European Commission

JRC SCIENCE FOR POLICY REPORT

Summary of the guidebook: "How to develop a Sustainable Energy Access and Climate Action Plan (SEACAP) in Sub-Saharan Africa"

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2019

Joint Research Centre

EUR 29761 EN

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EU Science Hub
https://ec.europa.eu/jrc

JRC113788

EUR 29761 EN

PDF	ISBN 978-92-76-04091-0	ISSN 1831-9424	doi:10.2760/483786
Print	ISBN 978-92-76-04092-7	ISSN 1018-5593	doi:10.2760/673001

Luxembourg: Publications Office of the European Union, 2019

How to cite this report: Palermo V., Kona A., Pinedo Pascua, I. Rivas S., Hernandez Y., Barbosa P., Bertoldi P., Vetters N., Dallemand J.F., Scarlat, N and Taylor N., *Summary of the guidebook: "How to develop a Sustainable Energy Access and Climate Action Plan (SEACAP) in Sub-Saharan Africa"*, EUR 29761 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-04091-0, doi:10.2760/483786, JRC113788.

Contents

Abstract

The Covenant of Mayors in Sub-Saharan Africa (CoM SSA) supports local authorities in Sub-Saharan Africa in the climate challenge and in their efforts in ensuring access to clean energy. It is one of the "Regional Covenant" of the Global Covenant of Mayors for Climate & Energy (GCoM). Under the CoM SSA local authorities are invited to make a voluntarily political commitment to implement climate and energy actions in their communities and agree on a long-term vision to tackle 3 pillars, namely access to energy, climate mitigation and climate adaptation. In order to translate the political commitment into practical measures, CoM SSA signatories commit to elaborate and implement a Sustainable Energy Access and Climate Action Plan (SEACAP).

This document has been prepared to assist Sub-Saharan Africa local authorities in preparing a Climate Action Plan. It provides step-by-step guidance and examples of measures relevant for local authorities in Sub Saharan context. Despite being framed and definite, the process of developing a SEACAP allows flexibility. The choice and sequence of actions can vary according to the policies and measures already in place. This flexibility allows local governments to develop a SEACAP that is coherent with and effective for their local circumstances and objectives.

This document has been partly adapted from previous Joint Research Centre's (JRC) experience in Europe and other regions of the world (see for example the JRC reports JRC113188 "Guidebook: How to develop a Sustainable Energy and Climate Action Plan (SECAP) in the MENA Region" and the JRC112986 "Guidebook - How to develop a Sustainable Energy and Climate Action Plan" released in 2018).

Acknowledgements

The preparation of this guidebook has been possible thanks to the support of the European Commission (EC) Directorate-General for International cooperation and Development (DEVCO). Special thanks to F. Zaccheo, C. Boldrini, V. Voracek, S. Martinez and other colleagues from the EC engaged in the Global Covenant of Mayors (GCoM) activities.

Special thanks also to C. Thiel, Head of JRC Energy Efficiency and Renewable Energies Unit.

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- The World Bank, E. Portale

Executive summary

Cities are key actors in the fight against Climate Change and their contribution is crucial to reach the global climate targets.

The Covenant of Mayors in Sub-Saharan Africa (CoM SSA) supports local authorities in Sub-Saharan Africa in the climate challenge and in their efforts in ensuring access to clean energy. The initiative is shaped to reflect the local context and specificities. For this reason, there is the need for a flexible framework, in which local authorities can develop and build their strategy according to their peculiarities and potentials. CoM SSA is one of the "Regional Covenant" of the Global Covenant of Mayors for Climate & Energy (GCoM). Under the CoM SSA local authorities are invited to make a voluntarily political commitment to implement climate and energy actions in their communities and agree on a long-term vision to tackle three pillars, namely access to energy, climate mitigation and adaptation to climate change. In order to translate the political commitment into practical measures, CoM SSA signatories commit to elaborating and implementing a Sustainable Energy Access and Climate Action Plan (SEACAP).

This document aims at supporting cities and local governments in their climate and energy efforts by presenting the technical framework for the three pillars of the initiative and providing step-by-step recommendations for the entire process of elaborating a climate action plan (SEACAP), from initial political commitment to monitoring.

The SEACAP process is divided into four phases:

- Initiation phase relates to the description of the overall SEACAP principles and covers the strategic issues of political commitment, mobilization of all municipal departments involved, and stakeholders engagement (preparing the ground, see chapter 4);
- Planning phase: including a *Pre-assessment* phase and a *Development* phase.

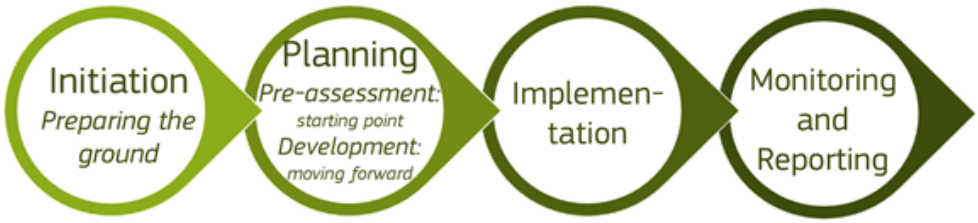
  The Pre-assessment phase is related to local government assessments, as pre-requisite to SEACAP elaboration. These include:

  - a greenhouse gas emissions inventory, named Baseline Emission Inventory (BEI) (see chapter 5.1) and setting objectives and mitigation targets (see sub-chapter 5.1.3);
  - Risk and Vulnerability Assessment (RVA) for the adaptation pillar (see chapter 5.2);
  - the Assessment of Energy Access (AEA) and setting targets (see chapter 5.3) for the Energy Access pillar.

  Development phase is dedicated to the description of technical measures and policies that can be implemented at local level by the local authority per sector of activity throughout:

  - focus on the SEACAP mitigation actions (see chapter 6.1);
  - focus on the SEACAP adaptation actions (see chapter 6.2)
  - focus on the SEACAP access to energy actions (see chapter 6.3).
- Implementation of the actions planned and
- Monitoring the progress towards the target setting (chapter 7).

Figure 1. The SEACAP process: main phases



Source: JRC own elaboration

Moreover, as SEACAP elaboration and implementation requires tailored dedicated financing, this document includes a specific section (see chapter 8) on frequent financing mechanisms and funding opportunities available in SSA region.

The present document provides a flexible but coherent set of principles and recommendations. The flexibility will allow local authorities to develop a SEACAP in a way that suits their own conditions, permitting those already engaged in energy and climate action to come on board of the Global Covenant of Mayors, while continuing to follow the approaches they have used before with as little adjustments as possible.

Remarks on this document

This document is part of the guiding materials developed to assist local governments in Sub-Saharan Africa in preparing their SEACAP. The full set of guiding materials consists of:

- "Guidebook: How to develop a Sustainable Energy Access and Climate Action Plan (SEACAP) in Sub-Saharan Africa" - Extended version (JRC 113786);

- The present document: "Summary of the "Guidebook: How to develop a Sustainable Energy Access and Climate Action Plan (SEACAP) in Sub-Saharan Africa"; which outlines the main aspects developed in the report JRC 113786";

- "How to develop a SEACAP in Sub-Saharan Africa: starting guide"- Shortened version (JRC 115962).

Throughout the present document, the "Guidebook: How to develop a Sustainable Energy Access and Climate Action Plan (SEACAP) in Sub-Saharan Africa" - Extended version, will be referenced as: "Guidebook Extended version" and "Summary of the "Guidebook: How to develop a Sustainable Energy Access and Climate Action Plan (SEACAP) in Sub-Saharan Africa" as "Guidebook summary version".

The guiding material is partly adapted from previous Joint Research Centre's (JRC) experience for Europe and other regions of the world ([1]) and it is coherent with the Global Covenant of Mayors for Climate and Energy (GCoM) Common Reporting Framework ([2]).

Signatories commit to preparing and implementing the plan and reporting on the status and their progresses, through the official reporting platforms. At the date of the preparation of this document, the reporting platforms accepted in the GCoM framework are: *My Covenant*- the European one- and the streamlined ICLEI's *carbonn Climate Registry (cCR)* and *CDP's* reporting platform. Other guidance material on climate action planning in Sub-Saharan Africa is a useful complement to the present document.

([1]) Bertoldi et.al. (2018). Guidebook "How to develop a Sustainable Energy Climate Action Plan (SECAP)" Luxembourg , Publications Office of the European Union , JRC112986 ; JRC113188; JRC113659

([2]) In order to ensure robust climate action planning, implementation and monitoring phases, as well as streamline measurement and reporting procedures, a set of global recommendations have been developed in consultation with partners and cities and local governments around the world, with the intention of providing flexibility to meet specific local or regional circumstances. More information available at: https://www.globalcovenantofmayors.org/common-global-reporting-framework/

CoM SSA addresses specifically the adaptation to the Sub-Saharan Africa context of the European experience. However, it is important to note that local authorities can use other equivalent reporting platform. Likewise, the climate action plan local authorities shall develop within the initiative, can be named SEACAP or CAP, which are the most common names used by CoM SSA cities for their plans. Although, this document mainly refers to SEACAP, both terms can be equally used and are considered as equivalent in the present document.

1 Introduction

1.1 Global Covenant of Mayors (GCoM)

The Global Covenant of Mayors for Climate & Energy (resulted from the merge of the European Covenant of Mayors with the Compact of Mayors ([3]) initiatives in June 2016) has become the broadest international alliance of cities and local governments with a shared long-term vision of promoting and supporting voluntary action to combat Climate Change and move to a low-emission resilient society. The Global Covenant of Mayors emphasises the importance of climate change mitigation and adaptation, as well as increased access to clean and affordable energy.

GCoM is a response by the world's cities to address the climate challenge, building on the commitment of over 9 000 cities and local governments from six continents and 127 countries representing more than 770 million residents (almost 10 % of the world's population)([4]).

Focusing on sectors where cities have the greatest impact, the GCoM supports ambitious, locally relevant solutions, captured through strategic action plans that are adopted, implemented and monitored and publicly available. The GCOM works to organise and mobilise cities and local governments to be active contributors to a global climate solution, mirroring the commitments their national governments have set to ensure the goals of the Paris Climate Agreement are met. Detailed information on the initiative can be found on the GCoM web site ([5]).

Regional chapters of the GCoM, managed by local, regional and global city networks ([6]) are core partners of the GCoM, serving as the primary support for participating cities and local governments. GCoM incorporates, under a single umbrella, the commitments of individual cities and local governments originally put forth either through the Compact of Mayors, pre-existing Regional/National Covenants, and now newly developing Regional/National Covenants operating under the shared vision principles and methods of the GCoM adapted to each region ([7]).

1.2 Covenant of Mayors in Sub-Saharan Africa

The Covenant of Mayors in Sub-Saharan Africa (CoM SSA) is an initiative launched by the European Union (EU) to support local authorities in Sub-Saharan Africa in the climate challenge and in their efforts in ensuring access to clean energy. It is one of the "Regional Covenant" or chapter of the Global Covenant of Mayors for Climate & Energy. CoM SSA is delivered through a partnership of global and local city networks as well as initiatives funded by the European Commission (EC). It is a bottom-up and voluntary initiative that invites cities to define and meet ambitious and realistic energy and climate targets set by themselves, in line with GCoM requirements. This means that targets are at least as, but preferably more, ambitious than cities' respective government's Nationally Determined Contribution (NDC) under the Paris Agreement. Furthermore, targets need to be in line with National Adaptation Plans (where these exist) and be

([3]) Launched in 2014 by UN Secretary General Ban Ki-moon and former New York City Mayor Michael Bloomberg (former UN Special Envoy for Cities and Climate Change), the Compact of Mayors was a global coalition of city leaders addressing Climate Change by pledging to cut greenhouse gas emissions and prepare for the future impacts of Climate Change (Barron-Lopez, Laura. "UN launches global mayors network to fight climate change". The Hill. Retrieved 2015-12-03.

([4]) Figures updated at August 2018. For further and more recent information on GCoM, please refer to www.globalcovenantofmayors.org

([5]) https://www.globalcovenantofmayors.org/

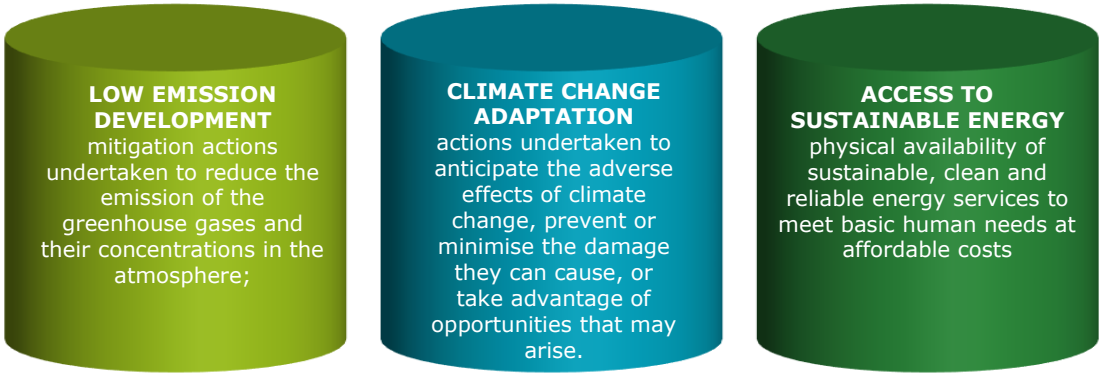
([6]) The terms "cities" and "local governments" are used throughout this document, understanding that the geo-political institutions of local governments may vary from country to country and terminology used may differ. In this document, a city refers to a geographical subnational jurisdiction ("territory") such as a community, a town, or a city that is governed by a local government as the legal entity of public administration. The term "city boundary" refers to a local government's administration boundary.

([7]) https://www.covenantofmayors.eu/; http://www.ces-med.eu/covenant-mayors-climate-energy

consistent with the principles around energy access and urban sustainability embodied in the Sustainable Development Goals (SDGs). Local authorities are encouraged to voluntary commit to the implementation of a climate and energy action plan in their area of influence. They are also encouraged to define long-term vision actions towards a sustainable future based on the pillars of Climate Change mitigation and adaptation, and sustainable, affordable and secure access to energy. CoM SSA is open to any city in Sub-Saharan Africa regardless the size ([8]).

Following and supporting the international dimension and the international principle of equality, the European Commission according to the *Neighbourhood Investment* policy has been funding the Covenant of Mayors initiatives in the Eastern European Partnership countries, to the South and to the sub Saharan African countries.

Figure 2. Pillars of the Covenant of Mayors in Sub-Saharan Africa.



Source: JRC own elaboration.

In order to translate the political commitment into practical measures, CoM SSA signatories commit to produce, adopt and implement a strategic and operational document called Sustainable Energy Access and Climate Action Plan (SEACAP).

Box 1. Sustainable Energy Access and Climate Action Plan: main steps

- Formally commit to the CoM SSA/GCoM;
- Engage with local stakeholders throughout the development and implementation of the climate strategy and action plan;
- Develop a community-scale greenhouse gas (GHG) emissions inventory and adopt ambitious, measurable and time-bound target(s) to reduce/limit GHG emissions;
- Develop a climate risk and vulnerability assessment and adopt ambitious Climate Change adaptation vision and goals, based on quantified scientific evidence when possible, to increase local resilience to Climate Change;
- Develop the access to energy assessment and adopt ambitious and goals to improve access to secure, affordable and sustainable energy;

([8]) CEMR coordinates the Covenant of Mayors Office for Sub-Saharan Africa partnering with six networks: Climate Alliance (CA), Energy Cities (ENC), United Cities of Local Governments Africa (UCLG Africa), ICLEI Africa and ICLEI World Secretariat. Three Institutional organisations: French Agency for Environment and Energy Management (ADEME), the International Association of Francophone mayors (AIMF), the Portuguese Energy Agency (ADENE); and two non-governmental organisations: Environment Development Action in the third world (ENDA) and Sustainable Energy for Africa (SEA). http://www.ccre.org/activites/view/40

- Develop a community strategy and integrated climate action plan to address Climate Change mitigation / low emission development, climate resilience and adaptation, and access to sustainable energy based on the assessments;
- Approve the developed SEACAP;
- Monitor the implementation of the plan and report achievements and progress on common reporting platforms, including provisions for regular progress reports.

2 Sustainable Energy Access and Climate Action Plan (SEACAP)

2.1 The SEACAP principles

The SEACAP is the key document that sets the strategies, plans and actions for a sustainable and low greenhouse gas (GHG) emission development while including climate adaptation actions and ensuring access to secure, affordable and sustainable energy, in response to the current and future impacts of Climate Change in the territory. Section 2.2 lists ten essential principles that constitute the key ingredients for a successful plan. These principles are linked to the commitments taken by the GCoM signatories and are further developed in the full version of the Guidebook – SSA 2018.

The SEACAP is both a strategic and an operational document. It uses the results of the Baseline Emission Inventory (BEI) to identify the best fields of action and opportunities for reaching the local authority's greenhouse gases (GHG) emissions target. It is based on the Climate Change Risk and Vulnerability Assessment (RVA), which identifies the most relevant city climate hazards and vulnerabilities. It includes as well an Access to Energy Assessment, which articulates a plan to improve the access to secure, sustainable, affordable and reliable energy.

The SEACAP can and shall be updated. It should not be regarded as a fixed and rigid document: as circumstances change and as the ongoing actions provide results and experience, it may be useful/necessary to revise the plan.

The SEACAP shall lead to Climate Change mitigation, adaptation and access to energy actions being integrated into development policy and planning at every level. The cities understand, while preparing their SEACAP, that mitigation and adaptation should complement each other, and should be mainstreamed into existing sectorial policies in order to foster synergies and optimise the use of available resources. Opportunities to make cities more climate resilient arise with every new development project to be approved by the local authority.

The SEACAP should consolidate and integrate existing initiatives. If a city has already developed a municipal action plan in the past, or any other development and climate related plans, it should prepare a SEACAP as a natural extension of the ongoing activities and measures.

A well-designed SEACAP, developed in collaboration with local stakeholders and the community, provides local governments with political visibility helps to improve the local governments' image, reduce their energy consumption costs as well as impacts related to CO_2 emissions. Moreover, citizens will benefit from the reduction of the health and safety impacts of energy consumption and its related CO_2 emissions. At the same time, the SEACAP makes the city more attractive to international donors and investors, when good financial figures are included for the implementation of the identified actions.

Joint SEACAPs can be developed with multiple partners: neighbouring SSA local authorities may choose to elaborate a joint or group SEACAP, and may choose between two approaches, further explained in the "Guidebook Extended version".

2.1.1 Spatial and temporal scope

The SEACAP covers the geographical area under the jurisdiction of the local authority and includes actions by both public and private sectors.

The SEACAP has to contain a clear outline of the actions that the local authority intends to take in order to ensure Low Emission Development or GHG emission reduction, taking into account the country's Nationally Determined Contributions (NDCs). In some cases, there may be a non-emission instead of a reduction. The SEACAP may cover a longer period. In this case the plan shall contain intermediate targets and goals for the year 2030, to be comparable with the NDC.

Both the long-term vision and the detailed measures shall be an integral part of the SEACAP. In addition to the mitigation commitment, adaptation goals have to be specified coherently with the main outcomes of the RVA, and levels of improvement in access to energy services based on the outcomes of the assessment.

2.1.2 Sector coverage

The SEACAP should address areas where local authorities can influence energy consumption, land use planning and climate change resilience on the long term. Local governments shall develop plans for both climate change mitigation and adaptation (climate resilience) and for access to energy, which may be presented in separate plans or an integrated plan. All actions of priority sectors (identified from the assessments) shall be included in the plan.

Within **mitigation**, local governments shall report GHG emissions from at least three main sectors: stationary energy (including buildings), transportation and waste. They should also report GHG emissions from Industrial Processes and Product Use (IPPU) and Agriculture, Forestry and Other Land Use (AFOLU) sectors ([9]) where these are significant. The emissions target boundary shall be consistent with all emissions sources included in the GHG emissions inventory, with the possibility to exclude sources that are not controlled by the local government.

For **adaptation** to the impacts of climate change, the SEACAP should include actions in the sectors and areas that are likely to be most vulnerable to climate change (hotspots). Vulnerable sectors vary considerably within urban boundaries, from one city to another and from urban areas to more rural areas. For this reason, gaining a deep understanding of the hazards and vulnerabilities of the local authority is of paramount importance.

For **access to energy** the attributes of secure, sustainable and affordable energy shall be taken into consideration when developing the assessment, in order to catch its multi-faced characterisation. The fields to be considered to assess the energy access in Sub-Saharan Africa are: clean cooking and electricity in households and public buildings and activities.

2.2 SEACAP elements

The following ten elements are presented to guide signatories in the elaboration of their SEACAPs. These steps are linked to the commitments taken by the Covenant signatories and constitute key ingredients of success.

- Strong political support
- Commitment to ambitious targets
- Suitable assessment of the current situation (BEI, RVA, AEA)
- Development and prioritization of actions
- Strategies and actions until 2030
- Governance
- Engagement of citizens and stakeholders
- Financing
- SEACAP submission
- Monitoring and reporting

([9]) Please refer to 2006 IPCC Guidelines for National Greenhouse Gas Inventories for more details on these sectors.

3 The SEACAP process

The SEACAP process includes four phases: initiation, planning (pre-assessment and elaboration of the plan), implementation and monitoring and reporting. Steps and recommended measures involved in each phase are described throughout this document. Some steps repeat or overlap among phases and/or may already be established or underway in a municipality. Local authorities will select and sequence the steps as appropriate to their situations. The phases of the process are outlined below:

1. **Initiation phase** relates to the description of the overall SEACAP principles and covers the strategic issues of political commitment, mobilisation of all municipal departments involved and stakeholders engagement (preparing the ground, chapter 4);

2. **Planning phase**: including a Pre-assessment phase and a Development phase.

Pre-assessment phase is related to cities and local government assessments, as pre-requisite to SEACAP elaboration. Through the pre-assessments, knowledge on the nature of the emitting entities, risk and vulnerabilities and status of access to energy in the local territory will be strengthened. Local authorities provide:

- a greenhouse gas emissions inventory, named Baseline Emission Inventory (BEI) (see chapter 5.1) and objectives and mitigation targets (see sub-chapter 5.1.3);
- a Risk and Vulnerability Assessment (RVA) for the adaptation pillar (see chapter 5.2);
- the assessment of the state of energy access (AEA) and targets for the energy access pillar (see chapter 5.3).

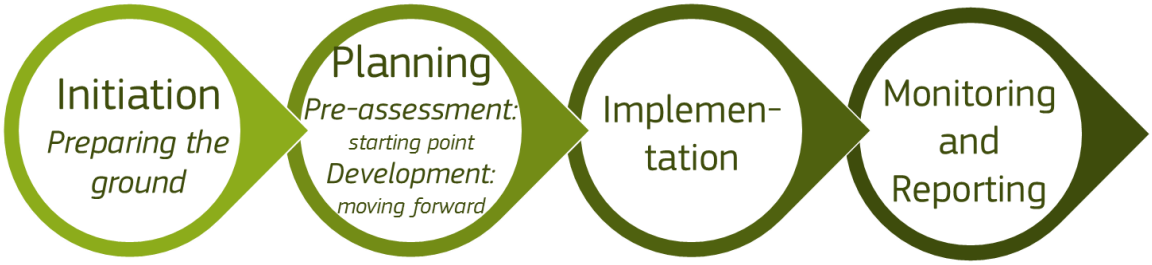
Development phase is dedicated to the description of technical measures and policies that can be implemented at local level by the local authority per sector of activity throughout:

- focus on the SEACAP mitigation actions (see chapter 6.1);
- focus on the SEACAP adaptation actions (see chapter 6.2)
- focus on the SEACAP access to energy actions (see chapter 6.3).

