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Technical Guidance for Development of Cities' CAP in Indonesia in the frame of GCoM

Based on pilot cities of IUC Asia - EU Funded Project

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Contents

Abstract

The Global Covenant of Mayors in Southeast Asia (GCoM SEA) supports Indonesian local authorities in the climate challenge and in their efforts in building more sustainable and resilient communities. It is the "regional covenant" of the Global Covenant of Mayors for Climate & Energy (GCoM). Under the GCoM SEA, local authorities are invited to take a voluntary political commitment to implement climate and energy actions in their communities and to agree on a long-term vision to tackle the three pillars of the initiative: climate mitigation, climate adaptation and access to energy (global framework under development). In order to translate the political commitment into practical measures, GCoM SEA signatories have also to elaborate and implement a Climate Action Plan (CAP).

This guidebook has been prepared to assist Indonesian local governments in preparing coherent and effective Climate Action Plans by means of step-by-step guidance and examples of measures especially relevant for the local authorities working in the Indonesian context. The Guidebook is coherent with the Global Covenant of Mayors Common Reporting Framework (CRF) whose structure allows to the specific choice and sequence of actions to vary according to the policies and measures already in place. This flexibility allows Indonesian local governments to develop a CAP that is consistent with their local circumstances and objectives.

It should be noted that this document stems from the previous experience of the Joint Research Centre's (JRC) in Europe and other regions of the world (see for example the JRC report: JRC113786 ""How to develop a Sustainable Energy Access and Climate Action Plan (CAP) in Sub-Saharan Africa and the JRC112986 "Guidebook - How to develop a Sustainable Energy and Climate Action Plan" released in 2018).

It is worth mentioning that the present guidebook also contains an initial overview of the current state of resources of local governments in Indonesia in climate action planning, covering two main aspects: 1) statutory, policy and institutional framework for local climate action planning; and 2) finance, human resources and infrastructures capacity of local governments in climate action planning. This initial overview serves as a basis and should assist the Indonesian local governments in developing a Climate Action Plan (CAP) according to the general principles set out in the GCoM Common Reporting Framework (CRF).

Acknowledgements

This guidebook has been produced as part of the Global Covenant of Mayors (GCoM) initiative. Authors would like to thank JRC colleagues helping in the development and review of this guidance, the International Urban Cooperation (IUC) Asia and the Global Covenant of Mayors - Southeast Asia (GCoM SEA) Secretariat.

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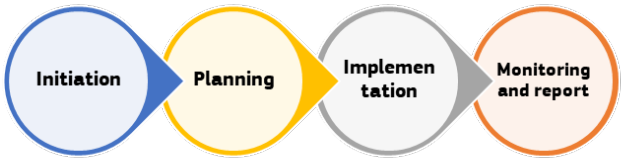
Executive Summary

The Global Covenant of Mayors in Southeast Asia (GCoM SEA) is the "regional covenant" originating from the Global Covenant of Mayors for Climate & Energy (GCoM) worldwide initiative. As part of its activities, GCoM SEA supports the Indonesian local authorities in their efforts to fight climate change and its adverse effects by means of the elaboration of local Climate Action Plans (CAPs). This guidebook aims to support local authorities by means of step-by-step recommendations covering the entire process of elaborating a CAP, from initial political commitment to progress monitoring. Funding, human capital, infrastructure and information technology have been widely recognised as the non-technical barriers to climate change mitigation and adaptation planning, which is particularly apparent at the local government level. In this context, the CAPs developed at the local level could play the role of "critical links" between the local, national and global climate change responses and initiatives.

According to the framework provided in the guidebook, climate action planning follows the four phases depicted in Figure 1 and detailed in the guidebook chapters as follows:

Figure 1. Climate action planning phases



Source: JRC analysis

— ***Initiation phase****:* chapter 2 provides detailed guidance throughout the initiation phase on the commitment to address climate change mitigation and adaptation.

— ***Planning phase****:* chapter 3, 4 and 5 provide detailed guidance on elaborating a CAP and its parts:

- chapter 3.2 presents how to undertake a GHG emission Inventory or Baseline Emission Inventory (BEI)
- chapter 3.3 shows how to undertake a Risk and Vulnerability Assessment (RVA);
- chapter 3.4 gives insights into the development of the assessment for energy access and poverty pillar
- Chapter 4 focuses on setting goals and targets for the three pillars;
- Chapter 5 illustrates how to elaborate climate mitigation, adaptation and energy access measures.

— ***Implementation and monitoring:*** chapter 6 and 7 present how to implement the actions planned in the CAPs and to monitor the progress towards the target.

An initial overview of the current state of Indonesian local government resources in climate action planning is also provided in chapter 1, with the aim to point out the major issues and barriers that the local authorities may encounter in developing the climate plans. Moreover, the document includes a section on financing the action plan (chapter 9) and some insights on local policies in the annexes.

Additional information on tools and methods is included in the appendix to this guide. The appendix complements this guide by providing additional information on how to build a GHG emission inventory.

PART 1 - Climate Action Plan (CAP) Process

1 Introduction

1.1 The Global Covenant of Mayors for Climate & Energy initiative

The Global Covenant of Mayors for Climate & Energy (GCoM) is the world's largest alliance of cities and local governments supporting voluntary action to fight climate change and promoting a low emission, climate resilient society while ensuring access to sustainable, affordable and secure energy for all. The GCoM initiative is a voluntary commitment by **local governments** (regions, cities, towns) to implement measures on three **GCoM pillars**: climate change mitigation, climate change adaptation and energy access and poverty.

Under the GCoM, 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 the three pillars. In order to translate the political commitment into practical measures, GCoM signatories commit to elaborating and implementing a **Climate Action Plan (CAP).**

The GCoM is a bottom-up and voluntary initiative that invites cities to define, set and meet ambitious and realistic **energy and climate targets**, in line with GCoM requirements. This means that targets are at least as ambitious as the 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 consistent with the principles around energy access and urban sustainability embodied in the Sustainable Development Goals (SDGs). Local authorities are encouraged to voluntarily 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.

The GCoM **Common Reporting Framework (CRF)** has been designed for signatories of the GCoM in any region around the globe and serves as a reference document for them. The CRF provides a set of general principles and recommendations, developed with the intention to be flexible in front of specific local /regional circumstances while also allowing for a global aggregation and comparability of data. The CRF is meant to guide the cities in assessing their greenhouse gas emissions, climate change risks and vulnerabilities (CRF on energy access is forthcoming) as well as in supporting authorities in planning and reporting, in an integrated and coherent way. The flexibility will allow local authorities to develop a CAP in the way that best suits their own circumstances, permitting those already engaged in energy and climate actions to come on board of the Global Covenant of Mayors, while continuing to follow the approaches they have used before joining the initiative with as little adjustments as possible.

Signatories commit to preparing and implementing the plan and should regularly monitor progress in implementing the action plan and toward achieving the targets set.

At global level, signatories report their data through two official GCoM reporting platforms: MyCovenant, historically developed in support of the European cities and the CDP/ICLEI's unified reporting system. In the context of Indonesia, the Indonesian Ministry of Environment and Forestry introduced two online systems: SIGN SMART, an online tool to calculate GHG emission established in 2015, which acts as the National GHG Inventory System of Indonesia; and SIDIK, an online platform that calculates and maps out cities' vulnerability level.

