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Federal Ministry for Economic Affairs and Climate Action

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INTERNATIONAL CLIMATE INITIATIVE

100% RENEWABLES SOLUTIONS PACKAGE

Smart metering

This solution is part of a package of solutions meant to guide local and regional governments in implementing a local renewable energy transition by providing guidance on mechanisms, applications or technologies that can help accelerate their climate and energy action.

It was produced as part of the 100% Renewables Cities and Regions Roadmap project, which supports nine cities and regions across Argentina, Indonesia and Kenya to develop bankable renewable energy projects and in-depth local strategy and action plans to achieve one hundred percent renewable energy. The 100% Renewables Cities and Regions Roadmap project is implemented by ICLEI – Local Governments for Sustainability and funded through the International Climate Initiative (IKI), which is implemented by the Federal Ministry for Economic Affairs and Climate Action (BMWK) in close cooperation with the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) and the Federal Foreign Office (AA).

DISCLAIMER

All cities are unique. The Solutions Gateway has been developed as an advanced knowledge catalogue to provide an overview of possible Low Emissions Development Solutions. The Solutions and Packages it contains provide guidance on general conditions, which may not correspond to the existing conditions in your city or jurisdiction. The consultation and use of the Solutions Gateway does not waive the need for the Local Government to assess the feasibility of a Solution or Package in the local context in its city or jurisdiction, prior to implementation. Please note that the impacts, benefits and co-benefits indicated are generally valid but may not materialize in particular circumstances.

ABOUT SOLUTIONS GATEWAY

Solutions Gateway is an online resource platform for Local Governments where they will be able to find possible Low Emissions Development (LED) Solutions for their cities.

In the context of the Solutions Gateway, Solutions are processes, or groups of actions, which Local Governments can implement to deliver climate change mitigation results and enhance local sustainable development. Taking an integrated approach, and focusing on Local Governments usual responsibilities and roles, Solutions include core actions as well as enabling and multiplying actions essential to maximize their effectiveness and efficiency. These include policy, regulatory, governance, capacity building, awareness raising, stakeholder engagement, etc.

ABOUT ICLEI – LOCAL GOVERNMENTS FOR SUSTAINABILITY

ICLEI – Local Governments for Sustainability is a global network working with more than 2,500 local and regional governments committed to sustainable urban development. Active in 125+ countries, ICLEI influences sustainability policy and drives local action for low emission, nature-based, equitable, resilient and circular development. ICLEI's Members and team of experts work together through peer exchange, partnerships and capacity building to create systemic change for urban sustainability.

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1. INTRODUCTION

As the climate emergency intensifies, and energy demand continues to increase, not only does the source of our energy matter but how we consume it. A number of measures can be deployed by local governments to address energy demand, including greater digitalization through the use of smart grids and smart meters.

Smart meters function by combining metering and communication technologies, measuring resource consumption and then displaying this data, either through energy displays located in buildings or via web-based information portals, as real-time information. This information can be used as a decision-making input for the more deliberate and smart use of energy, with the potential for improving energy system flexibility and decreasing both the power supply-demand gap and greenhouse gas (GHG) emissions.

Smart meters can be applied either in the residential, industrial, commercial or public sectors. For a successful implementation, they must be accompanied by proper regulation, mobilization of main energy players, behavioral changes and informational campaigns to increase consumer's awareness and acceptance.

1.1 RELEVANCE

Public authorities can benefit from smart metering programs especially on the management of quality regulatory programs. The tool provides the managers of the electricity system better statistics and data on performance, reliability, voltage quality and consumption in general, leading to independent access to energy data and the potential for increasing energy efficiency of a city or its public buildings.

The building sector consumes proportionately more electricity than other end-use sectors like transport, industry, and power—electricity demand in the building sector is projected to increase by 70% by 2050, despite improvements in appliance efficiency, because of strong growth in electricity demand (particularly in emerging economies) and increases in the electrification of heating [1].