3./4. **Implementation** of the actions planned in the plan and **monitoring** the progress towards the target setting (chapter 7).

Figure **3** illustrates the main phases within the Sustainable Energy Access and Climate Action Plan elaboration process, while Figure 4 includes for each of the phases: milestones and timeframe ([10]). Table 1 shows the main steps and role of key actors in the SEACAP process.

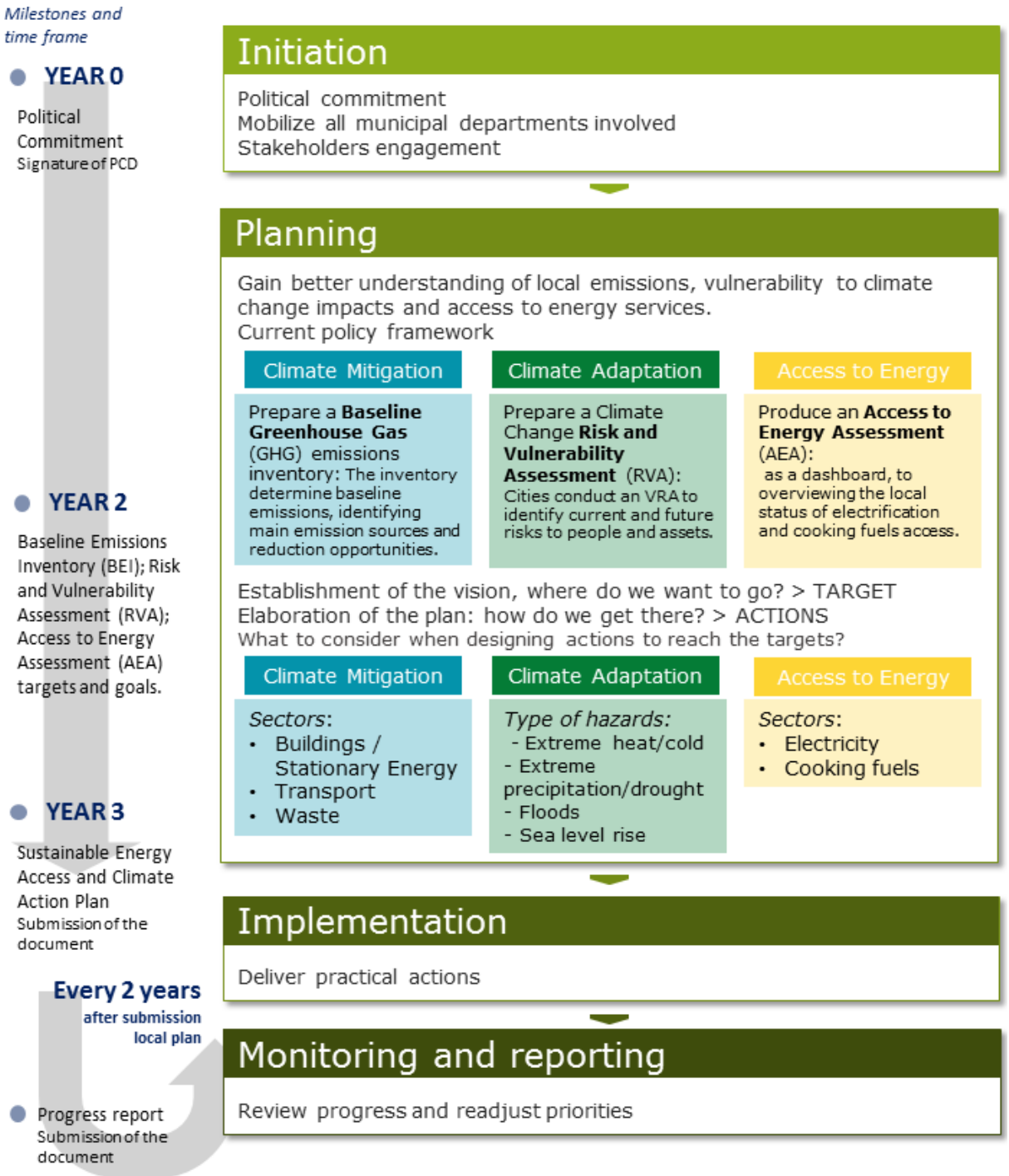
Figure 3. The SEACAP process: main phases



Source: JRC own elaboration.

([10]) CoM SSA reporting scheme follows the GCoM recommendations. Please consult the "Guidebook extended version".

Figure 4. The SEACAP process: main phases, milestones and timeframe.



Source: JRC own elaboration.

4 The SEACAP process: initiation phase

This chapter provides detailed guidance throughout the initiation phase on the commitment to address Climate Change mitigation and adaptation and access to energy (4.1).

4.1 Committing to addressing mitigation and adaptation to Climate Change and access to energy

4.1.1 Political commitment and signing of the Covenant of Mayors

Sufficient empowerment and support for the municipal staff in charge of the SEACAP from the highest political level is essential to its success. Political commitment and leadership should be sought early, as they are driving forces of the overall process. The formal approval of the SEACAP by the municipal council (or equivalent body, including national authorities), is crucial to ensure successful implementation.

4.1.2 Mobilise all municipal departments involved

The municipal council and local authority should further support the process by ensuring adequate human resources are in place to prepare and implement the SEACAP (this may require identifying, engaging and allocating, or recommending and requesting support from other levels of government to ensure the plan feasibility and success), including providing a clear mandate and sufficient time and budget. They should also involve relevant technical departments from the local authority in the SEACAP elaboration process to gain their acceptance and backing and to mainstream Climate Change.

4.1.3 Build support from stakeholders and establishing a governance structure

Developing and implementing a SEACAP is a challenging and time-consuming process. It requires well- planned and continuous collaboration and coordination among local and higher authorities and administrative departments, such as environmental protection, land use and urban planning, economics and social affairs, buildings and infrastructure management, mobility and transport, budget and finance, procurement, internal and external communications, etc. The SEACAP process should be integrated in the everyday work of each department (Table 1).

The governance structure could include:

Local resource coordination

SEACAP coordinator

SEACAP organisational structure

External support

Citizens and other stakeholders should be invited to take part at important stages of the SEACAP elaboration process. The stakeholder involvement constitutes a formal commitment by local actors to a future vision. Whenever possible, local authorities and significant actors should define together the paths to transform the vision into action.

The SEACAP should include a clear communication strategy that is feasible, efficient and adapted to local needs and cultural context as well as using accessible language. Good communication is particularly essential during the implementation phase, both internally among different departments of the local authority, the associated public authorities and all those involved (e.g. local building managers), and externally with relevant stakeholders, including citizens.

Table 1. SEACAP process: the main steps – role of key actors ([11])

PHASE	STEP	ROLE OF THE ACTORS		
		Municipal council or equivalent body	**Local administration**	**Stakeholders**
1.Initiation	Political commitment and signing of the Covenant	Make the initial commitment. Sign the Covenant of Mayors SSA. Provide the necessary impulse to the local administration to start the process.	Encourage the political authorities to take action. Inform them about the multiple benefits (and about the necessary resources).	Awareness raising among political authorities to take action (if necessary).
	Mobilise all municipal departments involved	Allocate sufficient human resources and make sure adequate administrative structures are in place (e.g. horizontal offices ensuring collaboration amongst different departments of the administration) to ensure a coordinated action between mitigation and adaptation.		
	Build support from stakeholders and establishing a governance structure	Provide the necessary impulse for stakeholders' participation. Show that you consider their participation and support as important.	Prepare an inventory of the relevant stakeholders, decide what channels of communication/participation you want to use, establish collaboration practices. Inform them about the process that is going to start, and collect their views.	Express their views, explain their potential role in SEACAPs development and implementation.
2.Planning phase (Pre-assessment and development	Assessment of the current framework: Where are we?	Make sure the necessary resources are in place for the planning phase.	Conduct the initial assessment, collect the necessary data, and elaborate the CO_2 baseline emission inventory, the climate risks and vulnerabilities assessment and the access to energy assessment. Make sure the stakeholders are properly involved.	Provide valuable inputs and data, share the knowledge.
	Establishment of the vision: Where do we want to go?	Support the elaboration of the vision. Make sure it is ambitious enough. Approve the vision (if applicable).	Establish a long-term vision and objectives that support the vision. Make sure it is shared by the main stakeholders and endorsed by the political authorities.	Participate in the definition of the vision, express their view on the city's future.
	Elaboration of the plan: How do we get there?	Support the elaboration of the plan. Define the priorities, in line with the vision previously defined.	Elaborate the plan: define policies and measures in line with the vision and the objectives, establish budget and financing sources and mechanisms, timing, indicators, responsibilities. Keep the political authorities informed, and involve stakeholders. Make partnerships with key stakeholders.	Participate in the elaboration of the plan. Provide input, feedback. Contribute to initiating and designing the processes.
	Plan approval and submission	Approve the plan and the necessary budgets, at least for the first year(s).	Submit the SEACAP and Communicate the plan.	Put pressure on political authorities to approve the plan (if necessary)

([11]) adapted from: Bertoldi P. (editor), 2018. Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP) – Part 1 - The SECAP process, step-by-step towards low carbon and climate resilient cities by 2030.

PHASE	STEP	ROLE OF THE ACTORS		
		Municipal council or equivalent body	**Local administration**	**Stakeholders**
3. Implementation and 4.monitoring of the SEACAP	Implementation	Provide long-term political support to the SEACAP process.	Coordinate the implementation. Make sure each stakeholder is aware of its role in the implementation.	Each stakeholder implements the measures that are under its responsibility and shares the results.
		Make sure that the energy and climate policy is integrated in the everyday life of the local administration.	Implement the measures that are under responsibility of the local authority. Be exemplary. Communicate the actions.	Put pressure / encourage the local administration to implement the measures under its responsibility (if necessary).
		Show interest in the plan implementation, encourage stakeholders to act, show the example.	Motivate the stakeholders to act (information campaigns). Inform them properly about the resources available for EE, RES and adaptation.	Changes in behaviour, EE, RES and adaptation action, general support to SEACAP implementation.
		Networking with other CoM signatories, exchanging experience and best practices, establishing synergies and encouraging their involvement in the Covenant of Mayors in Sub-Saharan Africa.		Encourage other stakeholders to act
	Monitoring	Ask to be informed regularly about the advancement of the plan.	Proceed to a regular monitoring of the plan: advancement of the actions and evaluation of their impact.	Provide the necessary inputs and data.
	Reporting and submission of the report	Approve the report (if applicable).	Report periodically to the political authorities and to the stakeholders about the advancement of the plan. Communicate about the results. Every second year, submit a report.	Provide comments on the report and report on the measures under their responsibility.
	Review	Ensure that plan updates occur at regular intervals.	Periodically update the plan according to the experience and the results obtained and based on new opportunities. Involve political authorities and stakeholders.	Participate in plan update.

5 SEACAP process- Planning phase: pre-assessment

This chapter provides detailed guidance throughout the pre-assessment phase in the elaboration of a SEACAP: developing a Baseline Emission Inventory (BEI) and setting objective and targets (see section 5.1) for climate mitigation, undertaking a Risk and Vulnerability Assessment (RVA) (see section 5.2) for climate adaptation and developing an Access to Energy Assessment (AEA) and setting targets (see section 5.3) for the energy access pillar.

5.1 Baseline Emission Inventory (BEI)

By developing a Baseline Emission Inventory (BEI) a local authority is measuring its GHG emission level in a base year, according to a common methodological approach. The BEI allows identifying the principal anthropogenic sources of CO_2 (and other GHGs) emissions and, then, prioritizing the reduction measures accordingly. In these guidelines, the requirements for emission inventories and reporting outlined in the common reporting framework under the Global Covenant of Mayors for Climate & Energy (GCoM) ([12]) are explained, and advice and recommendations for compiling the BEI and successive monitoring emission inventories (MEIs) under the GCoM are provided. The GCoM principles, concepts and methodologies to elaborate an emissions inventory are followed by recommendations and tips on the data collection of energy-related activity sectors.

Box 2. Tips on language used

To indicate which provisions are requirements and which are optional, language is used as follows:

- The term "shall" is used to indicate what is required (indicated as "mandatory").
- The term "should" is used to indicate a recommendation, so is not a requirement (indicated as "recommended").
- The term "may" is used to indicate an option that is permissible or allowable that local governments may choose to follow (indicated as "optional").

5.1.1 Reporting requirements

The emission inventory should be elaborated based on a sound knowledge of the local situation in terms of energy and greenhouse gas emissions. The requirements for accounting the emissions in the inventory are based on the sources, the type of gases and boundary of the inventory to be reported. Each of these elements will be defined in further detail in the following sections. At the date of the preparation of this document, three reporting platforms ([13]) are accepted in the GCoM framework: *My Covenant*- the European one- and the streamlined ICLEI's *carbonn Climate Registry (cCR)* and *CDP's* reporting platform.

Box 3. Notation keys

Notation keys may be used to accommodate limitations in data availability and differences in emission sources between local governments. Where notation keys are used, an accompanying explanation shall be provided.

- "NO" (not occurring): An activity or process does not occur or exist within the city. This notation key may also be used for insignificant sources.

([12]) In order to ensure robust climate action planning, implementation and monitoring phases, as well as streamline measurement and reporting procedures, a set of new global recommendations have been developed by the GCoM in consultation with partners, cities and local governments around the world, with the intention of providing flexibility to meet specific local or regional circumstances. The common reporting framework can be found at: https://www.globalcovenantofmayors.org/common-global-reporting-framework/.
([13]) Signatories compile and report data on a reporting framework

- "IE" (included elsewhere): GHG emissions for this activity are estimated and presented in another category in the same inventory, stating where it is added. This notation key may be used where it is difficult to disaggregate data into multiple sub-sectors.
- "NE" (not estimated): GHG emissions occur but have not been estimated or reported, with a justification why.
- "C" (confidential): GHG emissions which could lead to the disclosure of confidential information, and as such are not reported publicly.

5.1.1.1 Boundaries

The **geographical boundaries** of the "local territory" are the administrative boundaries of the entity (municipality, region) governed by the local authority which is a signatory to the initiative and shall remain the same boundary for consistent inventory comparison over time.

5.1.1.2 Type of emissions to be included

Local authorities shall account for emissions of the following gases: carbon dioxide (CO_2), methane (CH4), and nitrous oxide (N2O)([14]). The three main sources of GHG emissions to be potentially included in the emission inventory are ([15]):

1) **Direct emissions** due to fuel combustion in the buildings, equipment/facilities and transportation sectors within the city boundary. These emissions physically occur inside the city boundary ([16]).
2) **non-energy related emissions:** Other direct emissions that are not related to fuel combustion, including: fugitive emissions from disposal and treatment of waste (including wastewater) generated within the city boundary, which may occur inside or outside the city boundary ([17]), and fugitive emissions from natural gas distribution systems (such as equipment or pipeline leaks).
3) **Indirect emissions** due to consumption of grid-supplied energy (electricity, heat or cold) within the geographic boundary ([18]). Depending on where energy is generated, these emissions may occur inside or outside the city boundary.

The points 1) and 2) refer to emissions that physically occur in the local territory. Inclusion of these emissions follows the principles of the IPCC used in the reporting of the national GHG inventories to the United Nations Framework Convention on Climate Change (UNFCCC, 2017).

Local authorities should use **activity-based** emission factors (also referred to as IPCC emission factors, see 5.1.1.5), though they may use **lifecycle analysis (LCA)** based emission factors where this is required for GHG emissions reporting at the national level. The emission reporting unit to be chosen is "tons of CO_2 equivalent". The emissions of other greenhouse gases than CO_2 are converted to CO_2-equivalents by using the Global Warming Potential (GWP) values which shall be kept constant all along the SEACAP implementation period.

([14]) When reporting IPPU, it will include hydro fluoro carbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF6), and nitrogen trifluoride (NF3).
([15]) Emissions from biogenic carbon are not required to be reported
([16]) These are often referred to as Scope 1 emissions in some other commonly used GHG inventory standards
([17]) Emissions occurring outside the city boundary as a result of city activities, such as emissions from waste generated by the city but treated outside the city boundary, are often referred to as Scope 3 emissions in some other commonly used GHG inventory standards.
([18]) These are often referred to as Scope 2 emissions in some other commonly used GHG inventory standards

5.1.1.3 Emission sources

Under the GCoM, LAs shall consider all categories of emission sources and report all emissions that are significant. Exclusion of emission sources shall be disclosed and justified, using notation keys (Box 3). Local authorities shall report activity data ([19]) and emission factors for all sources of emissions, disaggregated by activity / fuel type. Based on these principles LAs shall report GHG emissions from main sectors listed in the following table (Table 2) ([20]).

Table 2. Emission sources to be included in the emission inventory

Type of Emission sources	
Stationary energy	All GHG emissions (direct emission from fuel combustion and indirect emission due to consumption of grid-supplied energy) occurring in stationary sources within the local authority boundary **shall** be reported. These emissions come from final energy consumption in residential, commercial and institutional buildings and facilities, as well as from industrial buildings and facilities ([21]) and agriculture/forestry/fisheries. GHG emissions from sources covered by a regional or national emissions trading scheme (ETS), or similar, should be identified. GHG emissions from "energy generation" industries **should not** be reported under this sector to avoid double counting of emissions. All fugitive emissions within the city boundary **shall** be reported.
Transportation	All GHG emissions (direct emission from fuel combustion and indirect emission due to consumption of grid-supplied energy) occurring for transportation purposes within the local authority boundary **shall** be reported. In addition, local authorities **shall where possible** further disaggregate by mode: on-road, rail, waterborne navigation and off-road and it is recommended to disaggregate road and rail travel by fleet type: municipal, public, private and commercial transport. Local authorities may use the "fuel sales", "geographic (territorial)", "resident activity" and "city-induced" methodologies to estimate activity data in the transport sector (see section 5.1.2.2 and the "Guidebook Extended version").
Waste / Other non - energy related	All GHG emissions non-energy related from disposal and treatment of waste and wastewater generated within the city boundary **shall** be reported and disaggregated by treatment type. Where waste/wastewater is used for energy generation, emissions **should not** be reported under this sector to avoid double counting of indirect emission (instead the notation key IE should be used).
Energy Supply	All GHG emissions from generation of grid-supplied energy within the local authority boundary, and all GHG emissions from generation of grid-supplied energy by facilities owned (full or partial) by the local authority outside the local authority boundary **shall** be reported, disaggregated by electricity-only, CHP and heat/cold production plants. *To avoid double counting, these emissions **will not be part** of the total direct emissions, but accounted through the local emission factor for indirect emissions.* In addition, local authorities are **recommended** to report all activity data for distributed renewable energy generation.

Source: JRC own elaboration.

([19]) Activity data is a quantitative measure of a level of activity that results in GHG emissions taking place during a given period of time (e.g., volume of gas used, kilometres driven, tons of solid waste sent to landfill, etc.).
([20]) See Box 2. for specifications on the language used.
([21]) This includes all emissions from energy use in industrial facilities, construction activities, and energy industries, except emissions from the generation of energy for grid-distributed electricity, steam, heat and cooling.

LAs should also report GHG emissions from Industrial Processes and Product Use (IPPU) and Agriculture, Forestry and Other Land Use (AFOLU) sectors where these are significant ([22]).

5.1.1.4 Activity data

Activity data quantifies the human-related activity occurring in the local territory. Examples of activity data are: amount of natural gas used for space heating in residential buildings, measured in MWh; distance travelled by private car journeys, measured in vehicle kilometres travelled (VKM); amount of waste sent to landfill, measured in Tonnes. The main activity data in the GCoM key sectors are related to final energy consumption, disaggregated per type of energy carrier. The energy carrier refers to the form of energy input (electricity, heat/cold, fossil fuels, municipal waste or renewable energy) required by the energy-related activity sectors of the society to perform their functions.

Collecting information from every individual energy consumer within the local territory is not always possible or practical. Therefore, a variety of approaches are likely to be needed to develop an estimate of energy consumption. Several options are available, and often a combination of them is necessary to have an overall picture of the energy consumption within the local territory:

1. Getting data for municipal/institutional buildings and facilities. Table 3 provides examples of regional/national data centres providing energy and GHG emissions data to the local authorities.
2. Getting data from regional/ national sources
3. Getting data from the market operators
4. Getting data from a consumer survey
5. Making and reporting estimates

Before starting the data collection process, it is recommended to investigate if there are already national or regional mechanisms, which could help to collect relevant data for the building of the local GHG inventory. A useful practical step-by-step guidance to energy and emissions data collection has been outlined by the CoM SSA (Figure 5).

Table 3. Examples of regional/national energy data collection.

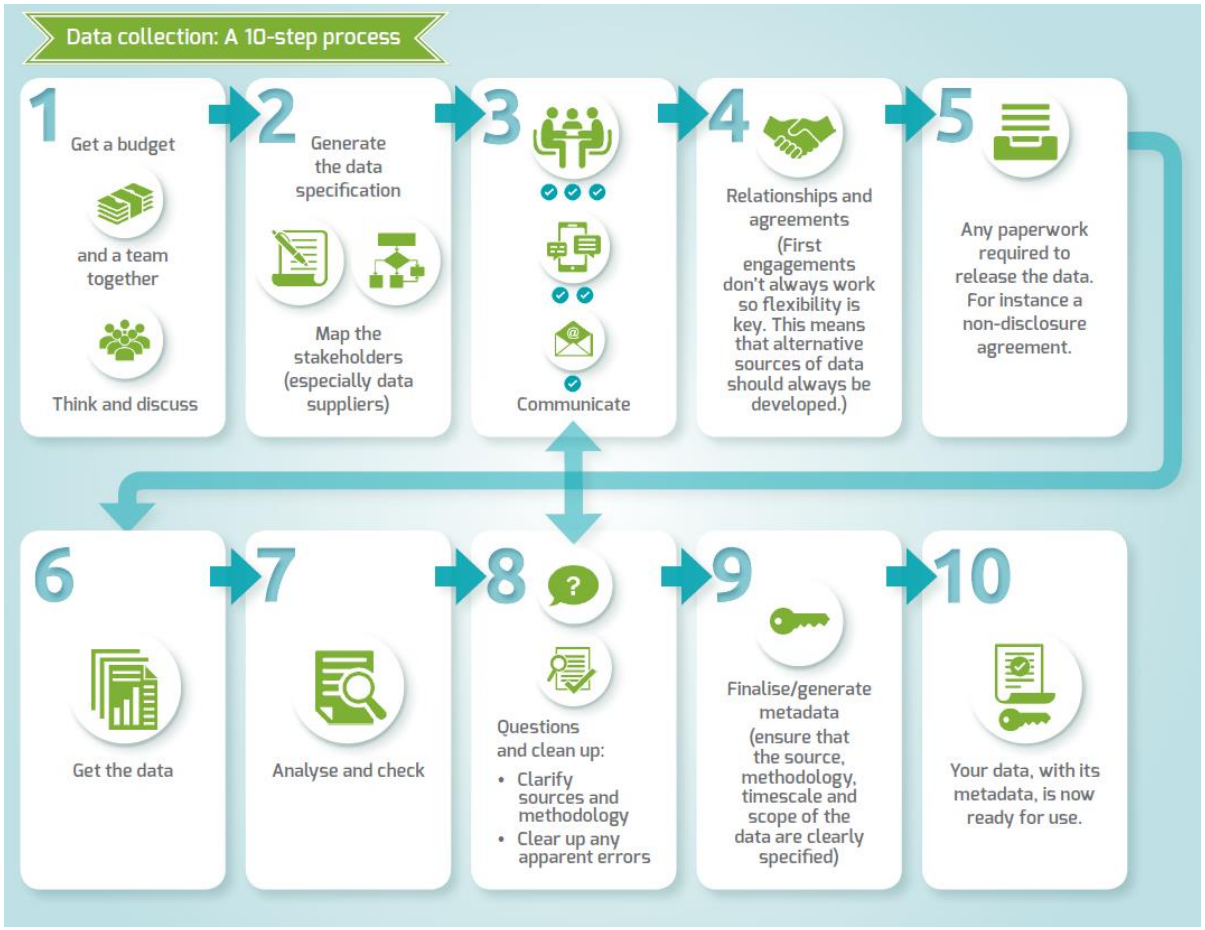
Data source	Description
Energy Information Systems	Specific energy information systems have been established in the following countries (as part of the SIE-Africa project): Benin, Burkina Faso, Cameroon, Congo, Ivory Coast, Guinea Bissau, Mali, Niger, Central African Republic, Democratic Republic of Congo (DRC), Senegal, Togo. https://www.sieguinee-dne.org/;www.sie-energie.gouv.sn;www.sie-niger.ne;www.sie-togo.tg;https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/sie-afrique_phase_ii_sie_senegal_2006_fr.pdf
Sources of African Energy Data	National statistics systems Specialised African Energy Institutions https://afrec-energy.org/En/index.html (African Energy Commission)
International energy emission databases providers	International Energy Agency: https://www.iea.org; Africa energy outlook: https://www.iea.org/publications/freepublications/publication/WEO2014_AfricaEnergyOutlook.pdf United Nations: https://unstats.un.org/unsd/energy/; Technology need assessment http://unfccc.int/ttclear/tna; State of African cities 2014: https://unhabitat.org/state-of-

([22]) Guidance note accompanying the Global Covenant of Mayors Common Reporting Framework. https://www.globalcovenantofmayors.org/common-global-reporting-framework/.

	african-cities-2014/ World Bank: http://www.worldbank.org/; OPEC: https://www.opec.org/opec_web/en/index.htm; The Emissions Database for Global Atmospheric Research: http://edgar.jrc.ec.europa.eu/#; World Resources Institute : http://datasets.wri.org/dataset/cait-country Global Environment Facility: https://www.thegef.org/;

Source: JRC elaboration resulted from the Expert consultation meeting held in Abidjan (Ivory Coast) June 2018.

