ADAPT and SAVE

Implementing Municipal Energy Management Systems

Disclaimer

Energy management systems enable municipalities to reduce and optimise energy usage

Introduction

Municipalities have an important role to play in changing energy consumption patterns and improving energy efficiency, starting with themselves. Municipalities have historically focused on electricity sales to customers as an important stream of municipal income, and have only recently started paying attention to their own energy use.

The long-term sustainability of energy management requires integrating energy efficiency into the municipal operational model, to become the new "business as usual", not simply implementing specific retrofit projects. However, this is difficult given the traditional governance of electricity in municipalities:

- **Energy consumption is invisible.** Energy such as electricity and liquid fuels usage is spread across many facilities, each managed by different facilities managers at the departmental level. Hence, there is no centralised control, monitoring or management of energy usage. As a result, the cost of energy, notably electricity to departments, is obscured in budgets, resulting in electricity becoming a background service that is not specifically managed,

- **Energy is not seen as a cross-cutting issue.** Energy/electricity management is largely left to individual departments but is not aligned to departmental objectives, which means that there are few incentives for reducing electricity. In a compliance-driven culture, individual departments may be unwilling to take on anything that falls outside the departmental mandate – and often lack the competencies and skills needed to implement energy management systems.
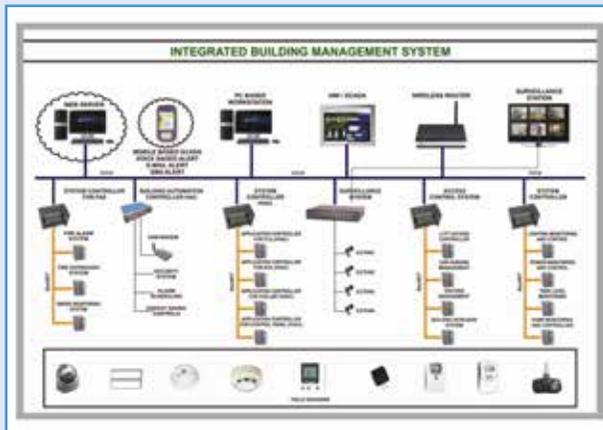
Building management system showing remote control of building equipment

LED streetlights retrofit

Replacing traffic lights with energy efficient LEDs

The process of energy data management starts with identifying the high energy consumers to enable informed action planning
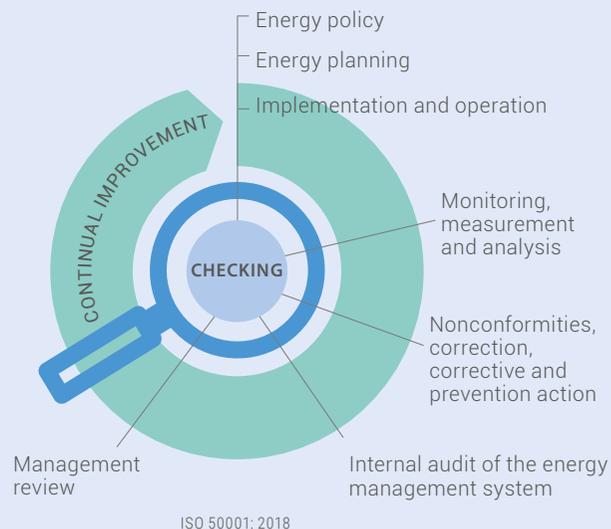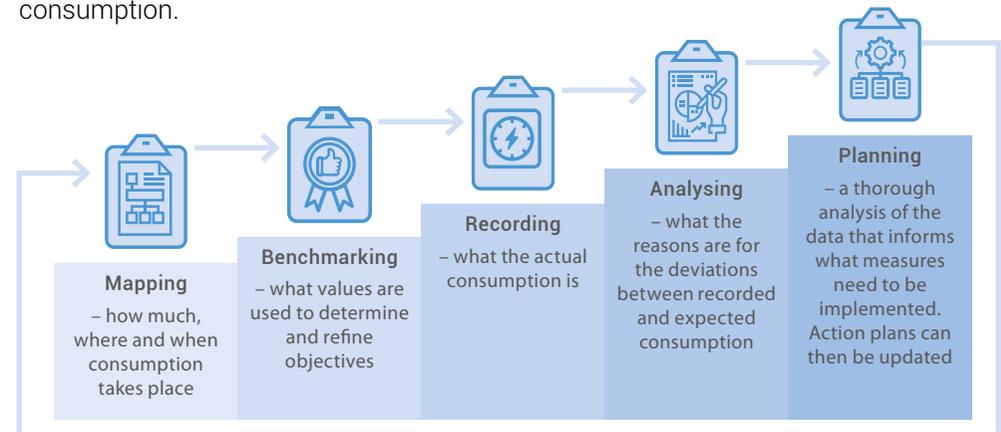
Energy Management Systems