Box 1 GCOM key definitions

Local governments: 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;

GCoM pillars: (1) Climate change mitigation, (2) Adaptation to Climate Change, (3) Energy Access and poverty;

Climate Action Plan (CAP): it is a strategic and operational document which translates the political commitment into practical measures;

Targets: energy and climate goals set by the local governments;

Common Reporting Framework (CRF): a global reporting framework based on standardised approach;

GCoM Platform: reporting tool, which allows local governments to report on the GCoM requirements and achievements.

1.2 The Regional Covenant of Mayors Southeast Asia: Indonesia

The regional Covenant of Mayors in Southeast Asia (GCoM SEA) engages with cities and local governments in Indonesia, Malaysia, Vietnam and Thailand to encourage local level climate and energy actions. The Covenant of Mayors in Asia has been established by the United Cities and Local Governments Asia Pacific (UCLG ASPAC) with the support of the European Union (EU) through the International Urban Cooperation (IUC) Asia. GCoM SEA kick-started ambitious and inclusive climate goals in 10 pilot cities in Indonesia, Malaysia and Vietnam. The implementation involves the processes and operational aspects in planning for low emission development; climate resilience and adaptation and access to sustainable energy. The UCLG ASPAC is leading the GCoM SEA Secretariat and Helpdesk in advancing cities' climate and energy ambitions through the advantage of technical and climate financing expertise and practical experiences in performing climate actions.

Among the three GCoM pillars, the GCoM SEA Indonesia Guidebook addresses climate change mitigation and adaptation, while energy access pillar has not yet been developed:

1. ***Low emission development*** - Mitigation actions undertaken to reduce the emission of the greenhouse gases and their concentrations in the atmosphere;
2. ***Climate resilience and adaptation*** - Actions undertaken to anticipate the adverse effects of climate change, prevent or minimize the damage they can cause, or take advantage of opportunities that may arise.
3. ***Energy access*** – Actions undertaken to know affordability, secure and sustainable energy security conditions.

Box 2 GCoM SEA/Indonesia signatories' pledges

To formally commit to the GCoM SEA

To engage with local stakeholders throughout the development and implementation of the climate strategy and action plan;

To develop a community-scale greenhouse gas (GHG) emissions inventory and adopt ambitious, measurable and time-bound target(s) to reduce/limit GHG emissions;

To 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;

To assess Energy Access towards the Sustainable Development Goal 7 achievement

To develop stand-alone or integrated climate action plan(s) to address climate change mitigation / low emission development, climate resilience and adaptation, and access to sustainable energy;

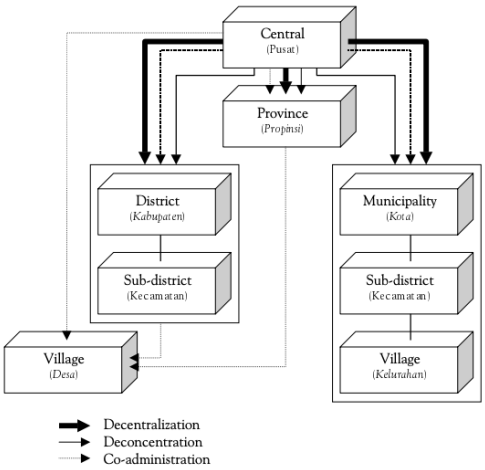
To approve the developed climate action plan;

To monitor the implementation of the plan and report achievements and progress on common reporting platforms, including provisions.

1.3 Local Governments in Indonesia

Indonesia is a unitary state country with the government's form of a republic ([1]) and a presidential system of government . Indonesia's governance structure consists of the central government and local government, where the local or regional government consists of the provincial-level government as well as the second-level local government (Adiputra 2018). The levels of government in Indonesia are divided into five layers: central provinces, districts (*kabupaten*), municipalities (*kota*), subdistricts (*kecamatan*) and villages (*kelurahan*/desa) ([2]). The first level is autonomous provinces, then districts and municipalities. Technically, districts and municipalities have the same level of government. This distinction is based on the location of its government administration. Districts' government administration is located in rural area while municipalities' government administration is in urban area. Within districts and municipalities there are smaller administrative government units called sub-districts (*kecamatan*). Each sub-district is further divided into villages ([3]) (Figure 1). Indonesia implements decentralisation where central government give autonomy directly to the local government of regencies and municipalities at the sub provincial level. By implementing the regional autonomy, local government is required to be able to manage its government independently.

Figure 2. Framework of government according to Law No. 22, 1999.



Source: Adiputra et al. 2018. ([2])

Table 1. Number of administrative governments in Indonesia

Administrative level	Number of administrative levels by 2021
Province	34
District	416
Municipality	98
Sub district	7094
Village (*desa*)	74957
Village (*kelurahan*)	8490

Source: JRC analysis

([1]) Article 1 paragraph 1 of the 1945 constitution (UUD 1945)
([2]) "Kelurahan" is the terminology used for village in municipalities, while "desa" is for districts
([3]) Usman. 2001. Indonesia's decentralization policy: initial experience and emerging problems. Available at https://smeru.or.id/sites/default/files/publication/euroseasexperience.pdf

1.4 Climate Action Plan

The CAP defines concrete measures for climate mitigation and adaptation and access to energy, with timeframes and assigned responsibilities, translating the long-term strategy into action. The Climate Action Plan (CAP) is the key document that sets the strategies, goals and actions for a sustainable and low greenhouse gas (GHG) emission development while including climate adaptation actions in response to the current and future impacts of climate change in the territory, and ensuring energy access to citizens.

The CAP is both a strategic and an operational document. It contains an assessment of the status of the local authorities in terms of energy consumption and emissions (GHG emission inventory or Baseline Emission Inventory - BEI), of the most relevant city climate hazards and vulnerabilities (Risk and Vulnerability Assessment) and energy access and poverty. Through the results of the assessments across the three pillars, local authorities can identify the best fields of action and opportunities for reaching the local authority's greenhouse gases (GHG) emissions target, increase resilience and ensure access to affordable, sustainable and secure energy to all citizens.

The CAP shall lead to climate change mitigation and adaptation and energy access actions being integrated into development policy and planning at every level. The cities understand while preparing their CAP that mitigation and adaptation should complement each other, and should be mainstreamed into existing sectorial policies in order to foster synergies and optimize the use of available resources.

A well-designed CAP, 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.

The CAP should consolidate and integrate existing initiatives. If a city has already developed a municipal action plan in the past, or any other development and/or climate related plans, the CAP should be a natural extension of the ongoing activities and measures. Moreover, when developing the plan, local governments can opt for integrated plans including all the three pillars (climate change mitigation, adaptation and energy access) or which may distinct plans dealing with each of the pillar separately.

The CAP 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.

To illustrate the CAP, three main aspects define it:

- Principles: the criteria defining the scope, boundaries and sector coverage of the plan
- Elements: the components of a well-designed CAP, from political support to well-designed actions
- Process: different phases to be followed to develop an integrated local climate action plan

1.5 CAP Principles

The principles of Climate Action Plans in terms of spatial and temporal boundaries, scopes, sector coverage and elaboration of the document are described in the following paragraphs.

