TANZANIAN UTILITIES REVIEW BEST PRACTICES IN ENERGY EFFICIENCY FOR INDUSTRIAL CUSTOMERS

WORKSHOP ON INDUSTRIAL ENERGY MANAGEMENT, TANZANIA

DECEMBER 2013 – DAR ES SALAAM, TANZANIA – At the workshop, representatives from Tanzania Electric Supply Company Limited (TANESCO), Zanzibar Electricity Corporation (ZECO), the Ministry of Energy and Mineral Resources, and the Rural Energy Agency reviewed best practices for utility-sponsored industrial energy efficiency programs and industrial energy management. Additionally, representatives from several large Tanzanian industries participated in the workshop.

Experts from Northern Indiana Public Service Company, Southern California Gas Company, ICF International and Cadmus Group presented their commercially-proven energy efficiency programs.

Supported by the U.S. Agency for International Development (USAID), the Tanzania–U.S. Utility Partnership provides capacity building assistance to Tanzania's electric utility through executive exchanges, workshops and technical assistance assignments.

BACKGROUND ON TANZANIA'S POWER SECTOR

TANESCO, Tanzania's national electrical utility, is vertically integrated and has an installed capacity of 1,501.24 MW, of which it generates 39% from hydro-electric and 61% from thermal (gas and diesel) sources. It serves 1.1 million customers, 21% of Tanzania's population. Of the 4.4 billion units of electricity sold in 2012, 48% were sold to large power users.

TANESCO is reviewing energy efficiency (EE) and demand response programs (DSM) for three main reasons: to increase the supply of electricity, to reduce outages during peak demand periods, and to provide industrial customers with cost-saving incentives. The utility's current Power Factor Correction Program and Public Awareness Campaigns have been successful in many ways, such as increased awareness among customers, the installation of

power factor equipment by industrial users, and increased energy saving habits among residential users. Future plans for energy efficiency programs include CFL and motor retrofits, engaging key stakeholders, and building capacity.

While TANESCO's DSM programs have had some success, their achievements are constrained by challenges in collections. Funds are lacking for DSM pilot demonstration and verification projects.

ZECO supplies power to the two islands of Ungula and Pemba mainly through a submarine cable from the mainland. This year, a second interconnector cable began supplying power from Dar es Salaam to Zanzibar. ZECO sells 30% of its electricity supply to large power users.

The utility faces challenges in meeting energy demand and addressing an aging distribution system with high capital costs. Low levels of bill payments by customers, including the government, also pose a great challenge. Current efforts at energy efficiency include arranging customer meetings in rural and urban areas to illustrate the most efficient and cost effective use of electricity. ZECO's future plans include minimizing connection time for new customers, initiating energy auditing in large customers, installing smart meters, and introducing time-of-use tariffs.

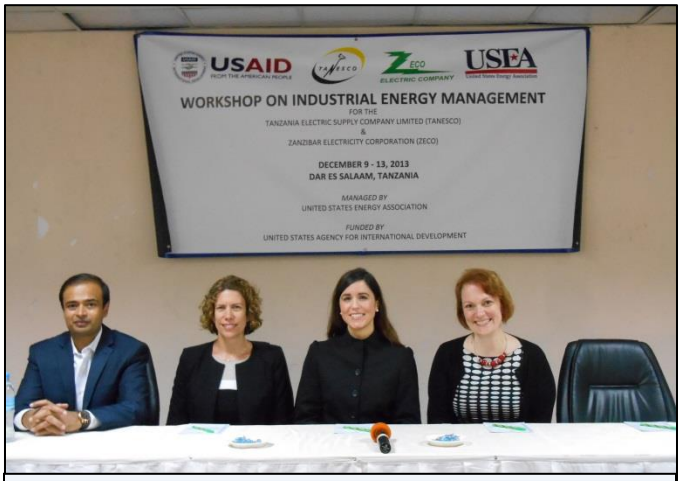
PRIMARY TOPICS OF THE EXCHANGE

Key topics of the four-day workshop included:

- **Energy efficiency programs**
- **Motor and air compressor efficiency**
- **Industrial efficiency at Tanzanian factories**
- **Industrial energy management**

ENERGY EFFICIENCY PROGRAMS

Workshop participants reviewed best practices in EE program design, implementation, monitoring, and evaluation. The presenters introduced several EE program types, such as custom rebates that provide companies incentives to install industry-specific measures (e.g. variable-frequency drives). They advised TANESCO/ZECO to design programs based on customer feedback and cautioned the participants not to become discouraged if new programs do not produce the desired outcome in the first year.



The workshop featured presenters from ICF International, Southern California Gas Company, Cadmus Group, and Northern Indiana Public Service Company.

For the early stages of an EE program, the presenters advised TANESCO/ZECO to develop relationships with customers and communicate the immediate and long-term benefits of EE. Customers are often unaware of the benefits of EE, and are concerned most about program cost and the likelihood that it would disrupt business operations. The presenters also introduced examples of successful EE/DSM marketing campaigns.

Additionally, the presenters introduced several best practices in program monitoring and evaluation. They outlined five different models for measuring cost-effectiveness, such as the Utility Cost Test, which compares the cost of EE to the cost of other sources of electricity supply. They also noted the outcome of any evaluation should feed back into the next planning cycle.

Workshop participants analyzed the cost difference between repairing and replacing electric motors.

MOTOR AND AIR COMPRESSOR EFFICIENCY

Workshop participants also reviewed the technical aspects of motor efficiency. The presenters described the different efficiencies and applications for various air compressors (reciprocating, rotary and centrifugal), combustion systems and electric motors, so that TANESCO/ZECO employees can communicate the technical aspects and benefits of EE to customers.

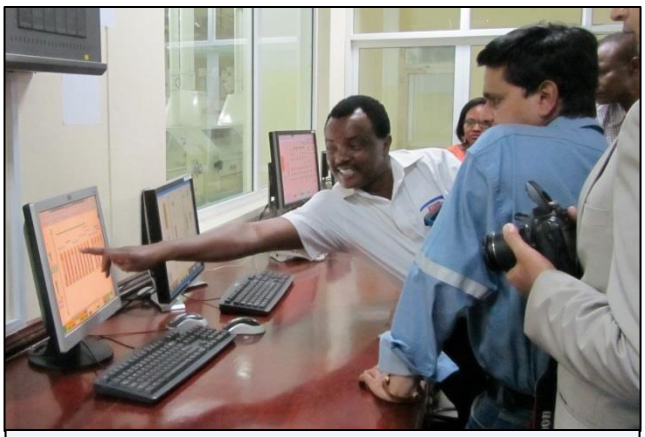
When evaluating the cost-effectiveness of electric motor replacement versus repair, industrial users should account for losses that accumulate from multiple rewinding. Repairing (rewinding) an electric motor involves the cost of repairs and the additional cost of lost efficiency over the lifetime of the motor (typically 1-5% per rewinding). Oftentimes, the cost of buying a new, more energy efficient motor is offset by energy savings in the long run. The presenters demonstrated this principle with a series of cost calculations based on different scenarios.

INDUSTRIAL EFFICIENCY AT TANZANIAN FACTORIES

To better understand the opportunities in energy efficiency, the participants toured three local factories that represented Tanzania's large industrial customers. On the first tour, participants visited the Urafiki textile mill. While the factory is beset by aging equipment and financial problems, the factory representative expressed interest in increasing energy efficiency. Workshop participants remarked on the value of visiting these older facilities, to better understand the conditions and needs of their industrial customers.

Participants toured a textile factory in need of major energy efficiency upgrades.

The next tour was held at a flour milling factory of the Bakhresa Group, one of the largest industrial companies in Tanzania. The mill employs many best practices in energy efficiency, including the use of natural light, timers, and occupancy sensors for interior illumination. Another example of Bakhresa's forward-looking use of EE technology is the factory's variable-frequency drives, which adjust a motor's speed to closely match output requirements, resulting in typical energy savings of 10 to 50%.



