

Revenue protection through systemic management of the energy use of internal municipal operations



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Abstract: Internal municipal operations consume significant amounts of energy, particularly electricity. GIZ, through the South African-German Energy Programme (SAGEN), is working with six municipalities to promote revenue protection through the development of Municipal Energy Management Systems.

At the outset, the six municipalities did not have consolidated energy data management systems. The programme, therefore, established excel systems that combined both internal metering and Eskom billing information for municipal operations. Consolidating this information in electronic form, in line with the fourth industrial revolution, helped the municipalities identify easy revenue saving opportunities such as identifying unmetered points of supply, changing Eskom tariffs and closing accounts for non-municipal and decommissioned facilities. Improved data management also made it possible to systematically identify energy efficiency interventions that could be packaged for implementation, resulting in long term energy savings. The institutional structures established through the programme provide clearer lines of responsibilities and a structured framework for the implementation and monitoring of energy efficiency interventions.

Preliminary results have demonstrated that systematic management of energy underpinned by good data, and an institutional management structure with clear assignments of responsibilities for energy management, supported by the identification and packaging of energy efficiency interventions results in reduced energy costs for internal municipal operations.

Introduction and overview of MEMS support and MEMS itself

Collectively, municipalities in South Africa consume significant energy for their day-to-day operations. This energy is typically in the form of electricity consumed for the provision of public lighting, municipal buildings and various water and sanitation services. Historically, tracking and managing electricity consumption for municipal facilities and services has not been prioritized by municipalities. This is because electricity prices in South Africa were comparatively cheap and the cost of electricity for internal operations when compared to the overall operating budget on the electricity department, was quite small. With increased electricity supply-side constraints in South Africa coupled with increasing pressure on municipal budgets, municipalities are now paying more attention to their own internal costs and usage of electricity.

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), through the South African-German Energy Programme (SAGEN), is working with six municipalities to promote revenue protection through the development of Municipal Energy Management Systems (MEMS)¹. The support programme to establish MEMS in the selected municipalities was introduced in 2019 and is currently ending its first phase of support in October 2021. The main aim of the programme was to support municipalities to set up MEMS and thereby assist municipalities to reduce their own consumption of electricity². The municipalities included in the programme are:

- Cape Agulhas Local Municipality, Western Cape
- City of Mbombela Local Municipality, Mpumalanga
- Elundini Local Municipality, Eastern Cape
- Knysna Local Municipality, Western Cape
- Mahikeng Local Municipality, Northwest
- Midvaal Local Municipality, Gauteng

For the purpose of the programme, a MEMS refers to a structured process to identify energy cost centres, measure energy supply, identify opportunities for energy savings, plan energy-saving interventions, implement interventions and measure and report impact³.

One of the key approaches to setting up the MEMS with municipalities was to recognise that energy management encompasses both technical and non-technical interventions. With this in mind, 7 different components of the MEMS were agreed to with the participating municipalities as outlined in the diagram below. Each one of these components of the MEMS had different activities and outcomes associated with it. For the purpose of this paper, the lessons from the organisation and information system of the programme will be focussed on as they align most closely with the paper theme of “Using Business Intelligence and Smart Technologies”

¹ <https://www.sagen.org.za/support-for-municipalities/energy-efficiency-support-for-municipalities>

² Available online: <https://www.sagen.org.za/support-for-municipalities/energy-efficiency-support-for-municipalities>

³ Available online: <https://www.sagen.org.za/support-for-municipalities/energy-efficiency-support-for-municipalities>