In light of these facts, it is critical to use tools to balance the energy demand and supply. Increasing efficiency in all forms of electricity consumption, both in usage patterns and quantity, without affecting social welfare and economic activity, are critical to enable the transition to renewable sources of energy.

1.2 MAIN IMPACTS

- Enable smarter energy systems, grids, and/or cities
- Changes in energy consumption behavior are expected to result in a reduction in carbon emissions
- Facilitate demand response by improving its monitoring and communication
- Encourage energy generation in microgrids, such as residential solar photovoltaic (PV) panels or time-of-use tariffs, in order to build a future smart grid in which users are included and receive revenues for services provided
- Allow researchers and policymakers to address urgent socio-economic issues like energy poverty through the generated data (consumption patterns and bills vs geographic localization)
- Introduction of innovative services and products that shift energy usage away from peak demand and/or periods when the generating mix is higher in carbon, to improve overall system flexibility and resilience
- For consumers, increased energy efficiency and changing demand patterns can lead to greater efficiencies in energy consumption and therefore lower expenditures on energy

1.3 BENEFITS

BENEFITS TO THE CUSTOMERS:

- Consumers (including public buildings) get more information about their energy usage and the quality of delivery, and can adapt behavior accordingly
- Bills are more understandable and easily managed
- It allows billing to be based on actual electric consumption in hard-to-reach areas or situations where a site visit is not possible
- Provides remote access to utility company staff, avoiding difficulties and conflicts for readings of meters located indoors.
- Facilitates cost savings through more efficient energy use
- Benefits to the city:
- Cities start to generate and register data related to energy consumption, having a reliable baseline for calculations of the impact of actions
- Facilitate changes of behavior to focus the usage on off-peak hours, reducing load on the electricity system and improving resilience
- Power outages and losses are reduced and easily identified and therefore managed

BENEFITS TO THE UTILITIES:

- Reduction of the demand peaks, avoiding the building of new power plant capacity to meet peak demand
- Remote control leads to better management of customer-related issues and troubleshooting
- Automated and remote meter reading enables electric systems to be monitored more quickly and helps to detect thefts or frauds
- Enabling more efficient use of power resources and dynamic pricing, improving system efficiency
- Optimizing income with existing resources
- Increased information available on low voltage networks
- Operational costs are reduced through greater data availability and efficiency

BENEFITS TO THE ENVIRONMENT:

- Contribute to the proper distribution of existing power usage and, as a result, reduce emissions by reducing the need to rely on fossil fuel plants for peak load generation
- Incentivize renewable energy by facilitating its use and integration into the system
- Indirect reduction of GHG emissions from existing power plants through more efficient generation
- Accurate and updated information on energy use and carbon emissions at the community level

1.4 SUGGESTED INDICATORS FOR MONITORING RESULTS

- Number of smart meters (SM) installed
- Energy saved in buildings due to smart-metering (baseline: consumption prior to the intervention) - KWh/month or kWh/year
- Savings on the energy bills - % (average cost of energy bills after SM/average cost before SM)
- Peak demand shaving (% reduction compared to baseline; GWh)
- For utilities, cost savings on operational efficiencies, including customer service and site visits (local currency or USD; staff hours decrease on notification calls * cost per man hour)
- Improved system performance due to efficient fault detection (improvements in SAIFI/SAIDI)
- Reduction in system losses and theft (GWh; % of earnings)
- Reduced outage notification calls - % (hours spent by staff of notification calls/total hours spent by staff on calls)
- Assessment of the customer acceptance (Net promoter system- NPS- index, for instance)
- Number of people that participate in awareness campaigns (number of people/year; % of households adopting smart meters)
- Number of companies and industries that adopted the technology (number/year; %age of customers served)