Figure 5. Step by step guidance to energy and emissions data collection



Source: Covenant of Mayors in Sub-Saharan Africa (CoM SSA). Guide available at http://comssa.org/wp-content/uploads/2018/07/data-collection-low-res.pdf.

5.1.1.5 Emission factors

The emission factors (EF) are coefficients which quantify the emissions per unit of activity. The local authority can either use local emission factors (based on the detailed properties of the fuels used) or default (national/global) emissions factors, such as the IPCC (2006). EFs are used to calculate GHG emissions from energy related activity sectors.

Local authorities can use country specific emission factors or develop own emission factors, based on the detailed properties of the fuels used within the local territory when calculating their local CO_2 or GHG emissions. Further guidance on emission factors that better reflect the fuels used in their territory or on how estimating GHG emissions using activity-based and LCA approaches, are available from:

IPCC (2006) default emissions factors, which can be used when country-specific data are unavailable. It provides a general guidance for acquiring and compiling information from

different sources and for applying the default emission factors (http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html).

EFBD Emission Factor Database which is a recognised library, where users can find additional emission factors and other parameters with background documentation or technical references (http://www.ipcc-nggip.iges.or.jp/EFDB/main.php).

The EPLCA European Platform on Life Cycle Assessment (http://eplca.jrc.ec.europa.eu/).

The JRC ILCD Handbook (Wolf et al., 2012).

5.1.2 Setting up an emission inventory

For some activities, local governments may be able to use direct measurements of GHG emissions (e.g., through use of continuous emissions monitoring systems at power stations). However, for most emission sources, local governments will need to estimate GHG emissions. To build the emission inventories, the GHG emissions from energy related activity sector (i.e. stationary and mobile sources) are calculated by multiplying the activity data by the emission factor per energy carrier (fuels and grid supplied energy) (eq.1). Activity data is expressed in MWh and the emission factors in tCO_2/MWh or tCO_2-eq/MWh.

$$\boldsymbol{GHG\ emissions} = \sum_{SOURCE} \sum_{CARRIER} (\boldsymbol{Activity\ data} \times \boldsymbol{Emission\ factor}) \qquad \text{(Eq.1)}$$

Activity data quantifies the human activity occurring in the local territory. The carbon content may vary considerably both among and within primary fuel types on a per mass or per volume basis. Converting the amount of consumed fuel to energy units using Net Calorific Values ([23]) (NCV) allows aggregating all the data. NCV values for different types of fuels are available as default (IPCC, 2006) and country specific (e.g., IEA, 2017) values. Activity data shall be reported in MWh.

The emission factors (EF) are coefficients which quantify the emissions per unit of activity. In order to ensure the consistency of the time-series, local authorities using national/global EFs, shall apply the same emission factors to all inventories (base year and monitoring years). This allows identifying the changes in local emissions that are due to local mitigation actions. Only when local emission factors reflecting changes in the fuel properties are used, may different emission factors be used in the emission inventories.

The following sections provide recommendations and tips for building an emission inventory, for the data collection regarding local sources of GHG in the GCoM activity sectors.

5.1.2.1 Stationary energy/Buildings

The stationary energy sources are among the largest contributors to energy consumption in urban areas and also the sectors on which local authority has generally a large degree of influence. The focus of the GCoM is to reduce direct and indirect emissions in these sectors. The following Sub-Sectors are mandatory and thus shall be covered in the emission inventory (Table 4).

The term "equipment/facilities" covers all energy consuming entities that are not "buildings". This includes also water and waste management units. If such units are owned by the LA they should be included under "Municipal buildings, equipment/facilities", otherwise they should be reported under "Tertiary (non-municipal) buildings, equipment/facilities".

([23]) A calorific value is a conversion factor (e.g. in MWh/t, MJ/l) used to convert a fuel quantity between natural units (mass or volume) and energy units (energy content).

A special case is the Municipal sector, which serves as an example to the citizens. The actions implemented herein could have a high replicability potential in the other key sectors. For the same purpose, the lighting in the municipal buildings should be reported under a specific CoM activity sector "Public lighting", whereas other public lighting should be included in the activity sector "Tertiary (non-municipal) buildings, equipment/facilities". Energy consumption in other buildings (e.g. primary sector and industry) should not be included unless the SEACAP includes energy/emission reduction measures in these activity sectors.

Table 4. Stationary sources accounted in the emission inventory.

Sector : *Stationary energy/ Buildings*	
Sub-Sector	**Description**
Institutional / Municipal buildings and facilities	All final energy consumption and related GHG emissions occurring in buildings and facilities public or owned by the local authority for cooking, heating & cooling, lighting and appliances usage; e.g. government offices, schools, police stations, hospitals, public lighting. All final energy consumption (and related GHG emissions) due to operation (electricity for pumping, natural gas for heating, etc.) of municipal water supply system, solid waste and wastewater treatment and disposal facilities are also included here. All non-energy related emissions (e.g. methane) produced in these facilities shall be reported under Waste sector.
Commercial/ Tertiary buildings and facilities	All final energy consumption and GHG emissions occurring in buildings and facilities of the tertiary sector (services) cooking, heating & cooling, lighting and appliances usage; e.g. offices of private companies, banks, commercial and retail activities, private schools, hospitals, etc. All final energy consumption (and related GHG emissions) due to operation (electricity for pumping, natural gas for heating, etc.) of private water supply system, solid waste and wastewater treatment and disposal facilities are also included here.
Residential buildings	All final energy consumption and GHG emissions occurring in buildings (including informal settlements and social housing) that are primarily used as residential buildings for cooking, heating & cooling, lighting and appliances.
Industrial buildings and facilities	All energy consumption and GHG emissions occurring in industrial (manufacturing and construction industries) buildings and facilities. Also GHG emissions from sources covered by a regional or national emissions trading scheme (ETS), or similar (e.g. above 20 MW as thermal energy input), should be identified. Energy generation industries should not be reported here (to avoid double counting).
Agriculture/Forestry/ Fisheries	Emissions from energy use in agriculture, forestry and fishing activities, including energy use associated with plant and animal cultivation, afforestation and reforestation activities, and fishery activities. This could include for example the on-site operation of farm vehicles and machinery, generators to power lighting, pumps and heaters.
Fugitive emissions	All fugitive emissions from the extraction, transformation and transportation of primary fossil fuels within the city boundary, including: 1) Fugitive emission from mining, processing, storage and transportation of coal 2) Fugitive emissions from oil and natural gas systems, such as equipment or pipeline leaks, evaporation and flashing losses, venting, flaring, incineration, and accidental releases etc.

Source: JRC own elaboration based on the GCoM reporting framework

5.1.2.2 Transport

This section aims to provide practical approaches to build emission inventories for the transport macro-sector focusing on CO_2 and where possible CH_4 and N_2O. Different resources and capabilities of local authorities are taken into account and feasible options to be implemented in mid-sized and even smaller local authorities are provided. Measuring transport emissions and collecting associated data is vital to guide Climate Change mitigation actions, but can also guide wider transport policy and planning. While this Guidebook focuses on greenhouse gas emissions, insights gained from the data collection and analysis described in this chapter, can also inform urban planning, the provision of transport services, air quality measures and other actions. The Global Covenant of Mayors defines the transport activity sectors, according to ownership and functionality criteria, as follows (**Table 5**).

Table 5. Mobility sources accounted in the emission inventory under the Transport sector

Sector: *Transport*	
Sub-Sector	**Description**
Municipal fleet	All GHG emissions from fuel combustion and use of grid-supplied energy for transportation within the city boundary shall be reported and disaggregated by mode: on-road, rail, waterborne navigation, aviation and off-road: - **on-road** transportation: urban street network under the competence of the local authority; - **on-road** transportation serving a larger area and/or not under the competence of local authority (e.g. highways) may be included if mitigations actions are planned in that area; - **off-road** transport: off road traffic of vehicles/mobile machinery in any activity sector; - **rail transportation**: local transport (metro, tram and local trains); long-distance trains, intercity trains, regional and cargo rail transportation may be included if mitigations actions are planned in that area; - **waterborne navigation**: local ferries in public and private transport acting on the local territory; - **aviation**: local governments may choose to report GHG emissions from the in boundary component of domestic and/or international aviation (such as the landing and take-off cycle for aviation), or assume these are all out of boundary emissions and use the notation key "Included Elsewhere".
Public transport	
Private and commercial transport	

Source: JRC own elaboration based on the GCoM reporting framework

It is not required (but recommended when possible) to provide energy data for each individual fleet type (municipal fleet, public transport, private and commercial transport) but only at the macro-sector level, meaning road and rail travel.

Where data is not available and cannot be estimated, notation keys shall be used.

There are relatively simple to more sophisticated ways to estimate transport emissions, but all are usually based on the following parameters (**Figure 6**):

The Vehicle-Kilometres Travelled (VKT) as a measure of traffic flow, determined by multiplying the number of vehicles on a given road or traffic network by the average length of their trips measured in kilometres; it can be measured as passenger-kilometre (a unit of measure = 1 passenger transported a distance of 1 kilometre) and tonne-kilometre (a unit of measure: 1 tonne transported a distance of 1 kilometre). There are three different methodological approaches to determine traffic activity ([24]):

- Vehicle approach, determined as: (vehicle stocks x annual average mileage);

([24])http://mobiliseyourcity.net/

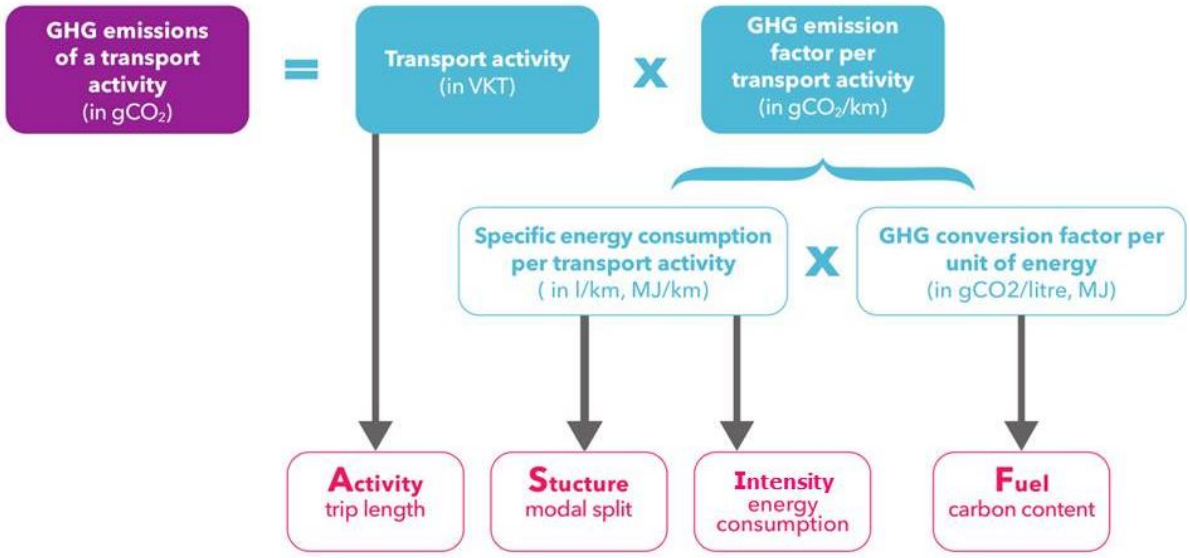
- User approach, determined as:
  (trips number by mode x the average trip distance / load factor);
- infrastructure approach, determined as:
  (traffics accounts (by vehicle type) x infrastructure link length)

The modal share and distribution of trips to different types of vehicles (fleet distribution), describing the portion of trips by different modes: Road (passengers and freight transport); rail, inland-waterways; air and maritime. In urban areas the most important mode relates to road passenger, which can be further disaggregated into vehicle types (e.g. passenger, light-duty or heavy-duty for road vehicles);

Energy intensity as a measure of the fuel consumption (actual in-use or alternatively average) assessed as the product of the average fuel consumption of vehicle the type [l fuel/km] and the Net Calorific Value (NCV) of the fuel [Wh/l]. This is often affected by the age of vehicle, especially in the region where the average vehicle life is sometimes over 10 years;

Fuel carbon intensity relates to the emission factors of the fuels (e.g. diesel, motor gasoline/petrol, electricity, hydrogen etc.).

Figure 6. The ASIF (Activity-structure-intensity-fuel) framework to calculate GHG emissions from the transport sector



Source: MobiliseYourCity, 2017

In order to ensure the overall consistency of the CoM methodology, it is suggested using the below equation (Eq. 2) to assess the total GHG emission in the transport sector.

Eq. (2):

$$\boldsymbol{GHG\ emissions} = \sum_{\boldsymbol{MODES}} \sum_{\boldsymbol{FUELS}} (\boldsymbol{Activity\ trip\ length\ x\ modal\ split\ x\ intensity\ x\ fuel\ carbon\ content})$$

One of the specificities of calculating the energy consumption/GHG emissions in urban transport is related to the potential high share of sources moving across the border of the urban territory, which makes it difficult to allocate the energy consumption to a certain territory.

5.1.2.3 Energy supply

Additionally to the emissions generated through energy consumption, local governments shall report GHG emissions from energy generation activities. To avoid double counting, these shall not form part of the GHG emissions inventory total, and will be reported under an "Energy Generation" or "Energy Supply" sector, as follows:

- All GHG emissions from generation of grid-supplied energy within the city boundary, and all GHG emissions from generation of grid-supplied energy by facilities owned (full or partial) by the local government outside the city boundary shall be reported and disaggregated by electricity-only, combined heat and power (CHP), and heat/cold production plants.
- GHG emissions from sources covered by a regional or national emissions trading scheme (ETS), or similar, should be identified if existing.
- In addition, local governments should report all activity data for distributed local renewable energy generation.

This means, the local production of energy and associated direct emissions are not part of the activity sectors included in the BEI but are considered in the calculation of the local emission factors to be applied to the local consumption of electricity and heat/cold. The principle is to allow signatories to reduce their emissions associated with the consumption of distributed energy, by encouraging both energy saving measures and measures related to the implementation of local energy production.

In order to calculate the indirect CO_2 emissions to be attributed to the local production of energy, the EC JRC developed a specific methodology, fully explained in the "Guidebook Extended version".

In many cases, the information on local production is directly available or assessable from the local (private or public) electricity provider, costumer and/or unit operator. For the large plants (such as Combined Heat and Power - CHPs), the information on the (distributed or centralised) local electricity production can usually be obtained via direct contact with the plant manager (municipal power agency or private company) or with the operators of the distribution network. In other cases, the data can either be obtained through questionnaires to the local producers/suppliers (e.g., Energy communities) and/or costumers or be derived from statistics (e.g., number of permits delivered, if required; number of subsidies granted) related to the amount of installations and power. Energy market operators may also have data about entities that provide electricity to the grid (e.g., from the certified green electricity).

In case of CHP plants, the energy input has to be split between electricity and heat/cold production. The selection of the plants to be reported as local electricity production will have a direct influence on the value of the local emission factor for electricity and consequently on the emissions associated with the local consumption of electricity.

In the selection of production units is required to ensure that the local emission factor reflects the real changes in local electricity production. For example, for the installations running on renewable energy sources, all the additional units reported in MEI(s) should be new installations, installed after the baseline year.

Table 6. Energy supply activity sectors/data

Sector: *Energy supply*	
Sub-Sector	**Description**
Electricity-only generation	All activity data and GHG emissions from energy (both renewable and non-renewable) consumption for the purpose of generating grid-supplied electricity in power plants that solely generate electricity.
CHP generation	In the case of Combined Heat & Power (CHP) plants, which generate heat and electricity simultaneously, or any other plants not listed, you should report here the amount of electricity produced (in MWh), both from renewable energy and non-renewable energy sources.
District heating/cooling generation	All activity data and GHG emissions from energy (both renewable and non-renewable) consumption for the purpose of generating thermal energy in district heating/cooling plants
Distributed local renewable energy generation	All activity data and GHG emissions from local energy generation (electricity, heat, etc.) facilities that are not grid-connected.

Source: JRC own elaboration based on the GCoM reporting framework

5.1.2.4 Waste/non-energy related sectors

The local authority shall report all GHG emissions from disposal and treatment of waste including solid waste and wastewater ([25]) generated within the city boundary and disaggregated by sub-sectors. Further definitions and guidance on sub-sectors are provided in Table 7.

The quantification of GHG emissions from disposal and treatment of waste should include:

Activity data: Local authority should identify the quantity of waste generated in the inventory year, categorised by different types of generation and treatment pathways where possible. Guidance on collecting this information is available in IPCC Guidelines ([26]).

The emission factor: Guidance for calculating emission factors from different waste disposal and treatment pathways, including equations and default data that local authorities may use in absence of local or regional/national data, is available within the IPCC Guidelines and the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories ([26]).

If the local authority has chosen to use the LCA approach, emission factors for landfills are available from the ELCD (2015) database ('Landfilling' class) ([27]).

For the end-life management of Photovoltaic systems and the end-of-life management of batteries in the off-grid solar sector please refer to the annex in the "Guidebook Extended version" ([28]).

([25]) Water access: GWOPA Global Water Operator Partnership Alliance www.unhabitat.org; - Solid waste treatment: IRRC Integrated Resource Recovery Centre – A low cost municipal solid waste management system in South East Asia- ESCAP.
([26]) The 2006 IPCC Guidelines focus on emission inventories at national level. The specific volume that is relevant for GCoM local authorities regarding non-energy related emissions is Volume 5, "Waste". The GPC is available at http://ghgprotocol.org/sites/default/files/ghgp/standards/GHGP_GPC_0.pdf and contains a detailed methodology, based on the IPCC one, on how to assess, at city level, the emissions from waste and wastewater (Chapter 8 "Waste").
([27]) http://eplca.jrc.ec.europa.eu/
([28]) For further information on this aspect, consult the Annex 11 of the "Guidebook Extended version" and the GIZ document: "END-OF-LIFE MANAGEMENT OF BATTERIES IN THE OFF-GRID SOLAR SECTOR - How to deal

Table 7. Non-energy related activity sectors/data

Sector: *Waste*	
Sub-Sector	**Description**
Solid waste disposal	All emissions from solid waste that are disposed of at managed sites (e.g. sanitary landfill and managed dumps), and unmanaged sites (e.g. open dumps, including above-ground piles, holes in the ground, and dumping into natural features such as ravines).
Biological treatment	All emissions from biological treatment of waste, including composting and anaerobic digestion of organic waste.
Incineration and open burning	All emissions from waste that are burned either in a controlled, industrial, process or in an uncontrolled, often illicit, process. The former is often referred to as incineration, and the latter as open burning. Note that this excludes emissions from waste incineration for the purposes of energy generation, also known as energy recovery.
Wastewater treatment & discharge	All emissions from the treatment process of wastewater, either aerobically or anaerobically, and direct discharge of wastewater into an open body of water.

Source: JRC own elaboration based on the GCoM reporting framework

5.1.3 Setting objectives and targets

Local authorities should establish a long term vision with clear SMART ([29]) objectives. The vision shall be tackled as the guiding principle of the SEACAP work, pointing out the direction that the local authority wants to follow. A comparison between the vision and the local authority's current situation is the basis for identifying which action is needed to reach the desired objectives.

The SEACAP work is a systematic approach to gradually get closer to the vision.

With regards to mitigation, all local governments and cities are required to set and report city-wide emissions reduction targets. The GCoM defines eight categories of requirements for target setting, as explained below ([30]):

- Boundary (geographic coverage, sectors, and GHGs): The emissions boundary shall be consistent with all emissions sources included in the GHG emissions inventory, with the possibility to exclude sources that are not controlled by the local government. In case that the target boundary does not align with the inventory boundary, any additions or exclusions shall be specified and justified.
- Target type: Local governments shall use one of the following four target types: base year emissions target, base year intensity target, baseline scenario target, or fixed level target (Box 4). For a baseline scenario target, the modelling methodologies, and parameters shall be transparently described.
- Target year: The target year shall be the same as the target year adopted in the Nationally Determined Contribution (NDC). Cities that set a target year beyond 2030 shall include an interim target before 2030.
- Base year (for base year target and base year intensity targets only): The base year shall be the same as the base year used in the NDC. Where the base year is

with hazardous battery waste from solar power projects in developing countries?" available at: https://www.giz.de/de/downloads/giz2018-en-waste-solar-guide.pdf

([29]) The principles of the SMART acronym: Specific, Measurable, Achievable, Realistic, and Time-bound. For further details, see the "Guidebook Extended version".

([30]) See also the Global Protocol for Community Scale Greenhouse Gas Inventory (GPC) 2014 available at: https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

different from the NDC (e.g. due to a lack of data availability), this shall be justified.

  - Ambition: At a minimum, the target shall be as ambitious as the unconditional components of the NDC. Local governments should set targets that are more ambitious than the NDC.
  - Units: Targets shall be reported as a percentage (%) reduction from the base year or scenario year. The absolute emissions in the target year(s) in metric tonnes CO_2-eq shall also be reported.