Bakhresa Group employees showcase the mill's use of computer-controlled variable-frequency drives for increased motor efficiency.

The last tour was hosted at the Tanzania Cigarette Company, where factory guides spoke about their on-site, gas-fired boiler and generator. This cigarette factory, like many factories in Tanzania, owns and uses their own generation due to concerns about the reliability of the national grid. The tour further convinced TANESCO/ZECO that improving grid reliability through DSM and EE measures will help them attract more customers.

INDUSTRIAL ENERGY MANAGEMENT

In the workshop meetings, the participants reviewed in detail the tools available for industrial energy management. Presenters from ICF International and Southern California Gas Company used the previous days' site visits as case studies in energy management opportunities. They analyzed TANESCO's

load profile to demonstrate how DSM for large industrial customers could shift load and provide for more grid stability.

Haider Khan from ICF International (standing, left) and Joseph Chilambo from TANESCO (standing, right) role-play the steps for enrolling customers in a DSM program.

Additionally, the presenters introduced energy savings calculator software used at Southern California Gas Company. The calculators are a marketing tool for utilities to demonstrate to a customer the amount of money it could save using certain EE programs and technologies. The TANESCO participants were very interested in using this software for their own operations.

Finally, the presenters focused on company culture, by challenging TANESCO and ZECO employees to reorient their mission statement towards a more service-centric perspective. They encouraged the participants to think about EE and DSM as a service to their customers.

BEST PRACTICES INTRODUCED

Over the course of the program, the workshop participants learned numerous best practices in energy efficiency and industrial energy management. Beyond the topics of EE and industrial energy management, the exchange also highlighted issues in customer relations and the integration of renewables into the distribution system.

Through the course of the workshop, presenters introduced the following best practices:

Energy Efficiency: Program Design and Implementation

- Learn from previously implemented programs and customer feedback.
- Keep it simple and start with one program, such as a custom rebate, which is a rebate that provides companies with incentives to install industry-specific measures (e.g. variable-frequency drives).
- Include the following program processes: experiments, pilot programs, full-scale programs, measurement & verification, and evaluation.
- Use the five best practice models for evaluating cost-effectiveness of an energy efficiency program: Utility Cost Test (UCT), Ratepayer Impact Measure Test (RIM), Total Resource Cost Test (TRC), Societal Cost Test (SCT) and Participant Cost Test (PCT).
- Communicate the benefits of energy efficiency to customers.

Energy Efficiency: Technical Advice for Motor and Air Compressor Efficiency

- When making a decision about replacing versus repairing an electric motor, consider the total cost of materials and energy.
- Rewind motors above 100 horsepower because replacement generally costs more than rewinding.
- Conversely, replace rather than rewind motors smaller than 5 horsepower.
- Avoid multiple rewinding of motors, because efficiency losses accumulate.
- When using an air compressor for industrial purposes, check for and repair leaks, as even small leaks can add significantly to energy costs over time.
- Calculate the cost for specific end uses of compressed air to determine whether an alternative device (e.g. fans or blowers) would be more efficient.
- Use pressure regulators at the end use to minimize oversupply of air pressure.
- Recover waste heat from air compressors, because a properly designed heat recovery unit can recover 50 to 90% of this heat for heating air or water.