1.5 TYPICAL LOCAL GOVERNMENT ROLES

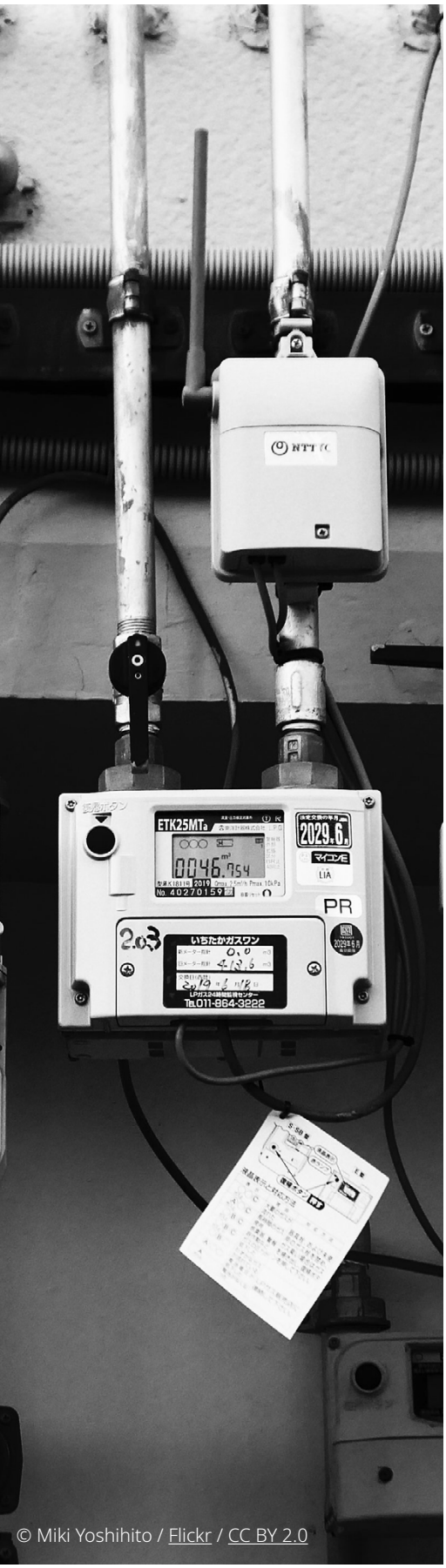
- Policy maker
- Planner
- Legislator/regulator
- Coordinator
- Consumer and procurement
- Operator of municipal facilities and infra-structures
- Mobilization and stakeholder engagement
- Education and awareness raising, professional trainer

2. INTEGRATED SOLUTION OVERVIEW

	Enabler Actions	Required Actions	Multiplier Actions
Policy	• Analyze successful case studies for insights on regulatory best practices and evidence of smart meter efficacy • Conduct viability studies for where smart meters would be most useful • Creation of a risk matrix based on the identification of major risks, their possible consequences, and mitigating measures • Ensuring a participatory process with multiple sectors of society	• Map out the timing and milestones of the smart meter rollout • Provide the appropriate design specifications, commercial and regulatory framework, and supporting activities. • Policies that highlight the advantages of smart meters for consumers and encourage their use • Define the essential and optional services that smart metering should offer • Create regulations regarding smart meter ownership and liability, that defines responsibility and roles for involved institutions • Regulate the disposal of old meterings, considering recollection network strategies • Ensure data protection regulations are being followed and customer data is not misused	• Promote and regulate competition in all relevant markets to foment improvements and generate benefits to the end user • Further support development of smart grids • Create incentives and set ambitious goals for energy savings to foment behavioral change • Addressing interactions with other relevant public policies • Incentives to improve accessibility and affordability of smart meters, ensuring implementation in all low income communities
Stakeholders and Awareness	• Provide information, data and transparency to attract and engage stakeholders, particularly first-movers who might benefit from smart meters the most • Engage the community on the development of analysis of risks and development of solutions • Highlight benefits of the solution to attract and engage smaller consumers such as households	• Deploy informative campaigns about efficiency and energy savings • Create ideas with comprehensive stakeholder participation and put customers at the center of the program • Engage energy poor and vulnerable areas who might benefit from energy savings • Make licenses and industry codes to define the duties, relationships, and economic agreements	• Require suppliers to meet milestones which will allow the smart metering rollout to be completed on time • Create a communication plan for all stakeholders to keep them up to date on program progress and advancements. • Facilitate the approach to smaller non-domestic consumers