- The use of transferable emissions units is only permissible when a city's target ambition exceeds the NDC. Where this is the case, the local government shall report the target, with and without the transferable emissions units, as well as identify the source of the transferable emissions units.
- Any conditional components included in the target shall be identified. Where possible the conditional components should also to be quantified. Conditional components include where cities set a stretch target, or where actions are identified for other key stakeholders beyond that which they have committed to themselves (for example, where a local government assumes a more ambitious reduction in the carbon-intensity of the national electricity grid than that committed to in the NDC or official government policy), if possible.

Box 4. Target type

Base year emissions target: Reduce, or control the increase of, emissions by a specified quantity relative to a base year. For example, a 25% reduction from 1990 levels by 2030.

Base year intensity target: Reduce emissions intensity (emissions per unit of another variable, typically GDP or capital Gross Domestic Product – GDP or per capita) by a specified quantity relative to a base year. For example, a 40% reduction from 1990 base year intensity by 2030.

Baseline scenario target: Reduce emissions by a specified quantity relative to a projected emissions baseline scenario. A Business as Usual (BaU) baseline scenario is a reference case that represents future events or conditions most likely to occur in the absence of activities taken to meet the mitigation target. For example, a 30% reduction from baseline scenario emissions in 2030.

Fixed-level target: Reduce, or control the increase of, emissions to an absolute emissions level in a target year. One type of fixed-level target is carbon neutrality.

5.2 Risk and Vulnerability Assessment (RVA)

Africa is a continent blessed with a substantial amount of environmental resources, and many African countries are quite rich with respect to biodiversity, minerals and favourable environmental conditions. Yet, Africa as a whole is one of the most vulnerable continents due to its high exposure and low adaptive capacity ([31]) (Niang et al., 2014). Indeed, the continent is highly exposed to Climate Change, and its structural weaknesses result in lower resilience. With 40% of its population living on arid, semi-arid, or dry sub-humid areas, Africa is one of the areas of the world most exposed to global warming. It has experienced a warming of approximately 0.7°C during the past century, and the average temperature is expected to increase by between 0.2°C and 0.5°C each decade (IPCC, 2014a).

A high proportion of Africans lives in coastal areas: one-quarter of the population resides within 100 km of a seacoast. Because of the combination of increased climate variability and rising sea levels, this population will be increasingly exposed in the coming decades. Africa is also particularly vulnerable to Climate Change because a large proportion of the population resides in rural areas and is heavily dependent on climate-sensitive livelihoods such as agriculture, and on water and non-timber forest products. Although more than half of the land area in southern Africa is marginal, a majority of southern Africans rely on rain-fed subsistence agriculture (Wamukonya and Rukato, 2001). African countries, as countries in other parts of the world, are highly vulnerable not only to climate shocks, but also to economic and political shocks. The conjunction of different shocks has cumulative effects and undermines countries' ability to cope with crisis.

Climate significantly influences day-to-day economic activities from household to regional levels, particularly in the agricultural and water sectors (Boko et al., 2007).

Africa is however a very diverse continent and any statement on the impact of Climate Change can hardly be applicable to the entire continent (Chhibber and Laajaj, 2008) (see the Box 5: "Key regional risks from Climate Change" and Box 6 for the key sources of information).

Box 5. Key regional risks from Climate Change

Water sector:

Key Risk: The main risk factor in the water sector is the multiple stresses on water resources that are currently facing significant strain from overexploitation, degradation and the increased demand in the future. The risk confidence is higher under the context of drought stress especially in the dry prone regions of Africa.

Adaptation issues and prospects: The adaptation issues and prospects to reduce the risk have been assessed, it consists of:

- Reducing non-climate stressors on water resources;
- Strengthening institutional capacities for demand management, groundwater assessment;
- Integrated water-wastewater planning, and integrated land and water governance;
- Sustainable urban development;

Measuring the risk in the future: The level of risk with current adaptation is gradually increasing with decades of years starting from low in the present to very high risk in the long-term timeframe (2080 - 2100) in a world of 4°C. The increase is attenuated with additional adaptation but somehow high in longer term.

([31]) Adaptive capacity is defined as the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. IPCC, 2014: Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

Climate drivers: Monitoring the warming trend, extreme temperature, drying trend and sea level are relatively critical to control the risks assessed in the water sector and take action accordingly.

Agriculture Sector:

Key Risk: There is currently a risk of reduction in the crop productivity associated with heat and drought stress, with strong adverse effects on regional, national, and livelihood and food security. The confidence is increasingly high given the increased pest and disease damage and flood impacts on food system infrastructure.

Adaptation issues and prospects: The adaptation issues and prospects have been identified in the:

- Technological adaptation response (e.g. stress tolerant crop varieties, irrigation, enhanced observation systems);
- Enhancement of smallholder access to credit and other critical production resources, diversifying livelihoods;
- Strengthening of institutions at local, national, and regional levels to support agriculture (including early warning systems) and gender oriented policy;
- Agronomic adaptation responses (e.g., agroforestry, conservation agriculture).

Measuring the risk in the future: The risk with additional adaptation is at low level until near-term (2030-2040) however, the adaptation measures in this sector should be constantly strengthened and enhanced. Meanwhile the risk level with current adaptation is very high in longer term (2080-2100) and still very high with additional adaptation esp. under the scenario of global mean temperature increase 4°C above preindustrial level.

Climate drivers: Monitoring the warming trend, extreme temperature and the extreme precipitation are important for reducing exposure to these risks in this particular sector and take action accordingly.

Health sector:

Key Risk: The risk factors in the health sector mainly originated from the changes in the incidence and geographic range of vector and water-born diseases due to the changes in the mean and variability of temperature and precipitation, particularly along the edges of their distribution (medium confidence).

Adaptation issues and prospects: Some fundamental Adaptation issues and prospects have been identified through:

- Achieving development goals, particularly improved access to safe water and improved sanitation, and enhancement of public health functions such as surveillance;
- Vulnerability mapping and early warning systems;
- Coordination across sectors;
- Sustainable urban development.

Measuring the risk in the future: The risk is now at the medium level, but the near term scenario (2030-2040) is anticipating adaptation reinforcement that will eventually reduce the health risk level in overall Africa. If the proposed adaptation measures are being adopted, it will sustain the risk at the medium level in longer-term (2080-2100) but increase the risk level very high with current adaptation.

Climate drivers: Monitoring the warming trend, precipitation and extreme precipitation are crucial to reduce the effect of Climate Change in health sector and take action accordingly.

Source: IPCC, 2014b

Box 6. Sources of information for the adaptation pillar in SSA

Climate data and future projections

- Climate Information Portal (CIP) developed by CSAG (http://cip.csag.uct.ac.za/)
- Future Climate Africa (http://www.futureclimateafrica.org)
- The African Risk Capacity (ARC) http://www.africanriskcapacity.org/

Disasters, disasters losses and disaster resilience

- Global Assessment Report Risk Data Platform (http://risk.preventionweb.net)
- DesInventar (http://www.desinventar.net)
- EM-DAT: The International Disaster Database (http://www.emdat.be)
- PREVIEW Global Risk Data Platform (http://preview.grid.unep.ch)
- Disaster Resilience Scorecard for Cities (https://www.unisdr.org/campaign/resilientcities/home/toolkit)

Box 7 summarises the key definitions relevant to climate adaptation.

Box 7. Definitions.

Climate change: Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use.

Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. In this report, the term hazard usually refers to climate-related physical events or trends or their physical impacts.

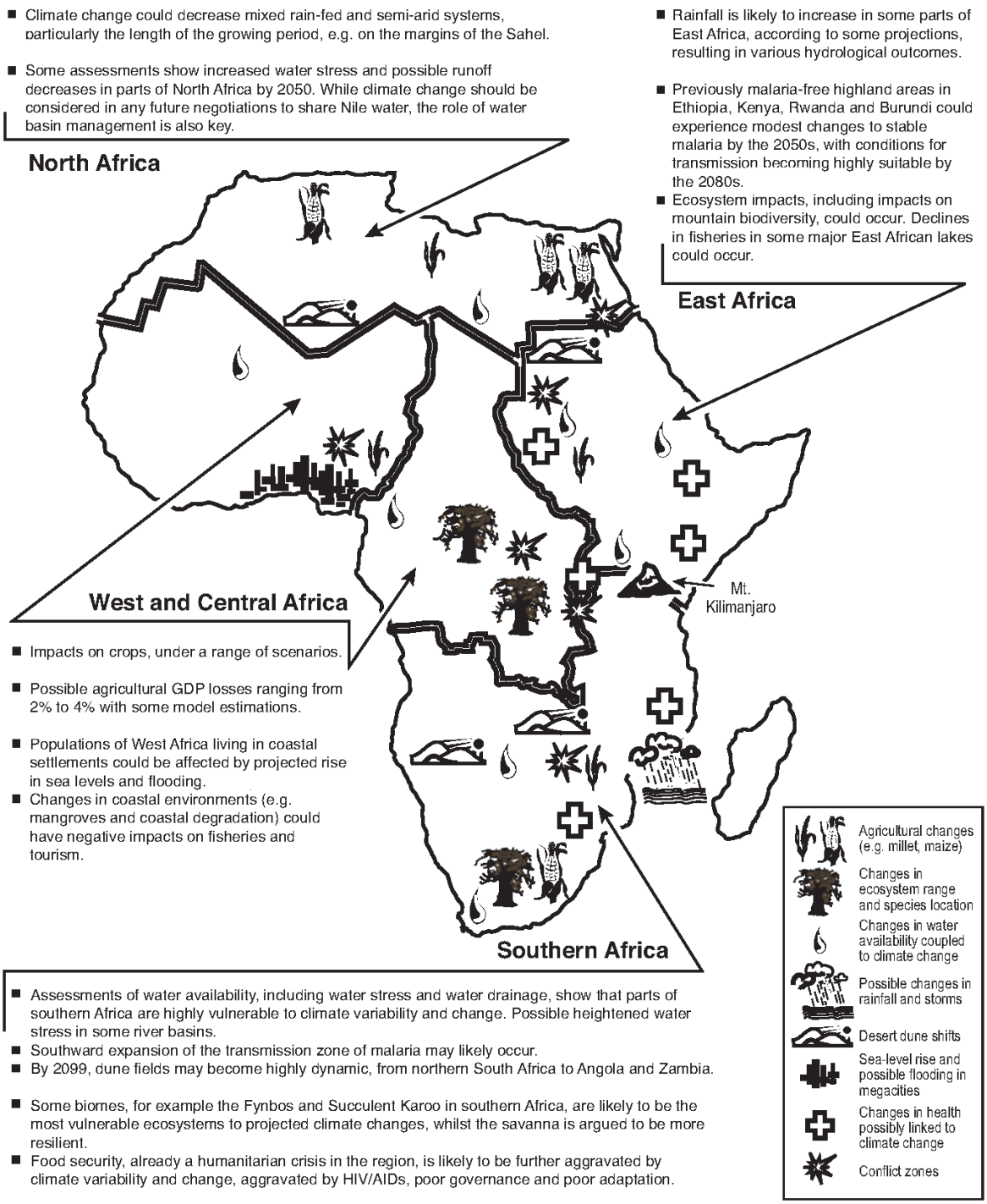
Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard.

Source: IPCC, 2014b

Figure 7. Some examples of current and possible future impacts and vulnerability associated with climate variability and Climate Change for Africa.



Source: Boko et al., 2007.

5.2.1 Climate Change Risk and Vulnerability Assessment

A Risk and Vulnerability Assessment (RVA) determines the nature and extent of a risk by analysing potential hazards and assessing the vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend (IPCC, 2014b). This can take the form of a single assessment or various assessments undertaken per sector. RVAs are the most commonly used tools for identifying, quantifying and prioritizing key risks of a system to Climate Change.

Many tools and methods exist for undertaking vulnerability and adaptation assessments, both qualitative and quantitative (Mukheibir and Ziervogel, 2007). The choice should be based on the purpose of the assessment, the spatial scale of assessment and the resources available, including data, tools, budget and technical skills. Table 8 summarises strengths and weaknesses of three different methodological approaches: indicator based, model and GIS based and participatory approach.

Table 8. Strengths and weaknesses of common vulnerability assessment methodologies.

Type	Description	Strengths	Weaknesses
Indicator based	Indicator-based methodologies use a specific set or combination of proxy indicators in order to produce measurable outputs across various spatial scales. Examples of indicators include the Livelihood Vulnerability Index (LVI) (Hahn et al., 2009), Household Adaptive Capacity Index (HACI), Well-being Index (HWI), Index of Social Vulnerability to Climate Change for Africa (SVA).	Produce measurable outputs across various spatial scales that can be easily used by policy-makers Valuable for monitoring trends and exploring the implementation of adaptation responses	Limited by lack of reliable data, particularly socioeconomic sources, at the scale required for assessment Challenges associated with testing and validating the metrics used, such as good governance.
Model- and GIS-based	Model- and GIS-based methods incorporate biophysical and socioeconomic modelling, and display vulnerability spatially through mapping. These methods commonly focus on a specific driver of change or sector and apply statistical measures and mapping techniques to display vulnerability as well as measures of adaptive capacity and resilience.	Mapping of climate change vulnerability provides an insight into the vulnerability of place, and may have some value in identifying vulnerable places and people	Typically, a snapshot of vulnerability, failing to encapsulate spatial and temporal drivers of structural inequalities
Participatory approaches	Participatory approaches focus on including stakeholders in the assessment process, and this can be done in a variety of ways and to various extents. A range of tools for participatory vulnerability assessments exist, including cognitive mapping, interviews, surveys, vulnerability matrices, stakeholder engagement workshops and expert-based inputs.	Recognise the local or context-specific knowledge that exists within a system, and the fact that many aspects are best known by those individuals operating within that system	The perception and understanding shared by participants should ideally be complemented with supporting socio-economic and biophysical data Challenges associated with identification of the appropriate target group, and ensuring that all voices are heard and equally included in the process

Source: Davis and Vincent, 2017

The Model- and GIS-based approach typically requires advanced technical skills and robust georeferenced datasets, which makes it more accessible to big cities that have the necessary resources and capacities.

The indicator-based approach requires less resources and technical skills which makes this type of vulnerability assessment a viable option for small and medium cities.

However, it is worth noting that not all issues that emerge from vulnerability assessments can be addressed, mainly due to budgetary limitations (World Bank, 2010). Therefore, to identify the optimal level of adaptation it is required to assess the trade-off between the costs of investment in resilience and the expected benefits in terms of reduced losses and damages, versus a scenario of inaction.

This cost-benefit analysis is a crucial step in developing adaptation plans, and cities are encouraged to undertake robust estimations of costs, benefits and uncertainties to the extent possible.

Box 8. Key Reporting element to be included in the RVA.

All signatories shall prepare a RVA within two years after committing to the CoM SSA.

It is mandatory to include:

- Boundary of assessment equal to or greater than the city boundary;
- Year of approval from local government;
- Data sources;
- A glossary of key terms and definitions;
- Leading/coordinating team in the city;

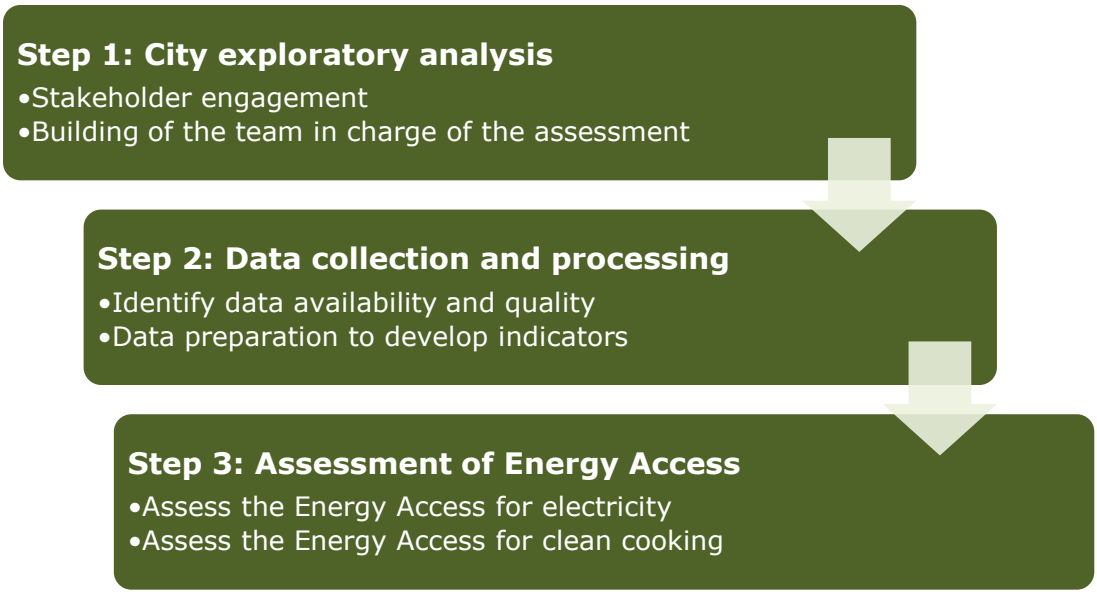
Terminologies and definitions used in the reports shall be consistent with those in the IPCC Fifth Assessment Report or update thereof as well as with national frameworks/requirements.

Source: GCoM Common Reporting Framework

5.3 Access to Energy Assessment (AEA)

The Access to Energy Assessment (AEA) is framed as a dashboard of multiple indicators that help to figure out a clear picture of the current condition of the local authority. Local Authorities can build upon the outcomes of the assessment to develop their energy access strategy. The first step of the procedure consists in building the team responsible for the assessment. For effective results, suitable skills and knowledge of both the topic and the territory should be important requirements for the team members. Moreover, the involvement of stakeholders may be essential for the following step. The second step regards the collection of data necessary for developing the indicators. In the third step, the indicators are used to assess the energy access in the key fields proposed within the CoM SSA framework (Figure 8). Detailed assessment of the current condition can support decision making process regarding policies and investments ([32]).

Figure 8. Procedure for the Access to Energy Assessment



Source: JRC own elaboration

5.3.1 Sectors and energy uses covered

In the framework of the CoM SSA initiative the fields to be considered to assess the energy access in Sub-Saharan Africa are: clean cooking and electricity in households and public buildings. While the lack of modern cooking systems affects mainly health and family issues, lack of electricity access has a strong impact on education and on productive income-generating activities. Access to electricity refers not only to household activities but also to community services from infrastructure such as hospitals and schools. As a consequence, it is important to recognise energy needs across homes, workplaces and community. The Sustainable Development Goals (SDG) related to living standards include (among the others) the access to both the mentioned aspects: clean cooking fuels and electricity (SDG 7). Despite the significant progresses in electrification, 590 million people – roughly 57% of the population – remain unconnected in Sub-Saharan Africa (OECD/IEA (2017). The use of electricity has numerous benefits including: increased lighting, ecological aspects (air quality and forest protection) and health well-being. As a result, the electricity for many households implies a change in welfare (Abdullaha and Jeanty, 2009). All developing regions of the world suffer from low

([32]) It must be noted that at the date of the preparation of the present document, the recommendations of the GCoM Technical Working Group (TWG) on energy access and energy poverty are not yet available.

access to clean cooking. In particular, in Sub-Saharan Africa by 2010 less than 30% of population had access to clean cooking fuels (Rao et al, 2017). Externalities arising from the lack of access to clean cooking include increased health risks due to smoke exposure, deforestation and social and gender imbalance.

The question of energy access requires the involvement of higher centralised institutional bodies. However, the local authority has a great role to play. Firstly in outlining and overviewing the local current status of electrification and cooking fuels. Secondly in establishing close cooperation with central governments and industrial bodies.

When developing the assessment, the disparity between urban and rural areas within the city and the state of informal settlements are key aspects to be taken into consideration. Only 22% of the population in rural areas has access to clean cooking. This particularly affects the life of the most vulnerable (including women and girls), as they are mainly responsible for procuring and using cooking fuels, particularly in rural areas, devoting less time to income-earning or educational activities (AfDB, 2016; Grosse-Puppendahl, San Bilal and Karim Karaki, 2017).

"Tracking SDG7: the energy progress report 2018" estimates that the 45% of the global population living without access to electricity is settled in rural areas of Sub-Saharan Africa, while only the 9% is in the urban areas of the region.

National figures may not be representative of the local conditions, since these are not sensitive to the significant differences and disparities among cities and between rural and urban areas within a local authority's area of jurisdiction. As a consequence, although national statistics and figures represent a key support for assessing the current condition of energy access, there is the need for a local approach. This enables local authorities to build a sound knowledge of the status of their territories and inhabitants and underpins premises for action. In this context, the assessment of the initial level of energy access is crucial. The key variables included in the assessment to describe the energy access and the main indicator used, are further developed in the following paragraphs.

5.3.2 Data collection

The collection of data to develop the assessment is a key step of the process. However, data is not always available. It also may vary in terms of detail, scale, aggregation, and typology. For this reason, several options of data collection can be considered and a combination of the different opportunities may allow filling the gaps. Modelling outcomes are a resource, as well. As previously mentioned, data regarding local territories would be optimal, but in case this is not accessible, integration with more aggregated data at regional or country level may be feasible. In this perspective, National data from public institutions may represent a key starting point. The need to integrate energy issues into national surveys to collect more in-depth information on energy access in a multi-dimensional perspective is urgent. Statistical Services may conduct periodic national population and housing census that may include household energy usage data ([33]). ESMAP([34])/World Bank/WHO is preparing a guidance note for statistical offices in countries to guide them on how to integrate better questions into national household questionnaires to capture quality data on access to electricity and clean cooking. There may also be initiatives led by central governments or international institutions focusing on particular regions or areas. In these cases, comparisons or modelling methodologies based on these data, if transparent and well-explained, may lead to acceptable results and estimations. Despite the complexity regarding data collection, the International Energy Agency (IEA) has historical values since 1971, by country and regions, including actual consumption levels and share of households relying on traditional fuels as primary

([33]) See the case of Ghana for instance. Mensaha G. S., Kemausuor, F., Brew-Hammon, A. (2014). Energy access indicators and trends in Ghana. Renewable and Sustainable Energy Review 30, pp. 317–323.
([34]) ESMAP is a partnership between the World Bank Group and 18 partners to help low and middle-income countries reduce poverty and boost growth, through environmentally sustainable energy solutions.

source for cooking. Data on access to electricity and clean cooking at household level are available in historical series 2010-2017 on the https://trackingsdg7.esmap.org/. In addition, ESMAP under the multi-tier framework energy access survey has data for 15 countries for public institutions (clinics, schools, public buildings). Food and Agriculture Organization (FAO) is working on the area of fuel and energy for cooking, heating, lighting and powering. Resources on this topic are publicly available on the website (http://www.fao.org).

Other options for data collection can be online platforms like the Climate Information Platform of CSAG - Climate System Analysis Group (http://www.csag.uct.ac.za). Collaborations with universities may be a strong point in the fact that specific courses, master thesis and PhD researches can focus on topics in specific areas within the local authority territory and produce useful results. This underlines the importance of collaboration and stakeholders' involvement.

Energy surveys are an essential data-collection tool. The type of data required for assessing the energy access in a given area can be obtained through surveys involving multiple categories of users according to the required data. The preparation of the survey is a crucial step. Questions should be focused in order to gather useful data for building the indicators and samples must be chosen accurately. Moreover, the same survey could be used to establish energy access and household fuel use for inventory purposes. In this context, it is also important to keep track of the categories and the samples surveyed. This tool could be useful in the case of off-grid areas and households. As an example, Winrock International conducted a survey on a small sample of the population in Liberia (Winrock, 2011; Alfaro and Miller, 2014). The survey results have been used for the determination of expected monthly electricity bills and customers' ability and willingness to pay.

