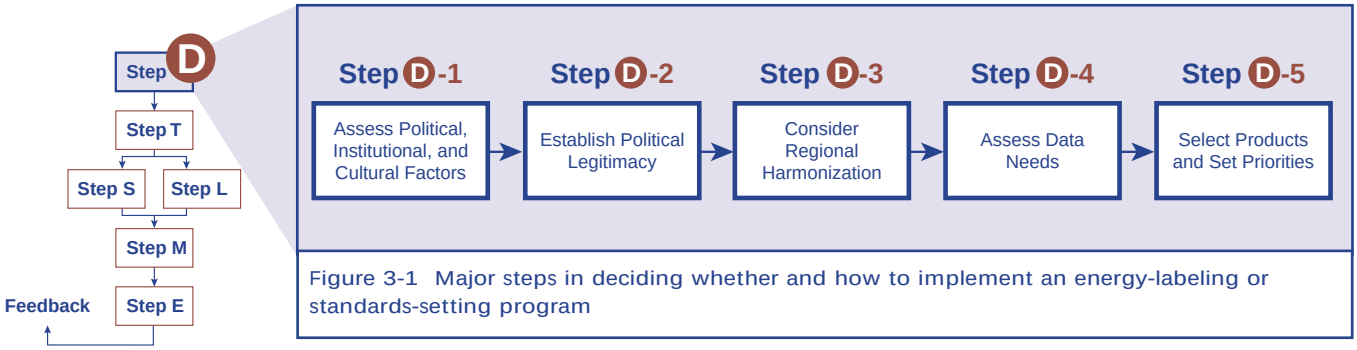

Figure 3-1 Major steps in deciding whether and how to implement an energy-labeling or standards-setting program

3.1.1 Assessing Existing Energy Regulatory Frameworks

It is useful to begin an assessment of local cultural and political factors by examining the existing regulatory framework. Is there legislation affecting the energy performance of products? Is any agency empowered to establish minimum energy-efficiency standards or a mandatory energy-labeling program? These questions must be answered early because legislation forms the basis of an effective mandatory program. Although legislation is not a prerequisite for the development of labeling and standards-setting programs and some voluntary programs have been effective, legislative support will greatly enhance the likelihood that a labeling or standards-setting program will be adopted and will have a significant impact.

For mandatory labels and standards, a legal basis must be established. Even in cases where voluntary agreements are reached with industry, these agreements are often only achieved when industry perceives that government negotiators may enforce a mandatory scheme instead. This has been the case in negotiations to develop voluntary appliance energy-efficiency targets in Switzerland, Japan, and the EU.

Legislation should provide a clear legal mandate for a government agency to require manufacturers (or retailers) to test products in a uniform way and place the labels on all affected products. The passage of legislation also signals strong political support for the program.

Voluntary comparative-labeling schemes have been implemented in countries as diverse as Thailand, Hong Kong, India, and Brazil. The success of these voluntary schemes has varied. In most cases, only appliances in the higher-efficiency classes tend to carry labels because manufacturers and retailers of lower-efficiency products have no incentive to advertise that their products are inefficient (see Insert Box: *Case Study of Thai Labeling Program: A Voluntary Labeling Example*). When only the most efficient products have a label, the comparative label becomes an endorsement label indicating the top-rated models.

The most widely practiced approach for developing legal authority for labels or standards entails two stages. First, general legislation, called "framework" legislation, is introduced. This establishment of legislation is followed by implementation of regulations that are tailored to specific product types (e.g., lamps, refrigerators, etc.). (See discussion of framework legislation in Section 3.2.2).

3.1.2 Assessing Existing Institutional Capacity

Early in the process of assessing local cultural and political factors, it is important to assess the existing institutional capacity to develop, implement, and maintain labeling and standards-setting programs. Such programs require a variety of institutional skills to carry out the following activities:

- test energy consumption, performance, and energy-efficiency levels;
- develop, issue, and maintain labels and standards regulations;
- monitor compliance;

Case Study of Thai Labeling Program: A Voluntary Labeling Example

The Thai voluntary labeling program has worked well for refrigerators but has been less effective for air conditioners. After two years of the program, 85% of single-door refrigerators in the market had achieved an energy label ranking of "4" or "5" (5 is the highest ranking), while after four years, 92% had achieved label rankings of "4" or "5," with more than 95% of these labels being the top-rated "5" ranking. Because the label levels were initially set with "4" being 10% more efficient than the market average and "5" being 25% more efficient than the market average, this indicates that the labeling program has resulted in a roughly 25% increase in the average efficiency of single-door refrigerators.

The voluntary labeling program for air conditioners has been less effective than the refrigerator-labeling program because of the uneven distribution of air conditioner efficiencies. In the air conditioner market, high-end domestic and imported units have higher energy efficiencies but cost twice as much as the lower-priced domestic units that dominate the market. As a result, only manufacturers or importers of the most efficient models attain a "4" or "5" label ranking on their products. After three years of the program, less than 40% of models in the market were labeled. These have only the "4" or "5" ranking. The remaining models—almost all with much lower efficiencies—were unlabeled.

Source: AMI (Agra-Monenco International) 1999.

- enforce regulatory requirements; and
- evaluate program implementation and impacts.

The review of institutional capacity should specify roles for appropriate institutions, identify areas that need strengthening, and evaluate the tasks needed to build to the necessary level the capacity in all the key institutions. The review will help to establish the existence of any major practical constraints that might limit program development. It should also give an early indication of the program's viability, taking into account the likely resources and depth of political support.

