Global Appliance Testing Costs Catalogue

Analysis of Appliance Energy Efficiency Testing Costs

A resource for scoping and budgeting government compliance programs

June 2019

SEAD | SUPER-EFFICIENT EQUIPMENT AND APPLIANCE DEPLOYMENT INITIATIVE

ABOUT THE CATALOGUE

Global Appliance Testing Costs Catalogue is a living compendium of global information on appliance energy efficiency testing prices and testing laboratory costs for common energy consuming products. The purpose of this catalogue is to make it easier for governments, industry, and energy efficiency practitioners to evaluate where and how to test products in accordance with the various test methods supporting appliance standards and labeling programs, and ultimately to make better-informed decisions when allocating their limited resources. The catalogue was funded by United Kingdom Department for Business, Energy and Industrial Strategy (BEIS) and developed by SEAD, CLASP, and P&R Energy LLC.

With thanks to the many project partners, SEAD members, policymakers, practitioners, test laboratories and others that contributed to the catalogue. Special thanks to SEAD's collaboration with the International Energy Agency's (IEA) Energy Efficient End-use Equipment (4E) Electric Motor Systems Annex (EMSA) for their contributions on appliances and motor testing information.

ABOUT SEAD

The Super-efficient Equipment and Appliance Deployment (SEAD) Initiative is a voluntary collaboration among governments working to promote the manufacture, purchase, and use of energy-efficient appliances, lighting, and equipment worldwide. SEAD is an initiative under the Clean Energy Ministerial (CEM) and a task of the International Partnership for Energy Efficiency Cooperation (IPEEC).

SEAD's 19 participating governments collaborate to accelerate and strengthen the design and implementation of appliance energy efficiency policies and related measures. The SEAD Initiative supports this effort by providing knowledge and tools that help impact policy change, raising awareness about the importance of increasing the efficiency of common appliances and equipment, identifying and highlighting technologies that will save energy, and providing technical expertise and best practices to stakeholders.

Product energy efficiency policies and programs are proven, cost-effective methods for lowering energy costs for consumers and increasing the resiliency of economies. They are often the lowest-cost tool for achieving significant emission reductions. If all SEAD governments adopted current policy best practices for product energy efficiency standards, 2,000 TWh of annual electricity could be saved in 2030, equal to the energy generated by 650 mid-sized power plants. Collectively, these measures would decrease CO_2 emissions over the next two decades by 11 billion tonnes, seven times more than the annual emissions of all road vehicles in the United States.

CLASP serves as the Operating Agent for the SEAD Initiative. As the Operating Agent, CLASP uses its extensive experience in energy efficiency standards and labeling (S&L) for appliances and equipment to support SEAD activities. CLASP improves the energy and environmental performance of the appliances and equipment we use every day, accelerating our transition to a more sustainable world. An international and impartial non-profit organization, CLASP develops and shares transformative policy and market solutions in collaboration with global experts and local stakeholders.

TABLE OF CONTENTS

GLOSSARY

AC	Air conditioner
AHRI	Air-conditioning Heating & Refrigeration Institute
ANSI	American National Standards Institute
ASEAN	Association of Southeast Asian Nations
BEE	Government of India's Bureau for Energy Efficiency
BEIS	United Kingdom Department for Business, Energy and Industrial Strategy
CEM	Clean Energy Ministerial
CFL	Compact fluorescent lamp
CIE	International Commission on Illumination
CLASP	Collaborative Labeling and Appliance Standards Program
GEMS	Australia's Greenhouse and Energy Minimum Standards Act
GSL	General service lighting
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IPEEC	International Partnership for Energy Efficiency Cooperation
ISO	International Organization for Standardization
LAC	Latin America and the Caribbean
LCD	Liquid crystal display
LED	Light-emitting diode
Luminaire	A complete lighting unit, including lamp, fixture, and connection to power supply
MENA	Middle East & North Africa
MEPS	Minimum energy performance standards
MOU	Memorandum of understanding
MRA	Mutual recognition agreement:
MSA	Market surveillance authority: entities responsible for conducting compliance tasks
NOM	Norma Oficial Mexicana (Official Mexican Standard)
S&L	Standards and labeling
SEAD	Super-efficient Equipment and Appliance Deployment initiative
SSL	Solid-state lighting

EXECUTIVE SUMMARY

With growing incomes in developing economies, millions of people will enjoy the conveniences and comforts of modern technologies including air conditioners, refrigerators and more. Use of electrical appliances is already a significant source of energy demand for many parts of the world.

Appliance energy efficiency standards and labeling (S&L) programs are vital to ensure new and existing products meet energy performance standards and enable countries to reduce the environmental and climate impacts of fossil fuel-based electricity generation. However, S&L programs are often faced with budgetary constraints, in particular when planning for compliance efforts to verify or test whether products actually meet the program requirements.

Product testing can be very costly, especially when governments consider it necessary to build a national testing laboratory to conduct the tests. Understanding the costs involved in product testing helps policymakers and compliance authorities prepare comprehensive and cost-effective testing plans. They will be able to determine the best solutions for where to test these products – for example, in existing national or foreign for-profit accredited test laboratories, or whether to invest in their own government-run accredited test facility.

The *Global Appliance Testing Costs Catalogue* addresses a key barrier to building financially sustainable S&L programs, a lack of accessible data on the costs of building and operating testing laboratories and testing prices. Further, the catalogue includes a series of case studies on best practices for minimizing the need for extensive check testing, making use of existing testing capacity and sharing resources, and strengthening regional collaboration on testing and market surveillance.

Laboratory Costs & Testing Prices

The purpose of this catalogue is to serve as a living resource to help government and industry stakeholders make the best use of limited resources for testing products, and managing or participating in appliance S&L programs. S&L program practitioners and participants can rely upon data in the catalogue as an initial resource, and should use the catalogue to supplement in-depth due diligence processes.

The *Global Appliance Testing Costs Catalogue* provides indicative cost and price estimates for establishing and operating appliance testing laboratories for five common categories of appliance technologies: Air Conditioners (ACs); General Service Lighting (GSL); Televisions (TVs); Motors; and Domestic Refrigerators. Test labs costs and testing fees for the five appliance types were desk researched and surveyed across five global regions: Sub-Saharan Africa (Africa); Asia; Middle East & North Africa (MENA); Latin America and the Caribbean (LAC); and Other Regions (including most of Europe and North America). For each appliance type, the catalogue includes observed differences in lab costs, testing fees, regional trends, and notes from the field.

TABLE 1: SUMMARY OF ESTIMATED LABORATORY CAPITAL AND OPERATIONAL COSTS

Technology	Capital Costs (USD)		Operational Costs (USD)
	Low	High	
ACs	$363,000	$665,000	$12,000 + Staff & Space
GSL	$74,000	$615,000	$7,000 + Staff & Space
Televisions	$30,000	$56,000	$5,000 + Staff & Space
Refrigerators	$265,000	$617,000	$4,000 + Staff & Space
Motors	$194,000	$388,000	$4,000 + Staff & Space

TABLE 2: SUMMARY OF ESTIMATED TESTING PRICES BY REGION (USD)

Technology	MENA		Africa		Asia		LAC		Other Regions	
	Low	High	Low	High	Low	High	Low	High	Low	High
ACs	$1,040	$8,057	N/A		$350	$6,825	$450	$3,360	$4,733	$11,101
GSL	$24	$422	$600		$18	$1,550	$360	$1,070	$18	$1,200
Motors	$855	$1,343	N/A		$148	$2,300	$900	$2,660	$2,950	$4,838
Refrigerators	$480	$2,939	N/A		$885	$2,500	$930	$3,000	$1,770	$2,360
TVs	$596	$2,939	N/A		$30	$1,000	$400	$1,470	$1,180	$2,360

Case Studies in Testing Best Practices

A series of case studies highlight several methods to reduce investment in product testing to maximize resources, improving program impact and cost-effectiveness.

Methods to Reduce the Need for Verification Testing – Several nations use innovative strategies to identify products at risk of non-compliance, thereby limiting the number of verification tests necessary to identify and remove non-compliant products. Different methods employed include: labeling and documentation review to identify spurious product performance claims; strategic field-testing of those appliances deemed most likely to fail, and criteria-based testing to target at-risk products utilizing market knowledge. These methods help to identify the brands and models that are most likely to be non-compliant, thereby reducing the risk of over-burdening test labs and avoiding needless testing of compliant products.