1.5.1 Spatial and temporal scope

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

The CAP 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). The CAP may as well cover a longer period, in which case it is advised that the plan contains intermediate targets and goals for the year 2030, to be comparable with the NDC.

The (long-term) vision and detailed measures shall be integral part of the CAP. This is particularly true for adaptation targets: local decision-makers often focus on the immediate benefits of a measure that fits into their political agenda, whilst adaptation is known to have long-term benefits. A robust planning of climate action must integrate short-term needs with long-term threats and consider the full range of interactions between sectors and policies.

1.5.2 Sector coverage

Crucial sectors in local energy consumption and GHG emissions are: stationary energy, transportation and waste. Moreover, GHG emissions from Industrial Processes and Product Use (IPPU) and Agriculture, Forestry and Other Land Use (AFOLU) sectors may be significant depending on local circumstances. Therefore, when developing their CAP Local Authorities shall ensure to cover the three main sectors in inventorying the GHG emissions and preparing specific measures, and are recommend to include emissions from AFOLU and IPPU if relevant. Additionally, GHG emissions from upstream activities, such as material extraction, or other out-of-boundary sources can be reported.

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.

On adaptation, the local government shall identify the most significant climate hazards faced by the community. For each identified climate hazard, the following information shall be reported:

- Current risk level (probability x consequence) of the hazard ([4]).
- Description of expected future impacts.
- Expected intensity, frequency, and timescale of the hazard.
- Relevant sectors, assets, or services that are expected to be most impacted by the hazard in future and the magnitude of the impact for each of them

The CAP should address areas where local government can influence energy consumption, land use planning and climate change resilience on the long term.

Climate change mitigation and adaptation measures should complement each other, and should be mainstreamed into existing sectorial policies, plans and programs in order to foster synergies and optimize the use of available resources.

A climate lens should be applied whenever a climate change mitigation policy or action is formulated, planned and/or implemented, to see whether it works in favour of or against the adaptation goals and – if relevant - adjust it, and vice versa.

All actions of priority sectors (identified from GHG emissions inventories and risk/vulnerability assessments) shall be included in the plan. For climate change mitigation, action in the building subsector including: municipal, residential and tertiary buildings (belonging to stationary energy sector), and urban transport sub sector (belonging to transportation sector) and waste need to be included in the plan.

The CAP may also include actions related to local electricity production (development of PV, wind power, CHP, improvement of local power generation), and local heating/cooling generation. In addition, the CAP should cover areas where local authorities can influence energy consumption on the long term (as land use planning), encourage markets for energy efficient products and services (public procurement), as well as changes in consumption patterns (working with stakeholders and citizens). Waste sector is also to be addressed.

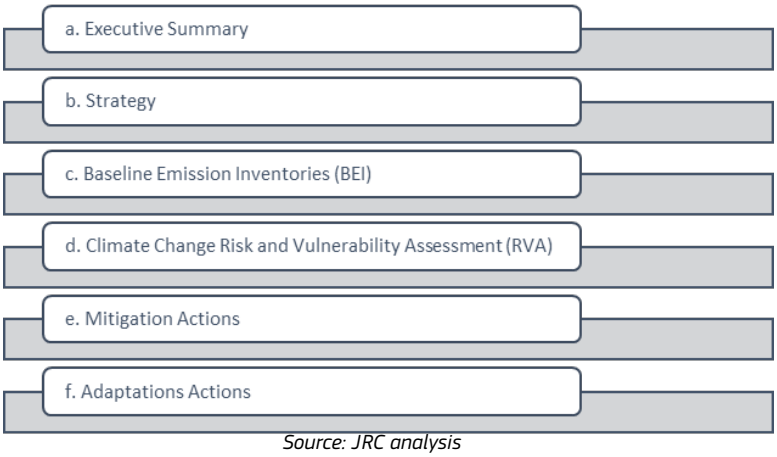
For adaptation to the impacts of climate change, the CAP should include actions in the sectors and areas that are likely to be most vulnerable to climate change in a local authority (hotspots). Vulnerable sectors vary considerably within urban boundaries, from one city to another and from urban areas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

([4]) Probabilistic risk analysis defines risk as the product of the probability that some event (or sequence) will occur and the adverse consequences of that event.

1.5.3 Elaboration of the document

Figure 3 shows the recommended structure of a Climate Action Plan. Content is detailed below.

Figure 3. CAP Structure and Content



Source: JRC analysis

Strategy

1. Vision
2. Commitments for mitigation adaptation to climate change and access to energy
   - For mitigation, the CAP document should clearly indicate the emission reduction target by 2030 (and possibly beyond) clearly stating the GHG emission inventory/ Baseline Emission Inventory (BEI) year and the reduction target type (absolute reduction / per capita reduction/ Baseline scenario target)
   - For adaptation, the CAP should include a certain number of adaptation goals, coherent with the identified vulnerabilities, risks and hazards.
   - For Access to energy the path towards Sustainable Development Goal 7 and local specific goal coherent with attributes and indicators outcomes
3. Coordination and organizational structures created /assigned
4. Staff capacity allocated
5. Involvement of Stakeholder and citizens / Participatory processes
6. Overall budget allocated for implementation and financing sources
7. Implementation
8. Monitoring process
9. Assessment of the adaptation options
10. Strategy in case of extreme climate events

GHG emissions inventory / BEI

1. Inventory year
2. Number of inhabitants in the inventory year
3. Emission factors approach (IPCC or LCA)
4. Emission reporting unit (CO_2 or CO_2-equivalent)
5. Responsible body/department (main contact)
6. Detailed BEI results in terms of final energy consumption and GHG emissions

RVA

1. Expected weather and climate events particularly relevant for the local authority or region
2. Vulnerabilities of the local authority or region
3. Expected climate impacts in the local authority or region
4. Assets and people at risk from climate change impacts

Actions and measures for the full duration of the plan. For each measure/action, please specify (whenever possible)

1. Sector
2. Title
3. Description
4. Department, person and/or company in charge of the implementation,
5. Timeline (start, end, major milestones)
6. Cost estimation (Investment and running costs)
7. Estimated energy savings and/or increased renewable energy production by target year (MWh/year)
8. Estimated CO_2 reduction by target year (tonnes/year) if relevant
9. Impacts, vulnerabilities and risks tackled if relevant
10. Indicators for monitoring
11. Action also affecting mitigation/adaptation/energy access
12. Stakeholders involved/advisory group

Actions and measures should be coherent with outcomes of the assessments, i.e. adaptation actions with the hazards and vulnerable sectors identified in the city vulnerability and risk assessment (RVA), mitigation actions should address most emitting and energy consumption sectors, energy access/poverty actions should be consistent with the identified attributes and selected indicators.

1.6 CAP Elements

The following ten elements are linked to the commitments taken by the Covenant signatories and constitute key ingredients of success of s Climate Action Plans.