It may be an inefficient use of limited financial, technical, and human resources for each nation to develop separate institutional capacity for labeling and standards programs. Consideration should be given to regional approaches or to relying on programs in other geographical areas that affect the local appliance market. Unless there is evidence of importation of highly inefficient products into a country, it may be able to rely on a neighbor's program.

Testing

In time sequence, energy-performance testing is the first capability that must be in place. Until there is reliable testing of energy performance, it will not be possible to start a labeling program or even to assess the benefit/cost implications of a national minimum energy-efficiency standards program.

The establishment of fully equipped, staffed, and accredited test laboratories, the subject of Chapter 4, can be the most resource-intensive and time-consuming aspect of developing a labeling and standards-setting program. Test laboratories are expensive to create and operate, and it is not generally practical for them to be sustained solely for the purpose of an energy-labeling and standards-setting program. If no suitable test laboratories are in place within a country, it may be necessary to consider their establishment as part of wider government programs covering product safety, quality, and environmental acceptability. Alternatively, policy makers may consider pooling resources with neighboring countries to establish a regionally funded and managed test laboratory.

Another option may be to rely on existing private-sector test laboratories. Care must be taken, however, to avoid potential conflicts of interest. For example, it is not appropriate for laboratories that are doing research testing for regulated companies on a contract basis to also act as program-designated test centers.

Administration

Ideally, one governmental agency should have overall responsibility for developing, issuing, and maintaining both labels and standards, to ensure that the labels and standards are enacted and upgraded in a consistent manner. Frequently, however, there are conflicting institutional claims for control of the programs. These claims must be addressed and resolved to avoid a damaging division of resources that will reduce program impacts. In some countries, a division of resources has occurred when different agencies or institutions issued separate energy/environment endorsement labels, comparative ener-

gy labels, or "eco labels." It is unusual for a single agency to have all the necessary skills to develop the labels and standards in-house. External experts are often hired to assist in the process, especially to provide information on specific products.

Monitoring

The agency responsible for monitoring compliance should be clearly designated and adequately funded. Compliance monitoring of labels and standards usually operates on two levels: first, through product testing to ensure that the labeled energy performance is correct; and second, through retail inspections to ensure that labels are correctly displayed at the point of sale. A variety of strategies can be used to check products on the market. These include random-check testing, manufacturer self-regulation, and establishment of an independent certification body, which could combine elements of the preceding two strategies. For a compliance program to be effective, there must be a clear system of procedures and penalties.

Enforcement

The enforcing institution must have an adequate budget and staff to carry out its task. One possible problem in developing countries is that civil service regulations and pay scales may make it difficult for government testing and enforcement agencies to attract and maintain high-quality staff. The institutional review that precedes the process of establishing a program should determine whether the agency responsible for enforcement has the personnel and resources to operative effectively.

Evaluation

The institution responsible for evaluating the impact of a labeling or standards-setting program must employ or have access to trained researchers capable of objective review. Ideally, the agency charged with the responsibility for evaluation should be independent of the administering agency, although this is rarely the case.

3.2 Step D-2: Establish Political Legitimacy

Mandatory labels and standards can have an inherent adversarial aspect because they force manufacturers to take action that they might not otherwise take. Minimum energy-efficiency standards, for example, compel the appliance and equipment industry to design, manufacture, and market more efficient products than they might otherwise. If such potential conflicts are not dealt with early in a program's design, they may prove detrimental to its operation. It is, therefore, important to establish strong and clear political legitimacy for standards as early and as thoroughly as possible. This is the second step in deciding whether or not to develop labeling and standards-setting programs.

Political legitimacy can take various forms depending on the nature of the government or other agencies involved. Legitimacy is strongest when a program is widely recognized as reflecting a social consensus

that is supported by top political leaders and articulated in binding legislation or decrees. Whatever the form of expression, political authorities should establish a clear sense of the:

- strength of their political resolve,
- objectives of the program,
- lines of program authority,
- boundaries for program intervention,
- need for an open and transparent process for program design, and
- relationships with other relevant energy and non-energy policies.

3.2.1 Determining Boundaries of Authority and Responsibility

For the sake of program effectiveness and economies of scale, governments may prefer to enact labels or standards in as large a market as possible. However, product markets often do not match political boundaries. The issues can be especially complex in federated states. The federal government may or may not have sufficient authority to regulate all types of commerce within its states or provinces. Below we provide three examples of the process of legislating labeling and standards setting in countries that each comprise a federation of states or provinces: Canada, Australia, and the U.S.

In Canada, federal jurisdiction over energy is limited to international and inter-provincial commerce. Thus, federal standards apply only to products imported into Canada and/or shipped between provinces and not to products manufactured and sold within a single province. Given the nature of the Canadian appliance and equipment market, federal jurisdiction is sufficient for an effective program. Standards apply to the vast majority of products sold in Canada.

In Australia, individual states and territories are responsible for legislation, regulation, and the associated administration. State-based legislation is necessary because the Australian constitution gives Australian states clear responsibility for management of resources, including energy. Thus, the role of the federal government has become to coordinate. Federal authorities assist in writing “model” legislation that the states and territories then “mirror.”

In the U.S., regulations enacted by individual states have been superseded by national regulations for most products. Manufacturers in the U.S. actually pushed for uniform regulation throughout the country so they would not be forced to offer different product lines in different states. Some economists have suggested that federal regulations are more economically efficient.