Joint Testing to Minimize Laboratory Investment – On-going and extensive laboratory testing of products is required to obtain the data needed for development of minimum energy performance standards (MEPS), labeling specifications for energy consuming products, and the establishment of national energy baselines, especially for new or emerging product categories. These activities can incur significant costs if conducted in commercial, specialized laboratories, or may not be possible in the case of emerging technologies. Governments are increasingly considering building national testing facilities to support their S&L program and compliance needs. However, this can be a costly and unsustainable investment if there are no defined business plans to expand services to other countries or regions or to serve multiple program needs. The costs of building and sustaining national testing capacity may outweigh the costs of shipping and testing products in foreign commercial or government-owned laboratories. In order to realize required testing needs, governments have adopted bilateral and multilateral strategies to leverage available resources, including the use of national laboratories in regional programs, utilizing mutual recognition agreements (MRAs), and exploring joint-testing efforts with other economies. Governments and programs should leverage existing test laboratories equipped with high quality test instrumentation and staffed by persons with specialist knowledge to conduct research on appliance performance and evaluate new or emerging technologies.

Simplifying Compliance Through Regional Cooperation – Relying on regional cooperation to improve the development and enforcement of standards can provide additional benefits to S&L programs looking to improve operations and cost-performance. Market surveillance authorities (MSAs) from different countries can strengthen regional coordination around market surveillance and enforcement by sharing best practices, information, and resources. Sharing information such as product test results and knowledge of bad-faith actors in markets allows regional governments to build upon current policies and strive towards compliance targets with a more comprehensive understanding of the market.

Through a better understanding of appliance testing program costs and practices, policymakers and other stakeholders can design the next generation of S&L initiatives to be more effective in regulating the market and protecting consumers. Further, improving the effectiveness of testing programs will free up government resources and allow for greater ambition in efforts to achieve energy and environmental goals. This catalogue provides the information needed to begin the process of improving the financial sustainability of appliance energy efficiency testing programs.

INTRODUCTION

Among any government's portfolio of energy and climate change mitigation policies, appliance energy efficiency programs are reliable, cost-effective methods for lowering energy costs for consumers and increasing the resiliency of economies. They are often the lowest-cost tool for achieving significant emissions reductions.

Governments develop appliance energy efficiency standards and labeling (S&L) programs to remove cost-ineffective, energy-wasting products from the marketplace and stimulate the development of cost-effective, energy-efficient technology. S&L programs – and more specifically their compliance schemes – require reliable energy performance information to ensure products meet program requirements, to safeguard program credibility, and to realize expected energy savings. This information is acquired through product performance testing in laboratories.

However, despite the criticality of product energy performance information, product testing is often a costly activity of appliance S&L compliance schemes. Governments must bear the cost of testing – industry often shares in the burden, as costs are passed down to companies participating in S&L programs.

Governments must, therefore, carefully consider and manage testing costs when allocating resources for their compliance schemes; the success and sustainability of appliance S&L programs depends on it. Understanding the costs of testing products can help practitioners prepare and budget for their compliance programs from the outset (for example, to plan their market surveillance activities, including which products to test, how many models, and in which laboratories).

A major barrier to successful and sustainable planning for any S&L program has been the deficiency and inaccessibility of data on the costs of building and operating a testing laboratory, and testing prices. This presents a risk to governments. For example, when a government develops or adopts an S&L program and does not have a national test laboratory to test the covered products, the assessment and decision to build its own test lab versus coordinating with neighboring countries often depends on a cost-benefit-analysis, ideally informed by reliable cost data. Until now, such data has not been readily available to inform such decisions.

This catalogue provides indicative sets of data on 1) the costs of setting up and operating an appliance energy efficiency testing laboratory, and 2) testing prices – to better inform policymakers, practitioners, and appliance stakeholders. The catalogue contains data from testing laboratories around the world on five appliances, selected for their prevalence and potential energy savings from improved efficiency:

Products:

- Air Conditioners (ACs)
- General Service Lighting (GSL)
- Televisions (TVs)
- Motors
- Domestic Refrigerators

Regions:

- Sub-Saharan Africa (Africa)
- Asia
- Middle East & North Africa
- Latin America
- Other Regions

The catalogue also includes case studies that highlight strategies used by governments to reduce the cost of the testing component of their appliance S&L programs.

The purpose of this catalogue is to serve as a living resource to help governments and industry make the best use of limited resources for managing and participating in appliance S&L programs. The data in the catalogue is expected to be used by S&L program practitioners and participants as an initial resource to supplements in-depth due diligence processes. The data consists of indicative cost and price estimates intended to aid the high-level strategic decision-making process. **This data is not comprehensive and will be updated whenever new data becomes available.**

METHODOLOGY

The catalogue is composed of information gathered through desk and field research on regional costs and prices of energy performance testing for commonly used residential and commercial appliances.

Data categorization

The list of products included in the catalogue was determined based on a combination of product ubiquity and potential energy saving impact (the greater were included). Global regions were identified as an appropriate geographic factor for analysis due to limited number of testing laboratories in the world and sensitivities of non-anonymized cost and price data being publicized.

The primary types of data catalogued are defined accordingly:

- Costs of setting up and operating a testing laboratory are indicative capital and operational costs incurred by testing laboratories to perform tests using the most common local/regional testing methods. These costs are broken down into major, one-time "capital costs," and ongoing "operational costs." Capital costs include equipment unique to a given product, generic equipment that is likely to be pre-owned by an existing lab (but would need to be purchased by a new lab), accreditation fees, and inter-laboratory trials. Operational costs include estimates of the number of full time staff and physical lab space to perform product testing. Staffing and space requirements are not presented in a USD ($) amount due to regional differences in costs.
- Laboratory cost data is presented in tables by product and inclusive of all regions.
- Testing prices are indicative prices incurred by a 3rd party to have a single product unit tested according to local/regional test methods.
- Testing price data is presented in tables by product and disaggregated by regions.

Data acquisition

Data was collected from testing laboratories that voluntarily provided cost and price quotes. Between 400-500 testing laboratories and practitioners were contacted via phone and email between March and August 2018, with requests for cost and price quotes, resulting in 100-150 responses. Contacts were identified through testing laboratory accreditation databases, professional relationships and referrals, and desk research.

Costs of setting up and operating a testing laboratory

Desk research was conducted on test methods, S&L programs, and subsequent testing equipment and requirements, for each of the five products. Data sources included equipment manufacturer catalogues, quotes from equipment suppliers, testing experts, and testing laboratories.

Testing prices

Laboratories were asked to provide price quotes for the relevant products to the test standards/regulations that applied in that country or region, as appropriate. Not all countries had standards for all five products, and not all laboratories had test facilities for all five products.

Indicative costs were requested for “generic” products (for a range of sizes where appropriate – e.g. motors). Some laboratories requested a product specification in order to provide a quote. Representative specifications were developed and used to standardize these “generic” products when requested.

Assumptions and interpretations

Additional assumptions and interpretations to complement the data are included in “Notes from the field” sections to further contextualize testing price data for each product.

Selected products

The five appliances selected for the first edition of this catalogue are defined accordingly:

- **Air Conditioners (ACs):** Unitary air conditioners or heat pump equipment, single or split units, but not whole-house central air conditioners.
- **General Service Lighting (GSL):** Self-ballasted lamps for general lighting, including solid state/LED lamps and CFLs, but not luminaires.
- **Televisions (TVs):** All televisions (no restrictions in size or technologies, but generally household units).
- **Motors:** Commercial single and polyphase induction motors and generators, inclusive of sizes from 3.7kW to 75kW (or as indicated differently).
- **Domestic Refrigerators:** All household refrigerating appliances (mostly single- and double-door units).

COSTS OF SETTING UP AND OPERATING TESTING LABORATORY

Indicative capital and operational costs incurred by testing laboratories (USD$)