Key aspects local authorities should have a clear picture of, are the financial institutions (FI) to be partnered with. FI should be contacted at the beginning of the SEACAP process (see chapter 8), since their support may deal with numerous options in addition to funds. As an example, scholarships may be funded allowing students and researchers to work on projects that are able to provide key data.

Other useful links on data regarding energy access are:

- Regulatory Indicators for sustainable energy (RISE) https://rise.esmap.org/

- Tracking SDG7 Report: https://trackingsdg7.esmap.org/

- Multi-tier framework for energy access in the following countries:

  Ethiopia-https://energydata.info/dataset/ethiopia---multi-tier-framework--mtf--survey--2018-

  Rwanda-https://energydata.info/dataset/rwanda---multi-tier-framework--mtf--survey--2018-

- https://energydata.info/

5.3.3 Key variables and indicators

Access to energy has a multi-dimensional nature which makes its assessment challenging. Binary definitions of energy access – 'having access' or 'not having access' – are unable to catch important differences in terms of energy technologies and communities' needs. On the contrary, the use of multiple indicators allows evaluating energy access with the aim of supporting decision-making, and clearly monitoring progress made. In literature numerous types of energy access indicators exist. In this guidebook, a collection of one-dimensional indicators, which measure a single aspect of energy access, is proposed. These indicators are easy to calculate and to interpret. They reflect the multi-faceted key elements (sustainability, security and affordability) of energy access. This ensures a holistic perspective that helps to identify co-benefits and avoid trade-offs. However, keeping track of specific issues (such as informal fuel selling

and illegal electricity connections) is extremely difficult. For this reason, local authorities are encouraged, but not required, to assess these aspects through their initiative and subjective proposal.

5.3.3.1 Electricity access Key indicators

In this section, ten key indicators for electricity access are proposed for CoM SSA initiative and the fundamentals for their developments are explained. There is an overall indicator and 9 indicators (Table 9) which are individually related to one of the three key attributes of energy access (Security-SC-, Sustainability-SU-, Affordability-AF), as detailed in the following. To lead the AEA, the local authority has to select and evaluate at least one indicator per each category, along with the overall one.

Table 9. Access to Energy indicators - Electricity

Attribute	Related Indicator
Overall	Percentage of population or households having access to electricity (grid/off-grid) [%]
SC2	Number of hours per day of available electricity [h/day]
SC3	Average number of electricity interruptions per day [n°/day]
SC4	Number of days without electricity per year [n°/year]
SU5	Percentage of electricity from RES [%]
SU6	Number of minigrids and stand-alone systems [n°]
SU7	Laws and regulations in place for mini-grids/stands-alone systems [+/-]
AF8	Percentage of population able to pay for electricity [%] or willingness to pay
AF9	Percentage of expenditure of Public Buildings for electricity [%]
AF10	Financial and regulatory incentives for renewable energy in place [+/-]

The overall indicator gives a general picture of the current situation of the access to energy in the local authority. This includes aggregated data that help building a starting point to be further developed with the use of other specific indicators (SU, AF, SC). Local authorities could only determine a comprehensive framework with the combination of multiple information and perspectives, which the proposed indicators aim to support. Moreover, as reported in a) giving information on the average characteristics of households is very important to build correct figures of the local situation. However, this is recommended but not mandatory.

SC (2/3/4) – In many Sub-Saharan African countries, electricity supply is unreliable. Frequently, supply is not sufficient to meet demand because of its instability, with a growth in the number of customers requiring electricity services. As a consequence, low electric power quality, exemplified by the occurrence of localised outages (interruption of the transmission and distribution of electricity due to a technical problem, a tempering or an overload) and load shedding (load reduction as a controlled option to respond to unplanned events to protect the electricity power system from a total blackout), incurs significant costs (Ahlborg et al., 2015), and badly characterises the quality of energy when it is available. The indicators in this category aim at assessing the reliability and the quality degree to which households and public buildings have access and use electricity. SC2 is calculated by considering the average number of hours of daily supply. SC3 assesses the average interruption of the energy supply during the day, while SC4 the shortfall in energy supplies during the year.

SU (5/6/7) - The share of renewable energy in the energy mix is crucial, also for creating more sustainable and inclusive communities. The solar energy potential for African cities is evident and it is gaining a wider consensus among citizens and stakeholders.

SU5- This indicator measures the share of renewable energy in electricity generation. The increase of renewable energy in the energy mix is an agreed target among international, national and regional levels. Renewable energy options are aggregated within the calculation of this indicator..

SU6- Technological innovations and new business models are making mini grids a scalable option for expanding energy services in low access areas like Sub-Saharan Africa. Mini-grid solutions need to be tracked and monitored in order to get a better understanding of the current condition.

SU7- The regulatory uncertainty and inadequacy of policies may hinder the advancement of the off-grid sector. The development of a regulatory framework represents a key aspect to assess the current status and the potential development of a fruitful environment for the off-grid sector. The positive value of the indicator indicates that policies or regulations are in place or under development. On the contrary, a negative value shows a policy vacuum.

AF (8/9/10) - Affordable electricity in Sub-Saharan region is a multifaceted question. Affordable energy is a mean to reduce poverty and increase the well-being of communities and put the basis for a continuous progress.

AF8- The share of households able to pay and/or the amount households are willing to pay for electricity services represent figures that may guide stakeholders when making tariff decisions and policy makers when examining the welfare impacts and viability of these services. Willingness to pay may be evaluated through surveys with several actors, as previously mentioned. Data regarding the percentage of households able to pay may be gathered by Energy suppliers.

AF9- This indicator aims at assessing the incidence of electricity cost in public expenditure. The services provided by public facilities (health centres, schools, municipal offices …) are determinant for the proper functioning of public affairs and for assuring wealth of communities. As a consequence, this indicator helps determining if the public facilities are able to afford these costs and may support policies towards the cost reduction and energy efficiency, in order to keep at acceptable level the public services provided to citizens.

AF10- Financial and regulatory incentives refer to measures to improve the financial returns or reduce the risk of private renewable generation projects. These mechanisms are one of the most cost effective supports for private investments in this field. This indicator will be positive if there is at least a scheme to support renewable energy penetration or the provision of grants or subsidies. These may be framed at national level and then disseminated and further developed at local level, tailored to specific conditions in urban and rural areas.

5.3.3.2 Clean cooking access Key indicators

Due to the cross-sectoral nature of the access to cleaner cooking fuels and more efficient cook stoves, indicators may relate to indirectly linked variables. However, this allows assessing the potential impacts of improvement on the local community on the whole. In this paragraph nine key indicators for clean cooking are listed and the fundamentals for their developments are explained. Also for this field, the approach considers one overall indicator and 8 indicators (Table 10) which are individually related to one of the three key attributes of energy access (Security-SC-, Sustainability-SU-, Affordability-AF), as detailed in the following. To lead the AEA, the local authority has to select and evaluate at least one indicator per each category, along with the general one.

Table 10. Access to Energy indicators – Clean cooking

Attribute	Related Indicator
Overall	Percentage of population/households with clean cooking access [%]
SC2	Percentage of population/households relying on the traditional use of biomass for cooking [%]
SC3	Percentage of population/households relying on LPG or other sources [%]
SC4	Availability of resources: time and distance to gather fuelwood [h and km]
SU5	Number of improved cook stoves used [n°]
SU6	Sustainable charcoal production [Y/N]
SU7	Awareness and/or Education programmes in place [Y/N]
AF8	Financial and regulatory incentives or subsidy mechanisms in place [Y/N]
AF9	Percentage of population able to pay (or willingness to pay) for the transition to clean cooking [%].

The Overall indicator gives a general picture of the current situation of the access to energy in the local authority. This indicator includes aggregated data that help building a starting point to be further developed with the use of the other specific indicators (SU, AF, SC). Local authorities could only determine a comprehensive framework with the combination of multiple information and perspectives, which the proposed indicators aim to support.

SC (2/3/4) According to OECD/IEA, 2017 access to clean cooking facilities means access to and primary use of modern fuels and technologies, including natural gas, liquefied petroleum gas (LPG), electricity and biogas, or improved biomass cook stoves, as opposed to the basic biomass cook stoves and three-stone fires.

SC2- The use of solid fuels, traditional biomass and coal, represent a measure of the deprivation of using more modern fuels. In the case data are not available, surveys may be conducted.

SC3- LPG is produced from natural gas liquids and from refinery supply and it is relatively safe compared to kerosene and biomass. LPG is transported and sold pressurised in cylinders, and therefore needs some distribution infrastructure, together with reliable roads. As a consequence, LPG is a common path to access clean cooking options, especially in urban areas (OECD/IEA, 2017). Along with LPG, other less polluting sources are accepted. Data could be locally available. However, the indicator can be calculated by cross-referencing data by suppliers by local census.

SC4- Women spend numerous hours in collecting fuelwood (usually at greater distance from the household) and in cooking. It is crucial to develop more detailed figures on this aspect to build upon strategies to reduce time spent in those activities and, in parallel, improve the conditions of women.

SU (5/6/7) The access to clean cooking is achievable principally through sustainable supply and improved cook stoves.

SU5- A traditional (or basic) cook stove is typically identified as a very cheap or no-cost device, characterised by very low efficiency and high burns solid biomass. An improved biomass cook stove (ICS) typically describes a stove which has a higher efficiency or lower level of pollution than a traditional stove, through improvements ([35]). The

([35]) USAID/WINROCK. Clean and efficient cooking technologies and fuels

introduction of improved cook stoves that decrease firewood and/or charcoal use contributes to the provision of clean cooking access in rural areas.

SU6- Sustainable charcoal production may reduce the impacts on the environment. There are already regulations and projects in place that support the use of certified charcoal. The indicator aims at assessing if there is a sustainable production of charcoal within the boundary of local authorities and, if positive, to provide further information in this regards.

SU7- The increase of education and awareness about the importance of clean cooking and the fuel and time savings, health and environment co-benefits is determinant for the transition. As a result, this indicator assesses if programs are already in place.

AF (8/9) Affordability can be assessed through an overall perspective that includes also issues related to sustainable and secure energy.

AF8- Financial and regulatory incentives and subsidy mechanisms refer to measures to boost the transition towards LPG or ICS. This indicator will be positive if there is at least a scheme to support the change in the supply or the provision of grants or subsidies. These may be framed at national level and then disseminated and further developed at local level.

AF9- The share of households able to pay and/or the amount households are willing to pay for changing the fuel and/or method to cook represent figures that may guide stakeholders when making tariff decisions and policy makers when examining the feasibility of financial policies. This indicator is strongly related to SU7 and AF8. Willingness to pay may be evaluated through surveys as previously mentioned. Data regarding the percentage of households able to pay may be gathered by Energy suppliers.

5.3.4 Setting the targets

Under the GCoM framework, the Local Authorities commit to improving the access to energy within the area of their responsibility. Through the indicators, an overview of the strategy already adopted is provided. The will to invest time and money on a certain field, rather than another, shapes the way the targets are to be achieved. Moreover, indicators are determinant, along with the assessment of the current status, to monitor the progresses after the selection of the strategies and implementation of the actions.

On the basis of the indicators and requirements previously described, LAs can choose and declare their objective, that means the extent to which they intend to increase the access to energy towards the 2030 SDG, and therefore, which indicators will change and how. The achievement of a minimum condition is essential for the overall indicators. Suggestions are provided for the specific ones (SC-SU-AF). This approach enables to keep a high level of flexibility which supports the consideration of local peculiarities. On the other side, the process to improve the energy access selected by local authorities will be clearly showed by the progresses in each indicator. In the following box, the SDG 7 contents are reported.

Box 9. SUSTAINABLE DEVELOPMENT GOAL n°7 (SDG7)

SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all. The targets are:

7.1 By 2030, ensure universal access to affordable, reliable, and modern energy services

7.2 Increase substantially the share of renewable energy in the global energy mix by 2030

7.3 double the global rate of improvement in energy efficiency by 2030

7.a By 2030, enhance international cooperation to facilitate access to clean energy research and technologies, including renewable energy, energy efficiency, and advanced and cleaner fossil fuel technologies, and promote investment in energy infrastructure and clean energy technologies

7.b By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, particularly least developed countries (LDCs) and small island developing states (SIDS).

5.3.4.1 Electricity targets

In line with the SDG 7 targets, LAs need to contribute to the universal access to energy. For this reason, along with the target for 2030, a mid-term target at 2025 for the overall indicator (*Percentage of population or households having access to electricity)* can be set. A target of at least a 20% increase is suggested for the indicator.

LAs shall declare the target years for the other indicators according to their conditions and potentials.

In literature (Worldbank, 2014), the supply of electricity for less than 8 hours per day cannot be considered adequate. Therefore, the indicator SC2 should show an increase of the duration of electricity beyond the 8 hours per day. However, in cases this would not be feasible, an increase of the number of hours will be already a successful step towards the final overall target. For SC3 the fewer the number of electricity interruptions, the more reliable is the energy supply. Having no interruptions is a key indicator of reliability. Also for SC4, a high quality energy supply should not encounter days without service. Although, the reduction of the number of days without electricity is linked to the supplier, also LAs can contribute to the quality of energy supply by supporting policies regarding the energy mix and taking care of the infrastructures within its boundaries.

Regarding the Sustainability (SU) indicators, LAs could choose the degree of commitment and improvement of energy sustainability within their authority. An increase of at least 20% could be considered in SU5 and SU6 (in the number), while the qualitative approach for SU7 includes the development of new specific regulations and their prospective amendment.

An improvement in the energy access is also described by an increase of the *Percentage of population able to pay for electricity* (AF8). Since the ambition is to assure universal access to energy, the combination of this indicator and the AF10 is of utmost importance to reach the target of universal access.

While the former provides a quantitative evaluation, the latter is qualitative and includes the development of new specific financing schemes or incentives that may make the electricity more affordable. Also for these two indicators (AF8 and AF9) a medium-term target, along with the 2030, is recommended. AF9 is also a measure of energy efficiency; hence, it is important to keep the quality of the service while reducing the expenditures.

5.3.4.2 Clean cooking targets

Within the clean cooking field, a mid-term target at 2025, along with the target for 2030, for the overall indicator (*Percentage of population/households with clean cooking access*) could be set. A target of at least a 20% increase for households could be considered.

Suggestions for SC indicators aim at reducing the reliance on traditional biomass (SC2) and in parallel, at increasing the use of other (sustainable, secure and renewable) sources (SC3). Moreover, SC2 is significantly linked to SC4: once SC2 tends to zero, also SC4 will tend to be nil. These ambitious goals should be achieved with a progressive improvement. Therefore, for these indicators setting a medium-term target is recommended.

The Sustainability (SU) indicators include two qualitative approaches (SU6 and SU7) and a quantitative one (SU5). The former will assess an improvement in the cleaning cooking condition if the development of awareness and education campaigns is put in place and if a sustainable charcoal production or identification of other energy sources for cooking is underway. However, the effects of these potential measures will be tangible on the long term. Therefore, it is important to have a short term target to start the measures. As an example, the target could be to replace the overall cook stoves for SU5 by 2030.

An improvement in the clean cooking access is also described by an increase of the Percentage of population able to pay for it (AF9). Since the ambition is to assure universal access to energy, the combination of this indicator and the AF8 is of utmost importance to reach the target of universal energy access.

While the former is qualitative and includes the development of new specific financing schemes or incentives that allow implementing healthier ways of cooking, the latter provides a quantitative evaluation of the real potential of paying, which must increase in time. Also for these two indicators (AF8 and AF9) a mid-term target, along with the 2030, is recommended.

6 SEACAP process: Planning phase-Development

The SEACAP shall lead to climate change mitigation, adaptation and access to energy actions being integrated into development policy and planning at every level. Mitigation, adaptation and access to energy should complement each other, and should be mainstreamed into existing sectorial policies in order to foster synergies and optimise the use of available resources. The benefits of policies that are implemented for various reasons at the same time are numerous. Most including policies, designed to address greenhouse gas mitigation, also have other, often at least equally important, rationales (e.g. related to objectives of development, sustainability and equity).

The following sections provide a short overview of the policies and measures usually implemented by local authorities to reduce their energy consumption and CO_2 emissions (6.1), to enhance climate resilience (6.2) and increase the access to energy (6.3). Actions are presented in separate sections, but they may have co-benefits and combine climate change mitigation/adaptation actions and socio-economic developments, such as improving energy access.

6.1 Elaboration of the plan: Mitigation actions

Strengthening the multilevel governance allows addressing more effectively the issues of Climate Change in cities. The transition towards a more sustainable urban environment at the local level includes a common understanding of the importance of curbing the city's CO_2 emissions. This understanding provides a basis upon which political leadership initiate a process of exploring possibilities and discussing different options with a wide range of stakeholders towards selecting, detailing, implementing and monitoring local action.

For successful climate and energy policies there are two main different forms of collaboration: horizontal and vertical. Both of them are crucial to bridge the gaps of knowledge, skills and authority. In this process, local authorities play a key role in facing Climate Change issues and have the capacity to support and mobilise action for local energy generation investments through several modes of urban climate governance. In the following, four modes of urban energy and climate governance are investigated and these ([36]) can be mainly summarised as:

- Municipal self-governing;
- Municipal enabling (governing through enabling);
- Governing through provision;
- Regulation and planning (governing by authority).

Overall, the barriers that can be addressed with each main tool under these modes of governance are different. For this reason, it is often necessary to combine multiple modes of governance to reinforce and align incentives for particular objectives. This must be supported by an analysis of the legal, physical, social and economic barriers hindering local energy generation prior to considering corrective actions and measures. Local authority itself assumes an exemplary role in the implementation of these actions. Committing to highly efficient buildings in their own facilities is not only one way local authorities can reduce emissions, but also lead by example, showing the community how to deal with the issue and results achieved. Public buildings and infrastructures (such as public lighting) do represent a field where large reductions in energy consumption can be achieved.

In the following, examples of mitigation actions and strategies for different sectors are illustrated.

([36]) Modes of urban climate governance are based on definitions in Kern and Alber, OECD and IEA

Public awareness and social engagement play a pivotal role for successful climate action. Measures to induce behaviour change and to provide education, significantly contribute to the decrease of energy consumption through social and non-technological approaches that must be included in policies that support energy efficiency and energy savings. In the CoM framework, local authorities are integrating policies aiming at increasing public awareness (such as information and benefit campaigns) towards a behavioural change in energy use in their territories.

Buildings and transports are among the most energy intensive sectors at local level. However, they are also fields where local authorities can take action to reduce energy consumption and carbon emissions in the framework of CoM SSA. The reduction of final energy consumption in the building sector contributes to Climate Change mitigation and to reduce the dependence on fossil energy sources.

One of the most common strategies for energy retrofit of buildings usually consists in reducing both thermal losses through the envelope and cooling loads, and in controlling the solar heat gains. The losses of energy through the envelope may be reduced through the implementation of several measures that affects glazing and frames and the walls and roofs characteristics. Through conscientious design of the lighting systems, the lighting load can be reduced as well. A set of options in the lighting sector allows reaching up to 50% of savings. The most common measure is the replacement of lamps with more efficient ones (lower consumption with the same performance). Moreover, correcting the misuse of the lighting appliances shows to be a significant contribution in the saving options. Strategies for improving the energy efficiency in buildings vary if either a new building or an existing one is considered.

Along with technical measures on buildings, other simple measures may contribute in both the reduction of energy consumption and in configuring sustainable buildings simultaneously:

- Behaviour and building management: adequate behaviour of building occupants may also generate significant savings.
- The management of technical installations in buildings may lead to energy savings
- Location: buildings located in summer climates will require active protection against solar radiation in order to minimise cooling loads.

Urban and land use planning: Land use and transport interaction, green infrastructures and local energy production are some of the main fields where urban planning may have a role to address Climate Change at local level. Furthermore, there are growing evidence and consensus that when local authorities act on these issues, there is a suite of economic, environmental and social 'co-benefits' which can fundamentally improve the liveability, sustainability and resilience of cities. As a consequence, Climate Change mitigation became a key pillar (alongside traditional economic, social and environmental aspects) in decision-making in cities. GHG emissions at urban level are deeply influenced by the layout of neighbourhoods. In particular the key issues that influence carbon emissions are urban density and efficient urban mobility. Urban form, land use and characteristics of the building stock are strategic issues for improving energy performance.

- Mixed-use development and sprawl containment: Sprawl represents one of the key aspects where the correlation that lies between energy and urban layout appears. Compact cities and the promotion of mixed-use developments can reduce mobility demand within cities and create more sociable, equitable and economical urban environments. Urban density can have significant benefits in terms of reducing the overall environmental impact of cities. In terms of GHG abatement, dense cities offer reduced travel distances and, hence, increase the feasibility for public transport and active travels; provide improved opportunities for district energy and preserve surroundings, green and rural areas, which may also potentially provide carbon sequestration.

Transport and land use: The integration of land use and transport planning is one of the key elements of a long term strategy aiming at energy efficient districts. In SSA public transport is a key sector, its shares range from 55% to 70% on a pkm basis. However, it is of utmost importance keeping the pace with the population growth and keeping updating the system and infrastructures to maintain a high quality level of performance. The widely recognised standard "ASI" for transport planning (Avoid, Shift, Improve) has been adapted for SSA context, with the integration of "Enable" approach, becoming "EASI" ([37]).

- The "EASI conceptual framework" aspires to become a powerful policy tool to improve accessibility and mobility in urban areas of Africa. Four levers of intervention are framed in the EASI approach: ENABLE (to establish an efficient and responsible governance system), AVOID (to limit and minimise the need for individual motorised travel through adequate land-use and transport planning and management), SHIFT (to orient transformations towards low impact transport models), IMPROVE (to improve the efficiency and safety of transport modes while minimizing their environmental footprint)
- Bus Rapid Transit was firstly developed in South America. It offered mass transit at far lower capital cost than rail. The development of BRT systems in SSA has not reached high levels since the capital intensity is still too high for the SSA context, where the trend shows sprawling cities, poor road infrastructures and low income populations. There are some South African experiments that reframed BRT as IPTN – Integrated Public Transport Networks.
- Transit Oriented Development (TOD) is a planning strategy which aims at producing low carbon development, by considering public transport and transit stations as priorities. The development of housing, employment, activity sites and public services are placed around existing or new stations served by frequent and efficient service. TODs are characterised by medium to high densities, compact urban forms and mixed use. In this framework, both corridor and nodal approaches to development are considered with the goal of moving citizens as efficiently as possible.
- Providing infrastructure for active travel to encourage cycling and walking as alternative forms of commuting and travel can significantly reduce vehicular traffic.

Local energy generation: Local energy generation and distribution systems are an important area of intervention for effective action at the local level within the competence of the local authority (Kona et al., 2017). Local authorities usually control or have influence over the local energy supply system as the owner or a partner in the local energy utilities. This can effectively enhance the opportunities by which renewable energy sources can be effectively integrated to support CO_2 mitigation targets. Planning urban form to enable renewable, low carbon and smart energy can offer significant benefits in terms of reducing emissions, but also improving access to sustainable and secure energy supply.

([37]) The World Bank (2015), "Policies for sustainable accessibility and mobility in urban areas of Africa", Africa Transport Policy Program (SSATP), TRANSITEC Consulting Engineers Ltd (M. Stucki), in collaboration with ODA, CODATU and Urbaplan.

