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ENERGY EFFICIENCY FOR DEVELOPMENT PROGRAM (EE4D)

SUCCESS STORY: ENERGY EFFICIENCY STANDARDS AND LABELING IN SOUTH AFRICA

MAY 2021

INTRODUCTION

Improving energy efficiency is one of the most cost-effective ways to address the challenges of energy security, high energy prices, air pollution, and climate change. For this reason, energy efficiency is often considered a 'win-win' proposition because end users enjoy positive returns on investments while society benefits through increased energy security and a healthier environment. Since the adoption of energy-efficient technologies usually requires upfront investment, which is rapidly paid off over time in the form of lower energy bills, it is important that the cost-effectiveness of this investment is fully understood for energy efficiency programs to receive continued support from policymakers. However, it can be difficult to demonstrate the cost-effectiveness of these investments in developing countries due to a lack of credible data and assessment tools.

The United States Agency for International Development's (USAID's) Energy Efficiency for Development Program (EE4D), in partnership with the Lawrence Berkeley National Laboratory, supports planning and implementation of effective energy efficiency policies for partner countries. EE4D technical assistance tools and research projects help to identify high-priority end uses and technologies, and support the design and implementation of government regulations and initiatives to encourage their adoption.

Just as transmission lines are the infrastructure for power grids, data and analytic methods are the infrastructure for market deployment of energy efficiency at scale. In this case study, USAID's Energy Efficiency for Development Program (EE4D) worked closely with South Africa's Department of Mineral Resources and Energy (DMRE) and the South Africa National Energy Development Institute (SANEDI) to assist the implementation of the country's Energy Efficiency Standards and Labeling (EESL) program. This effort leveraged tools developed by EE4D to collect data and assess the program's benefits, as described in more detail below. The collaboration also brought together international experts on technical specifications, allowing them to share international best practices and provide comprehensive trainings and recommendations for enhancing the EESL program's evaluation, monitoring, and enforcement capacities. As a result of the program's implementation, South Africa will save 1.2 gigawatt (GW) of energy at one-fiftieth the cost of a similarly-sized thermal power plant while reducing CO2 emissions by 6.8 million tons and water consumption by 10 billion liters. Air quality will also be improved by avoiding 3 kilotons of particulate emissions, 60 kilotons of sulfur oxide (SOx) emissions, and 31 kilotons of nitrogen oxide (NOx) emissions per year by 2030.

ASSESSING THE BENEFITS OF ENERGY EFFICIENCY PROGRAMS IN SOUTH AFRICA

BACKGROUND

Due to a combination of factors including aging power plants, slow development of new plants, and steadily rising energy consumption, South Africa experienced widespread rolling blackouts in 2008, which prompted the government to take drastic measures to implement energy saving initiatives. Chief among these was the implementation of an EESL program to reduce wasteful electricity consumption in the residential sector, which represented the largest peak demand of all sectors. In 2011, the Global Environment Facility (GEF), through the United Nations Development Programme (UNDP), awarded the Government of South Africa with a US$4.4 million grant to introduce and implement a mandatory EESL program.

EESL programs are a cornerstone of energy efficiency programs worldwide. They have been implemented in more than 80 countries, covering more than 50 different types of energy-using products in the commercial, industrial, and residential sectors. These programs encourage removing inefficient technologies from the market; deter more advanced economies from dumping older, less-efficient technologies on less developed economies; and empower consumers to make informed purchasing choices. They are essential for transforming markets toward more advanced technologies and fostering innovation.

However, implementation of the EESL program fell behind schedule, leading to a mutually agreed-upon extension of the GEF grant to March 2019. The main reason for this delay was the government's lack of experience in implementing such a program and the lack of accessible, reliable data on potential energy savings. To remedy this, EE4D worked with UNDP to provide technical assistance to DMRE and SANEDI by sharing best practices and deploying tools to prioritize implementation activities. The following two activities were crucial to the success of the program:

DEMAND RESOURCE ENERGY ANALYSIS MODEL (DREAM)

One critical element for an EESL program's success lies in determining the minimum energy performance standards (MEPS) to save significant amounts of energy and help reduce consumers' electricity bills. Technical assessment tools can demonstrate the value of EESL programs by estimating the benefits to consumers and society as a whole. One such tool, EE4D's Demand Resource Energy Analysis Model (DREAM), can provide an estimate of a program's potential energy savings. The EE4D team, DMRE, and SANEDI worked together over a five-month period to customize the DREAM tool so that it could be applied to the South African market. Additionally, a hands-on training session in Berkeley, California, enabled the EE4D team to co-create the tool's development with SANEDI and DMRE, while building capacity for its application to other energy efficiency programs. The training also included sharing international best practices and provided a closer look at the implementation program in the United States with insights from U.S. EESL experts. The training continued remotely to support the successful adoption of the methods and application of the tool in the department's modeling practice. Today, DMRE uses the tool as an input into the EESL regulation decision-making process, and the Energy Planning Unit team includes it in their modeling tools for developing the country's energy plans. For example, DMRE used the tool to assess the energy savings target for the residential sector set by the National Energy Efficiency Strategy and determine further energy efficiency activity. Recently, DMRE also commissioned an energy consumption survey with the University of Cape Town to collect data to supplement and enrich the tool's assumptions.