AIR CONDITIONERS

Capital Costs: **$363,000 - $665,000**

Operational Costs: **$12,000 + Staff & Space**

GENERAL SERVICE LIGHTING

Capital Costs: **$74,000 - $615,000**

Operational Costs: **$7,000 + Staff & Space**

TELEVISIONS

Capital Costs: **$30,000 - $56,000**

Operational Costs: **$5,000 + Staff & Space**

REFRIGERATORS

Capital Costs: **$265,000 - $617,000**

Operational Costs: **$4,000 + Staff & Space**

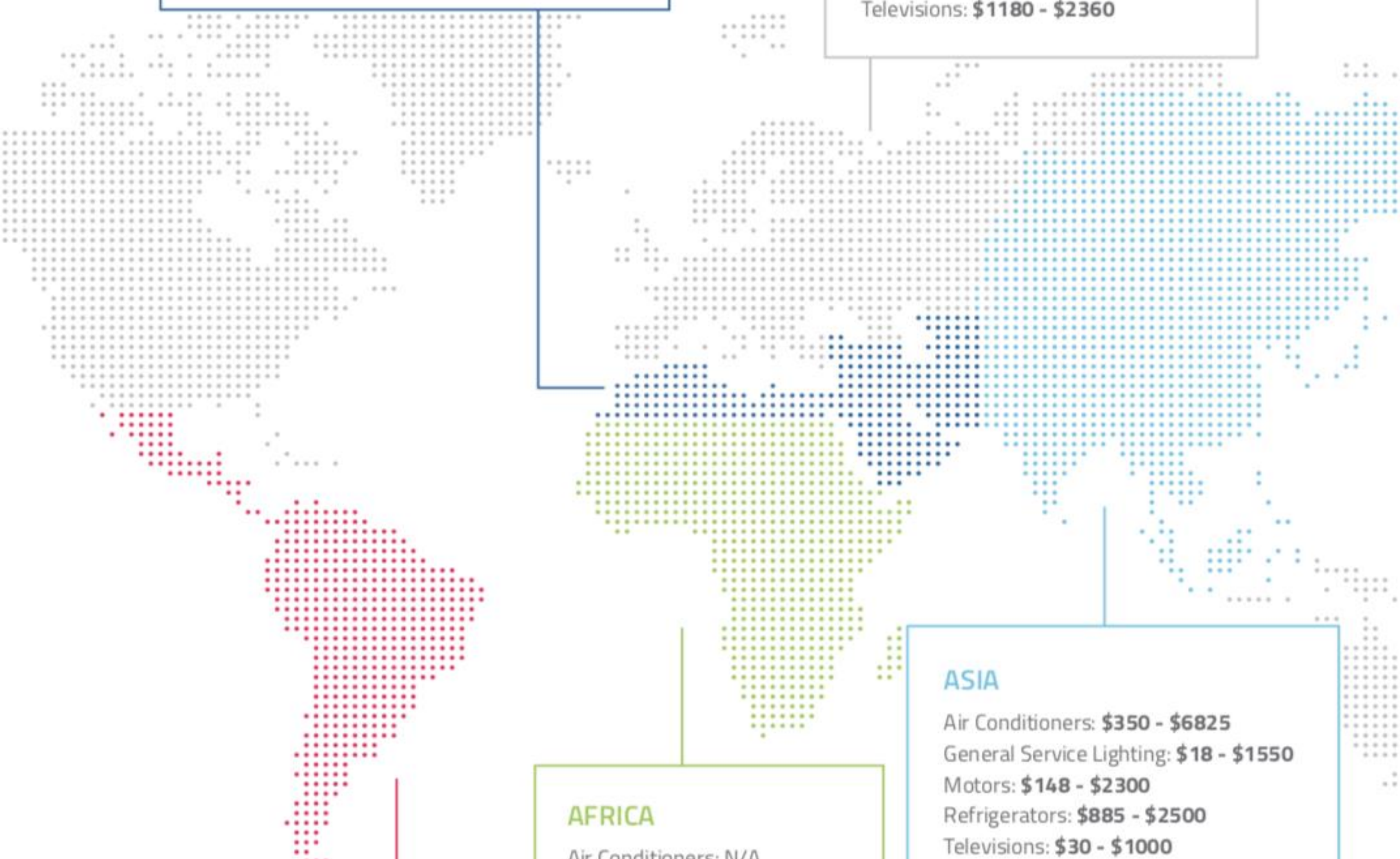
MOTORS

Capital Costs: **$194,000 - $388,000**

Operational Costs: **$4,000 + Staff & Space**

TESTING PRICES

Indicative price to test a single unit according to common regional standard (USD$)



MIDDLE EAST AND NORTH AFRICA

Air Conditioners: **$1040 - $8057**
General Service Lighting: **$24 - $422**
Motors: **$855 - $1343**
Refrigerators: **$480 - $2939**
Televisions: **$596 - $2939**

OTHER REGIONS

Air Conditioners: **$4733 - $11,101**
General Service Lighting: **$18 - $1200**
Motors: **$2950 - $4838**
Refrigerators: **$1770 - $2360**
Televisions: **$1180 - $2360**

ASIA

Air Conditioners: **$350 - $6825**
General Service Lighting: **$18 - $1550**
Motors: **$148 - $2300**
Refrigerators: **$885 - $2500**
Televisions: **$30 - $1000**

AFRICA

Air Conditioners: N/A
General Service Lighting: **$600**
Motors: N/A
Refrigerators: N/A
Televisions: N/A

LATIN AMERICA

Air Conditioners: **$450 - $3360**
General Service Lighting: **$360 - $1070**
Motors: **$900 - $2660**
Refrigerators: **$930 - $3000**
Televisions: **$400 - $1470**

LABORATORY CAPITAL AND OPERATIONAL COSTS

CONSIDERATIONS

Laboratory capital and operational costs are presented in a separate table for each product in the catalogue. The tables list the major budget items and estimated costs required to set up and operate a laboratory for energy efficiency performance verification testing of air conditioners (ACs), general service lighting (GSL), motors, refrigerators, and televisions (TVs).These include one-time capital costs to obtain the required equipment for testing, as well as ongoing operational costs, such as rent, equipment calibration, staffing, ongoing training and re-accreditation. All costs are listed in USD ($).

In general, costs for setting up and operating a testing laboratory are relatively consistent across regions. Staffing and space (i.e. lease or rent) costs may differ regionally, but equipment costs are fairly similar. The accreditation costs are estimated to obtain the accreditation to ISO 17025 *General requirements for the competence of testing and calibration laboratories,* which is the main ISO standard used by testing and calibration laboratories. Participation in inter-laboratory trials, such as round robin testing, is important to build technical capacity for establishing repeatable and reproducible testing results. Ongoing training of laboratory technicians is necessary to ensure equipment is operated and testing performed in accordance with ISO 17025.

The list of items includes only main components of the costs and is not comprehensive. Below are a few notes on the additional costs that are not reflected in these estimates:

- Equipment costs do not include any applicable import tariffs or local taxes.
- Specialized equipment installation inside specialized test chambers, which must be done by experienced technicians or suppliers' agents, is not covered. Installation costs can vary dramatically and increase capital costs.
- Staffing requirement does not include staff and responsibilities for laboratory administration and management functions.
- Building construction costs are not included. The listed space requirement assumes there is an existing, suitable building with a reliable electricity supply.
- Shipping costs to calibrate the equipment are not included. Some testing equipment may need to be shipped to the original supplier or qualified accredited provider for calibration and maintenance. The estimates are annualized as the frequency of calibration depends on the equipment and usually ranges from one to three years.

Reported costs are estimates and intended to serve as indicative values; actual values may vary based on product, test method, region, supply, or other factors.

TESTING PRICES

CONSIDERATIONS

In addition to laboratory capital and operational costs, testing prices are presented in separate tables for each product. Testing price tables contain indicative prices for a single product unit to be tested at an accredited laboratory in regions around the world. The reported ranges in USD ($) reflect quoted prices provided by both national (i.e. those owned by public entities) and private laboratories, and include relevant national and regional test methods and standards.

Reported prices are intended to serve as indicative values; actual values may vary based on product, test method, region, or other factors.

Impact of IEC 62552:2015 test method on refrigerator testing prices

During the collection of data for refrigerator testing prices, it became apparent that the relatively recent development of the IEC 62552:2015 test method is an important milestone to contextualize current refrigerator testing prices around the world. Prior to IEC 62552, there was wide variation in test procedures and test pricing, and some differences are expected to persist unless or until IEC 62552:2015 is adopted globally.

Published in 2015, the IEC 62552 test method has almost global recognition as a basis for national and regional policies. Adoption of this test method is complete in Japan, China, US and Thailand (largely equivalent, though some regional variations are used). Some other regions are currently in the process of transitioning to the new test method.

Compared to alternative test methods, IEC 62552 requires a similar testing duration. However, results are more complex to analyze, requiring greater emphases on staff training and updating analysis software. Required changes to equipment are not significant in cost or complexity.

IEC 62552 includes optional test components (such as the Annex on load processing energy consumption) and some regions have adopted those into their regulation (e.g. Australia) which increases the associated test cost by 10-20%. Testing refrigerators, especially using the IEC global test method, has implications for analysis and requires a thermal chamber with tightly controlled temperature and low speed air flow through the chamber. It is therefore important to ensure that the lab undertakes round robin testing to compare results with other competent labs.

AIR CONDITIONERS

LABORATORY CAPITAL AND OPERATIONAL COSTS

The equipment listed are those required for testing air conditioners using the calorimeter room method.

TABLE 3: AIR CONDITIONER - LABORATORY CAPITAL AND OPERATIONAL COSTS

Expense Category	Low Estimate (USD)	High Estimate (USD)	Description
Capital Costs			
Product-specific equipment	$350,000	$650,000	Room calorimeter, control air space chamber, compressor condensing units, air handling unit, humidifiers, pressure equivalence devices, water calibration system, air sampler and psychrometer box (complete setup required commissioning)
Generic equipment (usually pre-owned)	$3,000	$5,000	Voltage stabilizer, thermometer, hygrometer, sampler, etc.
Accreditation	$5,000		To ISO 17025
Inter-laboratory trials	$5,000		For calibrating proficiency
Operational Costs			
Staffing	2		Minimum number of trained technicians
Space	$60m^2$		Minimum space requirements
Equipment calibration and maintenance	$10,000		Estimated annual cost
Additional operating costs (capacity building, staff training, laboratory re-accreditation, re-certification)	$2,000		Estimated annual cost

AIR CONDITIONERS

TESTING PRICES

Prices include both split and unitary AC types, but they are not differentiated by type as many laboratories provided a single price for "AC testing". Factors that affect price differences are: the level of detail and complexity of the test requirements and product characteristics and design features.