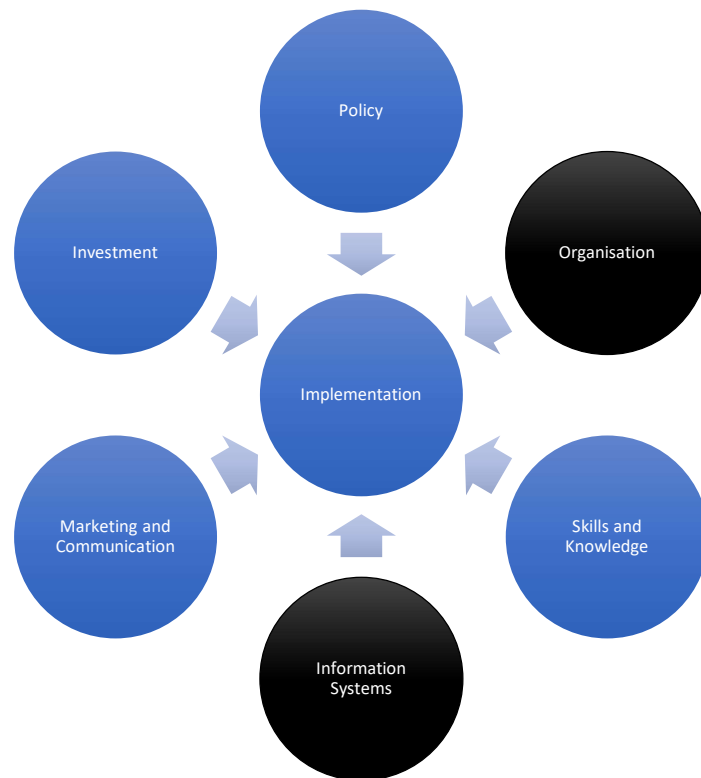


Figure 1: Components of the Municipal Energy Management System

The MEMS support programme also followed the ISO 50001 energy management system approach. The ISO 50001 defines energy management as the “proactive iterative process of tracking and optimising energy consumption to conserve energy”⁴. The ISO 50001 provides a recognized framework for developing effective energy management systems which adopt the “Plan-Do-Check-Act” (PDCA) cycle for continual improvement. The MEMS programme adopts this PDCA cycle and has emphasised it throughout the progression of the implementation.

Baseline in the municipalities

At the outset of the programme, a situational analysis was conducted for each of the six municipalities participating in the programme using an energy management matrix tool which is shown below. The purpose of the energy management matrix tool is to establish the baseline of the municipality concerning the seven components of the MEMS. Establishing this baseline assisted in identifying the most important intervention areas per municipality. For each component, the municipality can score between 1 (indicating that work has not yet been initiated in this area) and 5 (the municipality has put in place all the documents, systems and structures to be successful in the area).

⁴ Available online: <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100400.pdf>

Table 1: The table below is the Energy Management Assessment Matrix used to conduct a situational analysis of each of the participating municipalities

Level	Policy	Organisation	Skills & Knowledge	Information Systems	Marketing & Communicating	Financing	Implementation
5	Energy management policy, action plan and regular reviews, with the active commitment of top management	EM committee with a formal mandate represented by all key departments and dedicated EM post with clear accountability for EM	Multi-year EM staff training programme implemented and tailored to identified needs, with evaluation	Automated energy information system with alarms for anomalies and comprehensive performance measurement against targets	Extensive and regular communication internally and externally of energy issues reporting on progress towards EM targets	Energy cost savings used to leverage additional significant external EM funding opportunities	EM targets as set out in the policy successfully achieved
4	Formal EM policy but no active commitment from top management	Dedicated EM committee established and clear delegation of all EM responsibilities across key staff	Managers receive regular and specific training. Brief awareness training provided to all energy users.	Energy information based on sub-metering at sites updated semi-automatically and used for monitoring and targeting for interventions	Regular internal communication campaigns on EM	Energy cost savings used to leverage internal finance for new EM and energy efficiency projects	Action plan with annual targets and EM interventions with no direct or long payment periods being implemented
3	Un-adopted EM policy	EM discussed regularly at some committees and some formal delegation of EM responsibility for staff	Managers receive regular EM training, and occasional system-specific training.	Energy information database updated monthly with accurate site-specific account details and the information is being used for basic monitoring and targeting	Municipal communication mechanisms used to promote energy management	Annual internal allocation for low- or medium-cost measures considered if short payback period	Detailed action plan with timeframes and budgets and interventions with short payback periods being implemented

Level	Policy	Organisation	Skills & Knowledge	Information Systems	Marketing & Communicating	Financing	Implementation
2	An unwritten set of guidelines relating to EM	Informal responsibility for EM at a staff and committee level	Managers participate occasionally in EM training.	Energy information consisting primarily of billing data and only checked for billing purposes	Ad-hoc informal energy management communication with all municipal staff	External budget (e.g. EEDSM) used for low- or no-cost interventions	Draft EM action plan in place, with some energy audits and some ad-hoc low or no cost interventions
1	No explicit EM policy	No cross-departmental EM committee or delegation of EM responsibility in staff job descriptions	Managers rely on their existing knowledge for EM activities	No system for measuring energy costs or consumptions	No communication or promotion of energy issues with all municipal staff	No internal or external budget used for EM systems or energy efficiency projects	No EM action plan and no projects or implementation taking place

Table 2: The table below is the baseline situational analysis scores of each of the municipalities participating in the programme

Municipality	Policy	Organisation	Skills & Knowledge	Information Systems	Marketing & Communicating	Financing
Cape Agulhas Local Municipality, Western Cape	1	2	1	2	0	2
City of Mbombela Local Municipality, Mpumalanga	1	1	2	2	2	1
Elundini Local Municipality, Eastern Cape	0	2	1	2	2	1
Knysna Local Municipality, Western Cape	0	1	1	1	1	2
Mahikeng Local Municipality, Northwest	0	2	2	1	2	2
Midvaal Local Municipality, Gauteng	1	2	0	2	1	1

What we have done so far

Following the situational analysis assessment, the programme took forward several action areas to assist municipalities to move towards an improved municipal energy management system. Some of the key activities included:

Policy

- The development of formal energy management policies for each of the municipalities. In some instances, these policies were approved by the municipality council.