6.2 Elaboration of the plan: Adaptation measures for climate hazards

The adaptation pillar of CoM covers the following types of climate hazards that could potentially affect negatively societies, economies and the environment: extreme heat, extreme cold, extreme precipitation, floods, sea level rise, droughts, storms, landslides, and forest fires. However, other hazards may also be listed, (such as vector-borne diseases, water scarcity) according to the specificities of the city. Floods and droughts are the most frequent types of disasters in Sub-Saharan Africa, followed by wind storms. However, droughts tend to affect a much larger number of people. Among the problems that will be exacerbated by Climate Change, particular attention should be paid to the highly interrelated issues of desertification, food security, and water supply (Chhibber and Laajaj, 2008).

Box 10. Best practice examples

- Public Awareness Raising, Stakeholder Consultations, and Community Participation. Dakar, Senegal. (Wang, H.G., Montoliu-Munoz, M., Gueye, N.F.D., 2009. Preparing to Manage Natural Hazards and Climate Change Risks in Dakar, Senegal: A Spatial and Institutional Approach. World Bank, Washington, DC.)
- Floods and urban planning. Freetown, Sierra Leone. (http://www.eeas.europa.eu/archives/delegations/sierra_leone/eu_sierra_leone/tech_financial_cooperation/infrastructure/the_freetown_development_plan/index_en.htm)
- Tanzania – Drones Help Communities Map Flood Risk in Dar Es Salaam Slums (http://floodlist.com/africa/tanzania-drones-help-communities-map-flood-risk-dar-es-salaam-slums)

This section includes case studies found in the literature. The goal is to frame lessons in a manner that will facilitate learning from experience. A preliminary list of adaptation actions, identified from the international literature, and the best available practices are presented in Table 11 for five main sectors. These represent examples from which take inspiration for the choice of adaptation actions suitable to the local context. Actions could be framed as strategic actions, related to alert and communication and as technical measures. With time, this list will be progressively completed with examples from CoM signatories. Additional measures, depending also on the local needs and the national situation, would be necessary. However, these actions represented in the table below can be considered as a very good starting point.

Table 11. Adaptation actions by sector.

Sector	Actions	
Public health and quality of life	Strategic actions	Regularly improve monitoring systems in order to ensure that any disease development or any strong disturbance in public health shall be detected and efficiently addressed in its early stages. Improve sheltering capacities by ensuring that the cities have well established air conditioned facilities such as hospitals, city halls, mosques … etc. that can protect citizens who does not have the necessary infrastructure to protect themselves from extreme weather events such as heat waves, storms or floods.
	Alert and communication	Develop and regularly maintain an early warning system that can alert citizens ahead in case of extreme weather events. Such systems should be set up as early as possible and connected to national systems to be able to transmit the message in the most efficient and quick way to the citizens. Regularly conduct educational and awareness raising campaigns to inform people about possible health impacts of heat waves, floods, vector borne diseases and how to address them.

	Technical measures	Regularly improve water quality that can serve to cover the basic needs of citizens during heat waves. Improve the quality control of sewage, waste dumps, dormant waters and draining systems to avoid their high risk of being serious diseases reservoirs. Identification of potential hot spots for the development of vector borne diseases.
Infrastructure management	Strategic actions	Develop good systems to ensure the proper management of water flux especially in case of heavy waves that might overpass absorption capacities of cities. Improve infrastructure monitoring to anticipate problems related to extreme events such as floods and heat waves and quickly fix problems that may arise. Develop smart models to predict demand and electricity supply to avoid blackouts in times of heat waves. New specifications for bridges, according to maximum expected flow during floods or sea level rise and highest temperatures.
	Alert and communication	Develop early warning systems to alert citizens in case a part of the infrastructure has been or expected to be severely damaged. Regularly conduct awareness raising campaigns to increase people's awareness and advise them on how to save water and use the electricity efficiently.
	Technical measures	Develop efficient and sustainable drainage systems. Establishment of underground water reservoirs. Building desalination plants based on the best available technology. Establish or upgrade flood defence systems near affected facilities.
Buildings management	Strategic actions	Modify the building codes to promote more energy efficient and heat tolerant structures. Set up incentives for innovative climate friendly buildings. Develop integrated land use planning with zoning system depending on the different areas.
	Technical measures	Go more towards greening the infrastructure such as developing building's roofs and walls and cover them with more plants to increase the amount of shade and refresh the environment and generate a cooling effect on the environment Develop green areas in the city by planting trees and setting fountains to help reduce the heat island effect.
Economy	Strategic actions	Elaboration of drought, water and ground water management plan.
	Alert and communication	Educate tourists and citizens on ways to conserve natural resources, especially during extreme weather events.
	Technical measures	Utilization of drip irrigation practices. Promote the use of renewable energy technologies.
Biodiversity	Strategic measures	Establish a fire management plan. Elaborate an integrated coastal management plan.
	Technical measures	Improve or develop beach nourishment or replenishment ([38])

([38]) The artificial placement of sand on an eroded shore to maintain the amount of sand present in the coast.

6.3 Elaboration of the plan: Access to energy actions

Almost thirty Sub-Saharan African countries are in the process of completing their Action Agendas, describing a nationally tailored approach to deliver SEforALL objectives (World Bank, 2017). Most of these action agendas in Sub-Saharan Africa include the definition of national targets for energy access for 2030: Angola has set 100% access to electricity and clean cooking, Nigeria 95% and 80%; Tanzania above 75% for both, and Uganda above 98% for both. Energy is a key input for meeting basic needs and for achieving socio-economic development goals: access to energy, fuel for cooking, heating and lighting in households, power for industry, agriculture, and petroleum products for transportation. Energy access is linked to other basic services such as water and sanitation. The use of energy, the types of energy used and the lack of access to sufficient energy have far reaching implications for a city's economic development, its environmental health and for the poor. Access to energy is one of the factors that bring together human development, economic growth and sustainability. Living without energy has impacts on a wide range of development indicators, including health, education, food security, gender equality, livelihoods and poverty reduction. Thus if Sub-Saharan Africa is to achieve a reduction in energy poverty and sustainable access to renewable energy sources for all, resources as well as policy and regulatory frameworks to support energy service delivery need to be urgently reviewed. Cities have an important role to play in the shift to a more sustainable energy picture in Africa (Table 12).

Table 12. Recommended approaches to the urban challenges

	Accelerate shift to cleaner cooking	Scale up renewable energy	Increase energy efficiency of buildings and appliances
Benefits to the under-served	**Health:** Modern fuels result in dramatic reductions in particulate matter and associated mortality. **Economic:** Significant cost and time savings, productivity improvements for enterprises in the informal sector.	**Access:** Addresses the urgent need to provide electricity access, particularly in informal settlements. **Reliability:** More reliable supply of electricity. **Economic:** Costs of solar PV are declining rapidly; higher cost savings compared to diesel, productivity improvements, potential revenue source if owners can sell back to the grid (as "prosumers").	**Economic:** Significant cost savings from reduction in household energy consumption, increased productivity. **Health, Safety, Comfort:** Safer, more comfortable, and higher quality spaces to live and work with lower respiratory and heat-related illnesses.
Benefits to the overall economy and environment of the city	Cleaner cooking cuts outdoor air pollution from solid fuels. Reduced GHG emissions. Cost savings where subsidies are high	Avoided costs of new transmission infrastructure Reduced electricity demand Reduced GHG emissions Energy security and climate resilience. Local business development.	Increased energy productivity Reduced need for new installed capacity. Significant energy cost savings Air pollution benefits where cities rely on "dirty" electricity grids.

Source: Westphal et al., 2017

6.3.1 Key actions for improving access to energy

Departmentalization within local government often means that cities do not have a complete understanding of energy use, energy issues and energy initiatives within its boundaries. This is best gathered and understood in order to inform longer term energy planning (Batchelor et al., 2017).

Develop a State of Energy Report. This summarises current energy use, energy supply and key energy issues in a city. This can be used for discussion among your colleagues, to help them understand the role of energy in the city.

Develop a Sustainable Energy Strategy. This will coordinate energy planning with an overarching city energy vision and set realistic renewable and energy efficiency targets based on current data.

Develop an Action Plan. This maps out how the targets are going to be achieved and explores the technical opportunities for addressing energy poverty, as well as the policy challenges involved in promoting and deploying these technologies.

Box 11. Recommendations for substantial shift in improved household energy access

- Align and coordinate government plans and policies
- Strengthen city level information and data systems
- Review and rethink how policies are implemented
- Engage communities and civil society

6.3.2 Access to electricity

In the policy environment surrounding energy access, a major focus has been put on providing access to electricity and recent changes in the price of renewable energy technologies have sparked debate about the best way to do so. Different approaches include the following technologies (Morrissey, 2017):

Large-scale grids: Expanding the central electrical grid is the most established approach to provide access to electricity. In Sub-Saharan Africa, where regulation is often weak, utilities have performed notoriously poorly.

Mini-grids: Mini-grids are still capable of supplying electricity in quantities that can match the services supplied by the grid. However, the current cost of renewable components and battery storage might negatively impact the cost of electricity when compared to the grid. In addition, although the up-front costs of mini-grids are lower than grid expansion, they are still high compared with the incomes of local entrepreneurs (who might be expected to finance and run such grids).

Solar home systems (SHSs): SHSs can supply electricity to isolated households that are too dispersed to be connected through mini grids. However, SHSs suffer from limited capacity, which is sufficient only for lighting, information and communication technologies (ICTs), entertainment and cooling. In addition, electricity from SHSs is more expensive than electricity from both the grid and mini-grids. Although SHSs can provide households with basic quantities of electricity, they can also suffer from regulatory issues and be compromised in conditions where thefts of solar panels are a problem and where demand on the system grows rapidly. Due to high irradiation potential, the falling cost of solar photovoltaic, the speed of roll-out, and the limited capital investment required (compared to grid connections), solar home systems may be attractive solutions in sparsely populated rural areas of SSA. Even low levels of electrification, especially solar lamps, can bring substantial economic and noneconomic benefits.

Solar appliances: Solar appliances provide electrification on an even smaller scale than SHSs and therefore result in the lowest up-front cost, but also the highest cost of electricity of all the technologies mentioned here. Nonetheless, given the high value placed on electrical energy for lighting, electronics, and cooling, solar appliances have been observed to generate rapid transitions in household energy economies.

It's worth mentioning that few countries have set standards for off-grid solar products: Ethiopia, Kenya, and Tanzania—along with the 15 member countries of the Economic Community of West African States have or are in the process of adopting national standards for off-grid solar products (CLASP, 2018).

Error! Reference source not found. summarises the relative strengths and challenges a ssociated with electricity technologies.

Box 12. Off-grid rural electrification with solar energy in Mozambique

The off-grid rural electrification market in Mozambique is dominated by Fundo de Energia (FUNAE), a government agency, which controls the complete value chain (design, implementation, funding and often also operation in cooperation with local authorities) and which is 100 % government / donor funded. In most cases FUNAE implements and operates the projects itself, together with local communities / municipalities, and simply sources equipment from suppliers.

While the work of FUNAE is to be commended in having bought power to thousands in rural and poor populations, this activity doesn't facilitate private sector entry (except as equipment supplier) in those areas which could otherwise be open to enterprise and innovation (e.g. mini-grids operating on hybrid systems – solar, mini-hydro, wind and diesel generators as back-up; containerised utility solutions; productive use of power).

Source: Vaz et al., 2011

Box 13. Bringing Electricity to Kenya's Slums

Giving electricity access to the poorest seems a daunting challenge. But there are examples of how new approaches can help overcome difficulties. One recent example is how the Kenya Power and Lighting Company (KPLC), with support from the World Bank, is working to increase legal connections in poor areas, including the Kibera slum. While the program struggled to take off in the initial period, with only 5,000 connections in 2014, they counted 150,000 a year later. KPLC changed its business process: instead of taking down illegal connections, it listened to community leaders and marketed the benefits of legal connections. It collaborated with the Kenya Informal Settlements Improvement Project (supported by the World Bank). The World Bank provided funding to KPLC for each legal connection – reducing the cost of electricity, using the 'last mile' approach and ensuring electricity was available to households. Consequently, using power legally became less expensive for consumers than the illegal lines (World Bank 2015). In mid-2016, KPLC reported that 60 percent of Kibera was connected. The ability to increase electrification is not only dependent on financial and resource availability. Implementing innovative policies and a strategic framework can speed up this process.

Factors for the success: Using a community-based approach, Kenya Power has gone from 5,000 households connected under its informal settlements program, to over 150,000, in just one year. First of all, Kenya Power changed the way it was doing business, adopting a community-based approach in slum communities. This meant no longer taking down illegal connections. Instead, it focused on listening to community members and leaders, and marketing the benefits of the legal connections – safety, reliability, and affordability. The utility also stepped up collaboration with the Kenya Informal Settlements Improvement Project (KISIP), a World Bank-supported government program with widespread networks and a strong reputation in the slums. This collaboration helped Kenya Power 'segment' the country's slum areas and target areas where the new approach was most likely to take hold.

Source: World Bank 2015.
http://www.worldbank.org/en/news/feature/2015/08/17/bringing-electricity-to-kenyas-slums-hard-lessons-lead-to-great-gains

Table 13. Electricity technologies, strengths and challenges.

	Key features	Strengths	Challenges
Expanding the grid	Success in providing electricity to population around the world. Advantage of economies of scale. Large role for the state.	Can sell electricity at low cost. Can provide large quantities of electricity. Essential for increasing overall penetration of renewables.	Very expensive to build. State bureaucracy and unresponsiveness. Currently heavily reliant on fossil fuels.
Mini-grid	Very limited economies of scale. Future reductions in price of storage.	Very large scope for renewables. Can provide large quantity of electricity. Lower capital costs. Quick to deploy. Role for the private sector.	Possible lack of supply chains and relevant skilled personnel. Challenges to new technology.
SHSs	No economies of scale.	Large role for private sector 100% renewable. Established technology.	Expensive electricity. Limited quantities of electricity.
Solar appliances	No economies of scale.	100% renewable. Large role for the private sector. Potential to drive rapid changes in household fuel use.	Very limited quantities of electricity. Electricity is very expensive. Difficult to exercise quality control over different appliances.

Source: Morrissey, 2017

Box 14. SHS potential and limitations

Anna Aevarsdottir and colleagues discuss the potential and limitations of off-grid solar. The authors argue that due to high irradiation potential, the falling cost of solar photovoltaic, the speed of roll-out, and the limited capital investment required (compared to grid connections), solar home systems may be attractive solutions in sparsely populated rural areas of SSA. Even low levels of electrification, especially solar lamps, can bring substantial economic and noneconomic benefits. The authors cite a study in Tanzania that showed that the benefits of solar lamps include lower payments for lighting, kerosene, and mobile phone charging, along with increased income and even happiness. However, limited willingness and ability to pay will need to be addressed through broader financing mechanisms, flexible payment schemes, and possibly short-term targeted subsidies. Furthermore, available off-grid solutions are unlikely to provide the electricity needed for larger-scale productive uses; these activities will require mini-grid or on-grid solutions.

Source: Aevarsdottir , A. in Morrissey, 2017

6.3.3 Renewable energies

Cities must target specific renewable energy resources that best suits their conditions. For example, solar PV systems are suitable for cities in lower-latitude, high sunshine regions; geothermal power suits cities located near the tectonic plates; and bioenergy is most common in areas with a forest industry nearby. Cities with such a prime resource often try and develop, or attract, business ventures and investments relating directly to it. These commonly include waste-to-energy combined heat and power (CHP) plants, geothermal heat systems, solar thermal collectors on roofs and building integrated solar PV systems. Other forms of renewable energy carriers such as wind power, hydro power, concentrating solar power, solid biomass and liquid biofuels, usually need to be purchased from outside of the city and brought in by transmission lines, pipelines, road, rail or boats.

For a detailed description of solar water heating, solar photovoltaics, concentrated solar power and wind technology, please consult (SEA, 2017).

Given the key role of PV technology in future energy systems strategies are needed for dealing with large future volumes of end-of-life PV panels. Reuse and recycling technology is available today although the short term lack of waste volume means that economies of scale often can't be realised ([39]). Likewise, the end-of-life management of batteries in the off-grid solar sector creates new related challenges ([40]).

6.3.3.1 Policy recommendations for local governments for improving access to electricity and scale up renewable energies ([41])

- *Consumer centred policies*: too often, energy access planning is addressed exclusively from techno-economic perspectives, without seriously questioning the ways in which those services are perceived, used, and paid for by consumers. But, to serve population well, it requires an understanding of ability to pay, willingness to pay, the value of unserved energy, and how consumers value different attributes of energy service. In short, successful energy access measures require consumer-centred policies and business models (Morrissey, 2017).
- *Planning should focus on the energy services provided*: requires a shift from top-down to bottom-up planning of the electricity system.
- *Governance should involve stakeholders from multiple sectors*, not just energy, as well as local authorities. An integrated framework for electricity access relies on a strong enabling environment, a solid supply of products and services, and a robust demand for these products and services.
- Regardless of size, a city should undertake policy development to support *renewable energy deployment in association with other policies*, including national policies linked to sustainability goals and Climate Change, and local policies relating to energy security, energy access, health, employment, equity and reducing energy demands. Policies that are not directly energy-related, but could influence renewable energy uptake, can have direct or indirect impacts.
- Enabling environment with the right policies, institutions, strategic planning, regulations, and incentives is imperative for achieving universal access. When addressing energy issues, local authorities can be either constrained or empowered in what they can achieve by national policy instruments. For example, if a building act has building codes that specify energy efficiency standards, then authorities can use that as a means to improve the energy performance of new building stock. For example, a review of energy related policy instruments in 46 Sub-Saharan African countries showed that 63% had some kind of national energy policy in place, and 48% even had some kind of instrument specifically relating to renewable energy (sometimes these were technology specific e.g. solar, biogas) (Batchelor et al., 2017).
- *An assessment of available energy resources*, together with analyses of future energy demands and costs of alternative supplies to meet heating, cooling, electricity and transport demands, should be undertaken prior to promoting the use of renewable energy. The assessment should include the potential for renewable energy projects based around water supply, wastes, and land managed by the local authority.
- The *evolution of decentralised energy* systems will vary with the location, existing energy infrastructure, renewable energy resources available, and energy business

([39])For further information on this aspect, consult the Annex 9 of the "Guidebook Extended version" and contact the International Energy Agency Task 12, which focuses, among other activities, on recycling of manufacturing waste and spent modules. Some good quality documents and reports are found on its website (http://www.iea-pvps.org/index.php?id=56).

([40])For further information on this aspect, consult the Annex 11 of the "Guidebook Extended version" and the GIZ document: "END-OF-LIFE MANAGEMENT OF BATTERIES IN THE OFF-GRID SOLAR SECTOR - How to deal with hazardous battery waste from solar power projects in developing countries?" available at: https://www.giz.de/de/downloads/giz2018-en-waste-solar-guide.pdf

([41])(IEA, 2009)

ownership status. Local governments could take a lead role by developing policies that will help support the transition of the conventional energy sector to a less centralised system.

- *Setting priorities:* based on prior assessment and knowledge of the local circumstances, considering that resources are limited, LA would define their own priorities, targets and actions. Energy services for healthcare, for schools or clean water access; discover where services are falling short will highlight where priorities should focus.
- *Development of renewable energy deployment policies should be undertaken in association with energy efficiency measures.* In most countries, leading cities have attempted to reduce their energy demand through improved efficiency and energy management incentives, and this has been recognised as a key policy priority. Putting parallel policies in place to support the use of renewable energy by the local community usually makes good sense.

Box 15. Kasese district renewable energy strategy

Kasese District has developed a Renewable energy strategy to guide its initiatives of promotion and distribution of clean, renewable and efficient energy technologies through its Public Private Partnership (PPP) to replace the unsustainable harvesting of our natural vegetation in the name of energy supply.

The energy sector in Kasese district includes energy sources that are either locally produced or imported. The overall objective of the Renewable Energy Strategy is to diversify the energy supply sources and technologies in the district and aim to achieve 100% access to renewable energy by the year 2020. It sets out the district's vision, strategic goals, principles, objectives and targets for promoting and implementing renewable energy investments in Kasese.

For more information the document is available at:
https://d2ouvy59p0dg6k.cloudfront.net/downloads/kasese_district_renewable_energy_strategy.pdf

6.3.4 Clean cooking fuels and technologies

The 80% of people in Sub-Saharan Africa rely on biomass for cooking (OECD / IEA, 2017). Although the proportion of people accessing modern cooking fuels is expected to increase, high population growth rates in Africa means the absolute number of people relying on biomass is still expected to increase in coming years, placing increasing strain on biomass reserves. In previous decades, the motivation to improve the efficiency of cooking was driven by environmental concerns – deforestation and global warming. More recently, the impact of cooking on health, especially women and children has begun to be understood. 4.3 million people die worldwide from illnesses linked to cooking with solid fuels (most biomass) (OECD / IEA, 2017).

Evidence from the most recent World Health Organization (WHO) survey on the global burden of disease shows that nearly 600,000 Africans die annually and millions more suffer from chronic illnesses caused by air pollution from inefficient and dangerous traditional cooking fuels and stoves (Kammila et al., 2014). Diseases include stroke, heart disease, chronic obstructive pulmonary disease (COPD), pneumonia, and lung cancer. Another hazard associated with cooking includes fires and burns; burn deaths are estimated at 300,000 a year globally.

Densely populated slum areas are particularly vulnerable to fires caused by spilt fuels, because construction materials are not fire resistant, and because they lack access routes for fire engines. Women and girls, who have primary responsibility for cooking, spend hours each week collecting fuelwood. This translates into lost opportunities for increasing income, gaining education, and makes them subject to safety and security hazards. Extensive use of biomass in urban areas results in deforestation of neighbouring areas. Then suppliers have to travel further to source charcoal, and prices increase.

Burning biomass, especially on open fires and inefficient stoves, produces greenhouse gases that contribute to Climate Change at a global level (Batchelor et al., 2017).

The traditional African way of cooking is on a three stone wood fire. This is not an ideal practice in urban areas where wood is not readily available, so charcoal tends to be the fuel of choice. Although urban residents tend to have greater access to modern fuels for cooking, such as LPG and electricity, the majority still rely on biomass (Batchelor et al., 2017). Even in households that use modern fuels as their main cooking fuels, they will also use a variety of other fuels either at certain times (e.g. when an LPG cylinder is empty, or when cash is limited), on certain occasions (e.g. cooking for family gatherings), or for certain purposes (e.g. frying, boiling water for tea, stewing etc.) – this is known as *fuel stacking*.

The "business-as-usual" scenario for the clean and improved cooking sector's growth is encouraging but falls far short of potential and need. Existing market dynamics will ensure that tens of millions of new Sub-Saharan African households will gain access to at least minimally improved cooking solutions by the end of the decade without any further interventions. But by 2020, the business-as-usual scenario would still leave 80% of Africa's population without clean cooking solutions and more than 60% without access to even minimally improved cooking solutions (Kammila et al., 2014). Furthermore, in the absence of significant public- and private-sector investment, the spread of clean cooking solutions in Sub-Saharan Africa will be highly uneven—with successes in countries, such as Ghana, Kenya, Senegal, and South Africa (where the combined penetration of ICS and clean fuels is already above 50%) serving as exceptions amidst the overwhelming majority of SSA countries still mired in traditional solid-fuel cooking.