TABLE 4: AIR CONDITIONER - TESTING PRICES

Region	Product Category	Applicable or Reference International Test Standard(s)	Source	Price for 1 Unit (USD)
Africa	Split & Unitary	• ANSI/AHRI 1230-2010 • EN 12102	N/A	N/A
Asia	Split & Unitary	• ISO 5151: 2010 • ISO 15042: 2011 • ISO 16358 • ISO 5151: 2010	Accredited test lab(s)	$350 – $6,825
Middle East & North Africa	Split & Uncategorized	• EU 206-2012 • ISO 5151: 2010 • BS EN 14825- 2016	Accredited test lab(s)	$1,040 – $8,057
Latin America	Split & Unitary	• NOM-026-ENER • ISO 5151: 2010 • Various national standards	Accredited test lab(s)	$450 – $3,360
Other Regions	Split & Unitary	• ANSI/AHRI 1230-2010 • ISO 5151:1994 • EN 12102:2013 • EU 626/2011	Accredited test lab(s), Policy documents	$4,733 – $11,101

AIR CONDITIONERS

TESTING PRICES: NOTES FROM THE FIELD

Interpreting testing prices for air conditioners:

- Many of the laboratories provided a single price for “AC testing” and did not differentiate prices by type of AC unit (split or unitary).

Regional trends:

- In Asia the dominant test methods are ISO 5151 and ISO 15042. ISO 16358 is used for testing variable-speed AC units.
- In Latin America, AC test methods are often unique to each country or incorporated into national legislation; such is the case in Mexico, Brazil and Argentina.[1] The extent to which these national test methods are consistent with international test methods was not assessed. However, reported testing prices are inclusive of these national test methods.
- In the Middle-East and North Africa (MENA) region, countries have primarily adopted ISO 5151 but some adopted the EU regulatory framework (Tunisia) or the European normative documents (Jordan).
- In the rest of the world, a wider diversity of test methods are used, including ISO 5151 and the EU regulatory framework. The latter includes procedures beyond energy efficiency testing, such as inter alia and noise estimation procedures (EN 12102), which are not reflected in these prices.

Observed differences in testing prices and potential factors:

- Prices differed based on the level of detail and complexity of the test requirements; more detail and complexity results in higher prices.
- Prices differed based on product characteristics and design features, such as fixed vs variable-speed compressor, cooling and heating vs cooling only, or unitary window mounted system vs wall/high wall mounted split unit).
- In Asia and MENA, the price of testing in national laboratories (i.e. owned and managed by public entities) is less than private laboratories – as much as eight times less, in one country.
- In Asia, the price difference for testing a split unit vs a multi-split unit is significant if the equipment is cooling only ($1,200 vs $1,800, respectively). If the equipment is designed for both cooling and heating (heat pump), the price difference is small ($1,800 vs $2,000, respectively).
- Prices for testing ACs with a variable-speed compressors tend to be higher. One lab reported that the price of testing a fixed-speed AC was $667, compared to $977 for a variable-speed AC.
- In Latin America, the prices reported vary between $450 and $1,000 for fixed-speed AC units. In Mexico, where there is a standard specific to variable-speed AC units (NOM-026-ENER), the price of testing is significantly higher ($3,360).

[1] Brazil has a national standard for determination of the “EE index” (NBR 12010/1990).

GENERAL SERVICE LIGHTING

LABORATORY CAPITAL AND OPERATIONAL COSTS

The equipment listed are those required for testing general service lighting products using both relative and absolute photometric methods. Equipment for both of these methods was included based on the assumption that using these test methods result in more accurate performance assessments for all light sources, including LEDs.

TABLE 5: GENERAL SERVICE LIGHTING - LABORATORY CAPITAL AND OPERATIONAL COSTS

Expense Category	Low Estimate (USD)	High Estimate (USD)	Description
Capital Costs			
Product-specific equipment	$60,000	$600,000	Integrating sphere, goniophotometer, spectroradiometer, colorimeter, light meter, aging racks
Generic equipment (usually pre-owned)	$3,700	$4,700	Voltage stabilizer, meters, measurement software, temperature control, AC inverter
Accreditation	$5,000		To ISO 17025
Inter-laboratory trials	$5,000		For proficiency
Operational Costs			
Staffing	2		Minimum number of trained technicians
Space	25m^2		Minimum space requirements
Equipment calibration and maintenance	$5,000		Estimated annual cost
Capacity building, staff training, laboratory re-certification, others	$2,000		Estimated annual cost

GENERAL SERVICE LIGHTING

TESTING PRICES

Prices include linear lamps, compact fluorescent lamps (CFLs), light-emitting diodes (LEDs), and double-capped lamps (in Asia).

TABLE 6: GENERAL SERVICE LIGHTING - TESTING PRICES

Region	Product Category	Applicable or Reference International Test Standard(s)	Source	Price for 1 Unit (USD)
Africa	CFL	• IEC 60969	Accredited test lab(s)	$600
Asia	CFL, LED, Double-Capped Lamp	• IEC 60969 • IES NA LM-79 • IEC 62612 • EC 245/2009 • EU 1194/2012 • IEC 60081 • EU 1194/2012 • CIE S 0 25	Accredited test lab(s), Policy document, Practitioner	$18 – $1,550
Middle East & North Africa	CFL, LED	• IEC 60969 • EC 244/2009 • EU 1194/2012 • SASO 2870	Accredited test lab(s)	$24 – $422
Latin America	CFL, LED	• IEC 60969 • IES NA LM-79 • CIE S 025 • NOM-030-ENER	Accredited test lab(s)	$360 – $1,070
Other Regions	CFL, LED	• IEC 60969 • IES NA LM-79 • IEC 62612 • EC 245/2009 • EU 1194/2012 • IEC 60081 • CIE S 0 25	Accredited test lab(s), Policy documents, Practitioner	$18 – $1,200

GENERAL SERVICE LIGHTING

TESTING PRICES: NOTES FROM THE FIELD

Interpreting testing prices for general service lighting:

- Minimum Energy Performance Standards (MEPS) and labeling requirements for GSL generally include performance requirements beyond energy efficiency, covering such factors as colour temperature, colour rendering index, and switch on time (for CFLs). The reported prices reflect the costs to test these additional requirements, based on each regional or national MEPS.
- Testing prices for GSL are less comparable than other products due to much greater differences in underlying testing requirements – which are primary drivers of prices – across regions and S&L programs. Unlike many appliances, GSL testing requirements are not generally prescribed by test standards. Instead, the number and range of tests required, and subsequently the test prices, are dependent on particular regulations, which vary across countries and regions.
- Reported prices primarily reflect testing for general service (non-directional) lamps, as these are the mostly widely used. However, some of the quotes submitted by laboratories in Asia included prices for directional lamps, which results in a wider range of testing prices. Testing for the beam width and beam distribution, needed for directional lamps, requires additional equipment and skills and would be charged at additional costs. Based on quotes from a single lab in Asia, testing prices for directional LEDs was around four times greater than for non-directional LEDs.
- Some test methods require testing of multiple samples of the same lamp model (for example the EU MEPS requires 20 lamps to be tested). It is possible that some laboratories provided the cost per model rather than per sample and this may account for some of the wide range in values.

Observed differences in testing prices and potential factors:

- Variations in product lifetime testing requirements impact testing prices. For example, the prescribed length of time for measuring failure rates (i.e. number of failed lamps after a given time) requires resources to sustain (such as labour) and may vary across countries and regions.
- Variations in testing of lumen maintenance (measured light output after a given number of hours compared to output when new) also impact testing prices due to required resources for sustaining the test. Price quotes from laboratories often did not include the assumed test duration value for the lumen maintenance test, so the measure of its impact on price is not clear. However, data from one lab indicated that for LED lumen maintenance testing, the price for 5,000 hours of testing was about 2.5 times greater than the price for 1,000 hours or testing.
- The volume and frequency of testing at the laboratory impacts testing efficiency and laboratory overhead costs, which are reflected in testing prices. For example, some of the laboratories that provided testing price quotes are known to undertake a high volume of testing, either because they specialise in lamp testing or because the country they operate in requires test certificates to be provided when a product is registered – driving demand. High-volume testing laboratories can leave equipment permanently set up and operational, and spread training and calibration costs over a large number of tests – considerably reducing prices.