Energy management systems are the key to saving energy – and reducing costs. An energy management is a systematic and continuous monitoring of energy consumption and the planning of actions to optimise it and its cost to the municipality. Energy management brings energy to the fore, making it visible to management through steps that systematically identify usage, planning and monitoring, and through the evaluation of energy management impacts. Energy management systems embed these approaches into policies, procedures and work descriptions, thereby ensuring its sustainability.

The implementation of energy management systems is a continuous process in which targets are set, monitored and then re-assessed on a regular basis. The aim is to start small, with targets and objectives, and then through learning improve the process and scale up initiatives incrementally over time.

By reducing and optimising energy usage, municipalities:

- Save money,
- Reduce carbon emissions,
- Adhere to national energy policies.

Each year, the energy management objectives are refined based on the previous year's results, with the aim of continuously improving energy consumption.

Mapping
– how much, where and when consumption takes place

Benchmarking
– what values are used to determine and refine objectives

Recording
– what the actual consumption is

Analysing
– what the reasons are for the deviations between recorded and expected consumption

Planning
– a thorough analysis of the data that informs what measures need to be implemented. Action plans can then be updated

Energy policy

Energy planning

Implementation and operation

Monitoring, measurement and analysis

Nonconformities, correction, corrective and prevention action

Internal audit of the energy management system

Management review

CHECKING

CONTINUAL IMPROVEMENT

ISO 50001: 2018

The ISO 50001 is a standardised description of an energy management system. It is based on a "Plan, Do, Check, Feedback" cycle, which is process-driven to enable continual improvement. The ISO 50001 defines and addresses the most important requirements for energy use and consumption, including measurement, procurement, documentation, design, equipment, processes and personnel. All of these issues can affect the energy performance of any organisation. The diagram presents a simplified overview of the ISO 50001. "Checking" forms the crux of the cycle, as it includes the day-to-day operations and monitoring (O&M) that are carried out to improve energy performance.

Step-by-step guide to energy management systems in municipalities

Form a dedicated inter-departmental energy committee with an energy champion – this ensures buy-in and integration of best practices across departments.

Gather data to develop a baseline, assess performance, and set goals and targets for departments or facilities – data can be attained initially through billing and walk-through audits, and eventually through meters integrated into an automated energy management or building management system. Identify the significant energy users – these users will be prioritised in policy and planning.

Monitor energy – energy usage should be monitored on a continuous basis to improve data sets and inform the continuous evolution of plans and targets.

Develop a policy and vision – the policy provides the foundation for setting performance goals and integrating energy management into the municipality's culture and operations. Energy management plans need to align with other energy, environmental and climate change policies and plans in the municipality and be included in the Integrated Development Plans and municipal goals.

Create an Action Plan – the plan should identify measures, assign responsibility and set timeframes. The plan is continually updated as more data becomes available and new interventions are identified.

Identify funding needs and sources (e.g. grant funding, loans, Energy Service Companies (ESCos), internal budgets). Action plans should be aligned to financial cycles and the period of the funding. Short-term targets must be included and reviewed annually if the funding is annual.

Implement the Action Plan, which should include training, communications, O&M, monitoring, measurement and diagnostics. Continually monitor the execution of the plan and create traction using communication channels to eliminate barriers as they arise.

Train staff to build the awareness, commitment and capability of those who will implement the projects and monitor the data. Training can also include awareness-raising of building occupants.

Evaluate progress – evaluation results should be used to develop new action plans, identify best practices and set new performance goals.

Report on performance against the established goals and benchmark the results – these include financial savings, energy savings and any other co-benefits achieved.

Review process – policies should be updated and action plans refined using the data.