3.2.2 Enacting Framework Legislation or Decrees

Political authority for standards should be grounded in a strong but flexible foundation. In most countries, this means enacting a framework law or issuing a decree that mandates standards for certain products, with provisions for expanding and revising the program later (European Community 1992). Framework legislation should be generic and comprehensive rather than piecemeal in nature. It is best

if it creates a legal basis and authority for developing labels and/or standards without specifying technical details related to specific products. In occasional cases—for example, where there exists a solid but possibly fleeting political consensus in support of standards—it may be advisable to act quickly and outline only the very basic framework of the program in the law itself, leaving all the technical details to a capable regulatory body. In other cases, such as where the political consensus is weak, it may be advisable to write technical details into the law to make them more enduring. Generally, the preferable strategy is to develop a generic framework that empowers a capable agency to develop the technical details.

By empowering an implementing agency to develop product-specific regulations at a later date, framework legislation avoids the necessity of a return to the legislative assembly to seek approval for each new regulation. This approach has two benefits: it passes responsibility for developing product-specific legislation to a body with technical competence, and it removes a potentially serious cause of delays that could greatly reduce program effectiveness. Framework legislation should identify the main stakeholders and define their roles, responsibilities, and obligations with respect to the law. It should also designate a government agency as the "implementing agency" and give this agency the authority to issue product-specific minimum efficiency standards (see Insert Box: *Framework Legislation*).

Framework Legislation

Two good examples of framework legislation are the European Union Directive establishing a framework on energy labeling (92/75/EC) and the U.S. National Appliance Energy Conservation Act (NAECA) of 1987, updated in 1988. The EU Directive gives authority to the European Commission to issue product-specific energy labels following approval from a national panel of appointed specialists. The NAECA legislation empowers and obligates the U.S. Department of Energy (DOE) to issue minimum energy-efficiency standards for energy-intensive tradable equipment when a specific set of criteria are met. For a fuller discussion of framework legislation see Waide 1998.

At the very least, framework legislation or decrees should provide:

- defined program objectives,
- authorized types of intervention (mandatory standards and/or voluntary targets),
- criteria for determining which products are covered,
- criteria for the level of technical intervention (based on consumer payback time, life-cycle costing criteria, or harmonization with trading partners),
- an envisioned implementation time frame,
- process rules and deadlines, and
- a requirement for an evaluation report on the program's impact, including effects on manufacturers, consumers, and the nation.

In practice, the amount of technical detail (e.g., product categories, standards levels, implementation dates, revision schedules, etc.) specified in a law or decree is likely a matter of political strategy. Provisions such as the U.S. prohibition on standards that significantly impair product selection, product function, or national commerce can reassure concerned stakeholders.

3.2.3 Maintaining Political Support for Program Development and Operation

Standards must evolve with products and their markets, and a coalition of manufacturers and other interested parties must be maintained to support effective implementation and operation of a program over time. Without such political support, opportunities could be missed for substantial energy savings and carbon-emission reductions. In addition, a standard that is too stringent or overly prescriptive can result in a manufacturer backlash and create an unintended obstruction to development of efficient products.

Standards should be revised and updated regularly. In many cases, this requires a great deal of analysis concerning the viability and cost effectiveness of standards. The revision process can itself be a source of controversy. For example, in the U.S., standards development was delayed for more than a year during 1995-96 because of stakeholder discontent with the process of standards revisions. It is necessary to establish a revision process that minimizes nonsubstantive issues of disagreement and allows full consideration of substantive issues. In the U.S. case, the program got back on track only after an extensive reform of the process gave stakeholders a say in each step of the revision process—from priority setting to final rule making (Turiel et al. 1996).

It is also important for policy makers to keep in mind the resources needed over many years for the development, maintenance, operation, and evaluation of a labeling or standards-setting program. Substantive negotiations on the technical details of standards cannot take place without quality technical data and analysis and periodic program evaluation. Well-designed framework laws or decrees and procedural rules cannot be followed if they are not accompanied by adequate funding.

3.3 Step D-3: Consider Regional Harmonization

The third step in deciding whether or not to develop a labeling or standards-setting program is for policy makers to determine the extent to which they can rely on test facilities, test procedures, label designs, and standards that are already established by international organizations or in neighboring countries.

3.3.1 Rationale for Harmonization

Most electrical products and appliances are subject to national standards that specify minimum safety and performance requirements. Because countries have different industrial or product standards, it is difficult and time consuming for a manufacturer or exporter to carry out the necessary tests and get customs approval to import a product into many different countries. Costly and time-consuming customs procedures amount to a non-tariff trade barrier.

“Harmonization” is commonly used in international trade negotiations—and in particular in the World Trade Organization (WTO)—to refer to the use of common standards, test procedures, import

tariffs, etc., designed to liberalize or facilitate international trade. In some regional organizations, such as the Asia-Pacific Economic Cooperation forum (APEC), the preferred term is "alignment."

The goal of harmonization is to reduce non-tariff trade barriers by (IIEC 1999):

- simplifying and harmonizing customs procedures between countries;
- harmonizing test procedures, labels, and standards; and
- implementing mutual recognition agreements.

Below, we discuss the pros and cons of harmonization of test procedures, labels, and standards.

3.3.2 Harmonizing Test Procedures

Many countries already have a government-backed institution to oversee the development of testing and certification procedures for industrial and consumer products. Typically, the mandate of these standards agencies is to certify the safety and performance of designated products. Safety and performance standards are usually adopted by a local technical committee and are aligned with international standards such as those developed by the International Standards Organization (ISO) or the International Electrotechnical Commission (IEC). For most products, safety and performance standards specify protocols for testing performance and mandate some minimum levels of safety and quality. Only occasionally do national standards include energy efficiency as a criterion. Each country must decide how to design a minimum energy standards program drawing on the resources and expertise of the existing standards agency, the national energy agency, and other qualified bodies.