Organisation

- The establishment of energy management committees for those municipalities that did not have an existing committee through which energy management issues were monitored. To support these committees in their operation the agendas of the committees were structured around the energy management matrix tool so that the committee could monitor the current status of the municipalities with regards to each of the MEMS dimensions and take action to improve municipal performance in that area.
- The identification of the key officials in the municipalities that were taking on energy management responsibilities and ensuring that their job descriptions accurately reflected their energy management responsibilities.

Information Systems

- The establishment of an energy information management tool for each municipality that the municipalities can use to understand their energy consumption, identify energy savings opportunities and track the impact of any implementation measures. To ensure that the municipalities can populate the tool with energy data and use it for analysis going forward a set of standard operating procedures were established for each municipality. The tool was then used to analyze consumption data and accounts. The use of this tool helped identify a range of issues such as:
 - While municipalities largely have meters on their own facilities the meters were often not being read regularly and in some cases, metering readings were not taking place at all.
 - Significant amounts of energy consumption data sit with Eskom and this information is typically supplied to municipalities in the form of hard copy bills. To assist with securing this information in a more user-friendly form discussions were initiated with Eskom,
 - Many municipalities had open accounts with Eskom for facilities that had not registered any energy consumption for several years. Since there are some charges for an account that are not related to consumption these accounts still resulted in costs to the municipalities.
 - Many municipalities had facilities with Eskom accounts that appeared not to be on the most favourable tariff or had a higher notified maximum demand than necessary.
 - In some isolated cases, Municipalities were being billed by Eskom for accounts that were for non-municipal facilities.

Skills Development

- The hosting of an online training programme for all the municipalities in the programme as well as the development of training frameworks for each municipality that can guide the municipality in ensuring that staff have the skills and knowledge required for the implementation of the MEMS.

Communication and Marketing

- The development of communication plans for each of the municipalities that outline approaches to communicating important energy management messaging to staff.

Implementation

- Support to the municipalities to identify energy management intervention projects. For shortlisted projects, detailed concept documents were developed and for priority facilities, energy audits were conducted of the facilities.
- The development of Municipal Energy Management Actions Plans to assist the municipalities in planning, budgeting and monitoring of implementation projects.

Resource Requirements for Municipalities to set up a MEMS

Through the process of assisting the municipalities to establish and improve their MEMS, it was identified that a number of resources are required to get a MEMS system up and running. Based on the experience of the municipalities participating in the process of developing a MEMS the following resource requirements from the municipality itself are required:

- Political champion such as the mayor or a councillor who advocates for the process with the political committees of the municipalities. In terms of time requirements, this would involve participating in a monthly meeting and advocating at related events. (Half a day a month on average).
- A member of senior management who supports the process and advocates for the MEMS at a senior level in the municipality and chairs multi-departmental meetings. In terms of time requirements, this would involve chairing a monthly meeting, preparing for the meeting and advocating for the process in related events. (One day a month on average)
- A technical energy manager who leads the process and is the driving force behind making proposals and identifying technical solutions. This person ideally should be allocated to the MEMS half-time, however in reality this is often split between a number of technical staff. (10 Days a month on average; less in the establishment phase).
- Administrative support that is responsible for arranging meeting logistics and minuting meetings. In terms of time requirements, this would involve arranging and minuting 1 to 2 meetings a month (2 Days a month on average).
- On an ad hoc basis staff from other departments would be required to set aside time for energy management activities of specific relevant to their department.

During the set up and establishment phase of the MEMS only minimal financial resources are required as the work can be done internally by staff. However, in the medium term it will be necessary to secure financial resources for the implementation of a technical interventions identified through the MEMS.