	Enabler Actions	Required Actions	Multiplier Actions
Governance	• Define an implementation and roll-out strategy • Ensure adequate congruence between the program's aims and broader public policy objectives • Involving electricity industry and multilevel actors in the project and decision making, in a participatory process • Get practical and technical knowledge that can help make decisions • Set institutional arrangements and technical body to coordinate and execute the pilot project	• Support actions aimed at achieving the timely development and cost-effective implementation of smart metering • Ensure compliance to the data security and privacy protection laws • Create regulations regarding smart meter ownership and liability • Developing and implementing the regulatory framework, that defines responsibility and roles for involved institutions • Ensure that smart metering dependencies are recognized and incorporated in the strategic business case from larger areas of possible public policy value	• Foment future developments, such as smart grids, by increasing flexibility in commercial and regulatory frameworks • Ensure that the important policy goals for smart meter implementation are realized. • Make main results public to key stakeholders, to foment the adoption by other sectors
Capacity Building	• Assess the availability of the qualified labor force • Train professionals and build capacity force especially in the smart metering technologies	• Create informatives guides, documents and trainings to inform stakeholders and consumers • Educate customers ahead of time about smart meter installation, the changes that smart meters will bring, and how to adapt to them. • Absorb the capacity sessions on the on-boarding of new staff • Establish an official technical focal point to support the community on needs and doubts	• Promote research and studies around the topic • Increase relation with university and research institutes

	Enabler Actions	Required Actions	Multiplier Actions
Technical	• The formation and scope of the core data and communications function • Assess the brands and technologies available in the market • Assess availability of blockchain technologies	• To guarantee that the communications infrastructure, metering, and data management systems fulfill all levels of security and resilience criteria • Ensure that the technical requirements regulated by Policy are being delivered to the users. • Make sure that the disposal of the old meters are deployed in a conscious way	• Implement programs for assessment and continuous improvement of the systems • Foment the establishment of local distributors/industry
Finance	• Provide sufficient data and information to deliver the necessary confidence for the industry to facilitate investment • Enable a pilot-project funded by the municipality • Contacting key finance stakeholders for sensibilization • Create an dedicate fund to support users	• To manage the costs and benefits, in order to deliver the net economic benefits • Guarantee the management of costs in a way that none of the stakeholders are overcharged • Assessment of available funding lines and guarantee enough funding • Developing a bankable project with estimated payback time, considering savings that will occur due to energy efficiency	• Attract investments to improve the system and the program in general • Make finance indicators open to the public, such as savings and other impacts • Establish financement lines with local banks and finance institutions, so other sectors can benefit from the case



3. WORKFLOW /PROCESS PHASES

3.1 PREPARATION

- Analyze risks and opportunities e.g. high upfront cost, reluctance by consumers to adopt smart meters
- Assess the availability of resources, the profile of consumers, and operation of the energy suppliers to determine viability of a rollout
- Identify costs (installment, operational, maintenance) and financial status
- Assess market mechanisms for fomenting the technology, and fiscal or other incentives if necessary
- Identify and engage all relevant stakeholders
- Set the milestones, goals and indicators of the project
- Assess financial institutions to support the project implementation
- Draft the governance strategy and new policy/regulations
- Align roles, participation schedule and expectations with the energy supplies
- Assess any regional or national level schemes/policies that support smart-meter rollout
- Ensure there is adequate technical capacity to be able to assess the data generated

3.2 APPROVAL

- Make sure that the current energy and environmental regulations are being followed and ensure the approval of the project by the responsible institutions, when applied
- Seeking the needed approval in the internal escope of the local government, and also in the other level of governments

3.3 PROCUREMENT

- Mapping of available sellers and quotation
- Acquisition of the smart metering infrastructure through a transparent procurement process with clear evaluation criteria