DATA COLLECTION

One of the initial challenges that prevented implementation of the EESL program was the lack of information about the level of efficiency of the appliances sold in the market and the lack of experience in collecting this type of data. Berkeley Lab developed the International Database of Efficient Appliances (IDEA), which automatically gathers data from online retail sites and compiles it into a repository of information on the efficiency, price, and features of different appliances and devices in markets worldwide. Using this data gleaned from IDEA, the EE4D team worked with local consultants to analyze market data and

The training session at the Berkeley Lab. Photo by Stephane de la Rue du Can.

establish the efficiency baseline of South Africa's appliance market. By comparing current efficiency levels to those required by the new MEPS, it was then possible to estimate the potential energy savings from the program.

BENEFITS OF EESL IN SOUTH AFRICA

Energy efficiency is a least-cost energy resource

This collaboration led to the issuance of a new MEPS which entered into force in 2016 and included scheduled revisions in 2021 and 2023 for seven appliances. The impacts of these standards are expected to result in savings of 7.1 terawatt-hours (TWh) of electricity, equivalent to the total avoided capacity of a 1.2 GW thermal power plant, by 2030. As shown in Figure 1, the equipment with the highest potential energy savings is water heaters (geysers), which are primarily electric-powered in South Africa. MEPS for refrigerators, which were first introduced in 2015 and then revised in 2020, have the second-highest projected energy savings.

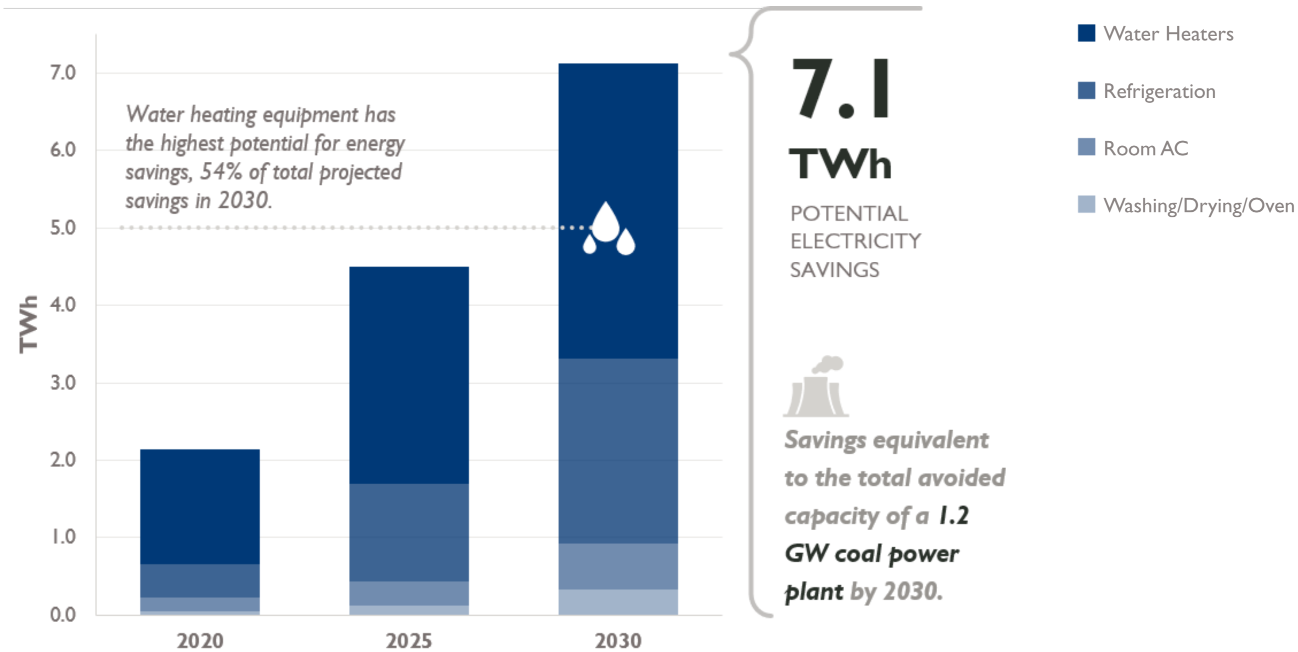


FIGURE 1: PROJECTED END-USE ENERGY SAVINGS FROM MEPS

Source: de la Rue du Can et al. (2020). South Africa's Appliance Energy Efficiency Standards and Labeling Program Impact Assessment. Department of Energy, Republic of South Africa, USAID, Lawrence Berkeley National Laboratory, Sanedi.