Figure 4. CAP Elements

Source: JRC analysis

a) Strong political support

Strong political support by municipal council or equivalent decision-making body is a prerequisite for the successful design, implementation and monitoring of a CAP. Local authorities must ensure that the vision and actions proposed in the approved CAP are aligned with and integrated into relevant national and/or regional plans, strategic development plans or land-use plans. The CAP should, therefore, be approved by the municipal council (or equivalent body, including national authorities).

b) Commitment to ambitious targets

The principle behind the chapter on mitigation of the CAP is a meaningful, actionable commitment by local authorities to implement low emission development strategies to ensure that local authorities develop in a way that limits the GHG emissions in their jurisdictions. For GCoM SEA signatories, the CAP must include the signatory's statement of commitment to reduce emissions beyond the country's NDCs by 2030 within the geographical area under its responsibility for the areas of activity, relevant to its mandate.

The commitment should be based on the quantification of associated GHG emitted in the baseline year. The base year shall be the same as the base year used in the NDC. Where the base year is different from the NDC (e.g. due to a lack of data availability), this shall be justified. Targets on the other hand should be based on a reference scenario called the Business-as-Usual (BAU) scenario.

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.

c) Suitable assessment of the current situation

The CAP should be elaborated based on a sound knowledge of the local situation in terms of energy and GHG emissions, as well as of climate hazards, vulnerabilities and access to energy. Therefore, an assessment of the current framework should be carried out. This includes calculating a Baseline Emission Inventory (BEI), preparing a Climate Change Risk and Vulnerability Assessment (RVA). The two assessments, BEI and RVA have to be included in the CAP document.

d) Development and prioritization of actions

Local authorities should identify and prioritize the required and/or most effective sectors in which to implement mitigation actions. Local authority should establish a long-term vision with clear objectives for each sector. The CAP must include a coherent set of measures covering the selected activity sectors. Those measures should be aligned with identified priorities and measurable in terms of energy consumption and GHG emissions reduction.

Adaptation to Climate Change requires a multilevel approach involving local, regional, national levels. In particular, adaptation to Climate Change is a shared competence between local and regional authorities and should be defined according to a city´s peculiarities and needs, which might be neglected by a solely large-scale national framework.

Local authorities can identify the most suitable measures to their conditions. Medium and long term visions allow prioritization and keeping the track of the progresses. Measures can be selected according to the needs identified in the assessment. Local authorities can target specific renewable energy resource that best suits their conditions; a major focus can be given on providing access to electricity and to clean cooking.

The mitigation and adaptation strategies could be part of the CAP and/or developed or mainstreamed in separate documents. Based on recognized local risks and vulnerabilities, the local authority should identify actions aimed at enhancing local adaptive capacity to respond to climate change impact or/and reducing city sensitivity to climate extremes.

e) Strategies and actions

The CAP must provide a clear outline of the specific actions the local authority intends to take to reach its commitments. It should include:

- Long-term strategy and goals in selected and/or mandatory sectors, as well as public procurement, standards for new/renovated buildings;
- Detailed actions for the next three to five years that will advance towards the long-term strategy and goals. For each action, include the department and persons in charge of implementation and monitoring, a timeline (start, end, and major milestones), a cost estimate and potential financing source(s), the estimated energy saving/increased renewable energy production, and the associated estimated GHG reduction. For the key adaptation actions, the stakeholders involved, the risk and/or vulnerability tackled and the outcome reached should also be specified.

f) Governance

An appropriate governance structure is fundamental to the successful implementation of the CAP. The CAP should outline which structures are in place or how they will be organized to implement the proposed actions successfully. Local authorities should ensure that the CAP is taken into account at different levels and by different departments, including those at a national level. The CAP should also specify the human resources required and how they will be made available, as well as the implementation and monitoring strategy. A coordinated interaction and cooperation between mitigation and adaptation through the mobilization of all municipal departments involved should be ensured.

Furthermore, the local authority should consider training and capacity-building to avoid delays in implementation. Municipalities with limited autonomy or opportunity for recruiting staff should draft recommendations to national authorities, including a request for suitable technicians and administrators to carry out some actions foreseen in the CAP.

g) Engagement of citizens and stakeholders

The involvement of relevant stakeholders, in particular Civil Society Organizations, throughout drafting and implementing the CAP is crucial in order to develop successful mitigation and adaptation coherence. The CAP should describe how each stakeholder was and will be involved during the preparation of the CAP document since the very first steps of the planning process until the end of the whole process, and how each will participate in the implementation and monitoring of the planned actions. Moreover, advisory groups should be created to ensure an exhaustive understanding of city specificities and problems, meet end-user expectations, guarantee a common agreement about selected indicators, and ensure a full uptake of the main outcomes and their inclusion into decision-making.

h) Financing

The CAP should identify the potential financing resources for each step of its development, implementation and monitoring. It should take into consideration the financial resources needed to build capacity within the municipality and to compensate external stakeholders such as architects, consultants, banks, developers and facility management involved in elaborating the CAP.

i) Document submission

The covenant signatories commit to submitting their CAPs within three years following adhesion.

j) Monitoring and reporting

Regular monitoring using relevant indicators, followed by adequate revisions of the CAP allows local authorities to evaluate progress towards targets over time and adopt corrective measures if necessary. The CAP should briefly outline how the local authority (or relevant decision-making body) intends to ensure the follow up and monitoring throughout implementation of the planned actions. GCoM SEA signatories must submit a monitoring Report every two years following the submission of the CAP.

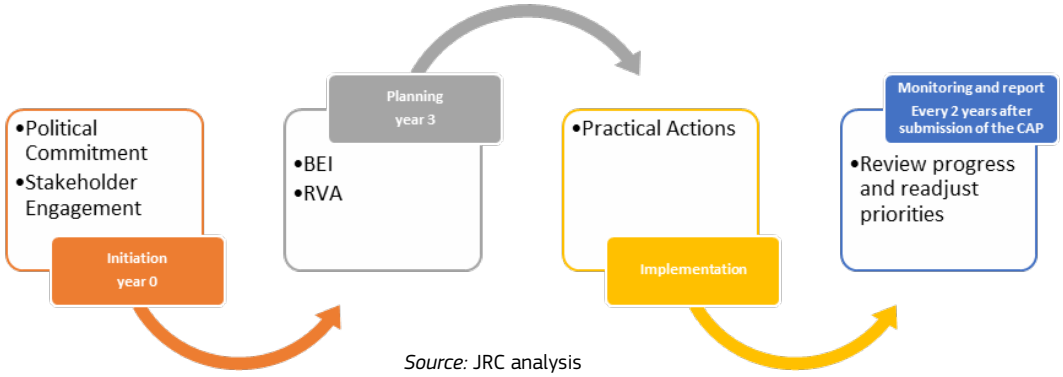
Box 3 Key principles for a successful CAP

- Document approved by the municipal council;
- Build strong political support; secure a long-term commitment;
- Commit to concrete and ambitious emission reduction targets under the municipal jurisdiction;
- Based the plan on assessments: GHG emission inventory/ Baseline Emission Inventory (BEI) and Risks and Vulnerabilities Assessment (RVA);
- Develop comprehensive measures covering key municipal sectors;
- Define concrete actions to 2030 but strategies beyond;
- Mobilization of all municipal departments involved;
- Engagement of all relevant stakeholders and empowerment of citizens;
- Ensure adequate financial resources;
- Ensure proper management, including monitoring and reporting, during implementation.