It is beneficial for national test procedures to be harmonized as closely as possible with international test procedures. This means that international procedures should be adopted with few changes or exceptions to the original. The best international testing protocols cover many climate conditions and a broad range of operating conditions. Test results under harmonized protocols provide benchmarks for product comparisons. However, in some cases a country may adopt modified test conditions to better reflect the local operating environment for a product. In addition, some countries may require testing of product characteristics that are unrelated to energy use (e.g., noise level) to ensure that energy-efficiency gains are not achieved at the expense of poor product performance. Appliance energy testing is discussed in more detail in Chapter 4.

3.3.3 Harmonizing Labels

Should policy makers harmonize their energy labels with those of other countries? The successful "harmonization" of the energy label among 15 countries and 10 languages of the EU shows that it is possible to devise a functional unified label that works across borders. Even slightly different labeling requirements among nations can be disruptive to trade and can ultimately limit choices and add to consumer costs. A regional labeling approach is appropriate if the marketplace, particularly for imported products, is more regional than national.

However, harmonizing labels may not be an important policy goal for every country. There is little reason for harmonizing labels unless a label used in one country or region would also be effective in other countries or regions (Harrington 1997). In fact, an effort to harmonize all information on energy labels among several countries could reduce the impact of the label in each country because the optimal design elements of an effective label may be different in different cultures; symbols or graphic elements that work in one country may not necessarily transfer to another. The best way for policy makers to design an effective label is to carry out consumer research in their country to determine which label design can be most readily understood and is most likely to influence consumers to purchase an energy-efficient product.

For smaller, developing countries with little or no manufacturing capacity for a particular product, harmonization could strengthen the national economy by fostering trade in a common regional market.

Table 3-1 below shows the advantages and disadvantages of harmonizing a label across countries.

Generally the advantages of harmonization outweigh the disadvantages.

Table 3-1 Advantages and Disadvantages of Harmonizing Energy Labels

Advantages	Disadvantages
International or regional market signals are clear, especially when discrete category labels are used.	Language differences require reprinting label text for many different countries.
Design costs among countries are reduced.	A single label may not be effective across political and cultural boundaries.
Printing costs are slightly reduced.	A "learning" curve among countries is unlikely because consumers only purchase in one country.
For small, culturally similar countries within a region, there may be economies of scale.	It is practical for manufacturers to apply a uniform energy label at the point of production if the destination markets all use the same language and the same label.

3.3.4 Harmonizing Energy-Efficiency Standards

If standards are to be adopted, careful consideration should be given to whether to harmonize the standards on a regional or international basis. A series of different standards applied in the same trading region can have a significantly disruptive effect on commerce for both native and importing industries. The benefits from harmonizing minimum energy-efficiency standards are important but may be secondary to the primary benefits of the standards themselves. Harmonization should not become the excuse for avoiding or delaying implementation of a labeling or standards-setting program.

Harmonization of mandatory rules limiting the sale of inefficient products requires expenditure of political capital. A developing country that is struggling economically may not find it practical to establish minimum energy-efficiency standards (MEES) that are aligned with the energy-efficiency standards of large developed nations such as Japan or the U.S. There are a number of reasons for this, including the following:

- there is likely to be a lack of energy-efficient products available in the developing country;
- the incremental cost of energy-efficient products is likely to be high relative to average income in the developing country; and
- tough energy-efficiency standards may hurt local industry and benefit importers of foreign products.

Still, harmonization of standards has often been found to be useful. The EU is harmonizing standards among its member countries. In connection with joining the EU, several central European countries (Hungary, Slovenia, the Czech Republic, and others) have adopted EU standards and directives concerning appliances. Small groups of neighboring countries of comparable economic status in Central or South America, Southeast Asia (the Association of Southeast Asian Nations, ASEAN), Africa, or the Middle East could benefit from a similar step. The economies of smaller developing countries with little or no manufacturing capacity for a particular product could be strengthened through harmonized standards that could foster trade in a common regional market.

3.3.5 Role of Mutual Recognition Agreements

Mutual recognition agreements (MRAs) simplify cross-border trade in products that must be tested and inspected. MRAs are:

> multilateral arrangements between two or more economies to mutually recognize or accept some or all aspects of another's conformity test procedures such as test results and certification (IIEC 1999, Motoomull 1999, Rath 1999).

APEC Electrical Mutual Recognition Agreement

The APEC Electrical Mutual Recognition Agreement (MRA) is an example of an intergovernmental MRA that was established to facilitate trade in electrical products within the APEC region, which includes 22 countries in the Asia-Pacific basin. The MRA has three main components:

Part 1: information exchange agreement

Part 2: mutual recognition of test results

Part 3: mutual recognition of certification.

These are separate parts of the MRA, and a country can choose to sign onto just one part (e.g., information exchange) or all three. The MRA covers most electrical products but not telecommunications equipment, which will be covered under a separate APEC MRA. The Electrical MRA was completed in 1999. The current draft of the Electrical MRA covers safety and performance requirements but not energy-efficiency requirements.

The MRA will reduce the barriers to trade in energy-using products by reducing the need to test a product several times in order to import it into multiple countries. This MRA will facilitate trade in electrical products with other signatory countries because test results certified by an accredited laboratory in that country will be recognized by other signatory countries.

Broadly speaking, there are two types of MRAs:

Intergovernmental MRAs

Intergovernmental MRAs are established between governments and cover products that are regulated by the government sector, such as electric appliances or telecommunications or food products. These agreements can be bilateral or multilateral. The recent trend has been toward multilateral MRAs, such as the APEC Electrical MRA, because forging agreements of this kind is much less time consuming than establishing separate, bilateral MRAs with a number of countries (see Insert Box: *APEC Electrical Mutual Recognition Agreement*, previous page).

