

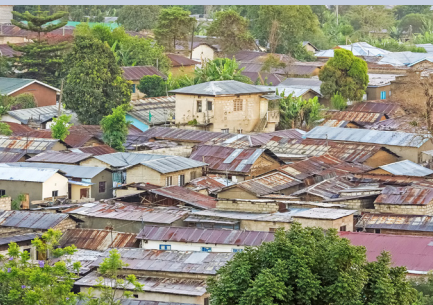


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TANESCO set six indicators to use in evaluating DSM program options:

1. Energy and capacity savings based on the level of estimated achievable MWh and MW potential.
2. Market transformation based on how programs influence their relevant market channels over time.
3. Equity based on how a set of programs would provide DSM options to each customer class within its target sector, and how the total portfolio of programs delivers DSM options to each customer class across all sectors.
4. Political feasibility based on how likely TANESCO and government stakeholders are likely to accept the program.
5. Cost-effectiveness based on program net benefits and utility benefit-cost test ratios.
6. Risk mitigation based on the risks posed by program start-up activities, and implementation.



## DEMAND-SIDE MANAGEMENT (DSM) SUPPORT IN TANZANIA

### INTRODUCTION

Electric utilities often struggle with managing energy demand in the face of insufficient generation and transmission and distribution (T&D) infrastructure. As power providers to commercial, residential, and industrial customers, these utilities are also well-positioned to provide customers with incentives to reduce energy and save money. These programs can alleviate the need for load-shedding and support utilities in meeting the demand of a larger number of customers at a lower cost than adding generation and the associated infrastructure. To take advantage of this demand-side management (DSM) opportunity, utilities need to understand how to design customer programs that will be effective at reducing peak energy demand while supporting economic growth.

In 2013-2014, USAID EECDP conducted a dual work stream project in Tanzania to improve integrated demand side resource planning for the energy sector. The first work stream focused on developing DSM programs to reduce consumers' current and future energy demands. The second work stream focused on a green buildings initiative, a longer-term approach to improve energy performance through energy efficiency and design strategies in buildings. For the DSM work stream, achievable DSM potential was estimated and used to develop seven program recommendations and implementation guidelines. If all programs are implemented, Tanzania could cost-effectively reduce system peak demand 11.5 percent after five years. For the Green Buildings work stream, an energy potential savings and market assessment were used to develop near-term recommendations for expanding green building activities for six commercial building types in Tanzania. If implemented, the modeled green building standard could result in energy bill savings from 10 to 40 percent across all six building types.

### Framework Overview

#### I. Demand Side Management

*Conduct analysis of demand side energy use and develop load profiles*

Tanzania is undergoing a construction boom of commercial buildings with central climate control (as opposed to traditional construction with passive ventilation and distributed air conditioning). These buildings will require an electricity load beyond the current capacity of the Tanzanian power system. Understanding how energy is currently used within a utility's service territory is the first step to developing estimates of DSM potential. The project:



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Estimated total system benefits due to DSM measures implemented over the 2014 to 2018 timeframe equaled \$16.7 million (TZS 26,584,000) in 2018. The *Utility Cost Test Benefit-Cost Ratio* for these programs showed that for every TZS invested by TANESCO in DSM, customers will save 2.4 TZS.

Program recommendations and guidelines for the residential, commercial, and industrial sectors:

- Residential Refrigerator Recycling and Replacement
- Residential Lighting
- Energy Solutions for Commercial
- Commercial Refrigerated Vending
- Commercial Direct Load Control
- Energy Solutions for Industrial
- Industrial Time-of-Use Tariff

- Conducted a literature review of the Tanzanian power sector
  - Collected data from the main power supplier, Tanzania Electric Supply Company (TANESCO) related to operations, business and cost structure, customer base, load, and technical challenges.
  - Collected additional information on the political, economic, and historical contexts of the power sector.
- Analyzed TANESCO's electric meter, demand factor, and power factor data.
  - TANESCO collects data through smart meters on around 16,000 industrial and commercial rate customers.
  - Detailed analyses of these data combined with site audit data allowed for the development of hourly and end-use profiles of each building or facility.
- Developed energy load profiles for residential, commercial and industrial customers
  - Aggregate end-use load profiles for each customer segment were developed using meter data, TANESCO customer data and secondary research.