3.4 IMPLEMENTATION

- Development of awareness campaigns
- Define an area and characteristics of a pilot project

- Supervise installation of the smart metering infrastructure for the pilot project ensuring appropriate regulations are being followed
- Monitor the installation of meters to ensure it is progressing on schedule

3.5 MONITORING

- Generate public reports periodically and provide transparent data on implementation progress and outcomes
- Assess and improve indicators
- Create feedback mechanisms for the public acceptance to improve future rollouts
- Ensure the data generated is used to improve service delivery and policymaking, and that there is accountability
- Comply by relevant data protection laws

4. REALITY-CHECK

This solution is applicable for:

- Cities, local communities and territories that need more independence, data transparency and accuracy in managing their energy consumption, decision-making and, establishment of policies
- Policy makers that want to start implementing smart grids and smart cities, facilitating the adoption of renewable energy, increasing energy efficiency and decarbonizing buildings
- Cities that want to control their peak demands and have their energy matrix formed mainly by renewable forms of energy
- Cities that want to build up on decentralized generation projects with a smart grid/data management

4.1 REQUIRED PRE-CONDITIONS

- Funding potential for the program
- For households, the possibility to afford a smart metering infrastructure, smart meters and associated devices like the in-home energy use display
- Existence of a communication and data processing infrastructure
- Data protection and security
- Qualified labor force for installation as well as data processing
- Economic and tax incentives to encourage adoption

4.2 SUCCESS FACTORS

- Support through awareness campaigns to enable consumers to better control their energy usage and spending while reducing carbon emissions;
- Fiscal or other incentives to encourage adoption by various categories of users
- Robust mechanisms to ensure the data is being used to generate energy and cost savings
- Ensure that timely information and appropriate functionality is provided through smart meters and the associated communications architecture;
- Alignment with regional or national level programs

4.3 FOLLOW-UP NEEDED AND/OR RECOMMENDED

- Realize site technical audits or walkthroughs to understand opportunities and consumer feedback
- Involve the electrical division and other key municipal divisions during project scoping to guarantee that the metering is implemented in the specified priority regions
- Ascertain that the municipal project team leaders designated have the necessary capabilities to guarantee successful execution of the project

4.4 BARRIERS

- Transition from old to new technologies can encounter resistance and skepticism; this can be addressed through robust stakeholder engagement and providing a clear overview of the benefits and drawbacks
- Energy related improvements can take longer to deliver a return on the investment, so investors can be reluctant; various kinds of support and incentives may be provided to overcome the hesitance
- Smart meter security and privacy issues, which can be addressed through robust data protection laws and frameworks at the national level
- Additional fees, revenue, tariff setting and Incorporation of costs of smart metering

4.5 RISKS

- When it comes to the residential sector, there is a strong aversion among homeowners to the concept of energy suppliers managing their energy use on their behalf; the benefits can be highlighted through awareness campaigns
- Disadvantages to smaller energy suppliers in a roll-out if they are unable to secure equipment and services at the same cost and rate as bigger suppliers
- Environmental impact due to an incorrect disposal of the old meters, which can be integrated into waste management or circular economy plans
- If old meters are changed before they reach the end of their economic life, their investments become stranded
- As long as old meters persist, it is necessary to run two systems in parallel
- Demand for qualified and skilled workers at an all-time high
- Concerns about the privacy and security of the smart system's data