Energy Management Organisational Model

To successfully implement Municipal Energy Management Systems (MEMS), all levels and departments within a municipality should be involved. At the centre should be the energy management committee, to make decisions and coordinate implementation among departments. It is crucial that the committee is led by (or has the strong backing of) political and administrative heads, to ensure an inter-departmental approach with sufficient resources (staff and budget). To gain political and administrative support requires compelling evidence:

● Energy and cost savings from energy efficiency projects that have already been implemented in your municipality or in other municipalities,

● Energy pricing trends and the impacts of energy efficiency in reducing greenhouse gas emissions.

In reality, municipalities rarely start with such an ideal institutional set-up, but develop it through the process of implementing MEMS and "making the case".

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MUNICIPAL COUNCIL

Provides political support to MEMS implementation.

Delegates authority and responsibility for practical implementation of energy management.

POLITICAL

ENERGY MANAGER

Responsible for coordinating municipal energy matters.
Link between energy responsible persons and central energy function.

ENERGY MANAGEMENT GROUP

Comprises energy manager and departmental heads
Plans and implements overall objectives.
Designates "energy responsible people" in each of the units within the departments.

SENIOR MANAGEMENT

| DEPARTMENT (A) | DEPARTMENT (B) | DEPARTMENT (C) | DEPARTMENT (D) |

Energy responsible person	Energy responsible person	Energy responsible person	Energy responsible person
Energy responsible person	Energy responsible person	Energy responsible person	Energy responsible person
Energy responsible person	Energy responsible person	Energy responsible person	Energy responsible person
Energy responsible person	Energy responsible person	Energy responsible person	Energy responsible person

DEPARTMENTAL

The City of Cape Town at a glance

The **City of Cape Town employs** nearly 30 000 people

owns approximately 1300 **facilities**

and (in 2018) **spent R472.5 million on electricity**

Through energy management, the City of **Cape Town has saved 15%** of its electricity consumption (off a 2007 baseline), **exceeding its target of 10%** included in the Energy and Climate Change Action Plan of 2011.

To date, the investment on energy management has been R230 450 826, which has **resulted in a saving of 201 488 MWh (R1 144/MWh).**
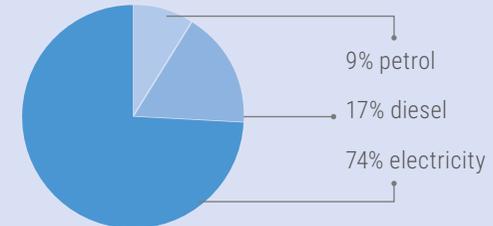
All traffic lights have been retrofitted with LED lamps

44 municipal facilities have been retrofitted with energy-efficient lighting

32% of all street lights have been retrofitted with energy-efficient street lighting

Over 700 smart electricity meters installed in 567 City facilities (41% of the 1300 facilities listed for metering), have greatly improved the City's monitoring and management of electricity consumption
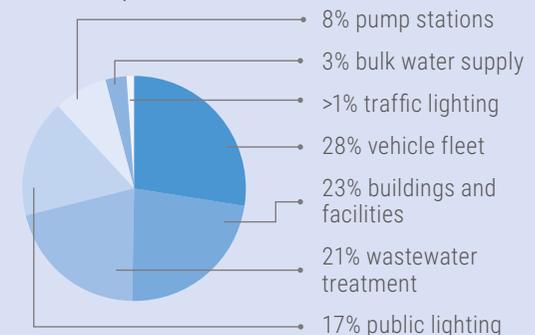
An integrated and automated resource data management system for City facilities, known as SmartFacility, was launched in November 2018. 100 facility managers have been trained to access the real-time electricity and water (for two facilities) consumption data and accompanying dashboards and reports, to enable proactive resources monitoring and management.

ENERGY CONSUMPTION BY ENERGY SOURCE, 2012

9% petrol

17% diesel

74% electricity

Source: City of Cape Town, Eskom

ENERGY CONSUMPTION BY SERVICE SECTION, 2012

8% pump stations

3% bulk water supply

>1% traffic lighting

28% vehicle fleet

23% buildings and facilities

21% wastewater treatment

17% public lighting

Source: City of Cape Town, Eskom

Electricity accounts for **74%** of the municipal sector's energy use, while its **vehicle fleet accounts for 26%**.

The biggest consumers of electricity in the City's operations are buildings, wastewater treatment plants and street lighting.

Government buildings account for 32% of the City's electricity consumption.