## 2. Create a DSM measure database and determine achievable potential of the measures

To facilitate uptake of DSM measures by each customer class, a suite of technically and economically achievable DSM measures was developed. This process included:

- Developing a database of DSM measures covering major end use within the residential, commercial, and industrial customer segments
  - For each measure, the DSM potential was estimated using energy and demand savings combined with measure lifetime and costs.
- Determining the technical and economic potential of DSM measures
  - Estimates of technical (the hypothetical level of attainable savings by DSM programs with no economic or market barriers) and economic potential (the level of savings attainable with economic barriers) were determined using ICF's Energy Efficiency Planning Model ("EPPM").
- Determining the achievable potential of DSM measures
  - Taking into consideration financial barriers, lack of awareness, and other market barriers, seven preliminary DSM program options were identified that could realistically achieve cost-effective savings for the 2014-2018 time horizon.

## 3. Develop DSM implementation plan guidelines and recommendations

DSM programs were evaluated for potential energy and capacity savings, market transformation rate, equity across customer classes, political feasibility, cost-effectiveness and risk mitigation potential. Based on this analysis, seven DSM programs were recommended, along with guidelines that provided a basic structure for each program option, and included indicative load and cost forecasts from 2014-2018:

- Residential Refrigerator Recycling and Replacement program removes and recycles old residential refrigerators and replaces them with energy efficient ones.
- Residential Lighting program provides customers with compact fluorescent light bulbs (CFLs) through a "giveaway" program.
- Energy Solutions for Commercial Customers program offers financial incentives and technical assistance to commercial customers to improve their energy efficiency.
- Commercial Refrigerated Vending program works with beverage companies to increase the use of efficient refrigerated beverage vending machines.



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### Examples of Green Building Rating Systems:

- Building Research Establishment's Environmental Assessment Method (BREEAM) claims the oldest and largest program with more than 500,000 registered certificates since its inception in 1993.
- The US Green Building Council's Leadership in Energy and Environmental Design (LEED) program was established in 1998 and is primarily focused on US buildings.
- The Green Star Rating System was originally designed in Australia based on experiences from LEED and BREEAM, and has been adapted for South Africa and most recently Ghana.
- Estidama Pearls was established in 2009 to address particular issues related to green buildings in the Persian Gulf region.

- Commercial Direct Load Control program enables TANESCO to cycle off participating commercial customers' air conditioners (ACs) during periods of peak demand.
- Energy Solutions for Industrial Customers program offers financial incentives and technical assistance to industrial customers to improve their energy efficiency.
- Industrial Time-of-Use Tariff program motivates facility owners and managers to shift electricity use from periods of the greatest demand on the grid to periods of lower demand.

## Green Buildings

### 1. Conduct an energy savings potential assessment for buildings

Green building initiatives can improve energy performance through energy efficiency and design strategies. To determine the energy savings potential for the six commercial building types with the highest energy savings opportunities in Tanzania (medium sized-office buildings, outpatient medical facilities, small restaurants, secondary schools, small hotels and retail outlets/strip malls) the project:

- Determined key building characteristics and efficiency levels
  - Baseline (current practices- established in the DSM project above) and proposed “green building” levels for building energy efficiency features were identified for each of the six building types.
  - Implementation of a “full green building code upgrade” (a package of features that includes efficient cooling equipment, lighting, water heating, windows and building orientation) was estimated to save energy by 11 to 43 percent.

### 2. Conduct a market assessment of the building sector in Tanzania

Promoting green buildings in Tanzania requires understanding guiding commitments to environmental regulation, standards, codes and construction laws, as well stakeholders and their interest and ability to support green building initiatives. To identify gaps, opportunities, and next steps in these areas, the project:

- Analyzed multiple construction policies, practices and infrastructure
  - Research indicated limited capacity to enforce current building regulations and standards and no clear mandates or authorities to create tangible instruments for the installation of green buildings in the country.
  - Public recognition, education, and financial incentives were determined to be the best tools for introducing green building standards, energy-efficient technologies, and other best practices.
- Identified and conducted outreach to stakeholder groups
  - Outreach to five key stakeholder groups (The Tanzania Green Building Council, Public Service Pensions Fund, Watumishi Housing Company Limited, TANESCO and School of Architecture and Design, Ardhi University) to determine their interest and needs for supporting green buildings in Tanzania.
  - All groups expressed interest in supporting green buildings, but required assistance and support through training, education materials, information and guidance.