Impacts and results so far

The main impacts and results so far of the project have been:

- **The establishment of an energy management policy and energy management** committees provides a clear mandate for energy management in the municipalities and a proper oversight committee that can identify key strategic actions for future improvement of the MEMS with the municipality. The committees are instrumental for the functioning of the PDCA cycle. Some of the key benefits that result from these committees are:
 - The committees are instrumental in planning ahead with regards to the energy management as well as monitoring and evaluating the implementation of energy management. In particular, the forward planning is done through development of the Municipal Energy Management Actions Plans which identify activities, responsibilities, timelines and budgets/resources for implementation.

- Since the committees bring together staff from various departments they overcome the barriers related to working in isolation. Some energy management actions require a cross-departmental implementation to be successful and the committee provides a place to coordinate that effort. In addition, opportunities for savings are identified through the synergy of staff from different departments sharing information.
- The oversight functions of the committees are important as the act of tracking implementation action ensures that these actions are moved forward and adjusted regularly.
- The committees also provide a structure through which information on energy management as well as the results of energy management actions can be shared. This aids improved decision making.
- **The energy information management tool** was critical to support good decision making with regards to energy management by the energy management committees and key staff. In particular, the tool aids in evidence-based decision making so that savings opportunities can be accurately identified and the impact of any implementation actions on energy consumption (e.g. kWh savings) and costs (e.g. Financial savings) can be quantified. The following opportunities for saving have been identified:
 - There is a potential opportunity for saving through the termination of inactive accounts or non-municipal accounts across the six municipalities. During the course of the programme savings of hundreds of thousands of rand per annum were identified for selected municipalities. It should be noted that each municipality is required to undertake a more detailed analysis of these accounts to understand the reason why they are still active or to confirm they are non-municipal accounts.
 - There is a potential opportunity for saving through changes in tariffs and notified maximum demand (NMD). For instance, in the case of one municipality, NMD changes were estimated to result in annual savings of over R1,5 Million. In the case of another, municipal tariff changes were estimated to lead to an annual savings of around R800,000. Each municipality is required to undertake a more detailed analysis of these accounts to ensure that the energy consumption will be in line with the historical energy consumption that was used to determine the potential savings.
 - There are also a large number of energy savings opportunities that have been identified for municipalities from energy audits that have been conducted of selected infrastructure. The exact scale of possible benefits from various interventions identified in the audits are still being quantified, but is significant.
- The establishment of **Municipal Energy Management Action Plans (MEMAPS)** allows for a better overview of implementation actions, improved planning, better coordination of fundraising activities, clearer monitoring and reporting of actual results (incl. savings in kWh, ZAR etc). These Municipal Energy Management Action Plans outline all the actions to be implemented by the municipality over a rolling three year period. For each action the following information is detailed:
 - Description: A description of an action.
 - Indicators of success: A list of indicators that if achieved prove that the action has been successfully implemented
 - Activities: Activities that need to be undertaken to achieve the action successfully
 - Time frame: The time frame of the action and each of its activities
 - Budget: The budget required for each of the activities per financial year

This information is then used to monitor the effectiveness of implementation as when activities and actions have been completed, those are noted in the Municipal Energy Management Action Plan and in addition it is noted if the indicator of success has been achieved. It is important that the Municipal Energy Management Action Plan is reviewed and updated annually based on ongoing monitoring and evaluation by the Energy Management Committee.

- **The training and communication activities** of the project have supported better decision making and action by the energy management committees and key staff

Barriers and further work

Some of the key barriers that have been identified are:

Policy

- An approved energy management policy establishes the institutional basis for energy management implementation. Some municipalities have not yet formally approved their energy management policies. Once the programme comes to an end a possible barrier to the sustainable implementation of the MEMS is the lack of formally approved energy management policies.
- Since internal electricity costs are sometimes hidden, written off as losses or considered insignificant in comparison to staff costs internal electricity use is often not prioritised for action. In reality, internal electricity costs are a significant cost to municipalities and allow for savings opportunities to free up funds for better service delivery. Once the programme comes to an end a possible barrier to the sustainable implementation of the MEMS is a lack of sufficient motivation to reduce internal electricity costs.

Organisation

- Energy Management Committees are critical structures for motivating to continually implement the MEMS. Some of the municipalities have not set up dedicated Energy Management Committees and the energy management responsibilities are reported on to a more general committee. It is apparent that in these cases the level of motivation for continual implementation of MEMS is lacking. In addition, where the Energy Management Committee do not have senior officials chairing them they tend to be less effective as there is a lack of senior buy-in and support for the MEMS. The funded programme is currently providing a strong impetus for the ongoing management of energy in the six municipalities. Once the programme comes to an end a possible barrier to the sustainable implementation of the MEMS is the lack of sufficient internal senior motivation from the municipalities to continue implementation.
- Some municipalities do not have staff formally allocated to energy management in their job descriptions and others have very few staff allocated to this responsibility. The current programme provides considerable human resources support to the municipalities and undertakes tasks such as convening meetings, documenting meetings, drafting reports and presentations. Once the programme comes to an end a possible barrier to the sustainable implementation of the MEMS is the lack of staff with the appropriate mandate to take forward the MEMS.