1.7 CAP process

The process to develop the CAP includes four phases: initiation, planning (assessments, goal and target setting and elaboration), implementation and monitoring and reporting. Figure 5 illustrates the main phases within the Climate Action Plan elaboration process, including milestones and timeframe.

Figure 5. The CAP process: main phases, milestones and timeframe.



Source: JRC analysis

Note that 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 following figure outlines the journey towards the CAP from commitment to action plan monitoring.

Figure 6. GCoM City journey

Source: GCoM available at: https://www.globalcovenantofmayors.org/journey/

With support from EU-IUC five Indonesian pilot cities, as shown in Figure 7, have endorsed the process for formulating their CAP.

Figure 7. Indonesian cities under EU IUC program ([5])

Source: JRC analysis

([5]) The cities of Minahasa Utara, Pontianak, Tanggerang, and Medan, Gorontalo, Cirebon, Pakanbaru, Tanjung Pinang, Bandar Lampung, Mataram, Banjarmasin, Kupang, Samarinda, Ternate are included in the 2nd phase

2 Climate Action Plan (CAP) process: initiation phase

2.1 Political commitment

Political commitment and leadership should be sought early, as they are driving forces of the overall process. The formal approval of the CAP by the municipal council (or equivalent body, including national authorities), along with budgets for the first year(s) of implementation, are crucial to ensure successful implementation.

The local authority is best situated to know who to contact and how to raise the political commitment needed (mayor, municipal council, ministries, national agencies, future partners, specialized committees, etc.). Before seeking this political commitment and support, ensure proposed CAP actions are aligned with, and even help to achieve, relevant approved regional and national plans. Doing so promotes buy-in and approval of the necessary resources from higher levels during implementation.

Establishing broad political consensus at all levels for CAP actions is highly recommended. It provides long-term support and stability, regardless of changes in political leadership, especially in countries where local and regional authorities depend heavily on national policies and budget.

The municipal council and local authority should further support the process by ensuring adequate human resources are in place to prepare and implement the CAP (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 CAP elaboration process to gain their acceptance and backing.

Other support activities within the municipal council and local authority's purview include taking steps to:

- Integrate the CAP vision with the actions and initiatives undertaken at the national and/or regional level;
- Make the CAP a part of the municipality's overall planning;
- Solicit the long-term commitment of relevant authorities and departments to implementation and monitoring;
- Foster the participation of different stakeholders, including citizens;
- Reinforce the local authority and citizen "ownership" of the CAP process.

As the responsible entity and authority, the municipal council must follow the implementation process closely. For CoM signatories, municipal council approval is required.

2.2 Establish governance structure

Developing and implementing a CAP 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 CAP process should be integrated in the everyday work of each department.

Multi-departmental and cross-sector involvement is required, and their organisational targets need to be aligned with and integrated into the CAP.

Past experience recommends establishing two CAP groups:

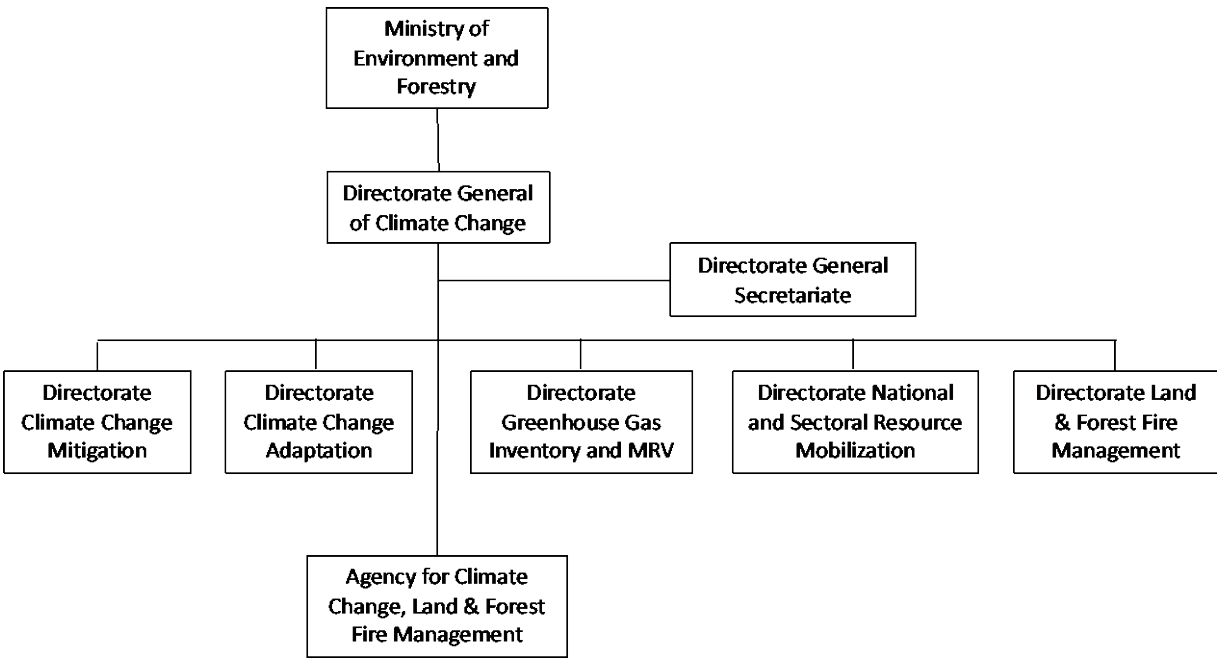
- **The steering committee** will provide strategic direction and political support.
- **The project committee** undertakes the actual CAP elaboration and follow-through to ensure stakeholder participation, organize monitoring, report progress, etc.

Both the steering and project committees require distinct and specific objectives, functions and leaders, as well as a well-defined meeting schedule/agenda and a project-reporting strategy.

Depending on their size and human resources availability, local authorities may benefit from the assistance of local or regional energy agencies, city networks, etc. It is even possible for them to subcontract some specific tasks (e.g. compilation of a BEI or of a RVA) or to work with interns and masters or PhD students. Local authorities, which do not have sufficient skills or resources to draft and implement their own CAP, should be supported by public administrations with such capacities.

In the early 2010s, Government of Indonesia has renovated governance structure to address climate change, by establishing National Council on Climate Change (DNPI) and (National Agency for the Management of Reduction Emission from Deforestation and Degradation, role of forest conservation, sustainable forest management and enhancement of forest carbon stock (BP REDD+). With the issuance Presidential Regulation No. 16 of 2015, the Ministry of Environment, Ministry of Forestry, DNPI and BPREDD+ is merged into the Ministry of Environment and Forestry (KLHK). Management of climate change is further operationalised at the Minister of Environment and Forestry Regulation No. 18 of 2015 under a Unit of Echelon I named the Directorate General of Climate Change Control (DJPPI). The Directorate General of Climate Change Control (DJPPI) consists of 5 Units Echelon II and 5 units of Echelon III located in 5 regions as shown in Figure 8.