Technical MRAs

Technical MRAs establish technical equivalency between bodies in different countries. These types of agreements can cover laboratory accreditation agencies, inspection accreditation, and testing certification organizations. The key usefulness of technical MRAs for electrical products is that they facilitate testing by manufacturers because they can eliminate the need for retesting a product in a foreign country. For example, technical MRAs between European and U.S. laboratories allow the results from a European laboratory that tests a product according to a U.S. test procedure to be accepted in the U.S. without requiring retesting.

3.4 Step D-4: Assess Data Needs

To optimize the design of a labeling and standards-setting program, it is necessary to gather, organize, and analyze a large number of diverse data. The fourth step in deciding whether or not to develop labeling and standards-setting programs is to assess the program's data needs and the capability of the government to acquire and manage that data.

The data needs are significant to support a sound, mandatory energy-performance standard that is economically and technically justified. This is one reason why consideration should be given to other types of standards and voluntary programs or to reliance on other standards programs in the region that have the effect of stimulating the manufacture and use of energy-efficient products. Even if a country is de-termined to proceed with mandatory standards, far fewer data are required to justify, for example, a simple standard that eliminates the 10 or 20% or even half of the products that are least energy efficient. Many more data are necessary to support the much more stringent energy standards regimes such as those in the U.S. or Europe, which are based on technological feasibility.

3.4.1 Assessing Types of Data Needed for Analysis

The data needed for labels and standards development can be put into the broad categories of market, engineering, usage, behavioral, and ancillary data.

Market data

General and specific market data are needed to assess potential program impacts and to optimize program design. These data should include the following:

- equipment annual sales volumes,
- sales prices,
- production volumes,
- import and export volumes,
- equipment distribution channels (including how the equipment is distributed from manufacturers and importers to retail outlets),
- retail-sector characteristics (including market shares by retail type and sector—e.g., electrical specialists/retailers, furniture or kitchen specialists, department stores, etc.; retail marketing strategies and niches; geographical spread; and typical profit margins), and
- manufacturing-sector characteristics (including information on competition; market shares; brands; parent groups and trade alliances; type of production—e.g., full production, final assembly only, etc.; type and quality of products produced; production capacities; component suppliers; distribution of production; costs of marketing, transportation, and vending; costs driven by regulatory policy; typical profit margins; research and development (R&D) levels; technical capabilities; access to high technology; and flexibility of the production process).

Most of the types of market data listed above would, ideally, be disaggregated into sales by equipment subcategories and efficiency levels. For example, for air conditioners, major subcategories of window- versus wall-type units might be further divided into split, multi-split, and cooling only, depending on the volumes of each type that are sold. The subcategories should also be grouped by size (e.g,. cooling capacity), if possible. The most useful type of data would be historical time series and would continue to be gathered after a program is under way, for use in program evaluation.

Engineering data

The goal of gathering engineering data should be to assemble a comprehensive database of summary technical and energy characteristics for individual product models available on the market. These data include:

- comprehensive technical descriptions of typical (baseline) products to conduct energy-engineering simulations for standards development (e.g., for some preselected, average-efficiency room air conditioners, this might include data on the compressor, accumulator geometry, evaporator coil, evaporator blower, refrigerant line, flow-control device, condenser coil, condenser fan, and operating temperatures and pressures), and
- component and material cost data to estimate life-cycle product costs associated with incremental design improvements to increase efficiency.

Usage data

These data include:

- historical, annual time series of equipment ownership levels and energy use or energy efficiency, ideally broken down by equipment subcategories;
- demographic statistics such as the number of households, number and size of office buildings, distribution of occupants per building, socioeconomic characteristics of occupants, data about occupants by income level and region, typical occupancy patterns, etc.;
- existing equipment stock, including the rate of replacement and rate of acquisition (needed for forecasts of the equipment market and of energy consumption); and
- end-use measurements of how the equipment is used in practice, both nationally and in different climate regions (for climate-sensitive appliances), including energy consumption, power demand, and time and frequency of use (Sidler 1997).

Behavioral data

These data include:

- attitudes of consumers and equipment users toward energy savings, purchasing decisions, label designs, environmental concerns, and product service;
- retailer attitudes toward and knowledge of energy efficiency in general, labeling, selling priorities, and consumer preferences;
- manufacturer attitudes concerning energy efficiency in general, energy labeling, specific label designs, product energy performance, and marketing priorities; and
- socioeconomic segmentation of equipment purchasers and users.

Ancillary data

These data include:

- known and forecasted energy prices and tariffs;
- information on utility generation, transmission, and distribution, including capacities, demand, costs (peak and off peak), and the fuel mix;
- national energy statistics;
- national trade, economic, and employment statistics;
- direct and indirect environmental emissions;
- any additional environmental impacts of equipment production and usage; and
- comparative data on the effectiveness of alternative and complementary energy-efficiency programs.

It is not always possible to gather all of the data just listed. Prior to designing a program, officials should establish minimum data needs and prioritize the need for the remaining data. The intended use of the data needs to be clearly defined, and proxy data or reasonable assumptions should be used whenever specific data are not available.

3.4.2 Specifying the Data-Gathering Process

It can be very difficult to gather detailed, product-specific engineering and cost data from manufacturers and suppliers unless a high level of trust has been established between manufacturers and government. Manufacturers should be brought into the process from the outset through the formation of a stakeholder committee. The committee structure allows manufacturers to present their views and concerns and to "buy in" to the standards-setting process. In addition, the committee can facilitate the process of collecting data to analyze the impact of the labeling and standards-setting program.