MOTORS

LABORATORY CAPITAL AND OPERATIONAL COSTS

Primary testing equipment for testing motors, and subsequently costs, can vary dramatically by the motor's size. For example, a dynamometer required to perform motor load tests is applicable for a specific range of motor rated power outputs. Most laboratories have more than one dynamometer to accommodate a range of motor sizes. The equipment listed are those required for testing motors between 3.7kW to 75kW.

TABLE 7: MOTOR - LABORATORY CAPITAL AND OPERATIONAL COSTS

Expense Category	Low Estimate (USD)	High Estimate (USD)	Description
Capital Costs			
Product-specific equipment	$180,000	$370,000	Torque transducer, power analyzers, measurement and control equipment, software, rack, motor frame.
Generic equipment (usually pre-owned)	$6,200	$10,000	Voltage stabilizer, ambient temperature controls, meters and sensors.
Accreditation	$5,000		To ISO 17025
Inter-laboratory trials	$3,500		For calibrating proficiency
Operational Costs			
Staffing	2		Minimum number of trained technicians
Space	$25m^2$		Minimum space requirements
Equipment calibration and maintenance	$2,000		Estimated annual cost
Capacity building, staff training, laboratory re-certification, others	$2,000		Estimated annual cost

MOTORS

TESTING PRICES

The reported prices reflect motors ranging in size from 3.7kW to 75kW (or as indicated differently). There were no motor testing capabilities reported for Africa, but Kenya is in the process of setting up a national test laboratory for motors.

TABLE 8: MOTOR - TESTING PRICES

Region	Product Category	Applicable or Reference International Test Standard(s)	Source	Price for 1 Unit (USD)
Africa	Motors	• IEEE 112 • IEC 60034-2	NA	NA
Asia	3.7 kW up to 75 kW	• IEEE 112 • IEC 60034-2	Accredited test lab(s), Practitioner	\$148 – \$2,300
Middle East & North Africa	0.75 kW up to 18.6 kW	• IEC 60034-2	Accredited test lab(s)	\$855 – \$1,343
Latin America	Unknown up to 7.5 kW	• NOM-016-ENER • IEEE 112	Accredited test lab(s)	\$900 – \$2,660
Other Regions	4 kW up to 75 kW	• IEEE 112 • IEC 60034-2-1:2014	Accredited test lab(s), Practitioner	\$2,950 – \$4,838

MOTORS

TESTING PRICES: NOTES FROM THE FIELD

Interpreting testing prices for motors:

- In all regions, prices correspond with the size of the motor, such that testing prices are greater for larger motors.
- Data for Latin America comes from a test lab using Mexico's national test method.
- Some of the main equipment required for testing motors, such as a dynamometer, is designed to test motors of specific sizes or rated power output. In order to test a wide range of motor sizes, multiple dynamometers are need. Most laboratories have more than one dynamometer, as they reported a relatively broad range of testing services, up to 37kW (50 HP).
- None of the laboratories reported capacity to test three-phase induction motors with rated power output from 0.75kW to 375kW (1HP to 500HP) as specified in the regulations for motor efficiency adopted by large economies/countries (e.g. EU, US, China, India, Japan). It is assumed that this is due to the extensive investment costs of purchasing and owning the required sets of dynamometers to perform such tests.

Regional trends:

- The primary test method reported by laboratories in Asia and Europe is IEC 60034-2-1.
- Virtually all motor testing laboratories are located in economies/countries where regulatory requirements for motor efficiencies exist.

Observed differences in testing prices and potential factors:

- In general, lower prices for testing induction motors occur in Asia (India and Thailand with less than US$300 for motors with rated power below 45kW or 60HP). Test prices for motors with similar power rating in Turkey (below 37kW or 50HP) range from US$855 to US$1,343. Motor testing prices in China to meet the EU requirements range from US$1,450 to $2,300.

DOMESTIC REFRIGERATORS

LABORATORY CAPITAL AND OPERATIONAL COSTS

The equipment listed are based on testing requirements for variable-speed compressor refrigerator units.

TABLE 9: DOMESTIC REFRIGERATOR - LABORATORY CAPITAL AND OPERATIONAL COSTS

Expense Category	Low Estimate (USD)	High Estimate (USD)	Description
Capital Costs			
Product-specific equipment*	$252,000	$602,000	Test chamber, air handling system, chiller, control and measurement equipment, test loads and conditioning, software.
Generic equipment (usually pre-owned)	$3,000	$5,000	Voltage stabilizer, ambient temperature controls, meters and sensors.
Accreditation	$5,000		To ISO 17025
Inter-laboratory trials	$5,000		For calibrating proficiency
Operational Costs			
Staffing	2		Minimum number of trained technicians
Space	$50m^2$		Minimum space requirements
Equipment calibration and maintenance	$2,000		Estimated annual cost
Capacity building, staff training, laboratory re-accreditation and re-certification	$2,000		Estimated annual cost

DOMESTIC REFRIGERATORS

TESTING PRICES

Prices reflect testing of standard household refrigerators (single-door, double-door, and frost-free) to the local full test method.

TABLE 10: DOMESTIC REFRIGERATOR - TESTING PRICES

Region	Product Category	Applicable or Reference International Test Standard(s)	Source	Price for 1 Unit (USD)
Africa	NA	• NA	NA	NA
Asia	Domestic refrigerators	• IEC 62552 • ISO 7371 • EC 643/2009	Accredited test lab(s), Practitioner	$885 – $2,500
Middle East & North Africa	Domestic refrigerators, Frost-free refrigerators	• ISO 15502:2005 • EC 643/2009 • SASO 2892:2018 • IEC 62552 • ISO 7371	Accredited test lab(s), Practitioner)	$480 – $2,939
Latin America	Domestic refrigerators, Double-door refrigerators	• NOM-015-ENER • ISO 15502:2005	Accredited test lab(s)	$930 – $3,000
Other Regions	Domestic refrigerators	• ISO 15502:2005	Accredited test lab(s), Practitioner	$1,770 – $2,360

DOMESTIC REFRIGERATORS

TESTING PRICES: NOTES FROM THE FIELD

Observed differences in testing prices and potential factors:

- Refrigeration appliance testing is based on monitoring the temperature and measuring the volume of each compartment. Energy efficiency is assessed of one unit relative to another. The presence of more compartments means a more complex test and higher costs.
- The presence of a freezer compartment (as opposed to a single door refrigerator/freezer unit) pushes the price of testing up most significantly due to the need for freezing capacity testing. Testing a freezer or fridge-freezer costs around 50% more than testing a simple refrigerator (per 2018 EU laboratory quotations following the IEC method).
- Some regional policies (including in the EU) include noise testing as part of the regulatory checks (for the energy label), which requires a specialist test chamber, often located separately; this could add 20% to the testing cost if the same lab has noise testing facility but could add 50% to 60% if the test is further subcontracted.
- Shipping products internationally for testing can be problematic in some regions. For example, in Africa, refrigerant charge may have to be removed to comply with rules for safe transportation when travelling into some countries and with some carriers. Doing so could invalidate the legal viability of test results for non-compliant product that can be used as proof for enforcement actions.
- Test procedures and quoted pricings involve the testing of only one appliance, although market surveillance authorities in some regions require test results from a further 3 models if one model fails in order to prosecute a supplier.

TELEVISIONS

LABORATORY CAPITAL AND OPERATIONAL COSTS

The equipment listed are those required for testing televisions using local and regional test methods.

TABLE 11: TELEVISION - LABORATORY CAPITAL AND OPERATIONAL COSTS

Expense Category	Low Estimate (USD)	High Estimate (USD)	Description
Capital Costs			
Product-specific equipment	$16,850	$39,300	Power analyzer, control and measurement equipment, test disk and control software.
Generic equipment (usually pre-owned)	$3,200	$6,700	Voltage stabilizer, ambient temperature controls, meters and sensors.
Accreditation	$5,000		To ISO 17025
Inter-laboratory trials	$5,000		For calibrating proficiency
Operational Costs			
Staffing	2		Minimum number of trained technicians
Space	$25m^2$		Minimum space requirements
Equipment calibration and maintenance	$2,500		Estimated annual cost
Capacity building, staff training, laboratory re-certification, others	$2,000		Estimated annual cost

TELEVISIONS

TESTING PRICES

TABLE 12: TELEVISION - TESTING PRICES

Region	Product Category	Applicable or Reference International Test Standard(s)	Source	Price for 1 Unit (USD)
Africa	NA	• NA	NA	NA
Asia	Televisions	• IEC 62301 • IEC 62087 • EC 642/2009	Accredited test lab(s), Practitioner	\$30 – \$1,000
Middle East & North Africa	Televisions	• EC 642/2009 • IEC 62087	Accredited test lab(s), Practitioner)	\$596 – \$2,939
Latin America	Televisions	• IEC 642/2009	Accredited test lab(s)	\$400 – \$1,470
Other Regions	Televisions	• IEC 60107-1	Accredited test lab(s)	\$1,180 – \$2,360

TELEVISIONS

TESTING PRICES: NOTES FROM THE FIELD

Interpreting testing prices for televisions:

- Despite being one of the most common household appliances, few laboratories with television testing capabilities were identified or reported testing prices for this project.
- The costs to set up a testing facility for TVs can be relatively lower than for other appliances, and primarily depend on the precision level of measurement equipment.