Box 16. Awareness campaigns 'Fumbalive' and "Good Stove Better Cooking" brand

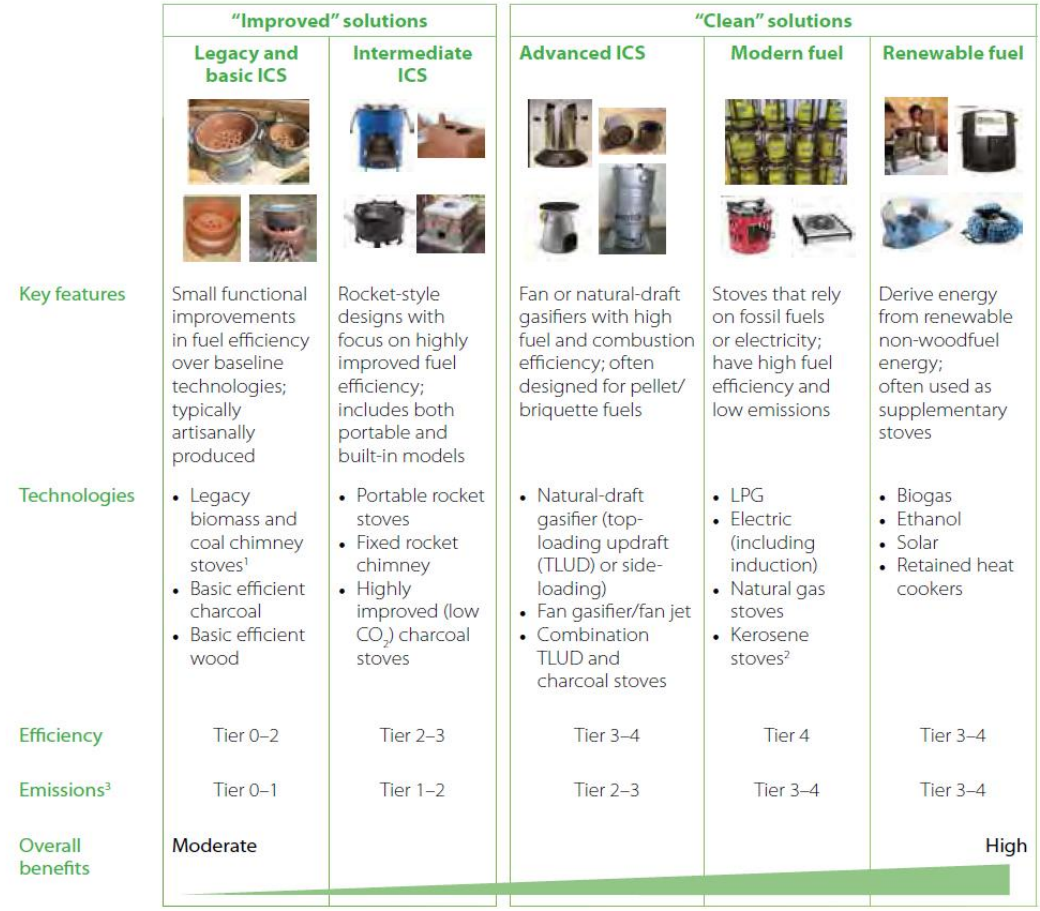
The Uganda Ministry of Energy and Mineral Development, together with the Global Alliance for Clean Cookstoves and Uganda National Alliance of Clean Cook stoves (UNACC) launched in 2016 a campaign dubbed 'Fumbalive' aimed at encouraging consumers to adopt the use of the improved cookstoves as a way of promoting energy saving cooking practices. The locally made improved cookstoves have also been clearly marked with the Good Stove-Better cooking quality mark as the standard sign for genuine stoves.

The first-ever certification program for improved cookstoves in Uganda. Market transformation polices – such as standards and labelling – can help accelerate the transition to cleaner and more efficient cookstoves that burn less fuel. In the case of Uganda, "Good stove better cooking" brands, Serves as a quality seal for buyers to identify quality stoves. All stoves promoted under the brand are tested to: Save at least 40% in (specific) consumption of fuel and Show measurable and significant reductions in emissions.

Source: http://www.cleancooking2015.org and

http://cleancookstoves.org/about/news/04-06-2016-alliance-launches-fumbalive-cookstoves-campaign-in-uganda.html

Figure 9. Overview of improved and clean cooking solutions



Source: Kammila et al., 2014

6.3.4.1 Policy recommendations for local governments for improving access to clean cooking ([42]).

- *Increase support for clean cooking solutions*, while maintaining momentum for intermediate and basic ICS technologies where cleaner alternatives are not feasible in the near term.
- Design interventions to drive *consumer behavior change*; simply distributing cleaner cooking solutions and fuels will not lead to optimal health and environmental outcomes. The challenge of achieving the benefits of universal clean cooking in SSA is not simply one of technology and economics. Like water and sanitation programs and other public health initiatives, clean cooking solution promotion efforts can achieve health impact objectives only when accompanied by large-scale behavior change in the target end-user population.
- *Prioritize market-based approaches*, but also deploy direct subsidies linked to health and climate impacts. Market-led models should be emphasised wherever feasible to ensure sustainability. However, maximizing climate and health benefits might also require targeted subsidies delivered through carbon markets and focused "pull" mechanisms (e.g., results-based credits for health benefits).
- *Support sustainable production of clean-biomass and renewable fuel alternatives* alongside efforts to improve stove efficiency and reduce emissions. Given rapidly rising demand, more efficient cooking solutions alone will not be enough if the sustainability issues in African wood fuel value chains remain unaddressed.

([42]) (Kammila et al., 2014)

- Focus *on providing critical public goods* to accelerate the development of the clean cooking sector. Policy makers should emphasise consumer education, access to finance, funding for R&D, the expansion of standards and testing, and enabling fiscal and trade reforms (e.g., tax, tariff, and subsidy reform).

Box 17. Cookstoves performance label in Ghana

Over 70% of Ghanaian households cook their meals using biomass fuel – primarily wood in rural areas and charcoal in urban areas. Ghanaians also face more than 13,000 smoke-related deaths each year from cooking with biomass fuel. Because of their consistent proximity to cook stove emissions, children under the age of five are the most vulnerable.

Sources: SUMP Guidelines: http://www.eltis.org/guidelines/sump-guidelines

Table 14. Clean cooking fuels and technologies.

Clean Fuel Intervention	Description	Potential scope
Liquefied Petroleum Gas (LPG)	A bottled gas containing mainly propane and butane, among the most effective and available large-scale alternatives to solid fuels. Requires an LPG stove connected to a LPG cylinder (different sizes available) through a hose and a regulator. A distribution infrastructure should be in place to ensure fuel supply.	LPG is already a fuel largely used in urban middle-income households of most LMICs for all or most cooking tasks and increasingly represents a likely alternative for less advantaged households in a number of areas with emergent supply and infrastructure.
Biogas	A combustible gas (mainly methane) produced by anaerobic digestion of organic materials such as animal wastes and, to a lesser extent, agricultural residues and human excrement. Biogas is not a universal fuel, as its potential is largely restricted to rural households owning a sufficient number of livestock and being located within a certain temperature and altitude range to ensure adequate gas production.	Construction and installation of biogas plants is usually expensive, and requires some form of financial support even among high and middle-income rural households. Proper operation and maintenance of the plant is crucial for ensuring biogas production.
Solar cooking	Emission free solar stoves convert solar radiation into energy used for cooking.	Although the actual energy source is free, the use of solar energy for cooking is restricted to countries and settings with high levels of solar radiation, and needs to allow for day-to-day and seasonal variation. These considerations, and the need to plan for use around the middle part of the day, limit the opportunities for widespread promotion.
Alcohol fuels	Ethanol (bio-ethanol) is a high-viscosity liquid produced by sugar fermentation from a variety of feedstocks including sugar-, starch- and cellulose-containing materials. Ethanol is a renewable fuel.	Ethanol: The low cost and availability of raw material for ethanol production make it a competitive fuel in a number of countries, although land competition with agricultural production may present a challenge, as well as taxation related to the use of alcohol for beverages.
	Methanol is a fossil fuel produced by natural gas or oil products at a production cost usually lower than for ethanol. Methanol is toxic to humans and should be handled carefully. Its use in the cooking sector is limited to feasibility studies.	Methanol: Potential for methanol for the domestic cooking market may be greater in countries with natural gas supplies.

Source: Puzzolo et al., 2016

6.4 Energy efficient lighting and appliances

According to the IEA, in 2013 lighting was responsible for 20% of global electricity consumption. The use of energy efficient lighting is one of the simplest ways of reducing the consumption of energy, which can, hence, be available for other uses (see also 6.1).

Lighting includes energy consumed for interior or exterior lighting of dwellings today mainly powered by electricity. Incandescent lamps, which have been around for more than a century, are slowly being replaced by more efficient fixtures, e.g. fluorescent tubes, compact fluorescent lamps and LEDs (light emitting diodes). More and more countries are passing regulations to phase out the use of incandescent bulbs. Households that do not have any access to electricity still rely on traditional forms of lighting such as kerosene and LPG lamps, and sometimes even candles and flashlights. Moreover, off-grid solar applications for lighting may become more prominent in the future.

Over 108 TWh of electricity – nearly 18% of Africa's total consumption in 2014 – would be saved in 2030 if markets transitioned just to more efficient lighting, refrigerators, air conditioners and motors (CLASP, 2018).

Energy efficient lighting can be implemented by (SEA, 2017):

- replacing traditional incandescent bulbs with compact fluorescents light bulbs (CFLs);
- replacing old fluorescent tubes with efficient fluorescent tubes;
- replacing old magnetic ballasts with electronic ballast in fluorescent tube systems;
- Installing lighting control systems (motion and lux level sensors);
- Using light-emitting diode (LED) technology whenever possible. This technology is developing fast and is getting steadily cheaper;
- Making streetlights more efficient (e.g. by replacing mercury vapour lights with high-pressure sodium lights or LEDs that operate on around a third of the power.

Box 18. Energy Efficiency Strategy (EES) in South Africa

The Energy Efficiency Strategy (ESS) is the first review of the National Energy Efficiency Strategy of 2008. It provides sector-by-sector guidelines for the implementation of efficient practices within the South African economy. There are 8 goals, grouped in terms of social, environmental and economic sustainability, and which includes affordable energy for all. Energy Conservation Target: Energy efficiency improvement of 12% by 2015, set in 2003, by the Department of Minerals and Energy. It takes its mandate from the White Paper on Energy Policy, published in 1998.

Source: Policies and Measures Database, IEA

Trade and energy efficiency policies often influence each other. EE policies affect the products that can be sold on the market, and thus can restrict trade of inefficient products (eg. Minimum Energy Performance Standards, MEPS and Energy labelling), while trade policies (like taxes: local content requirements, and tariffs: product bans) can complement or hinder energy efficiency policies designed to increase the uptake of efficiency technologies (CLASP, 2018).

Ghana implemented minimum energy performance standards and bans the importation of incandescent light bulbs and used appliances. It has been reported that Ghanaian refrigerator imports jumped from 6% new products to only new, more efficient products. Seizing and destroying inefficient used refrigerators from this policy alone has saved around 400 GWh of electricity.

High-quality, energy-efficient appliances are essential to the growth of off-grid energy markets (CLASP, 2018).

In 2017, 2.8 million air conditioners (ACs) were sold in Africa, following 8.3% market growth over just the two years prior. The market grew 8.3% in 2016 compared to 2015. To date, only ten African countries have implemented energy efficiency policies for appliances such as room air conditioners, leaving many countries at risk of being saddled with inefficient, environmentally harmful, and poor quality appliances. But as demand for ACs grows, many policymakers are looking to energy efficiency policies as a key component of building sustainable cooling markets (CLASP, 2018).

Implementing standard and labelling policies will drive African AC markets towards high-efficiency ACs to increase the uptake of affordable, low-impact, high quality appliances and cut the catastrophic climate impacts of air conditioning.

Box 19. Standards for appliances

Kenya is in the process of implementing its first minimum energy performance standards for appliances, including refrigerators and room air conditioners. In collaboration with the Kigali Cooling Efficiency Program, CLASP has partnered with the Kenyan Energy Regulatory Commission to support their recently approved energy performance standards for ACs and on labelling and policy compliance. By reducing the projected cooling demand through energy efficiency policies and programs, Kenya can reduce utility bills for households and businesses, decrease the need for additional power supply, cut greenhouse gas emissions, and increase national energy access rates.

Source: https://clasp.ngo/programs/africa

Regarding refrigerants, while most African countries have instituted regulations to assist the phase out of HCFCs, few have regulations to control the importation of ACs that use HCFCs. Only South Africa has implemented HCFC regulations that cover AC units.

Minimum performance standards have been set for refrigerators, non-ducted air-conditioners and CFLs. Import duty and VAT were waived on the importation of CFLs in 2002 and on light emitting diode (LED) lamps in 2010. However, there are currently no energy standards or labelling for LED lighting in Ghana. (Energy compliant Products list http://www.energycom.gov.gh/efficiency/energy-compliant-products)

Box 20. The Ghana Electrical Appliance Labelling and Standards Programme

The Government of Ghana is already an energy efficiency leader in Africa. In 2007 the country implemented a program to replace 6 million incandescent lamps with CFLs, which resulted in peak savings of 124MW and CO_2 savings of 112,320 tonnes per annum.

Ghana already operates a successful mandatory standards and labelling program for domestic refrigerators, air conditioners, and compact fluorescent lamps (http://www.energycom.gov.gh/efficiency/standards-and-labelling). Ghana is operating a Mandatory Appliance Standards and Labelling regime under which importers and retailers of Room Air Conditioners and Compact Fluorescent Lamps (CFL) are required to import and sell ONLY products that meet minimum efficiency and performance standards approved by the Ghana Standards Board.

It is an offence under LI1815 to import, display for sale or sell Air Conditioners and Compact Fluorescent Lamps in Ghana unless they meet the minimum performance standards and are properly labelled. The minimum energy efficiency standard for air conditioners to be acceptable in Ghana is an Energy Efficiency Ratio (EER) of 2.8 watts of cooling per watt of electricity input. This is equivalent to 9.55BTU/Watt.

In April 2003 the Government of Ghana removed import duties and VAT on Compact Fluorescent Lamps, commonly called Energy Saving Lamps to make them affordable to the general public as a measure to save energy and reduce electricity cost paid by consumers. CFLs should have a minimum service life of 6,000 hours. The lamps should also have a minimum efficacy of 33 lumens per watt.

The Ghana Electrical Appliance Labelling and Standards Programme requires that every products sold in the country must meet a minimum energy performance standard and be marked with a Ghana Energy Label. Ghana is well positioned to support the development of S&L activities for cookstoves and fuels (https://clasp.ngo/updates/2017/ghana-cookstoves-label).

Source: Dramani and Tewari, 2013

6.5 Partnership and awareness campaigns

Support from citizens and local businesses for the greater deployment of renewable energy technologies and promoting energy access is essential, based on a good understanding of the issues. The personal benefits that would result for individuals and businesses need to be identified and disseminated. Leaders can motivate residents, offer them enhanced pride in their community as a result of being an early adaptor, as well as provide them with greater energy independence, energy security, employment and social cohesion. Strong leadership based on clear objectives is essential (see also 6.1 for mitigation actions).

Box 21. Actions included in Kampala Climate Change Action plan.

Eco-stoves for the Wandegeya Market Kitchen: Kampala Capital City Authority (KCCA) has decided to support the development of Eco-Stoves in the city. 220 burners have been installed in the Market. Instead of firewood or charcoal, they use volcanic stones that can be re-used during 2 years.

They can be coupled with a solar photovoltaic panel to maintain longer the heat inside the stove and bring electricity for other use (lighting the kitchen, battery charger). This technology has social, economic and environmental benefits for the user, the guests and the local economy.

Solar energy for street lighting: KCCA has decided to develop the street lighting across the City to improve the conditions of mobility and security and to cut on the electricity monthly bill of Ugx200m. Decision has been taken that each new street light point will be supplied by solar energy. In October 2015, 170 photovoltaic solar panels have been installed (250 W to produce 90 MWh each year). KCCA has decided to add 700 solar street lighting points before the end of the year for a global amount of 3 million dollars on its own budget.

KCCA has embarked on a quick decommissioning exercise of old street lights and replacing them with solar powered lights in some sections of the city.

This action presents different benefits: the use of a free energy source, the continuous lighting during potential national electricity grid network breakdown, the promotion of these technologies for the private sector and an encouragement to the local economic fabric to invest in green growth potentials.

Biogas recovery at school: KCCA has implemented a bio-digester in Kansanga School which recovers biogas from the fecal waste of the pit latrines. This biogas is used to produce energy for cooking. The estimated amount of biogas produced is 36 m3 per month, which corresponds to about 2.6 MWh produced annually. This action presents different benefits: it turns a waste into resource, it is available on site and reduce the external energy supply, it reduces the particles emissions from firewood or charcoal used for cooking, it improves the management of operating costs

Source: Kampala Climate Change Action: http://www.kcca.go.ug/

Table 15. Communication: what can I do to contribute? Raise awareness example from the Climate Action Plan of the city of Kampala

Who?	What?
Individual	Ride bicycle instead of motorised vehicle; Reduce, Reuse, Recycle; Take the bus; Plant a tree; Use train service.
Household	Use solar energy; Switch off power when not in use; Make compost from food/ organic waste; Harvest rainwater; Plant trees; Plant greens around the home; Recycle and reuse waste.
Institutions (schools, hospitals, government, donors)	Grow green for students meals; Segregate and reuse waste; Use energy efficient cookstoves or briquettes instead of firework; Harvest rainwater; Conduct energy audit; Develop biogas system to reduce energy costs; Allocate funds to climate smart projects; Promote shared transport systems for staff; Train staff¬ in sustainable daily practices; Support public awareness campaigns; Set up climate smart policies.
Corporates (big and small business)	Promote staff awareness; Develop climate smart policies; Use energy efficient cookstoves or briquettes instead of firewood; Use energy efficient equipment; Take your waste to others who can reuse it; Conduct energy audit; Support the green economy.
Groups (Communities, religious cultural leaders, associations)	Hold dialogues to answer questions and solutions; Raise awareness; Advise people on why they need to take action now; Collect data on climate smart actions in your area; Do recycling projects, get your friends to join in; Support local actions eg: cleaning; Harvest rainwater; Support local actions eg; planting trees; Compost organic waste to set up community garden.

Source: KCCA, 2016

7 Implementation and Monitoring

7.1 Implementation

Box 22. Tips for putting the SEACAP into practice

- Adopt a Project Management approach: deadline control, financial control, planning, deviations analysis and risk management. Use a quality management procedure.
- Divide the project into different parts and select persons responsible.
- Strengthen horizontal cooperation between different policy-areas and mainstream climate actions into existing strategies.
- Prepare specific procedures and processes aimed at implementing each part of the project.
- Plan the follow-up with the stakeholders establishing a calendar of meetings in order to inform them.
- Anticipate future events and take into account negotiation and administrative steps to be followed by the Public Administration.
- Propose, approve and put into operation a training programme at least for those persons directly involved in the implementation.
- Motivate and offer training and support to the involved team.

7.2 Monitoring and reporting

Monitor the evolution and impacts of the actions included in the SEACAP and update it regularly allows ensuring continuous improvement in the process. CoM SSA signatories must submit a Progress Report every second year following the submission of the SEACAP for evaluation, monitoring and verification.

Box 23. Monitoring and reporting

It is mandatory to:

- Submit monitoring reports every two years after submitting the action plan(s);
- Provide information about the implementation status of each action/action area/sector contained in the action plan;
- Update and resubmit the action plan(s) when there are significant changes to the existing plan(s).

It is recommended to report the implementation cost for each action.

The reporting requirements include timelines for different elements of reporting. The following table (Table 16) shows the overall reporting time for CoM SSA, coherent with GCoM recommendations (see all the Recommendations of the GCoM Framework). Year 0 corresponds with the year in which the Local Authority commits formally to join the initiative by signing the Political Commitment Document. Starting from then, they will be asked to submit the first group of documents within two years, while in year 3 they must submit the SEACAP. The reporting platforms accepted in the GCoM framework are *My Covenant*, and the streamlined ICLEI's *carbonn Climate Registry* (cCR) and CDP's reporting platform.

Table 16. Reporting elements and corresponding timelines for all CoM regional chapters.

Reporting element	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Baseline Emissions Inventory			**X**			
Risk and Vulnerability Assessment			**X**			
Targets and goals (mitigation and adaptation)			**X**			
Access to Energy assessment			**X**			
Climate action plan(s) (mitigation and adaptation, or integrated plan)				**X**		
Progress report						**X***

Source: JRC own elaboration. * Every two years after submitting the SEACAP.

Progress reports should include an updated CO_2 emission inventory called a *Monitoring Emission Inventory* (MEI) developed according to the same methods and data sources of the BEI to ensure comparability. Ideally, local authorities compile CO_2 emissions inventories on an annual basis. If that frequency over-burdens human or financial resources, local authorities may carry out inventories after longer intervals and/or with simpler methodologies.

8 Financing Sustainable Energy and Climate Action Plans

SEACAP(s) elaboration and implementation require tailored dedicated financing. The achievement of the sustainable targets often implies big investments at local and national level. Cities do not always have the capability to finance the investments identified in the plans from their budgets alone. To deliver such investments, local authorities face the challenge of accessing to finance. Moreover, LAs should take this challenge with holistic approaches in identifying both the kind of support required within the SEACAP process and available schemes and mechanisms. The need of financing support may arise for different stages of the SEACAP process: capacity buildings and trainings, technical and legal studies, feasibility assessments, assistance with financial studies for actions and implementation. The C40 report (2018) (Moro et al., 2018) shows how the type of assistance needed by cities to advance in the implementation of climate related projects not only focused on financing modelling and development of bankable projects. On the contrary, it ranges from capacity development activities (such as capacity building, best practices, finance training) to implementation (such as organisational structuring, risk management, operational study), from technical studies (impact assessment) to feasibility studies, from legal studies to financing studies and stakeholder engagement. These financing options are oriented at supporting the building capacity of actors involved in the process, who will then be able to seek and apply for funding autonomously. Table 17 describes frequent mechanisms that can be used to support key actions in cities.

Table 17. Frequent financing mechanisms for SEACAP development and implementation

Local Authorities' own financial resources	These resources may come from grants (national or external), local taxes (houses, business, income-producing sources), borrowing in terms of debt financing and loans.
Grant programs	Investment grants or interest rate subsidies are often provided by governments to support the upfront cost of energy efficiency projects.
Soft loans	Soft loans give long-term financial coverage to help bridge the pre-commercialisation financing gap for EE projects by direct subsidies on interest payments or by risk premiums.
Green Bonds	Green bonds are bonds where revenues are allocated to "green" projects. In particular, these bonds have emerged as a financing tool for Climate Change mitigation and adaptation actions within cities ([43]).
Public-private partnerships (PPPs)	The public-private partnership (PPP) is a collaboration based on the awareness that both the public and private sectors can benefit by combining their financial resources, know-how and expertise.
Revolving funds	Revolving funds are intended to establish sustainable financing for a set of investment projects. The fund may include loans or grants and have the ambition of becoming self-sustainable after its first capitalisation.
Crowdfunding	It is based on individuals' efforts to support other's initiatives or projects by investing small sums of money.
Third-party financing	The third- party financing is a mechanism that allows another party (as ESCOs) to provide the capital and take the financial risk. It is perhaps the easiest way for municipalities to undertake ambitious projects.

Source: JRC own elaboration from "Guidebook Extended version"

([43]) How to Issue a Green Muni Bond - Climate Bonds Initiative.