Industrial Energy Management

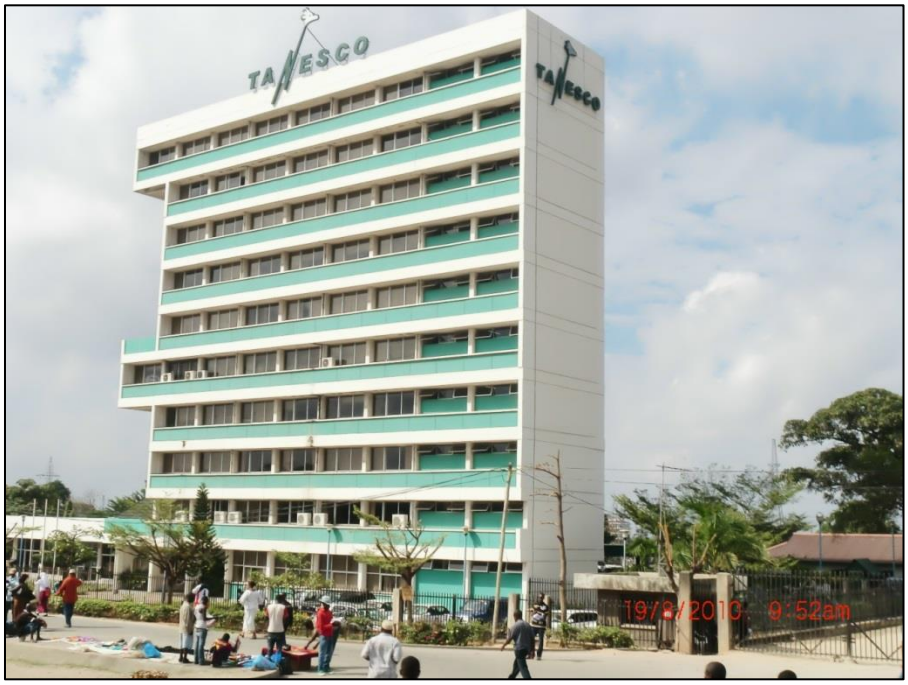
- Use an infrared gun as a simple, low-cost diagnostic tool to look for heat, which represents energy loss.
- Use energy assessments/audits to compare heat containment options.
- Include energy audit training for employees.
- Use natural light or CFLs, timers and occupancy sensors to illuminate facility interiors.
- When it is economical, use organic waste from industrial processes to generate energy.

RESULTS

- ***Finding Opportunities for Energy Efficiency*:** All presenters concluded by highlighting the opportunities that exist to improve energy efficiency for industrial customers.
- ***Implementing Energy Efficiency at TANESCO Facilities*:** TANESCO aims to implement EE/DSM programs at their own facilities.
- ***Using Energy Savings Calculators*:** TANESCO aims to use energy-savings calculators, based on the Southern California Gas Company model, to inform customers about EE/DSM benefits.
- ***Working to Improve Reliability*:** TANESCO recognized the need to use EE/DSM to increase energy supply, improve grid reliability during peak hours, and to attract more industrial customers.
- ***Doing Market Research*:** To design effective EE/DSM programs, TANESCO recognized the need to talk directly with their large customers.
- ***Increasing Customer Awareness*:** TANESCO identified several forms of communication, which they are not currently using, that inform customers about EE/DSM programs, such as online social media, text messaging, bill inserts, websites and community spokespeople.
- ***Establishing Internal Cooperation*:** TANESCO employees expressed interest in forming internal, cross-functional committees for planning and analysis of EE/DSM programs.
- ***Working with Industry*:** TANESCO proposed to hold regular meetings with large power users on EE/DSM.
- ***Including Energy Audit Training*:** TANESCO aims to include training on energy audits for their employees.

WORKSHOP PARTICIPANTING ORGANIZATIONS

1. Ms. Allison Asplin, Senior Analyst, Cadmus Group
2. Ms. Alison Becker, Manager of Regulatory Policy, Northern Indiana Public Service Company
3. Mr. Haider Khan, Technical Specialist, ICF International
4. Ms. Gillian Wright, Vice President of Customer Service, Southern California Gas Company
5. Tanzania Electric Supply Company Limited (TANESCO)
6. Zanzibar Electricity Corporation (ZECO)
7. Tanzania Ministry of Energy and Mineral Resources
8. Tanzania Rural Energy Agency
9. Chemi & Cotex Industries
10. Barrick Africa Gold
11. Bakhresa Group
12. Urafiki Textiles



For additional information, please contact Dan Will at dwill@usea.org or +1-202-312-1242.