Regional trends:

- The testing methods for TV energy consumption are based on US DOE (US Code of Federal Regulations)/Energy Star; EU (IEC) Ecodesign regulation for televisions (EC) 642/2009, Amended by regulation (EU) 801/2013, Transitional measurement methods 2010/C 114/05, and Standardisation mandate M/544; China Energy Label (GB 24850-2013); India's BEE Schedule No.: 11 for Color Televisions.
- All test methods use similar equipment/test set up and all reference IEC 62087 dynamic broadcast-content video signal.
- There are littler to no laboratories with TV energy performance testing capabilities outside of the US/EU/China combined areas.

Observed differences in testing prices and potential factors:

- Variations in testing costs depend on the test method used, the level of details required, and the requirements for precision. (US and EU - $1,000 – $2,000 typical; China $400 - $1,000).
- Test pricing is independent of screen size but dependent on display resolution or definition. For example, test pricing for 4k can be 10-25% (or more) higher than SD.
- Typical price of laboratory testing covers time required, plus reporting and analysis (for US, EnergyStar testing takes about 1 – 1.5 days and analysis 0.5 – 1 day, for a total of 2 – 3 days).
- TVs with dynamic backlight and picture controls/setting may have factory settings based on the requirements of the region in which they are sold. Even small changes in several settings (backlight or LCD brightness, contrast, volume) can combine to change the measured power consumption, so costs of testing may be in the same range for each region, but measured energy consumption may not be the same for each TV unit because of the different test methods.
- Data from several regions indicates that the price of testing in national laboratories (i.e., owned and managed by public entities) is significantly lower compared to the prices of 3rd party accredited laboratories.

CASE STUDIES: STRATEGIES FOR REDUCING COMPLIANCE TESTING COSTS

In this section, three strategies are presented, each with multiple examples of how programs and governments are currently minimizing costs of implementing compliance schemes for appliance energy efficiency standards and labeling programs. In particular, the examples reveal opportunities for avoiding or reducing costs associated with laboratory testing. The strategies covered include:

- Methods to reduce the need for testing
- Joint testing to minimize laboratory investment
- Simplifying compliance through regional cooperation

These case studies are intended to complement the Laboratory Costs and Testing Price information presented in this report. The information can be used by governments, practitioners, and industry stakeholders as a reference or starting point to aid their assessments of where and how to test products, to evaluate the potential budget implications of testing, and ultimately to make better-informed decisions about how best to allocate resources for S&L compliance activities.

METHODS TO REDUCE THE NEED FOR TESTING

Introduction

Establishing energy performance through product testing is an essential component of any S&L program. Systematic performance testing of products is a critical programmatic investment – the process relies upon internationally agreed upon test methods, sophisticated equipment operated in controlled environments, and experienced technicians. Governments implementing energy efficient policies must consider how to allocate scarce resources to support their testing activities.

S&L programs are typically required to monitor products entering the market and products already on the markets for compliance, usually with a designated budget for conducting market surveys and testing of products. The following case studies from Australia, Denmark, Ghana, and Lithuania highlight examples of how compliance programs can minimize testing needs through strategies such as label and nameplate inspection, document inspection, field check testing, and criteria-based verification testing.

Label and Nameplate Inspection in Ghana

The Ghanaian S&L program[2] requires suppliers to provide proof of compliance with relevant standards, including 3rd party test results, upon product registration, thus ensuring that the program does not need to allocate resources towards initial testing as products enter the market. Using this information, Ghanaian compliance authorities can conduct **nameplate inspections**, wherein they check to see if products are properly labeled and if the information on product labels conforms to the provided laboratory results. The

---

[2] Energy Commission (Ghana). (2019). "Ghana Appliance Energy Efficiency Standards and Labelling Programme." http://www.energycom.gov.gh/efficiency/standards-and-labelling

Ghanaian Energy Commission uses a number of strategies to ensure program compliance, including the following:

- Verification of registration information (for example, the accreditation of 3rd party laboratories used by suppliers).
- Market check for compliance with the requirement to display labels.
- Market check for mislabeled products, or 'suspicious-looking' labels (wrong format, colors, language etc.)
- Verification of product "nameplate" information compared to the information suppliers' provided during the registration process.

By requiring test results from an accredited 3rd party laboratory before allowing products onto the market, Ghana reduces the number of non-compliant products on the market. The subsequent label or nameplate inspections ensure that, at a minimum, products are properly labeled.

Document Inspection in Denmark

In Denmark, energy-related products covered by legislation regarding energy labeling and Ecodesign must be inspected to ensure that they meet the given requirements when placed on the EU market. Activities conducted by the Danish Secretariat for Ecodesign and Energy Labeling include both inspection of supplier's' own documentation for products as well as measurements of randomly selected product units in a test laboratory. This information is also shared regionally in order to increase cost efficiency and improve market surveillance overall.

One of the compliance checking options under EU regulation is **document inspection**. As an EU Member State, Denmark uses this as one of its key means to reduce requirements for, and therefore the cost of, lab testing. The Danish market surveillance authority usually begins inspection of a product series by conducting low-cost document inspections of several models. In cases where the documentation is clearly non-compliant, indicating the product does not comply with the applicable regulation, enforcement actions can be taken immediately without needing to test the physical product in a lab. In addition, a supplementary risk analysis (assessment of possible non-compliance) is made so that expensive testing is limited to those products judged most likely to be non-compliant. Some of the assessment factors include the brand's performance in previous inspections and the inspector's overall impression of the presented documents (credibility, transparency, issuer of documents).[3]

Field Check Testing in Lithuania

Lithuania's market surveillance program is a part of its non-food products program operated by the State Non-Food Products Inspectorate, and covers both energy-using and non-energy products. The Inspectorate's main objectives are to conduct market surveillance of non-food products for compliance with marking/labeling requirements, safety, and to investigate consumer-related complaints. The Lithuanian Market Surveillance Authority uses low-cost **field check tests** as one means to reduce the cost of lab

---

[3] Danish Energy Agency. (2019). "Energy Requirements for Products." https://ens.dk/en/our-responsibilities/energy-requirements

testing. Instead of the full suite of full laboratory tests, which may include long-term testing or other time and/or labor-intensive procedures, field check tests are designed to measure those key performance parameters which can act as indicators for a product's overall performance or compliance risk.[4]

One example is measurements of standby and off-mode consumption by inspectors using a hand-held instrument when visiting shops. Field staff can usually access appliances without moving them and complete the measurements quickly. Field check testing can be completed without significant testing costs beyond the initial purchase of measuring instruments and costs to train field staff. While small hand held power meters are not as accurate as the instruments used for full compliance testing, they are suitable for identifying non-compliant products. Results obtained in this manner are good enough to inform subsequent risk analyses used to decide which models have higher and lower risks of non-compliance, thus ensuring that costly full-scale laboratory testing is limited to those models most likely to be non-compliant. Field check testing still requires trained technicians who can interpret results in the field, and in many cases – quality equipment with a degree of precision, calibrated or matched to their laboratory counterparts. Note that different products will require different types of field check testing approaches.

Criteria-Based Verification Testing in Australia[5]

Under the Greenhouse and Energy Minimum Standards (GEMS) Act, products regulated for energy efficiency in Australia and New Zealand must be registered and meet a number of legal requirements, including Minimum Energy Performance Standards (MEPS), energy rating label requirements, or both, before they can they can be sold on the market. In Australia, the responsibility of ensuring product compliance and monitoring the market for non-compliance in more than 24 product categories falls to the GEMS Regulator. To identify and deter non-compliance, the GEMS Regulator uses a combination of strategies and responses, including criteria-based verification testing, market surveillance, and investigation of suspected non-compliance.