Figure 8. Organization structure of Directorate General of Climate Change



Source: JRC Analysis

The main tasks of the Directorate General of Climate Change Control is to carry out the formulation and implementation of policies in the field of climate change. The function is to formulate, to implement, to prepare, to coordinate and synchronize, and to provide technical guidance and supervision on the implementation of mitigation, adaptation, reduction of greenhouse gas emissions, reduction and elimination of ozone-depleting substances, resource mobilization, greenhouse gas inventory, monitoring, reporting and verification of climate change as well as controlling forest and land fires in the regions. Sub-national governments in many cases also establish a climate change task force that facilitate the formulation of climate action plan (CAP).

Box 4 Climate Change Task Force at Pontianak City

Pontianak City Government has established a Climate Change task force to facilitate the process of developing CAP. The task force represents various stakeholders such as local government, sectoral agencies, and academics. The structure of the task force consisted of technical team, climate change adaptation group and climate change mitigation group. The function of the taskforce is to facilitate the process of developing Climate Action Plan which comprises of various activities namely giving recommendation on strategy, policy, program, and activities related to climate change adaptation and mitigation (Decree of Major No. 40/ BAPPEDA)/2022 on Establishment of Climate Change Taskforce

2.3 Stakeholders engagement

Citizens and other stakeholders should be invited to take part at important stages of the CAP elaboration process: building the vision, defining the objectives and targets, setting the priorities and defining the necessary human and financial resources. Such 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.

It is important to involve in the CAP process stakeholders whose interests are affected or whose activities affect the issue at stake, those who possess or control information, resources or expertise needed for strategy and/or implementation, and/or whose involvement is needed for successful implementation.

Box 5 Stakeholders' involvement

Local administration, relevant municipal departments and companies (e.g. municipal energy utilities, transport companies, etc.);

Relevant representatives of national or regional administrations and/or neighbouring municipalities, to ensure coordination and consistency with plans and actions that take place at the regional and national level;

Institutional stakeholders such as chambers of commerce, professional organizations (e.g. architects, engineers), universities, professionals and research centres, observatories, experts;

Local and regional energy agencies, suppliers, utilities, facilities management companies, Energy Services Companies, supporting structures, national energy agencies;

Financial partners, banks, private funders (including international);

Transport/mobility actors (e.g. private/public transportation companies);

Construction sector (e.g. building companies, developers);

Businesses and industries, including tourism where it represents a large share of the local Authority's CO2 emissions;

NGOs and other civil society representatives, including students, trade unions and consumer associations;

Small Scale businesses and community service organisations (e.g. waste collectors);

Informal businesses;

Youth and women organizations.

The roles of local authorities and potential stakeholders are summarised in Table 2: many stakeholders activities indicate long-term partnerships and require ongoing communications about CAP implementation to motivate and maintain the necessary stakeholder involvement. Such requirements should factor into the CAP communication.

Table 2. CAP process: the main steps role of key actors

PHASE	STEP	ROLE OF THE ACTORS		
		Municipal council or equivalent body	**Local administration**	**Stakeholders**
Initiation	Political commitment and signing of the Covenant	Make the initial commitment. Sign the GCoM SEA. 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).
	Mobilize 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 CAPs development and implementation.
Planning phase 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 CAP and Communicate the plan.	Put pressure on political authorities to approve the plan (if necessary)
Implementation and monitoring of the CAP	Implementation	Provide long-term political support to the CAP 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 CAP implementation.
		Networking with other GCoM signatories, exchanging experience and best practices, establishing synergies and encouraging their involvement in the Covenant of Mayors in Indonesia.		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.

Source: Adapted from JRC112986 Guidebook (2018) (Palermo et al., 2019)

Communication, both to expedite CAP actions and promote their adoption, is an essential mean of keeping external and internal stakeholders motivated and supportive. The CAP 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.

A good communication plan will promote visibility, investment, awareness, behavioural change and broad support throughout implementation (an example of dissemination see).

Lack of communication channels at all levels can be a major challenge. Local authorities may need to invent the necessary strategy, channels and tools and/or enlist a dedicated communications officer or external partner (schools, private sector, NGOs, etc.). Consider creating a "Citizen Awareness Promotion Plan'' as part of the CAP communications strategy to ensure effective implementation.

Networking with other local authorities, especially GCoM signatories, to exchange experiences and best practices is highly recommended. It accelerates learning and highlights the actions taken by each local authority, which may also attract investors and additional funding to support pilot and/or demonstration projects.

Box 6 Effective Communication

- Have a clear message to produce the desired outcome;
- Identify the audience for each message;
- Establish indicators to evaluate the impacts of the communication (Head count at a seminar, quantitative/qualitative surveys, hits on website, feedback via e-mails, etc.);
- Specify the most appropriate communication channel(s) (i.e. the most accessible and the easiest to implement and finance) face-to-face (most effective), advertising, mail, e-mail, internet, blogs, talks/meetings, brochures, posters, newsletters, printed publications, media releases, sponsorship, etc.
- Specify planning and budget;
- Set up internal communication to improve collaboration among departments

3 Climate Action Plan (CAP) process: planning phase

3.1 Assessment of current policy framework on the three pillars

Before starting the detailed planning process at the municipal level, it is recommended to review the policy framework in which the plan will be established – taking into consideration relevant international frameworks, national policies and regulations as well as existing strategies and plans at the regional and local level.

A review of the existing policy and regulatory framework is a good starting point towards better policy integration and makes sure that potential synergies or conflicting policies and procedures are addressed early on in the planning process.

A first step is to identify the existing municipal, regional and national policies, plans, procedures and regulations that affect energy and climate issues within the local authority. For example, National Adaptation Strategies serve as a good entry point for existing information on adaptation at country level. Cities sometimes can also draw on existing national RVAs and available climate projections, and may come across adaptation-related instruments, but also ongoing actions at the city level (i.e. disaster risk reduction, biodiversity protection, land use planning, existing regional or sectoral plans). Similarly, National Low Emission Development Strategies may provide a good overview on existing national policies, legislation, programmes and data availability related to climate change mitigation.

The next step is to go through, check and compare the objectives and goals in the identified documents with the ones for a sustainable energy policy and resilient sectoral development. The aim is to establish whether these objectives and goals are supporting or conflicting. If such conflicts are detected in policy goals, ideally they should be amended and aligned with the CAP goals. In order to do so, the local authority should, where possible, invite all the relevant actors and stakeholders to discuss the conflicts identified, trying to reach an agreement on the changes that are necessary to update policies and plans.

The planning phase include the understanding of the status and elaboration of the assessments: GHG emission inventory/ Baseline Emission Inventory (BEI), the Risk and Vulnerability Assessment (RVA) and the energy access. The following chapters will deal with the assessment phase for each pillar.

Government of Indonesia is in the process of updating the NDC in the light of Paris Agreement, and it is planned to be submitted to the UNFCCC by the end of this year (2022). In addition, Government of Indonesia has also issued Carbon Pricing Policy to support the achievement of NDC. This carbon pricing policy is defined in the Presidential Regulation 98/2021.