5. CLIMATE CHANGE MITIGATION POTENTIAL

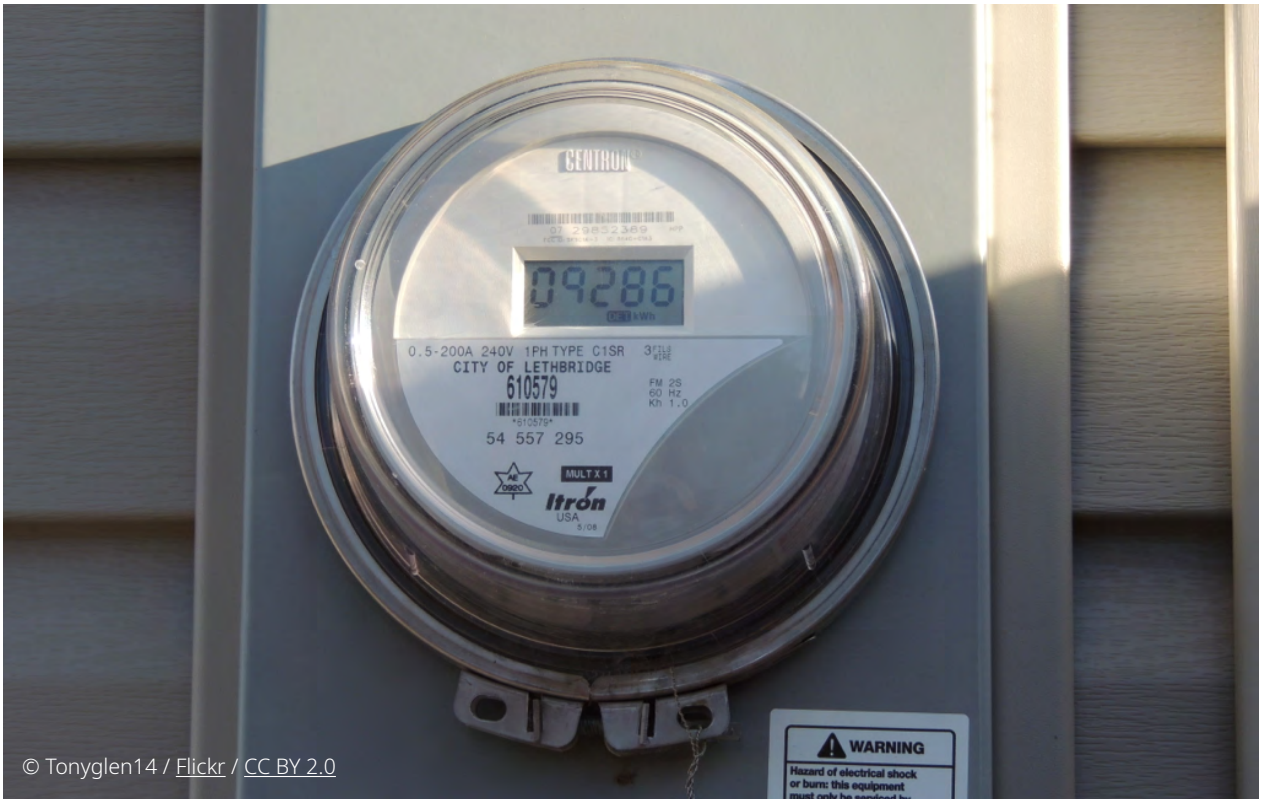
Concerns over the climate emergency are a major reason why people are encouraged to optimize their energy usage. Smart metering may be a useful tool owing to its ability to give knowledge, raise awareness, and influence consumers' behavior towards renewable energy, all of which have a direct impact on reducing GHG emissions from power generation.

Smart metering gives customers the tools they need to control their energy use, allowing them to access new solutions and incentives to promote energy efficiency and take greater personal responsibility for the environmental consequences of their actions. By being a management tool that provides data for decision-making, its climate change mitigation potential is linked to actions developed by the users based on the available data. Reduction of emissions are associated with energy savings, the avoidance of the establishment and operation of new power plants (primarily fossil-fired generation to meet peak demand) and an increase in the use of decentralized renewable energy generation (rooftop, for example).

Qualitatively speaking, the smart-metering adoption, followed by decisions on consumption and generation patterns, transforms people and local governments into active participants and decision-makers in the energy transition. It also helps to improve the management and exploitation of renewable energy resources, by facilitating the use of smart demand-side management systems like time-of-use (TOU) and dynamic tariffs.