Criteria-based verification testing encompasses a combination of screening and testing to ensure market compliance while minimizing actual testing costs. National Association of Testing Authorities (NATA) accredited or affiliated bodies based in Australia or overseas conduct verification testing on behalf of Australia's GEMS Regulator. Annually testing every registered model from each product type is not feasible, so a cross-section of models on the market is selected for verification testing. Rather than choosing models randomly, the GEMS Regulator has developed a criteria-based approach to verification testing, based on market intelligence and risk. The GEMS Regulator prioritizes models for verification testing based on:

- Information and intelligence on the model's actual energy efficiency performance
- Brands with a history of non-compliance or lack of verification testing history
- Product types with a history of non-compliance
- Test labs with a history of publishing inaccurate test reports
- Models with a large market share

---

[4] State Non-Food Products Inspectorate under the Ministry of Economy of the Republic of Lithuania. (2016). "Market Sectorial Surveillance of Non-Food Products Program in Lithuania." https://slideplayer.com/slide/5720940/
[5] Australia and New Zealand Energy Rating Website. http://www.energyrating.gov.au/

- Product types that use more energy or produce more greenhouse gases
- Models make high energy efficiency claims relative to competitor models
- Newly regulated products
- Models not recently tested by the GEMS Regulator

In Practice: From January 1, 2018 to June 30, 2018, the GEMS Regulator tested 54 models across 11 product categories regulated under the GEMS Act. In total, 89% of products passed the Stage 1 testing. The 6 models that failed Stage 1 testing underwent a second round of testing. Three models (6%) that underwent Stage 2 testing failed and had their registrations canceled.

GEMS Regulated Product	Stage 1 Pass		Stage 1 Fail	
Clothes dryers	4	100%	0	0%
Dishwashers	9	100%	0	0%
Electric motors	10	100%	0	0%
Gas storage water heaters	1	100%	0	0%
Household refrigerators/ freezers	8	100%	0	0%
Televisions	2	100%	0	0%
Clothes washers	8	89%	1	11%
Air conditioners	4	80%	1	20%
Transformers & electronic step-down converters for ELV lamps	2	67%	1	33%
Electric storage water heaters	0	0%	1	100%
Incandescent lamps	0	0%	2	100%
Totals	**48**	**89%**	**6**	**11%**

Australian Government GEMS Regulator. *GEMS Act Compliance: Check Testing Results January 2018 to June 2018.* http://energyrating.gov.au/document/report-check-testing-results-january-june-2018

By utilizing a criteria-based approach to verification testing, Australia can identify and test those models with a higher risk of non-compliance and those products which, if non-compliant, will have a large impact on energy consumption and greenhouse gas emissions. A random approach to model selection may prevent identification of many non-compliant models.

Lessons Learned/Takeaways

These programs have chosen strategies that include testing of products in order satisfy their regulatory requirements, while meeting their particular market characteristics. By relying on these innovative strategies, these programs have been able to successfully survey and test products in their markets while keeping the actual costs to the compliance programs low.

JOINT TESTING TO MINIMIZE LABORATORY INVESTMENT

Introduction

On-going and extensive laboratory testing of products is required to obtain the data needed for development of minimum energy performance standards (MEPS), labeling specifications for energy consuming products, and the establishment of national energy baselines, especially for new or emerging product categories. These activities can incur significant costs if conducted in commercial, specialized laboratories, or may not be possible in the case of emerging technologies. Governments are increasingly considering building national testing facilities to support their S&L program and compliance needs. However, this can be a costly and unsustainable investment if there are no defined business plans to expand services to other countries or regions or to serve multiple program needs. The costs of building and sustaining national testing capacity may outweigh the costs of shipping and testing products in foreign commercial or government-owned laboratories. In order to realize required testing, Sweden, the U.S., the International Energy Agency, and Singapore adopted strategies to leverage available resources, including the use of national laboratories, mutual recognition agreements (MRAs), and international cooperation.

Sweden's TestLab

In addition to national programs, the Swedish Energy Agency (SEA) is responsible for work concerning EU directives on energy labeling and Ecodesign. This work includes developing new methods and drawing up new laws and regulations for appliance labeling and standardization. SEA staff also conducts market surveys and spot checks of appliances to ensure that information on the energy labels provided by manufacturers is correct.

The SEA has a product-testing laboratory, TestLab, which was originally developed for another authority that undertook performance testing of consumer products. When this laboratory was transferred to the SEA, the SEA was able to further develop the lab's equipment and staff skills to enable full energy efficiency testing at an authoritative level for a range of appliances. Because the lab is equipped with state-of-the-art facilities, the SEA can conduct original research tests on appliances, and new or emerging technologies. The test results are shared to help manufacturers with product development and to guide consumers in making long-term decisions, both in buying new products and in using them. A large part of the work at TestLab focuses on new laws and regulations for labeling and standardization, as the EU Directives concerning Ecodesign and energy labeling require energy and environmental expertise that is not easily found elsewhere or is available at much higher costs from the private sector.

Joint Verification Testing and Energy Efficiency MOUs in North America

The US Department of Energy (DOE) follows a four-phase, prescribed process when reviewing and developing energy-efficiency standards for appliances and equipment. DOE currently covers more than 60 different products. Laboratory testing is needed to determine the technical characteristics of these products, including their energy performance. Test results are then used by DOE to inform policies to improve efficiencies, determine the impact of such policies, and identify any need for new test methods.

To leverage regional testing resources, DOE and Natural Resources Canada (NRCan) have a broad Memorandum of Understanding (MOU) covering road transportation, energy efficiency, and alternative fuels. The MOU provides a formal mechanism for negotiating and harmonizing North American policies on these areas, and a framework for joint projects and studies in areas of mutual interest. The MOU also allows joint access to technology assessments and energy efficiency-related studies, including test results, conducted by DOE national laboratories or by Canadian research institutions.[6]

DOE and US EPA have a joint verification testing programs in support of the ENERGY STAR program to minimize duplicate testing where appropriate.[7] DOE also works with industry associations to leverage their activities in support of market surveillance and verification activities. For example, DOE has an agreement with the Association of Home Appliance Manufacturers (AHAM) to refrain from conducting verification testing on models that are part of AHAM's verification program, including clothes washers, dishwashers, residential refrigerators, refrigerator-freezers and freezers, or dehumidifiers, so long as AHAM meets several requirements including for testing and reporting results.[8]

IEA 4E SSL Annex and the LED Market

Solid-state lighting (SSL) has the potential to provide high-quality, energy-efficient lighting that surpasses traditional technologies and offers a lower life-cycle cost. There is potential for there to be a wide variation in the performance and quality of SSL products entering the international market, and poor-quality products could undermine consumer confidence in SSL, delaying market penetration and the associated energy and environmental benefits. As SSL is a new product category, assessment of product performance and quality is dependent on the development and wide acceptance of laboratory test methods and test results. The IEA 4E SSL Annex[9] was launched in 2010 as a joint initiative of nine countries aiming to address the policy needs of the SSL market: global agreement on SSL testing standards, mutual recognition of test results, and accreditation programs.[10]

The IEA 4E SSL Annex is working with testing laboratories and accreditation bodies to address these challenges. For instance, it produced a common proficiency test that testing laboratories can use to compare their LED product testing performance (integrating sphere) with other laboratories around the world, and which regional accreditation bodies can use in support of mutual recognition of other accreditation programs. This measure lowers accreditation and product testing costs for LEDs. The next phase of this work, launched in June 2017, is to develop a similar global inter-laboratory comparison for

---

[6] U.S. Department of Energy, Office of International Affairs. (2014). "Natural Resources Canada and DOE Announce Enhanced Energy Collaboration." https://www.energy.gov/ia/articles/natural-resources-canada-and-doe-announce-enhanced-energy-collaboration
[7] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. (2019). "Energy Star." https://www.energy.gov/eere/buildings/energy-star
[8] U.S. Department of Energy. (2013). *AHAM verification letter.* https://www.energy.gov/sites/prod/files/2013/12/f5/aham_verification_letter.pdf
[9] IEA Solid State Lighting Annex. https://ssl.iea-4e.org/
[10] Current sponsoring governments include Australia, Canada, Denmark, France, the Republic of Korea, Sweden, the United Kingdom and the United States.

goniophotometers. Current sponsoring governments of the SSL Annex include Australia, Canada, Denmark, France, the Republic of Korea, Sweden, the United Kingdom and the United States.

Bilateral MRAs in Singapore[11]

In Singapore, in support of the country's Mandatory Energy Labeling Scheme, refrigerators, refrigerators/freezers, room air conditioners, clothes dryers and televisions are required to be tested, registered and labeled in accordance with the Energy Conservation Act of Singapore. As part of this process, suppliers seeking to register a product must submit a test report to the National Environment Agency (NEA). To ensure that local testing capability is not a limiting factor for suppliers seeking to register a product in Singapore, the NEA accepts reports that come from test labs accredited by the Singapore Accreditation Council (SAC), from locally accredited test labs in foreign countries where the accreditation bodies have signed an MRA with the SAC, or from manufacturer's in-house testing labs. Rather than investing in increasing the number of locally accredited testing facilities, Singapore's method of utilizing MRAs reduces some of the costs associated with testing, both for registration of new products and during verification testing.