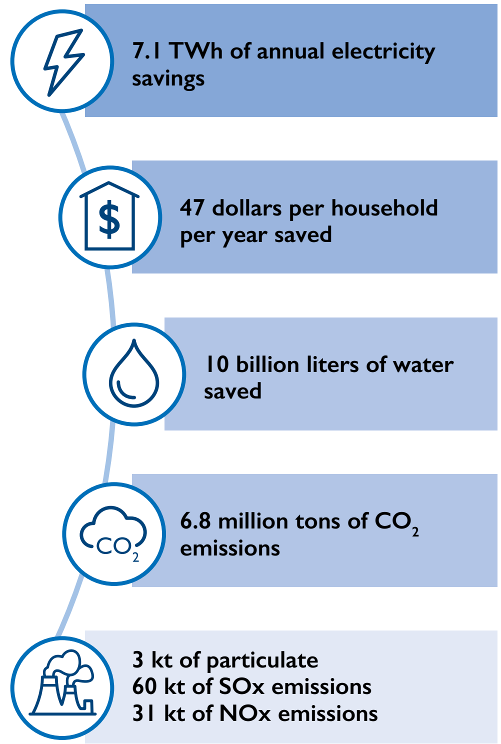
As the program rolls out, EE4D continues to provide technical assistance to the government for developing additional standards. For example, South Africa is considering implementing first-in-the-region technology-neutral MEPS for lighting to eliminate low-efficiency lamps and transform the market to adopt quality LED lamps. If implemented, this program will save an additional 1.5 TWh by 2040, representing an additional avoided capacity of a 250 MW thermal power plant.

Electricity savings also constitute direct savings for consumers. Using the average electricity price of US$0.15 per kWh in South Africa, consumers will save a combined US$1 billion in utility bills in 2030. These savings come with the same level of energy services (e.g., the same level of luminosity, the same level of refrigeration) provided before implementing energy efficiency standards. On average, household utility bills will be $47 lower annually by 2030.

Electricity savings from energy efficiency also offer significant environmental benefits. By 2030, the implementation of energy efficiency standards will reduce CO_2 emissions by 6.8 million tons (Mt), reducing emissions equivalent to the total CO_2 emissions of Zambia.[1] The country will also save about 10 billion liters of water per year by 2030, which would help alleviate stress on South Africa's water supplies from recurring droughts. Air quality will also improve, as particulate emissions will be reduced by 3 kt, SOx emissions by 60 kt, and NOx emissions by 31 kt, which will alleviate the economic and health damages of poor air quality.[2]

Energy efficiency also proved to be a more cost-effective option to address South Africa's energy needs. For example, based on the $4.4 million South Africa received from the GEF and the estimated $8.8 million of in-kind and cash co-financing, it is estimated that the cost of implementing these EESL programs will be US 0.18 cents per kWh. This is much cheaper than the cost to supply an additional 1 kWh, which South Africa's Integrated Resource Plan estimates to be US 7.9 cents per kWh. Comparing these two options, the cost of supplying an additional 1 kWh would be about 40 times more expensive than saving 1 kWh. Therefore, the investment in energy efficiency is much cheaper and can support efforts to reduce electricity tariffs and increase access to affordable electricity to all of South Africa's citizens.

ANNUAL BENEFITS OF THE PROGRAM BY 2030



CONCLUSION AND IMPLICATIONS

Electricity consumption in South Africa comes with a hefty environmental cost to society. For every kilowatt-hour (kWh) produced, 1 kilogram (kg) of carbon dioxide (CO_2) is emitted, 1.4 liters of water are used, and 0.37 grams of particulate emissions are released in the atmosphere. These environmental implications result from the large share of electricity produced from coal (91 percent in 2015). While planned new capacity will ramp up renewable energy, the 2019 Integrated Resource Plan for the country still projects coal generation to be ~60 percent of electricity production in 2030 at an estimated average cost of US 7.9 cents per kWh. Energy efficiency programs provide a cleaner and much cheaper alternative. This case study demonstrates the multi-benefits of energy efficiency and highlights how technical assistance can provide expert advice to develop specific policies and programs, as well as to address information gaps by supporting key datasets and modeling that underpin energy efficiency efforts. Specifically, the study provided credible evidence of the benefits of the program which helped persuade stakeholders of the need for the market to implement minimum energy performance standards. It also helped build capacity at the government level by assisting with implementing and operating an impactful EESL program.

EESL programs are an important entry point in the implementation of energy efficiency programs as they help create a level playing field for manufacturers and importers, where the performance of equipment

[1] International Energy Agency (2021). Country page: Zambia.
[2] Altieri and Keen (2016). The Cost of Air Pollution in South Africa. International Growth Center.

sold can be measured on the same ground. This allows consumers to benefit from clear and transparent information about the energy performance of the equipment they buy, thereby contributing to more transparent markets. The effectiveness of these programs depends on various factors including access to regularly updated data and methods to estimate energy savings potential. Over the past seven years, DMRE, SANEDI, and other key South African stakeholders have built significant capacity to implement EESL programs by working with the EE4D team. Ultimately, they can inform neighboring countries desiring to implement similar programs.

USAID FROM THE AMERICAN PEOPLE

Energy Efficiency for Development (EE4D) provides technical assistance to energy system planners, regulators, and utility managers to overcome challenges associated with implementing energy efficiency programs.

FOR MORE INFORMATION

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EE4D is supported by the Center for Environment, Energy and Infrastructure (EEI) of the Bureau for Development, Democracy and Innovation (DDI) at the U.S. Agency for International Development (USAID).