Cape Town Case Study

The City of Cape Town has been one of the first municipalities in South Africa to reduce internal energy consumption. The City of Cape Town example shows how municipalities can transition from project-based energy-efficiency interventions to a programmatic energy management systems approach, through the use of an intermediary department to coordinate internal energy projects, which are now embedded within the overall operations of the City.

The role of an intermediary department

Energy efficiency requires an integrated and coordinated response across the organisation in order to achieve systemic change. This change can be driven by an intermediary that initiates projects, mediates, builds relationships, provides platforms for learning and experimentation, and develops visions and strategies.

In the case of the City of Cape Town, the intermediary and institutional champion for much of the City's energy efficiency work was the Environmental Resource Management Department, now called the Sustainable Energy Markets Department. Unlike operational, service-delivery municipal departments that focus on mandate compliance, the department's mandate is strategic – to drive the City's sustainable energy objectives – which enables space for innovation. The early activities demonstrated the financial impacts of energy efficiency projects and the workability of these projects. This led to a commitment from high-level management and the acceptability of these projects in other departments.

Energy efficient vehicle fleet

The City of Cape Town is working towards reducing the energy consumption used by the vehicle fleet. A partnership is being established between the Economic Opportunities and Asset Management Directorate, responsible for the management of the vehicle fleet, and the Energy and Climate Change Directorate. Its aim is to determine the extent of environmental compliance within fleet management in order to reduce the City's carbon emission footprint based on the Energy 2040 goals. Focus areas include a holistic approach that considers electric vehicles procurement, eco-smart driving programmes, alternative cleaner fuels, and reducing the average age of the fleet.

Photo: City of Cape Town

Electricity saving campaign in Cape Town

ENERGY MANAGEMENT

1st demonstration in public building

Audit of 13 buildings

Receive donor funding for retrofitting four buildings

Increase scale of implementation in buildings through National Treasury funding
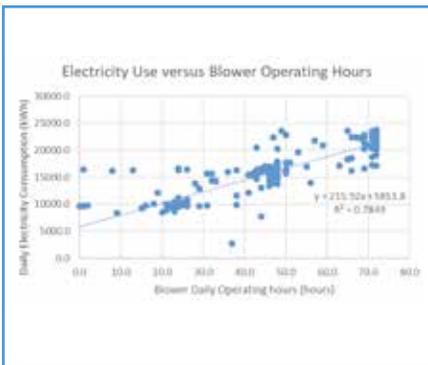
Start of building metering using smart meters and training

Scale up of buildings retrofit

2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016

1st Cape Town State of Energy Report

Energy and Climate Change Strategy

IDP Focus Area: Energy for Sustainable Development.

Political & administrative institutional changes

2nd Cape Town State of Energy Report & 1st Energy Futures study

Energy and Climate Action Plan adopted

3rd Cape Town State of Energy Report & 2nd Energy Futures study.

Energy2040 Vision

Updated Sustainable Action Plan

ENERGY POLICY

DATA COLLECTION AND DEVELOPMENT OF A BASELINE

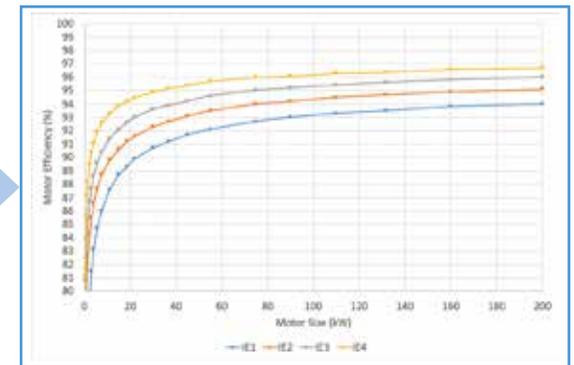ENERGY MANAGEMENT POLICY WITH TARGETS
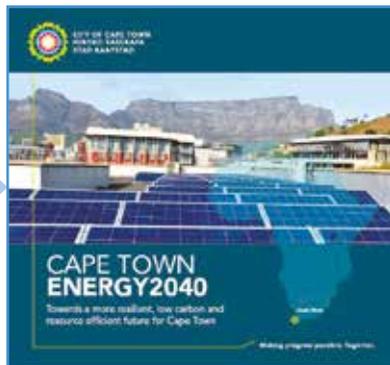
AWARENESS-RAISING AND CAPACITY-BUILDING
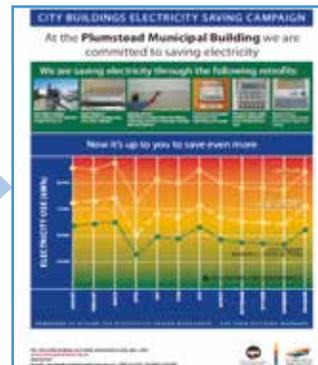
TECHNOLOGY IMPROVEMENTS THROUGH DATA MATURITY