External funding is available and International Financing Institutions (IFIs) on sustainable projects are active in the region. Several multilateral funds are available in the region for both mitigation and adaptation projects. The following table summarises some of the available options. Further details ([44]) can be found in the "Guidebook Extended version".

Table 18. Financing and funding opportunities available in SSA region

The Africa Climate Change Fund – ACCF > Funds (AfDB)
Global Environment Facility (GEF) implementing Agency> Funds (AfDB)
The African Development Bank Partial Risk Guarantees (PRGs) > Risk guarantee product (AfDB)
The African Development Fund (ADF) Partial Risk Guarantees> Risk guarantee product (AfDB)
The Africa Climate Business Plan > (WB)
Maximizing Finance for Development (MFD) > (WB)
The External Investment Plan (EIP) > (EU)
European Fund for Sustainable Development (EFSD) > (EU)
The Africa Investment Platform (AIP, former AfIF) > Regional investment platform (EU)
The Neighborhood Investment Platform (NIP, former NIF) > Regional investment platform (EU)
The French Fund for the Global Environment (FFEM) > bilateral funding instrument (AFD)
CICLIA (Cities and Climate Change in Sub-Saharan Africa Initiative) > regional facility (AFD)
The C40 Cities Finance Facility (CFF) > implemented by GIZ and C40 (BMZ, USAID, IADB)
The TAP (Transformative Actions Programme) > incubator/project preparation facility for municipalities (ICLEI)
The Green Climate Fund (GCF)
The Climate Investment Funds (CIF) > (WB, AfDB)
The Global Environment Facility Trust Fund (GEFTF)> donor countries
The Global Energy Efficiency and Renewable Energy Fund (GEEREF) > (EU, Germany and Norway)
The Adaptation Fund

Source: JRC own elaboration

Where:

AfDB – African Development Bank
WB – The World Bank
EU – European Union
GIZ – Deutsche Gesellschaft für Internationale Zusammenarbeit
BMZ – German Federal Ministry for Economic Cooperation and Development
USAID – United States Agency for International Development
IADB – Inter-American Development Bank

([44]) Inputs and insights on climate investments opportunity can be found in the document developed by International Finance Corporation (2018)

References

Abdullaha, S., Jeanty, W., 2009. Demand for Electricity Connection in Rural Areas: The case of Kenya. BATH ECONOMICS RESEARCH PAPERS 26/09. Department of Economics

AfDB / OECD / UNDP, 2016. African Economic Outlook 2016. Special Theme: Sustainable Cities and Structural Transformation.

AfDB, 2016. Empowering women and girls in the quest for universal energy access for all. April 2016.

Africa Progress Panel, 2015. Africa Progress Report 2015: Power, People, Planet.

Africa Progress Panel, 2017. Lights, Power, Action: Electrifying Africa.

Ahlborg, H., Boräng, F., Jagers, S. C., Söderholm, P., 2015. Provision of electricity to African households: The importance of democracy and institutional quality. Energy policy, 87, pp. 125-135.

Alfaro, J., Miller, S., 2014. Satisfying the rural residential demand in Liberia with decentralized renewable energy schemes. Renewable and Sustainable Energy Reviews 30, pp. 903–911

Arnstein, S.R., 1969. A Ladder Of Citizen Participation. Journal of the American Planning Association, 35, pp. 216–224. doi:10.1080/01944366908977225

Bafana, B., 2016. Africa's cities of the future: Proper planning key to sustainable cities. AfricaRenewal 4–14.

Batchelor, S., Scott, N., McAllister, J., 2017. Guidelines to clean energy. A practical guide for Sub Saharan African municipalities. SAMSET: Supporting Sub-Saharan Africa's Municipalities with Sustainable Energy Transitions.

Bazilian, M., Nakhooda, S., Van de Graaf, T., 2014. Energy governance and poverty. Energy Research & Social Science 1, pp. 217–225. doi:10.1016/J.ERSS.2014.03.006

Bella-Corbin, A., 2011. The cost of adaptation to Climate Change in Africa. First Conference on Climate Change and Development in Africa (CCDAI), Addis Ababa.

Bertoldi, P. and Rezessy, S., 2010. Financing energy efficiency: forging the link between financing and project implementation. [online] Ispra: Joint Research Centre of the European Commission. Available at:

Bertoldi P. (editor), 2018. Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP) – Part 1 - The SECAP process, step-by-step towards low carbon and climate resilient cities by 2030, EUR 29412 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79- 96848-8, doi:10.2760/68327, JRC112986

Bertoldi P. (editor), 2018. Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP) – Part 2 - Baseline Emission Inventory (BEI) and Risk and Vulnerability Assessment (RVA), EUR 29412 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-96929-4, doi:10.2760/118857, JRC112986

Bertoldi P. (editor), 2018. Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP) – PART 3 – Policies, key actions, good practices for mitigation and adaptation to climate change and Financing SECAP(s), EUR 29412 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-96927-0, doi:10.2760/58898, JRC112986.

Bhatia, M., Angelou, N., 2015. Beyond Connections : Energy Access Redefined (ESMAP Technical Report; 008/15). Washington, D.C.

Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R., Yanda, P., 2007. Africa. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, eds. ML Parry, OF Canziani, JP Palutikof, PJ van der Linden and CE Hanso.

Brew-Hammond, A. (2010). Energy access in Africa: Challenges ahead. Energy Policy, 38, pp. 2291–2301

Castán Broto, V., Stevens, L., Ackom, E., Tomei, J., Parikh, P., Bisaga, I., Seng To, L., Kirshner, J., Mulugetta, Y., 2017. A research agenda for a people-centred approach to energy access in the urbanizing global south. Nature Energy 2, pp. 776–779. doi:10.1038/s41560-017-0007-x

Castán Broto, V., Stevens, L., Salazar, V., 2015. Energy Access and Urban Poverty: energy and everyday life in an informal settlement in Maputo, Mozambique. Poor People's Policy Brief. Ser. 4.

Chhibber, A., Laajaj, R., 2008. Disasters, Climate Change and Economic Development in Sub-Saharan Africa: Lessons and Directions. Journal of African Economies 17, pp.7–49. doi:10.1093/jae/ejn020

CLASP, 2018. Africa Air Conditioner Market Scoping Study. Collaborative Labeling and Appliance Standards Program (CLASP), Washington, DC, USA.

Dalberg Advisors, Lighting Global, 2018. Off-Grid Solar Market Trends Report 2018. International Finance Corporation, Washington, D.C.

Davis, C.L., Vincent, K., 2017. Climate risk and vulnerability: A handbook for Southern Africa.

Dickson, E., Baker, J.L., Hoornweg, D., Asmita, T., 2012. Urban risk assessments: understanding disaster and climate risk in cities (urban development).

Dramani, J., Tewari, D., 2013. Electricity End-Use Efficiency in Ghana: Experience with Technologies, Policies and Institutions, Mediterranean Journal of Social Sciences. doi:10.5901/mjss.2013.v4n13p669

Eberhard, A., Rosnes, O., Shkaratan, M., Vennemo, H., 2011. Africa's power infrastructure: investment, integration, efficiency. The World Bank, Washington, DC.

Ellis J. (2010). Energy Service Companies (ESCOs) in Developing Countries. International Institute for Sustainable Development, Winnipeg, Canada

Eriksen, S.H., Kelly, P.M., 2007. Developing Credible Vulnerability Indicators for Climate Adaptation Policy Assessment. Mitigation and Adaptation Strategies for Global Change 12, pp. 495–524. doi:10.1007/s11027-006-3460-6

Escudero, S., Savage, R., Kravva, V., Steeds, E., 2017. Future Energy Scenarios for African Cities: Unlocking Opportunities for Climate Responsive Development. European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF), Eschborn, Germany.

Field, C.B., Barros, V., Stocker, T.F., Dahe, Q., 2012. Managing the risks of extreme events and disasters to advance Climate Change adaptation: special report of the intergovernmental panel on Climate Change. Cambridge University Press.

Field, C.B., et al., 2014. Technical Summary, in: Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.L. (Eds.), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 35–94.

Foster, V., Briceño-Garmendia (editor), C., 2010. Africa's Infrastructure. A Time for Transformation. Agence Française de Développement and The World Bank, Washington.

Grosse-Puppendahl, S., Bilal, S., Karaki, K., 2017. EU's Financial Instruments for Access to Energy. Support in remote and poor areas in Africa, Discussion Paper No. 218.

Hansen S., Langlois, P., Bertoldi, P., 2009. ESCOs Around the World: Lessons Learned in 49 Countries.

How to Issue a Green Muni Bond - Climate Bonds Initiative. Available at: https://www.climatebonds.net/resources/publications/how-to-issue-a-green-muni-bond

ICLEI - Local Goverments for Sustainability, UN Habitat, UNEP, 2009. Sustainable Urban Energy Planning: a handbook for cities and towns in developing countries.

ICLEI- Local Goverments for Sustainability, 2015. Dialogue report: 100% renewable energy in cities, in: Cites and Regions Pavilion – TAP 2015 | COP21. Renewable Cites, Local Governments for Sustainability (ICLEI) and World Future Council, Le Bourget, Paris.

IEA - International Energy Agency, 2009. Cities, Towns and Renewable Energy. Agency, International Energy. doi:https://doi.org/https://doi.org/10.1787/9789264076884-en

IEA - International Energy Agency, 2017. Energy Access Outlook 2017. From Poverty to Prosperity : World Energy Outlook Special Report. Paris (France).

IFI- International Finance Corporation, 2018. Climate Investment Opportunities in Cities. An IFC Analysis. Washington, D.C. 20433, www.ifc.org

IPCC, 2006. 2006 IPCC guidelines for national greenhouse gas inventories. Institute for Global Environmental Strategies Hayama, Japan.

IPCC, 2007. Contribution of working group I to the fourth assessment report of the intergovernmental panel on Climate Change, 2007. Cambridge University Press, Cambridge.

IPCC, 2014a. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandre. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC, 2014b. Summary for policymakers, in: Field, C.B., Barros, V.R., Mastrandrea, M.D., Mach, K.J., Abdrabo, M.-K., Adger, N., Anokhin, Y.A., Anisimov, O.A., Arent, D.J., Barnett, J. (Eds.), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment

Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1–32.

Kammila, S., Kappen, J.F., Rysankova, D., Hyseni, B., Putti, V.R., 2014. Clean and improved cooking in Sub-Saharan Africa : a landscape report. World Bank, Washington, DC, USA.

KCCA, 2015. Energy and Climate Profile. Kampala Climate Change Action. Kampala Capital City Autority, Kampala, Uganda.

KCCA, 2016. Kampala Climate Change Action. Kampala Capital City Autority.

Kern K., Alber, G., 2009. Governing Climate Change in cities: Modes of urban climate governance in multi-level systems. In: The international conference on Competitive Cities and Climate Change, Milan, Italy, 9 - 10 October, 2009. - Paris : OECD - p. 171 - 196.

Leal Filho, W., 2011. Experiences of Climate Change adaptation in Africa. Springer.

Ministry of Infrastructure - Republic of Rwanda, 2015. Energy Sector Strategic Plan 2013 / 14 - 2017 / 18.

MobiliseYourCity, 2017. "MobiliseYourCity - Monitoring & reporting approach for GHG emissions". Printed and distributed: October 2017 Authors: Urda Eichhorst, Daniel Bongardt (GIZ) Contributors: Benjamin Fouchard, Damien Verry (Cerema)

Moro, A., Walker, O., Hooks, A. (2018). Analysis: The demand for financing climate projects in cities. This report, co-authored by the C40 Cities Finance Facility, CDP, and in collaboration with the Global Covenant of Mayors for Climate and Energy.

Morrissey, J., 2017. The energy challenge in Sub-Saharan Africa: A guide for advocates and policy makers Part 2: Addressing energy poverty. Oxfam Research Backgrounder series.

Mukheibir, P., Ziervogel, G., 2007. Developing a Municipal Adaptation Plan (MAP) for Climate Change: the city of Cape Town, Environment and Urbanization.

Nakhooda, S., Barnard, S., Caravani, A., Schalatek, L., 2013. Climate Finance Regional Briefing: Sub-Saharan Africa (Climate Funds Update). Overseas Development Institute and Heinrich Böll Stiftung North America, London, UK, Washington, North America.

Niang, I., Ruppel, O.C., Abdrabo, M.A., Essel, A., Lennard, C., Padgham, J., Urquhart, P., 2014. Africa, in: Barros, V.R., Field, C.B., Dokken, D.J., Mastrandrea, M.D., Mach, K.J., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.L. (Eds.), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1199–1265.

OECD/IEA, 2017. Energy Access Outlook 2017. From Poverty to prosperity. IEA Publications, France, October 2017

OECD / IEA, 2017. Energy Access Outlook: World Energy Outlook 2017 Special Report. Electricity Access Database [database].

OECD / IEA, 2017a. Energy Access Outlook: World Energy Outlook 2017 Special Report. Electricity Access Database [database].

OECD / IEA, 2017b. Energy Access Outlook: World Energy Outlook 2017. WEO Clean Cooking Access Database [database].

OECD, 2008. Handbook on constructing composite indicators: methodology and user guide. Organisation for Economic Co-Operation and Development (OECD), Paris (France).

Puzzolo, E., Pope, D., Stanistreet, D., Rehfuess, E.A., Bruce, N.G., 2016. Clean fuels for resource-poor settings: A systematic review of barriers and enablers to adoption and sustained use. Environmental Research 146, pp. 218–234. doi:https://doi.org/10.1016/j.envres.2016.01.002

Quinn, A. K., Puzzolo, E., Dickinson, K., Sturke, R., Jack, D.W., Mehta, S., Shankar, A., Sherr, K., Rosenthal, J.P., 2018. An analysis of efforts to scale up clean household energy for cooking around the world. Energy for Sustainable Development, 46, pp.1–10. doi:10.1016/J.ESD.2018.06.011

Rao, ND, Pachauri, S. 2017, Energy Access and living standards: some observations on recent trends. Environment Research Letter, vol. 12, 2.

Rivas, S., Melica, G., Kona, A., Zancanella, P., Serrenho, T., Iancu, A., Koffi, B., Gabrielaitiene, I., Janssens-Maenhout, G., Bertoldi, P., 2015. The Covenant of Mayors: In-depth Analysis of Sustainable Energy Actions Plans. JRC, Luxembourg. doi:10.2790/043140

Rosenzweig, C., Solecki, W., Romero-Lankao, P., Mehrotra, S., Dhakal, S., Bowman, T., Ibrahim, S.A., 2015. ARC3. 2 Summary for City Leaders Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network.

Scarlat, N., Motola, V., Dallemand, J.F., Monforti-Ferrario, F., Mofor, L., 2015. Evaluation of energy potential of Municipal Solid Waste from African urban areas. Renewable and Sustainable Energy Reviews, 50, pp. 1269-1286 doi:10.1016/J.RSER.2015.05.067

Schwerhoff, G., Sy, M., 2017. Financing renewable energy in Africa – Key challenge of the sustainable development goals. Renewable and Sustainable Energy Reviews, Volume 75, Pp. 393-401

SEA, 2017. Sustainable energy solutions for South African local government: a practical guide. Sustainable Energy Africa, Cape Town.

Sims R., et.al., 2014. Transport. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Sokonan Y., Mulugetta, Y., Gujba, H., 2012. Widening energy access in Africa: Towards energy transition. Energy Policy, 47, pp. 3-10.

Sovacool, B., Florini, A., 2012. Examining the Complications of Global Energy Governance. Journal of Energy & Natural Resources Law, 30, 235–263.

Swilling, M., 2015. Greening African Cities: Urbanization, Structural Transformation and Sustainable Resource Use. Report commissioned by United Nations Economic Commission for Africa, Stellenbosh.

Tanko, A.I., 2016. Urban energy challenges in Sub-Saharan Africa. Current Opinion in Environmental Sustainability, 20, pp. 80–85. doi:10.1016/J.COSUST.2016.07.002

Taylor, A., Cartwright, A., Sutherland, C., 2014. Institutional Pathways for Local Climate Adaptation: A Comparison of Three South African Municipalities. Agence Française de Développement.

The World Bank, 2013. Harnessing urbanization to end poverty and boost prosperity in Africa. An action agenda for Transformation.

The World Bank, 2017. World Development Indicators [database].

Tracking SDG7: The Energy Progress Report 2018. Available at: http://trackingsdg7.esmap.org/

UN Habitat, 2011. Global report on human settlements 2011: Cities and Climate Change. United Nations Hum. Settlements Program, Earthscan.

UN Habitat, 2014. State of African Cities Report 2014: Reimagining Sustainable Urban Transitions. United Nations Human Settlements Programme (UN-Habitat), Nairobi, Kenya.

UN Habitat, 2016. World Cities Report 2016: Urbanization and Development : Emerging Futures. United Nations Human Settlements Programme (UN-Habitat), Nairobi, Kenya.

UN-ENERGY/Africa, 2007. Energy for Sustainable Development: Policy Options for Africa. United Nations, New York.

UNFCCC, 2013. Reporting guidelines on annual inventories for Annex I Parties. URL http://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf#page=2

UNFCCC, 2017. Interim National Determined Contributions Registry. URL http://www4.unfccc.int/ndcregistry/Pages/All.aspx

United Nations Conference on Trade and Development, 2017. The Least Developed Countries Report 2017. Transformational energy access. Geneva.

Urban Climate Change Research Network, 2015. Case Study Docking Station Overview. econd UCCRN Assessment Report on Climate Change and Cities (ARC3.2) [WWW Document]. URL http://uccrn.org/case-study-docking-station-overview/

Vaz, K., Storey, P., Cipriano, A., Cuamba, B., D'Addario, P., Falcao, P., Lehman, N., 2011. Green Investments in Mozambique. Agence Française de Développement and Banco de Mocambique.

Wamukonya, N., Rukato, H., 2001. Climate Change implications for Southern Africa: A gendered perspective. Minerals and Energy Policy Centre, Johannesburg.

Wang, H.G., Montoliu-Munoz, M., Gueye, N.F.D., 2009. Preparing to Manage Natural Hazards and Climate Change Risks in Dakar, Senegal : A Spatial and Institutional Approach. World Bank, Washington, DC.

Weber, S., Sadoff, N., Zell, E., de Sherbinin, A., 2015. Policy-relevant indicators for mapping the vulnerability of urban populations to extreme heat events: A case study of Philadelphia. Applied Geography, 63, 231–243. doi:10.1016/J.APGEOG.2015.07.006

Westphal, M., Zhou, L., Satterthwaite, D., Martin, S., 2017. Powering Cities in the Global South: How Energy Access for All Benefits the Economy and the Environment. World Resources Institute, Washington (D.C.).

Winrock International, 2011. Load demand assessment and socio economic survey for proposed mein mini hydropower project. Monrovia, Liberia.

Wolf, M.-A., Pant, R., Chomkhamsri, K., Sala, S., Pennington, D., 2012. The International reference life cycle data system (ILCD) handbook-JRC reference reports.

World Bank, 2010. Economics of adaptation to Climate Change: Synthesis report.

World Bank, 2015. Progress Toward Sustainable Energy Framework 2015. The World Bank, Washington, D.C.

World Bank, 2017. Global Tracking Framework 2017: Progress Towards Sustainable Energy. Washington (D.C.). doi:10.1596/978-1-4648-1084-8

List of abbreviations and definitions

AC	Air Conditioning
AU	African Union
AFOLU	Agriculture Forestry and Other Land Use
BEI	Baseline Emission Inventory
CCS	Carbon capture and storage
CH_4	Methane
CHP	Combined heat and power
CO_2	Carbon dioxide
CO_{2CHPE}	CO_2 emissions from electricity production in a CHP plant
CO_{2CHPH}	CO_2 emissions from heat production in a CHP plant
CO_{2CHPT}	total CO_2 emissions of the CHP plant
CO_2EH	CO_2 emissions related to heat that is exported outside of the territory of the LA
$CO_{2\text{-}eq}$	CO_2-equivalents
CO_2GEP CO_2	emissions due to the production of certified green electricity purchased by the LA
CO_2IH	CO_2 emissions related to imported heat from outside the territory of the LA
CO_{2LPE}	CO_2 emissions due to the local production of electricity
CO_{2LPH}	CO_2 emissions due to the local production of heat
CoM SSA	Covenant of Mayors in Sub-Saharan Africa
CoM	Covenant of Mayors for Energy and Climate
COM-EF	CoM default Emission Factors data collection
CTC	Covenant Territorial Coordinators
DSO	Distribution system operator
EC	European Commission
EEA	European environment agency
EF	Emission Factor
EFDB	Emission Factor Database
EFE	Local emission factor for electricity
EFH	Emission factor for heat
ELCD	European Reference Life Cycle Database
EMEP	European Monitoring and Evaluation Programme
ENEL	Ente Nazionale per l'Energia Elettrica
EPLCA	European Platform on Life Cycle Assessment
ETS	European Union Greenhouse Gas Emission Trading System
EU	European Union
EU-28	European Union 28 Member States

EUROSTAT	Directorate-General of the EC providing statistical information to the institutions of the EU
GCoM	Global Covenant of Mayors
GEP	Green electricity purchases by the local authority
GHG	Greenhouse gas (only refers to N_2O, CH_4, CO_2 in this report, if no explicit list)
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventory
GPG	Good practice guidance
GWP	Global Warming Potential
HDD	Heating Degree Days
HDDAVG	Heating Degree Days In An Average Year
ICLEI	Local Governments for Sustainability
IEA	International Energy Agency
ILCD	International Reference Life Cycle Data System
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre of the European Commission
LA	Local Authority
LAU	Local administrative unit
LCA	Life Cycle Assessment
LED	Light emitting diodes
LEP	Local energy production
LHC	Local heat consumption
LHC_TC	Temperature corrected local heat consumption
LPE	Local production of electricity
LULUCF	Land Use Land Use Change and Forestry
MEI	Monitoring Emission Inventory
MESHARTILITY	Measure and share data with utilities for the Covenant of Mayors
N_2O	Nitrous oxide
NACE	Statistical classification of economic activities in the European Community
NCG	National Coordination Group
NCV	Net calorific value
NDCs	Nationally Determined Contributions
NEEFE	National or European Emission Factor for Electricity consumption
NUTS	Nomenclature of territorial units for statistics
OECD	Organisation for Economic Co-operation and Development
PCD	Political Commitment Document
PKM	Passenger-kilometre
PV	Solar photovoltaic installation

RES	Renewable energy sources
RVA	Climate Change Risk and Vulnerability Assessment
SDG	Sustainable Development Goal
SEACAP	Sustainable Energy Access and Climate Action Plan
TCE	Total electricity consumption in the territory of the local authority
UNFCCC	United Nations Framework Convention on Climate Change
VKT	Vehicle-Kilometres Travelled

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Annexes

The full version of the present CoM SSA Guidebook includes detailed information and also:

-List of countries, SSA Nationally Determined Contributions (NDCs),

- Recommendations from the Global Covenant of Mayors Common Reporting Framework.
- How to account indirect emissions from the consumption of electricity
- Default Net calorific values (IPCC, 2006)
- CO_2 emission factors for fuels (IPCC, 2006)
- Selected vulnerability indicators at community level identified within the CLUVA project.
- Energy potential of waste from urban areas in Africa.
- End-of-life Management of Solar Photovoltaic Panels.
- Kasese district renewable energy strategy
- End-of-Life Management of Batteries in the Off-Grid Solar Sector.

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KJ-NA-29761-EN-N

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doi:10.2760/483786
ISBN 978-92-76-04091-0