There are a number of sources for the data needed:

- Stakeholders (parties who may have an interest in the required data, and should be the first point of contact), can be helpful in identifying a range of data sources including existing literature, reports, or market surveys when available.
- Industry organizations, such as trade, manufacturer, or retailer associations, will often have valuable market and product data that they may be prepared to share.
- Market research companies may be prepared to sell market data.
- Manufacturer catalogs can be good sources of model-specific technical data for statistical analyses.
- Long-established test laboratories often have model-specific data on product performance.
- Direct contact with manufacturers is the best way to gather detailed engineering data and data on production processes and manufacturing costs.
- Surveys and questionnaires can be used to gather behavioral data. Such data may already be available from local market research firms.
- Government ministries and information agencies and their publications are the best source of ancillary and demographic data. These agencies include census bureaus, national statistics bureaus, ministries of industry or energy information centers, customs departments, housing authorities, and electric or gas utilities.

3.4.3 Finding a Home for the Data

Policy makers should designate an institutional home for the data generated throughout the course of the program. In both industrialized and developing countries, an outside consultant is often contracted to collect and analyze the data. Both governments and funding agencies must recognize the need for skill transfer so that, when consultants complete their task, the local institution can maintain the database.

The local institution should not only store the data but also be capable of updating the database, providing useful and consistent analysis based on it, and making it available to third parties, such as academics who wish to use it for research and analysis.

3.5 Step D-5: Select Products and Set Priorities

The fifth step in the process of deciding whether or not to develop labeling or standards-setting programs is to screen and select which types of products are the highest priorities for these programs. Every energy-consuming product—and some non-energy-using ones, such as windows and doors—is a candidate for labels and standards. In theory, there are no limitations on which products can be addressed by energy-efficiency regulations. However, energy-efficiency regulations require considerable financial and managerial resources, so it is only possible and practical to develop labels and standards for a limited number of products at a time. It is therefore necessary to establish priorities among a government's market transformation policy options and, within the labels and standards option, among products, based on which product regulations are likely to have the most impact. In practice, for reasons that will be explored here, both regulatory and non-regulatory energy-efficiency policies have focused on only a few products.

3.5.1 Setting Screening Criteria

What are the main criteria for selecting products? The arguments for establishing product priorities are numerous; among the most well known are:

Impact on total energy demand

For each product considered, the total energy demand of the stock must be significant compared to the energy demand of the sector. Assessing the energy demand of a given end use may require a combination of market analysis, specific surveys, end-use metering, laboratory testing, and educated guesses. The problem may be to decide when the energy demand is significant for a given end use. To start with, any product whose stock represents more than 1% of total energy demand should be considered. In the context of mitigating greenhouse gas emissions, the amount of CO_2 emissions that result from the energy demand for a given stock of products is also a consideration.

Level of ownership and turnover

Energy-efficiency policy should focus on products that have a high level of market penetration and for which market penetration is rapidly increasing. The penetration of a given appliance is measured by the level of ownership, that is, the percentage of households that own and use the equipment in question. The rate of increase in ownership is also important.

In the current global market, the penetration of many new types of energy-consuming equipment, especially electronic or information technology products, is growing much faster than the penetration of traditional major appliances. Even though these electronic devices use less energy per unit than a

traditional household appliance, their proliferation has a significant impact on energy demand. However, for the new generation of electronic equipment, such as personal computers, the short useful life of the products makes it difficult for regulators to introduce minimum performance standards in a timely and meaningful way. Using personal computers as an example, we can see that it is difficult to assess the energy consumption of the next generation of processors when the technology is likely to change drastically within only one or two years. For these types of products, regulators may choose to establish minimum performance standards for some key components, such as the power supply, energy management of the display, or standby losses.

Potential for energy-efficiency improvement

A specific research study may be required to determine the potential for energy-efficiency improvements in a product. In particular, it is necessary to understand the importance of both the design of the technology itself and the impact of user behavior on final energy consumption of an appliance. For instance, refrigeration appliances are excellent candidates for an energy-efficiency standard because they run constantly, there are numerous technical options to improve their efficiency, and the impact of user behavior on final energy consumption is smaller than for many other products. At the opposite extreme, the energy consumed by an electric iron is primarily dependent on individual user behavior, and the technology is simple, so irons are less promising candidates for energy-efficiency regulation.

Assessment of winners and losers

The adoption of mandatory energy-efficiency labels and standards creates winners and losers. Some manufacturers will benefit, and some will be worse off. Some consumers will profit, and some will never recover added investments in energy-efficiency features. For both manufacturers and consumers, there will be a range of profitability and loss. (An example of the magnitude and extent of benefits and losses can be seen in Chapter 6.)

If especially stringent standards levels are anticipated, consideration should be given to the possibility that some manufacturers or consumers will be discontent. In general, the range of gain or loss for consumers is relative to normal purchase and operating costs. Regulators need to consider whether the regulations might cause any manufacturer to close a production plant, resulting in the loss of local jobs.

In some situations, it may be appropriate to consider measures to mitigate negative impacts of standards. For example, in extreme cases, increased welfare assistance might be appropriate in conjunction with a mandatory energy-efficiency standard for a basic appliance like refrigerators in order to ensure that those appliances are affordable in most households. Tax relief might be in order for manufacturers that are seriously adversely impacted by a particular standard.

Whether a product is covered by a test procedure

The existence of a test procedure that establishes the performance, including energy consumption, of a given product greatly facilitates implementation of minimum performance standards. International

norms and test protocols are always preferable for developing minimum energy-performance standards. International test protocols, in both their form and application for safety, can be used as models for developing minimum energy-performance standards. Analysis of international norms for the safety of energy-consuming equipment can provide valuable insights into strategies for future energy-efficiency regulation.