Images supplied by the City of Cape Town

The City of Cape Town's improved data collection has allowed for the continuous update of energy policies and goals, leading to targeted interventions undertaken by better-capacitated staff, and the realisation of energy savings.

Lessons from the City of Cape Town's Energy Management Programme

BUILD THE EVIDENCE BASE

Implement measures through demonstration projects to motivate for municipal funding

Raise the awareness of MEMS by showcasing realised financial savings

Publicise data e.g. State of Energy reports

SHOW THE VALUE

Train and raise awareness e.g. energy management & behaviour change workshops, interactive displays about energy efficiency

Provide technical advice and support to other departments, e.g. business plans, tenders, monitoring processes

Contribute to fulfilling departmental mandates, e.g. reframe projects within the bigger energy efficiency strategy

NETWORK AND ADVOCATE

Make use of national and international networks

Build the necessary political support through engaging with politicians and leveraging networks

Motivate for funding within the City and engage with interdepartmental platforms aimed at optimising facilities and infrastructure management

EMBED IN CITY SYSTEMS

Get commitment from senior staff and develop an internal energy management policy with targets

Assign dedicated staff to implement energy management and include these tasks as part of their KPIs

Stock replacement energy efficient items, as energy efficient technologies should be a critical determinant in Supply Chain Management

The Energy Management Matrix

The table below shows the typical progression of energy management in municipalities and helps assess where they are in terms of energy management performance.

Level	Energy Policy	Organising	Training	Performance Measurement	Communication	Investment
4	Energy Policy, Action Plan and regular reviews have active commitment of top management	Fully integrated into senior management structure with clear accountability for energy consumption	Appropriate and comprehensive staff training tailored to identified needs, with evaluation	Comprehensive performance measurement against targets with effective management reporting	Extensive communication of energy issues within and outside of organisation	Resources routinely committed to energy efficiency in support of organisational objectives
3	Formal policy but no active commitment from top management	Clear line management accountability for consumption and responsibility for improvement	Energy training targeting major users following training needs analysis	Weekly performance measurement for each process, unit, or building	Regular staff briefings, performance reporting and energy promotion	Same appraisal criteria used for energy efficiency as for other cost reduction projects
2	Un-adopted policy	Some delegation of responsibility but line management and authority unclear	Ad-hoc internal training for selected people as required	Monthly monitoring by fuel type	Some use of organisational communication mechanisms to promote energy efficiency	Low or medium cost measures considered if short payback period
1	An unwritten set of guidelines	Informal, mostly focused on energy supply	Technical staff occasionally attend specialist courses	Invoice checking only	Ad-hoc informal contacts used to promote energy efficiency	Only low or no-cost measures taken

Source: The Carbon Trust, 2011

FAQs

How do I set objectives and targets for MEMS?

Targets should be aligned to national and provincial targets for energy and water (e.g. Blue Drop and Green Drop programmes), and linked to the City's energy and climate change targets, if already set. Using this as a basis, energy-efficiency (EE) targets for each sector can be further refined over time, as audits for facilities and buildings are completed and opportunities identified.

How can a municipality with limited staff capacity implement MEMS?

Cities can use interns and maintenance staff within each department to assist buildings and facilities managers with monitoring. As maintenance staff have a good understanding of their systems and equipment, their knowledge should be continually tapped into to pick up anomalies. Training should be provided to these staff on a regular basis, and guidelines (or Standard Operating Procedures) should be developed to enable easy handover to new staff and interns. To motivate staff, the savings and co-benefits achieved should be regularly shared.

How can I develop a baseline?

As a first step, the municipality needs to develop an asset register, which can be refined over time as more information becomes available. Past and current energy consumption can be determined by analysing energy bills of facilities and using sub-meters. From the analysis of energy consumption and usage patterns, baselines can be developed and used as a benchmark for similar facilities and buildings. Different energy performance indicators can be used depending on the applicability and what can be measured e.g. kWh/m^2 year for energy use in buildings; kWh/luminary or kWh/h functioning for public lighting; and L/100 km for municipal fleets. The ESCo can develop baselines through an auditing process.