6. FURTHER SCIENTIFIC AND TECHNOLOGICAL INSIGHTS

Although Smart metering is presented here and often perceived to be used in the power sector, it can also be relevant for other network industries such as gas, water and district heating.



7. NATIONAL – SUBNATIONAL INTEGRATION IN THE CONTEXT OF THIS SOLUTION

This section shows how the national-subnational integration can facilitate the implementation of this solution, focusing on the benefits that such integration can bring to the different levels of government.

7.1 BENEFITS TO LOCAL GOVERNMENT

- Smarter cities enables improved data-driven policy making, which can help local governments implement their energy and climate action plans effectively
- Cities can act as pioneers and share best practices with peer cities and advocate for improved national policymakers

7.2 BENEFITS TO OTHER LEVELS OF GOVERNMENT

- Enable development of smart grid/cities and grid integration, which can improve energy system operations
- Local action can help meet international and national climate commitments, as well as urban development goals

8. RESOURCES/SUPPORT

8.1 CASE STUDIES

IMPLEMENTING A BUILDING ENERGY METERING PROGRAMME IN SEVEN MUNICIPALITIES IN SOUTH AFRICA. AN URBAN-LEDS II DEMONSTRATION PROJECT CASE STUDY.

As part of their jurisdictions, local municipalities in South Africa own and manage a significant number of buildings. Through ICLEI Africa's work over the past eight years with eight subnational municipalities in the country, it has become evident that the key contributors to a municipality's greenhouse gas emissions are the municipal building portfolio. It is therefore imperative that municipalities reduce their own energy demand to improve the resource efficiency of buildings and ultimately reduce the overall greenhouse gas emissions of these cities, towns, and regions. The first step is to undertake an energy audit to understand the current consumption. However, in South Africa, few – if any – buildings in municipal portfolios are metered.

Because of this data gap, South African municipalities rarely receive financial support for increasing energy efficiency and reducing greenhouse gas emissions. A lack of robust energy data also reduces the quality of proposals for energy efficiency programmes that subnational governments typically submit to potential funders, further exacerbating the challenge of accessing finance.

The Urban-LEDS II pilot programme in South Africa took a practical approach by installing energy meters in municipal buildings of seven municipalities."

Using energy data to reduce emissions and unlock climate finance. Implementing a building energy metering programme in seven municipalities in South Africa. An Urban-LEDS II demonstration project case study. ICLEI Africa, 2017-2021. Available at: https://learnwithicleiafrica.org/resource/using-energy-data-to-reduce-emissions-and-unlock-climate-finance/

THE SUCCESS CASE OF THE CITY OF ARMSTRONG (SANTA FE, ARGENTINA)

This work describes a possible solution, when in the same intelligent electrical network, that operates under different communication standards, and / or under different devices from different companies, which make impossible an integration of the measurements in the same platform in a harmonic and orderly way, which would allow an intelligent software, that works in a superior plane to predict and in this way act against the behavior of the users of the network, based on the learning of the information gathered previously. The use of technology known as the Internet of Things, makes it possible to turn from an intelligent network that only reports data to one that, based on the analysis of all the data that reaches it, can be self-administered. For the topology of the electrical network and the distribution of the measurement points, in the town of Armstrong, Santa Fé, it has been possible to verify that the LoRa technology is correct to implement in its own measurement network, respecting the maximum distances of communication, with the possibility also of integrating all the measurement data, within the same information platform.

Politi, Marcos, Alex Cruz, Cristian Acosta, José Luis González, and Héctor Laiz. "Desarrollo de sistema para interoperabilidad de inversores fotovoltaicos en proyecto de red inteligente con aporte de fuentes renovables. Prier-Armstrong (Santa Fe, Argentina)." Avances en Energías Renovables y Medio Ambiente-AVERMA 22 (2018): 1-12. Available at: http://sedici.unlp.edu.ar/handle/10915/108535 (retrevied in 16.03.2022)

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