3.1.1 Climate mitigation framework

The government has set a policy for the Acceleration of the Battery-Based Electric Motor Vehicle (BEV) Program for Road transportation. Currently BEV infrastructure, starting from the battery industry, the vehicle industry (motor cycle, car, bus) has been and is being developed. The purpose of using BEV is to reduce imports of gasoline and ADO and reduce GHG emissions. In the future, it is planned that there will be no more sales of motorcycles based on internal combustion engines (ICE) since 2030 and cars since 2035.

Box 7 Indonesian Policy framework

- Law Number 22 Year 2019 concerning Sustainable Agricultural Cultivation Systems;
- Government Regulation Number 79 of 2014 concerning National Energy Policy;
- Presidential Regulation No. 61/2011 concerning the National Action Plan for GHG emission reduction;
- Presidential Regulation No. 71/2011 concerning Implementation of National GHG Inventories;
- Presidential Regulation No. 97/2017 concerning Policies and National Strategies for the Management of Domestic Waste and Waste Similar to Domestic Waste;
- Presidential Instruction No. 13/2011 concerning energy efficiency in offices;
- MEMER Regulation Number 18 of 2014 concerning Energy Saving Sign Labels for Self-Ballast Lights.
- MEMER Regulation Number 57 of 2017 concerning Minimum Energy Performance Standards (SKEM) and inclusion of energy-saving sign labels for air conditioning appliances;
- MoEF Regulation No. 84/2016 on Climate Village Program;
- MoEF Regulation No. 72/2017 concerning Guidelines for Measuring, Reporting and Verifying Action and Resources for Climate Change Control;
- MoEF Regulation No. 73/2017 concerning Guidelines for Implementation and Reporting of National GHG Inventories;

- Regulation of the Minister of PUPR Number 2 of 2015 concerning Green Buildings;
- MoEF Regulation No. 77/2018 concerning Management of Environmental Funds;
- National Sustainable Transport Policy;
- Governor Regulation No. 38/2018 concerning Regional Action Plan (RAD) to Reduce GHG Emissions in South Sumatra Province;
- Regional Regulations concerning Development of Control and Utilization of Swamp Land;
- Regional Regulations on RTRW;
- Regional Regulations on Sustainable Development;
- Regional Regulations on City Forests;
- Regional Regulations concerning Management of Domestic Waste and Waste Similar to Domestic Waste;
- Regional Regulations concerning the 2018-2023 Mid-term Regional Development Plan for Palembang City;
- Regional Regulations on the Use of Gas Fuel (BBG);
- Regional Regulations concerning Domestic Wastewater Management;
- Regional Regulations concerning the Designation of Areas without Motorized Vehicles and Locations of Special Bike Lanes;
- First Nationally Determined Contribution of Republic of Indonesia;
- Energy Efficiency Program in the Company

3.1.2 Climate adaptation framework

Geological and geographical condition of Indonesia increase its vulnerability to the adverse effects of climate change namely floods and droughts, which affect agriculture sector as well as other livelihood sectors. Erratic rainfall may disrupt water resources, which are critical to support many economic activities. Thus, economic activities are also disrupted due to climate change. The coastal area also highly susceptible to climate change specifically sea level rise.

Indonesia has ratified Paris Agreement as stipulated in National Act No. 16 in 2016 on the Ratification of Paris Agreement to the United Nations Framework Convention on Climate Change. Indonesia's government had established several national strategies/policies and measure regarding climate change adaptation such as Regulation of the Ministry of Environment and Forestry No. 33 in 2016 on Guidelines for Developing Climate Change Adaptation Actions. This regulation gives a mandate to the local governments to formulate climate change adaptation actions that are integrated into regional/sectoral development planning. The integration of climate change adaptation actions into regional/sectoral development planning also regulated in Regulation of the Ministry of Home Affairs No. 90 in 2019. Moreover, Government Regulation No. 46 in 2017 regarding Environmental Economic Instruments also includes development planning, economic activities and environmental funding.

3.1.3 Status of energy access

The government is committed to provide commercial energy through the whole country. Commercial energy provided by the government to meet final energy needs include: electricity, fuel oil (gasoline, avtur, kerosene, ADO, IDO, MFO, LPG, natural gas, and coal).

3.1.3.1 Fuel access

The supply of fossil fuel is carried out through own production, except for gasoline, most of which is imported as demand exceeds production. LPG consumption for cooking continues to increase in line with the success of the kerosene substitution program. However, as LPG imports are still high, diversification of fuel for cooking has been put in place through a natural gas connection program for households, a policy on the use of electric stoves, and a policy for down streaming coal with the construction of a dimethyl ether (DME) plant.

Box 8 kerosene substitution program

This program was developed under the Presidential Regulation Number 104 of 2007 concerning Provision, Distribution, and Pricing of 3 Kilogram Liquefied Petroleum Gas. The main objective of the kerosene conversion program for cooking in households and small businesses is to ensure the supply and procurement of fuel in the country and reduce subsidies for fuel oil in order to ease the financial burden on the State. The program has been completed in 5 major Indonesian islands, namely Java-Bali, Sumatra, Kalimantan, Sulawesi, and the islands in West Nusa Tenggara. The total population living on the island reaches almost 95% of Indonesia's 270 million population in 2020 (Statistics Indonesia 2021). Nevertheless, areas not reached by this program still use subsidized kerosene.

Being natural gas demand high, particularly by the industrial sector, the government encouraged the construction of natural gas transmission and distribution infrastructure and Floating Storage and Regasification Units (RFSU) to meet domestic natural gas demands. Natural gas is also supplied to meet the demands of the land transportation sector and the commercial sector. In addition, the government has also set a policy of not extending natural gas and LNG export contracts that have expired.

Domestic coal consumption by the industrial sector continues to increase due to the very the national coal production which is mostly exported. The implementation of Domestic Market Obligation (DMO) policy since 2009 aims to prevent a shortage of coal supply and ensure the security of domestic coal supply in a sustainable manner.

Box 9 Domestic Market Obligation (DMO)

Regulation of the Minister of Energy and Mineral Resources Number 34 of 2009 concerning Prioritizing the Supply of Mineral and Coal Needs for Domestic Interest. In this framework, each company has an obligation to sell the coal it produces based on the Minimum Percentage of Coal Sales determined by the Minister and stated in the coal sale and purchase agreement between the Coal Mining Business Entity and the coal user. In 2021, the DMO obligation covered the 25% of production per producer where the price of coal for power plants reaches the maximum of US$ 70/ton, as stipulated in the Decree of the Minister of Energy and Mineral Resources No. 255.K/30/MEM/2020.

In general, the price of electricity and fuel is the market price. However, there is still a small part of the fuel that is subsidized by the government, especially for gasoline consumption with Research Octane Number (RON-88 and RON-90) biodiesel B-30 for the Transportation Sector, 3 kg LPG cylinders and kerosene for cooking in Household Sector. Due to these conditions, the consumption of firewood is gradually decreasing since there is a wider access to commercial energy distribution. Households that use firewood are generally located in remote areas where the supply of firewood is easily obtained.

3.1.3.2 Electricity Access

Electricity access to the public is increasing, the electrification ratio has reached 99.45% in 2021, being 67% in 2010. The electrification ratio is the ratio of the number of household customers who have a source of lighting both from the State Electricity Company (PLN) and non-PLN electricity to the number of households. Around 69000 households in 2019 were not having electricity per 73 million households nationwide. These households that are not yet electrified generally live in frontier, remote, and mountainous areas that are difficult to be reached by the PLN electricity distribution network.