When is metering necessary?

Energy meters do not have to be installed on all equipment, especially if the energy use does not vary significantly – in which case, a portable meter reading is sufficient to monitor the consumption. This type of measurement is useful for benchmarking and estimating the energy consumption of the same type of facility. In addition, the cost of monitoring should ideally not exceed the estimated savings, except where it is absolutely necessary – e.g. if it is needed to monitor energy performance indicators or a critical parameter.

How can a municipality implement MEMS if there is no funding?

Municipalities should use donor agencies to implement energy-efficiency measures. Then, once savings have been demonstrated, a proposal should be made to Council for an ongoing budget to implement further projects. One option is to use opportunities provided by ESCos through an Energy Performance Contract. Energy management should be implemented in a staggered but methodical approach where priorities have been identified.

Resource: Energy Performance Contracts
http://www.energycontractsupport.org/

Where can I find a list of ESCos?

The South African National Energy Development Institute (SANEDI) and the Department of Energy are in the process of developing an ESCo register, which will contain a list of consultants, installers, auditors, and a list of ESCos that offer financing. More information can be found here
http://www.sanediesco.org.za/

How does a municipality utilise Energy Performance Contracting (EPC) in accordance with the Municipal Finance Management Act (MFMA)?

EPC through either shared savings or guaranteed savings contracts, provides an opportunity to scale up implementation of energy-efficiency projects. Given that these contracts are typically longer than three years, municipalities need to apply Section 33 of the MFMA. This process is often seen as a challenge due to the increased administrative requirements, as municipalities are obliged to carry out detailed financial assessments and impact studies, a comprehensive consultation process, and obtain approval from council and endorsement by National Treasury. The development of Energy Performance Contracting will be supported through the forthcoming Energy Efficiency in Public Buildings and Infrastructure Programme (EEPBIP), led by the Department of Mineral Resources and Energy.

Resource: Opportunities in Energy Efficiency for Municipalities in South Africa, SACN, 2018
https://www.sagen.org.za/publications/62-opportunities-in-energy-efficiency-for-municipalities-in-south-africa/file

Is it necessary to certify my municipality's energy management system with ISO 50001?

While ISO 50001 and other MEMs certification are good and useful standardisations, you do not need to be certified in order to have a good, functioning system. However, the advantage of being certified is that it shows that your municipality is fully committed to maintain and improve the MEMS over time, and, more importantly, ensures the quality of implementation which embodies established "best practices".

Useful Resources

1. UNIDO. 2015. Practical Guide for Implementing an Energy Management System.
    https://www.unido.org/sites/default/files/2017-11/IEE_EnMS_Practical_Guide.pdf

2. Western Cape Department of Environmental Affairs and Development Planning. 2008. A Guide to Energy Management in Public Buildings.
    http://www.cityenergy.org.za/uploads/resource_156.pdf

3. eThekwini Municipality. 2012. Internal Energy Management Policy http://www.cityenergy.org.za/uploads/resource_146.pdf

4. SEA. 2017. Sustainable Energy Solutions for South African Local Government, A Practical Guide.
    http://www.cityenergy.org.za/uploads/resource_434.pdf

5. SALGA. 2017. How to Include Energy Efficiency and Renewable Energy in Existing Infrastructure Grants: Information guide for municipalities.
    http://www.cityenergy.org.za/uploads/resource_435.pdf

6. National Treasury and Western Cape Government. 2013. Energy Efficiency Guidelines: Guide For Municipal Officials in South Africa.
    https://www.westerncape.gov.za/eadp/files/atoms/files/Municipal%20Energy%20Efficiency%20Guidelines%20%282013%29.pdf

7. Mahomed S, Tait L and Kruger W. 2019. Building Energy Efficiency in City of Cape Town Operations. In Scott D, Davies and New M (eds.) *The Role of the Energy Intermediary in Mainstreaming Climate Change in Urban Development: Lessons from Cape Town.* Cape Town, South Africa: UCT Press.

8. ISO 50001:2018. Energy Management Systems – Requirements with Guidance for Use. https://www.iso.org/standard/69426.html