For some products—new products and those that are used only in some regions—international test protocols may not exist. This is the case for rice cookers, for example, which have a high market penetration in some cultures where rice is a staple food. In cases like these, a test protocol must be designed with the goal of sound energy performance, not only when the product is in use but also when it is not performing its primary function—for example, while in standby mode.

Existence of energy-efficiency regulations in other parts of the world

Many energy-consuming products are traded internationally. It is a good idea when proposing a new standard to at least consider adopting (or adapting) the applicable regulations from the exporting country. For example, minimum energy-efficiency standards for household refrigerators are in place in several parts of the world, including North America, Europe, Japan, and Australia. As a result, refrigerators are a priority candidate for an energy-efficiency regulation elsewhere. Policy makers can save time and resources and avoid having inefficient products dumped in their countries by examining existing regulations in other markets and adapting them to their own national markets. However, caution must be exercised in adapting existing regulations from other markets; consideration should be given to local user habits, power distribution infrastructure, and other influential factors.

Existence of an energy-labeling scheme

Energy labeling may be the best precursor to the introduction of minimum performance standards. Manufacturers of appliances covered by an existing energy-labeling program are aware of the need to conserve energy and are in a better position than most manufacturers to recognize the impact of marketing products that consume less energy. They may also be better prepared to participate in negotiations to set minimum performance standards.

In Europe, voluntary energy performance targets have been established for both domestic clothes washers and dishwashers. These targets were based directly on the energy-efficiency rankings in the energy-labeling scheme and may eventually become mandatory minimum performance standards in Europe.

Table 3-2 characterizes appliances into two tiers based on the priority for establishing minimum energy-performance standards for these products. The characterization is based on the international experience of the authors and reviewers. Actual priorities in any country will depend on local conditions (e.g., dishwashers may not be a priority in some developing countries because of very low market penetration). Specific results in any one country will also vary according to the prevalence and use of each appliance or product.

Because most countries have the capacity to implement labels or standards for only a few products at a time, it is important to pick those that will have the highest impact first.

Table 3-2 **A Sample Priority List of Appliances to be Covered by Minimum Energy-Efficiency Standards**

Top Candidates for Minimum Energy-Efficiency Standards
Domestic refrigerators, freezers, and combined refrigerator-freezer units
Air conditioners
Fluorescent lamp ballasts
Fluorescent tube lamps
Electric motors
Washing machines, tumble dryers, and combined washer-dryer units
Boilers
Furnaces
Storage water heaters
Heat pumps
Pumps
Fans
Television sets
Second-Tier Candidates for Minimum Energy-Efficiency Standards
Cooking products (including stoves, rice cookers, and hot plates)
Dishwashers
Chillers
Commercial refrigeration appliances
Electricity distribution transformers
Photocopiers
Other lamps (compact fluorescent, incandescent, high-intensity discharge) and illumination and lighting systems for buildings
Office equipment and new information technologies
Standby power
Peripheral equipment for television sets (videocassette recorders [VCRs], satellite antennae, decoders, set-top boxes)
Personal computers
Peripheral equipment for personal computers (printers, modems) (standby power)
Radio sets, stereo equipment (standby power)
Telephone apparatus, fax machines (standby power)
Public illumination and lighting systems
Lifts/elevators

3.5.2 Assessing Potential Costs and Impacts

During the screening process, analysts evaluate the likely energy savings, cost savings, and associated environmental benefits from developing standards and/or labeling. Products to be included in the program are screened and ranked in terms of cost effectiveness and potential for savings. The existence of national goals for total energy savings helps in this screening.

The basic steps in assessing the potential cost and impact of a standards or labeling program are:

- Develop a baseline model. The baseline represents the energy performance of a typical model for a given product (e.g., refrigerators) and is the starting point for the engineering analysis. Baseline characteristics determine what type of design modifications can be made to the product to improve its energy efficiency.
- Identify potential energy-efficiency improvements. This involves assessing the technical options available for improving the energy efficiency of each product.
- Estimate the cost of energy-efficiency improvements. Based on market research, the energy-efficiency improvements and extra manufacturing costs associated with each of the options can be calculated as in Table 3-3, and analysts can evaluate any associated increased manufacturing costs likely to be passed on to the customer through the supply chain (see Insert Box: *Cost Efficiency*). Alternatively, analysts can collect data on the cost and performance of existing units on the market, to determine a cost-efficiency relationship.
- Calculate the potential savings from energy-efficiency improvements. This involves estimating the energy savings from the energy-efficient design options for each product.
- Calculate cost effectiveness. This involves estimating the life-cycle costs and payback periods for different levels of minimum energy-efficiency standards or from a labeling program.

A baseline representing the amount of energy used by a product in the absence of labels and standards must be developed.

It is much easier to measure the savings potential for minimum energy-efficiency standards than for labeling. This is because minimum energy-efficiency standards remove all products with a lower-than-mandated energy-efficiency level from the market, which makes the savings calculation comparatively straightforward. Comparative labeling, however, affects all models on the market, so any net energy-efficiency changes associated with it are difficult to separate from ongoing market trends.