During the first round of verification testing by the NEA in 2014, after randomly selecting 46 registered products on the market and acquiring samples from suppliers, the NEA engaged a SAC accredited local laboratory, M/s TÜV SÜD PSB Pte Ltd (TÜV SÜD), to perform the verification testing. TÜV SÜD tested 26 products locally, and contracted with a laboratory in Guangzhou, China to test 20 air conditioner models. Singapore was able to cost-effectively export some of the testing to China, because the testing company in Guangzhou was accredited by the China National Accreditation Service for Conformity Assessment (CNAS), and CNAS had signed an MRA with the SAC in Singapore. MRAs are a useful tool for Singapore, both in the registration and verification testing process.

Lessons Learned/Takeaways

In these examples, governments and programs operate or leverage test laboratories equipped with high quality test instrumentation and staffed by persons with specialist knowledge. Such facilities are needed to conduct research on appliance performance and evaluate new or emerging technologies. National, accredited testing labs are relied upon to draw up effective new laws and regulations for labeling and standardization, to guide product development, and to assist consumers in making purchasing decisions or adapting their usage of certain products. Commercial or other third-party accredited labs are relied upon for more routine testing needs more appropriate to their expertise.

Investments in testing equipment and expertise can require significant national or international funding. The costs and challenges of product testing and analysis lead many countries to consider the possibility of setting up MRAs with neighboring countries or harmonizing with, or adopting, MEPS from larger markets with which they have strong trade relationships.

[11] CLASP. 2019. Market Surveillance for Air Conditioners: Voluntary Guidelines for ASEAN Member States.

SIMPLIFYING COMPLIANCE THROUGH REGIONAL COOPERATION

Introduction

Establishing energy performance through product testing is an essential component of any S&L program, while compliance schemes play a key role in ensuring that products can satisfy program requirements and meet consumer expectations. The systematic performance testing of products is a critical programmatic investment – the process relies upon internationally agreed upon test methods, sophisticated equipment operated in controlled environments, and experienced technicians.

Governments implementing energy efficient policies must consider how to allocate scarce resources to support their testing activities. The following case studies from the EU, the Nordic states, and Association of Southeast Asian Nations (ASEAN), highlight examples of how some governments and programs share resources to support the development and enforcement of standards.

Large-Scale Regional Cooperation in the EU

In the EU the same energy labeling and EcoDesign (MEPS) regulations apply across the 28 member states. Each member state is responsible for enforcing the regulations through its individual national compliance framework. For the EU as a whole, ensuring products are compliant with energy performance regulations is critical – it is expected that by 2020, full implementation of EU product efficiency legislation will be one of the most important contributions to the EU's energy efficiency target. Official cooperation exists between market surveillance authorities (MSAs) responsible for enforcing EU energy labeling and MEPS, facilitating the sharing of information and other resources, such as product testing.

EU MSA cooperation takes a number of forms:

- *ADCOs*: The European Commission provides funding for MSAs to meet at regular intervals (currently twice a year). These meetings, known as Administrative Cooperations (ADCOs), provide a forum for members to address difficulties in interpreting regulations, share information on their organization, and discuss issues, challenges, and initiatives. Currently, the ADCOs are not used for planning large-scale joint compliance testing or other pan-EU campaigns to support compliance.[12]
- *ICSMS:* The internet-supported information and communication system (ICSMS) is a shared database covering all product regulations in the EU. The database is accessible to all EU MSAs and is operated by the European Commission. Results of compliance inspections and tests are shared on the database in a secure area accessible only to MSAs. This enables EU MSAs to share their inspection results and related information such as test reports, thereby helping to avoid duplication of testing efforts.[13]

---

[12] European Commission. (2019a). "Administrative Cooperation Groups (AdCos)." Internal Market, Industry, Entrepreneurship and SMEs. http://ec.europa.eu/growth/single-market/goods/building-blocks/market-surveillance/organisation/administrative-cooperation-groups_en
[13] Website of the ICSMS. https://webgate.ec.europa.eu/icsms/

- *Joint Inspection and Testing*: Since 2011, the European Commission has funded a continuing series of coordinated projects in which MSAs from the different Member States are encouraged to work together, share plans, and conduct joint inspection and testing activities. So far, there have been four joint actions covering a range of Member States and Products (ECOPLIANT, EEPLIANT1 and 2[14], MSTyr15[15]).

EU co-ordination of market surveillance has provided essential support to MSAs (ADCOs are well-known and well-attended activities), but cooperation has taken time to build and take full effect. Participation in joint actions by MSAs is increasing – each of the four joint actions has had more participating authorities than the previous, and the 5th, which is being planned, will involve more than 25 different authorities. On the other hand, the ICSMS is not universally used, because manually entering test results is time-consuming, and its basic template is set up for reporting safety non-compliances. However, those MSAs working on energy labeling and Ecodesign who use the ICSMS speak enthusiastically of its benefits and are helping to increase awareness among their fellow MSAs.

Regional Cooperation among the Nordic States

Nordsyn is one of the programs of Nordic Cooperation, an institution under the responsibility of the Nordic Council of Ministers. The aim of Nordsyn is to improve Nordic market surveillance of regulations under the EU Ecodesign and the Energy Labelling Directives. Since 2011, the Nordic countries comprising Denmark, Finland, Iceland, Norway and Sweden have co-operated on market surveillance activities via Nordsyn. The steering group includes MSAs of each Nordic country: the Swedish Energy Agency, the Danish Energy Agency, the Finnish Safety and Chemicals Agency, the Norwegian Water Resources and Energy Directorate, and the Icelandic Consumer Agency.

Under Nordsyn, a system for coordination on market surveillance plans was established in 2011, test results and experiences were shared, and the first common market tests were conducted. In 2012, barriers to coordination and solutions for effective cooperation were identified and a secretariat was set up to handle administrative tasks and budgeting, and to prepare meetings and workshops. The secretariat manages day-to-day coordination, information exchanges, efficient sharing of market control plans and test results, and preparation of the coordination strategy, including drafting working methods and commissioning studies.

Since 2013, all of the Nordic MSAs have participated actively to ensure consistent implementation of legislation and to leverage available regional resources. Nordsyn has provided a platform to develop regular cooperation, produce information materials, and jointly perform requested studies. Notable successes of Nordsyn are that Nordic MSAs now continuously share their test results along with feedback and answers from the EU Commission, and more coordinated market surveillance has strengthened the Nordic countries' influence in EU-negotiations.

[14] Website of EEPLIANT. http://www.eepliant.eu/
[15] Market Surveillance Action for Tyres 2015. http://www.mstyr15.eu/index.php/en/

The structured and systematic cooperation of Nordic MSAs under Nordsyn is innovative and allows for improved, wide-ranging, and less costly compliance activities to enforce Ecodesign and energy labeling requirements. Given the impacts and efficiencies that have come out of this multi-country effort, Nordsyn can be a blueprint for further regional cooperation on energy efficiency policy compliance within Europe.[16]

Regional Harmonization in Southeast Asia

The ASEAN Standardization Harmonization Initiative for Energy Efficiency (ASEAN-SHINE),[17] was formed in 2013 with the objectives of increasing the market share of higher efficient air conditioners in the region through harmonization of test methods and energy efficiency standards, adoption of common MEPS, and changing consumer purchasing attitudes in favor of energy efficient air conditioners in Southeast Asia. In 2016, ASEAN-SHINE started working on lighting products with the same objectives and approach.

An initial regional market assessment for ACs, which included evaluation of efficiency policies and regulatory frameworks in ASEAN member countries, led to the development of a regional policy roadmap. The roadmap builds on existing national and regional mechanisms to facilitate the harmonization (or alignment) of critical components of energy efficiency policy at the regional level. Elements of this roadmap include:

- Robust, technology-neutral, and harmonized energy performance standards for ASEAN. All ASEAN economies are targeting the same agreed upon AC MEPS level for 2020, so that each economy can develop a path for future alignment by setting more stringent MEPS and introducing higher performing products.
- Building testing capacity in existing facilities, reducing differences in laboratory testing conditions, and encouraging the use of mutual recognition agreements (MRAs), which increase access to competent laboratories and reduce the domestic expense of testing and certifying product conformity with regional energy efficiency standards.
- Consistent monitoring and verification practices operating at the regional level, including: a coordinated approach to verification testing, establishment of a regional network, industry engagement, increasing the visibility and transparency of compliance activities through information sharing, and development of a regional product database.

In the long run, the ASEAN-SHINE program will help to reduce the cost of testing and market surveillance for both suppliers and compliance authorities.

[16] Energy Efficiency Watch 3. (2016). *Energy Efficiency Policies in Europe: The Nordic Market Surveillance on Ecodesign and Energy Labelling Directive - Nordsyn.* http://www.iipnetwork.org/Case_Study_Nordic_Market_Surveillance_Final.pdf
[17] ASEAN SHINE. https://www.aseanshine.org/

superefficient.org