Skills & Knowledge

- Some key skills are lacking in some municipalities. In particular, many officials are not comfortable with the use of data management tools. The programme selected excel as the most well-known data management tool, however, many officials are still intimidated by the more complex functionality required for an effective data management tool. In addition, officials sometimes lack the skills to draft the type of reports and presentations required to report back on energy management issues and to propose energy management implementation actions. Once the programme comes to an end a possible barrier to the sustainable implementation of the MEMS is insufficient skills to maintain the energy information data management tool and motivate for energy management implementation actions.

Information Systems

- Before the implementation of the programme energy management information was typically located in three areas: the energy management staff, the billing staff and Eskom. The programme intervened to set up systems to consolidate this information into one energy information data management tool. This tool however requires ongoing updating with the information from the three locations. Once the programme comes to an end a possible barrier to the sustainable implementation of the MEMS is that the linkages established to secure energy data for the tool are not maintained and the tool becomes rapidly out of date.

Financing

- Municipalities in the programme are still not allocating their budgets to energy management implementation actions. While several actions that will result in savings do not require a budget, to achieve significant savings municipal budget will need to be allocated for the implementation of the Municipal Energy Management Actions Plans. Once the programme comes to an end a possible barrier to the sustainable implementation of the MEMS is the lack of financing for the Municipal Energy Management Actions Plans.

Implementation

- Municipalities in the programme in some cases are not adequately funding and implementing routine maintenance activities. This has a negative impact on energy management as in many cases this ultimately results in poor energy management practices. In addition, important energy management activities can be addressed through inclusion in routine maintenance. Once the programme comes to an end a possible barrier to the sustainable implementation of the MEMS is the lack of maintenance effort in the municipality.

The role of Business Intelligence and Smart Technologies

There is an obvious role for Business Intelligence and Smart Technologies to assist municipalities with their Energy Information Systems. Some municipalities are already adopting automatic meter reading (AMR) technologies in their larger infrastructure environments. However, AMR solutions should not be seen as the “silver bullet” for municipal energy information system needs. AMR systems tend to be expensive and difficult to justify for smaller facilities with low energy costs. They also don’t address some systemic problems such as consolidating municipal and Eskom data into one energy data system.

To be effective for municipalities, Business Intelligence and Smart Technologies need to consider the entire municipal energy information system. They, therefore, need to include the following functions:

1. Collect Data
 - a. Be able to combine both AMR and manual readings into one system
 - b. Assist municipalities to collect data from external providers such as Eskom
2. Store Data
 - a. Integrate with and expand on the functionality of the municipal billing system
3. Clean Data
 - a. Assist municipalities in combining data from different sources (e.g Eskom and municipal accounts) into one composite energy data management system
4. Report Data
 - a. Provide municipalities with information that will help identify energy management problems and opportunities across the entire municipal infrastructure environment.
 - b. Assist municipalities with identifying readings that are anomalous or incorrect
 - c. Assist municipalities to understand how estimates are calculated and what impact more frequent readings have on the reliability of estimates.

There is also an important role that Business Intelligence and Smart Technologies can play to assist municipal energy committees to better administer and coordinate energy management interventions. This can be achieved through the following

1. Meeting Origination Automation
 - a. Systems can be put in place to automate the setting up, inviting, and recording participants of energy management committee meetings. This is currently mostly done manually by municipalities for each meeting.
2. Tracking Progress of Interventions
 - a. Systems can be put in place to assist municipalities to automatically or semi-automatically track the progress of interventions and then report these to the committee members regularly.

Conclusion

Since Internal municipal operations consume significant amounts of energy the implementation of Municipal Energy Management Systems provide the opportunity for substantial energy and cost savings to municipalities across South Africa. The Municipal Energy Management Systems programme has demonstrated that there are significant benefits to the establishment of Municipal Energy Management Systems, and that these benefits ultimately result in the identification of energy and cost savings opportunities of significant amounts. The initiation and implementation of Municipal Energy Management Systems at other municipalities is recommended in order to enhance the level and effectiveness of implementation of energy efficiency in municipalities throughout South Africa. This has a two-fold benefit of assisting resource constrained municipalities with cost reduction, as well as helping South Africa to meet global greenhouse gas emission reduction targets.