Once cost and energy-efficiency data have been collected, baseline energy-efficiency information is used to estimate how much energy will be saved if the average energy efficiency of all models is increased by a certain amount. Energy end-use forecasting models that accurately predict energy demand can be used for projecting policy impacts. In reality, however, detailed end-use data may not be readily available. In the absence of these data, simplified methods can be used to forecast the energy savings achievable through energy-efficiency standards. It is better to rely on simple forecasts based on limited but reliable

Cost Efficiency

A cost-efficiency table is a method for deciding how to establish a level for minimum energy-efficiency standards. Table 3-3 is a real example from a recent analysis that was performed to establish minimum energy-performance standards for Thailand. The table begins with a row showing the annual electricity use of a baseline ("base case") Thai refrigerator—255 kWh/year. It then shows the cost and energy-efficiency improvements associated with additional technical measures that can be taken to improve the refrigerator energy efficiency. Note that the first few measures are the most cost effective, with the highest benefit/cost ratios. Subsequent steps are still cost effective but have slightly lower benefit/cost ratios. Also, be aware that methodologies for more sophisticated analyses that account for variability among consumers and uncertainty in the data are available.

A cost-efficiency table is a useful tool for establishing the appropriate level for a minimum energy-efficiency standard.

Table 3-3 **Cost Efficiency of a Thai Refrigerator**

	Description	Annual kWh	Energy Saving (%)	Manufacturer Cost (Baht)	Retail Cost (%)	Benefit/Cost Ratio (see notes)	
						This Step	All Steps
	Base case	255	N/A	N/A	N/A	N/A	N/A
1	Add 1 cm insulation to side walls	234	8.4	47	1.5	2.9	2.9
2	Add 1 additional cm to side walls (add 2 cm total, including Step 1)	227	11.1	94	3.0	1.1	2.3
3	Add 2 cm insulation to back walls (2 cm were added to side walls in Step 2)	216	15.3	137	4.4	1.9	2.1
4	Small "good" compressor: 52.9 kCal/hr, 0.92 COP* (replacing 58 kCal/hr, 0.89 COP compressor)	201	21.1	237	7.6	1.1	1.7
5	Add run capacitor to small compressor: COP=1.01	183	28.5	362	11.6	1.1	1.5
6	Improve door gasket design (reduce gasket heat loss by 25%)	171	32.9	442	14.2	1.1	1.4

Notes:
- Baseline model is a 176-liter, 1-door, manual defrost refrigerator freezer.
- Each of the steps listed in this table is incremental to the previous step.
- The benefit/cost ratio is the ratio of the discounted net present values of the societal benefits to the societal costs.

* COP = Coefficient of Performance

Source: ERM-Siam 1999, p. 2-19

data than on detailed forecasts from end-use models that are based on unreliable proxy data. An equipment stock model can organize product ownership and retirement data and use key demand drivers such as forecasts of the number of households and of household income. Such a model or spreadsheet can generate forecasts of equipment sales. In practice, crude sales forecasts are often made during the screening stage using simple spreadsheets.

The next steps in a thorough assessment are to:

- identify technical potential: the maximum technically achievable energy savings,
- estimate economic potential: the economically optimum energy savings from a product-user's (consumer's) perspective, and
- evaluate achievable potential: the practical, sustainable energy-savings potential, given market barriers and competing policies.

Technical potential

An assessment of the technical potential for energy savings can be focused on the best theoretically conceivable design, the best design using conventional technologies, or the best design currently on the market (either national or international). These three reference points for focusing the measurement of technical potential offer different levels of possibility for the "maximum" technical savings potential and the time horizon in which this potential could be achieved. Typically a national and/or international statistical analysis can be used to compare the difference in energy-efficiency levels between currently available products and the reference energy-efficiency level. The magnitude of that difference can be translated into savings potentials by assuming that all new equipment sales are at the higher energy-efficiency level in the energy-forecast model or spreadsheet.

Economic potential

The economic potential can be estimated in one of two ways. One method is to assume that labels and/or standards will achieve the greatest economic efficiency from the consumer perspective. This entails calculating the estimated incremental increase in product price against the expected reduction in the cost of operating the product for any given increase in the energy-efficiency level. In the absence of a thorough analysis, this estimation can be made in a rough way using market data on the correlation (if any) between product price and energy efficiency. Another method is to assume that the labels and/or standards will achieve the greatest economic efficiency from a societal perspective. This will be the case when the initial costs of the energy-efficiency improvements are less than the utility's cost of supplying energy over the life of a product.

Achievable potential

Achievable potential is the analyst's best estimate of how much of the economic potential can be achieved in practice for a given product or program, based on experience with a similar program or product in another location or country. Achievable potential is less than economic potential because

Table 3-4 **Barriers to the Purchase of Efficient Products**

What appear to be cost-effective investments in energy efficiency are often not made because of the presence of market and non-market barriers.

Market and Non-Market Barriers
Higher first cost
Low energy price
Lack of awareness of energy efficiency
Lack of information about efficient products
Low priority for consumers
Low priority for manufacturers/retailers
Equipment purchased by third party
Lack of technology availability
Lack of government programs/support

of the presence of market and non-market barriers that will reduce the actual savings achieved. The most commonly cited barriers are listed in Table 3-4. The shortfall is generally less for mandatory programs than for voluntary ones.

3.5.3 Planning for Phase-In, Evaluation, and Update

Minimum energy-efficiency standards need to be periodically reviewed and raised as the overall energy efficiency of products on the market improves and new technical options become available. The method and amount by which any minimum energy-efficiency standard is increased will vary depending on the product.

Establishing a procedure for revisions will require input from the various stakeholder committees. It will require a discussion of methods for setting and adjusting minimum energy-efficiency standards levels as well as for accommodating industry feedback on time frames that can be reasonably met given other external pressures on manufacturers.

International experience has shown that the most effective minimum energy-efficiency standards regimes involve industry input in the establishment and periodic review/raising of minimum levels.

This chapter of the guidebook has discussed considerations that are useful in deciding whether or not to develop an energy-efficiency labeling or standards-setting program. Once the decision has been made, the next step is to establish test procedures and facilities. This subject is addressed in Chapter 4.