### 3. Use key findings to develop recommendations to promote green buildings

Tanzania presents a well-positioned market with ready stakeholders to develop green buildings initiatives, but needs to address significant information, technical, and policy barriers. Key findings and recommendations include:



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Commercial building types in Tanzania found to have the highest energy savings opportunities:

- Medium-size Office Building
- Outpatient Medical Facility
- Small Restaurant
- Secondary School
- Small Hotel
- Retail Outlet/ Strip Mall

- Finding – Green buildings offer significant energy savings potential for Tanzania
  - A Tanzania-specific green building standard could be developed based on successful regional models with early focus on the highest savings opportunities in retail outlets and office buildings.
- Finding – Existing regulations and policies do not support energy-efficient or green buildings
  - The lack of regulation and limited enforcement capacity for building construction creates a gap both in the technical guidance and quality assurance infrastructure needed to support green building construction.
- Finding – Stakeholders are already engaged and ready to take action, but need significant support
  - The newly launched Green Building Council (GBC) needs support to develop technical capacity, and also financial and organizational support to ensure its viability.
  - Many of the stakeholders are well positioned to transform the market for green buildings but need to receive support to address their own priorities.
- Recommendation – Support public recognition, education, and financial incentives determined to be the best tools for introducing green building standards.
- Recommendation – Provide assistance and support to key stakeholder groups (the Tanzania GBC, Public Service Pensions Fund, Watumishi Housing Company Limited, TANESCO and School of Architecture and Design, Ardhi University) for training, education materials, information and guidance.
- Recommendation – Conduct further collaboration and support for the three major stakeholders (Tanzania GBC, TANESCO, and Ardhi University) as the most effective way to reach the broader community and leverage critical opportunities for energy savings through green buildings.

### Project Accomplishments

- Created a suite of DSM programs based on analysis of demand side use in the power sector
  - Developed energy load profiles for residential, commercial and industrial classes based on meter data, TANESCO customer data and secondary research.
  - Created a suite of technically and economically achievable DSM measures and determined the achievable potential of the measures for the 2014-2018 time horizon.
- Developed seven DSM programs for the residential, commercial and industrial sectors along with guidelines that provide a basic structure for each program option, and include indicative load and cost forecasts
  - If implemented, the portfolio of projects could save a total of 142 GWh, and 153 MW, by 2018. This is equal to 2.1 percent of forecasted load and 11.5 percent of peak demand in 2018, respectively.
  - Total system benefits due to DSM measures implemented over the 2014 to 2018 timeframe are estimated to equal \$16.7 million (TZS 26,584,000) in 2018.
- Conducted an energy savings potential assessment for six types of commercial buildings, medium sized-office buildings, outpatient medical facilities, small restaurants, secondary schools, small hotels and retail outlets/strip malls



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#### Key findings from codes and standards analysis:

1. National and municipal government agencies, including the Ministry of Works, the Tanzanian Buildings Agency, the directorate of Dar-es-Salaam, and the Tanzania Standards Bureau, are positioned to fulfill the quality assurance needs of green building construction and regulation.
2. There is limited capacity to enforce regulations and standards.
3. Due to the lack of existing regulation, the best tools for introducing green building standards, energy-efficient technologies, and other best practices are to pursue public recognition, education, and financial incentives.

- Determined that implementing a “full green building code upgrade” (a package of features that includes efficient cooling equipment, lighting, water heating, windows and building orientation) was estimated to save energy by 11 to 43 percent.
- Developed recommendations for outreach, technical assistance, and collaboration to promote green buildings based on a market assessment of the building sector in Tanzania.

#### Recommendations for Replication and Scaling-up

- Develop training, outreach programs, technical assistance tools and identify funding to implement recommended DSM programs
  - Residential customers may be unable to recognize or afford high efficiency products that can reduce their electric bills and demand side energy use.
  - Commercial and industrial customers may require education, financial incentives and technical assistance to improve the efficiency of existing facilities or purchase higher-efficiency new equipment purchases and facility upgrades.
- Public recognition can expand outreach and accelerate DSM programs and green building initiatives
  - Development of government standards, regulations and “green” awards can foster rapid adoption of energy improvements and mobilize capital to fund projects.
  - Public support of sustainable initiatives can increase awareness in all customer categories encourage others to participate.
- Establish pathways to address barriers that prevent implementation of DSM programs and green building initiatives
  - Working with government agencies can improve laws, rules, guidelines and regulation of initiatives to improve energy efficiency and develop green buildings.
  - Collaborating with major stakeholders can improve stability and sustainability of interest and support in DSM programs and green building initiatives.



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