National electricity consumption in the timeframe between 2010 and 2021 experienced an average growth of 6% per year from 145 TWh to 275 TWh. The growth in electricity consumption during this period was higher than the national GDP growth with an average electricity elasticity of 1.33%.

In 2021, the share of national electricity consumption was dominated by the household sector which reached 41.75%, followed by the industrial sector (36.21%), the commercial sector (21.93%), and the rest in the transportation sector (0.21%). The pattern of electricity consumption per city can also be described according to the conditions of each city.

There are two pricing mechanisms or tariffs for selling electricity to household, namely subsidized tariffs for all households with 450 watts of power and some households with 900 watts (especially for low-income households), and non-subsidized tariffs for some customers with 900 watts (wealthy household), 1300 watts, 2200 watts, and > 5,500 watts. The electricity tariffs for industrial customers, buildings, and government

buildings are generally set as non-subsidized tariffs. The electricity tariff can be subject to a tariff adjustment every 3 months by referring to 4 macro assumptions, namely the exchange rate, the average price of Indonesian crude oil (Indonesian crude price), and the price of coal supply. The tariff adjustments also take into account the people's purchasing power and the continuity of industrial production and the business sector.

3.2 GHG emissions inventory / Baseline Emission Inventory (BEI)

3.2.1 Principles and requirements for emission accounting

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. It identifies the principal anthropogenic sources of CO_2 (and other GHGs) emissions and prioritises the reduction measures accordingly. In these guidelines, the requirements for emission inventories and reporting outlined in the Common Reporting Framework under the GCoM ([6]) are explained, and advice and recommendations for compiling the BEI and successive monitoring emission inventories (MEIs) under the GCoM are provided.

The BEI will show where the local authority was at the beginning (in its baseline year) of its path towards low carbon development, and the successive MEIs will show the progress towards the target set by the Local Authority. Elaborating these reference emission inventories is of critical importance, as they will be the instrument allowing the LA to measure the impact of its Climate Action Plan (CAP) and adjust it over time. They are also very important elements to maintain the motivation of all parties willing to contribute to the local authority's emissions reduction objective, allowing them to see the results of their efforts.

Box 10 Common Reporting Framework Notation

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”).

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.
- “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.

3.2.1.1 Principles for emission accounting

The emission inventory should conform to the following principles:

– *Relevanc*e: The Emission Inventory data should allow assessing final energy consumption and CO_2 emissions by energy carrier and by activity sector. They should be relevant to the particular situation of the local authority. Signatories are encouraged to prefer local data over national estimates –

([6]) https://www.globalcovenantofmayors.org/our-initiatives/data4cities/common-global-reporting-framework/

whenever relevant and available – as it allows reflecting the efforts made by LAs to reach its CO_2 reduction targets.

- *Flexibility*: The methodology is based on the principles of simplicity of use and flexibility to suit various regional and local situations, and accommodate cities of various sizes and resource, reflecting the specific activities and policy-making needs of the city by taking into account its capacity and regulatory context.
- *Completeness*: The GCoM emission inventories are not meant to be exhaustive GHG inventories but to focus on emissions from final energy consumption in GCoM key sectors. In order to be complete, the emission inventories shall cover all emission sources included in the GCoM framework in these sectors.
- *Availability*: The data should allow building emission inventories until the target year. Therefore, the sources of data used should be available in the future: it is important to identify from the beginning all the data sources, including departments and external stakeholders that will be able to provide data over such a long time period.
- *Accuracy*: Within the limits of possibility, the emission inventories should be accurate, or at least represent a vision of the reality. This requires, in particular, using reliable local activity data and robust methodologies, based on internationally agreed definitions, standards and emission factors, including those presented in this guidebook.
- *Consistency*: The methodology, data sources and emission factors should be in line with GCoM specifications and consistent through the years. When defining the methodology, it is important to ensure a consistent choice of the different options.
- *Documentation*: The data collection process, data sources and methodology for calculating the emission inventory should be well documented, if not in the CAP official document, then at least in the local authorities' records. The methodological choices and the main aggregated results of the emission inventories used to report should be included in the CAP document.

3.2.1.2 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.

Acquiring this sound knowledge may require some initial efforts by the local authority and a close collaboration with local expertise like universities, consultants and NGOs and in some cases external technical assistance. However, it should be stressed that the picture acquired is extremely useful both for the CAP and service delivery planning in the local government. In this respect, the CAP process can be complementary to existing activities and goals, particularly where capacity is constrained.

In the boxes and tables below the key definition and requirements of emission inventories are reported. Further details are available in the CRF document ([7]).

Box 11 Inventory boundary

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

Box 12 Type of emissions to be included in the BEI

Local authorities shall account for emissions of the following gases: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The three main sources of GHG emissions to be potentially included in the emission inventory are:

([7]) Common Reporting Framework. Available at https://www.globalcovenantofmayors.org/our-initiatives/data4cities/common-global-reporting-framework/

- 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 ([8]).
- Non-energy related: 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 ([9]) and fugitive emissions from natural gas distribution systems (such as equipment or pipeline leaks).
- Indirect emissions due to consumption of grid-supplied energy (electricity, heat or cold) within the geographic boundary ([10]). 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).

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. Local authorities shall report GHG emissions from main sectors reported in the following (Table 3).

LAs should also report GHG emissions from Industrial Processes and Product Use (IPPU) ([11]) and Agriculture, Forestry and Other Land Use (AFOLU) sectors where these are significant.

([8]) These are often referred to as Scope 1 emissions in some other commonly used GHG inventory standards

([9]) 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.

([10]) These are often referred to as Scope 2 emissions in some other commonly used GHG inventory standards

([11]) When reporting IPPU, it will include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

Table 3. Emission sources to be included in the emission inventory

Type of emissions	
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 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.
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 analysis from CRF

3.2.2 GHG emissions accounting

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 final energy consumption are calculated for each energy related activity sector, by multiplying the activity data by the emission factor per energy carrier (electricity, heat/cold, fuels).

GHG Emissions = Activity data x Emission factor (Eq.1)

- Activity data quantifies the human 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.

If no measurements are taken, activity data that can be used for calculating GHG emissions is fuel sales data (BBM, LPG, natural gas, coal) supplied by state oil and gas companies and other private business entities to final energy consumers. Meanwhile, electricity consumption according to customers can use City Statistics in Figures ("*Statistik Kota dalam Angka*") as the main reference source or information from the state electricity company. Table 4 shows the step for data collection.

- Emission factors are coefficients which quantify the emissions associated with each unit of activity.

Examples of emission factors are: amount of CO_2 emitted per litre of petrol combusted, amount of CH_4 emitted per tonne of waste sent to landfill. The local authority can either use local emission factors or national emission factor that have been defined by national government (based on the detailed properties of the fuels used) or default global emission, such as the IPCC (2006). Local authorities should use activity-based emission factors (also referred to as IPCC emission factors), though 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 "tonnes 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 CAP implementation period.

Box 13 Emission Factors

Life cycle assessment

A widely used technique defined by ISO 14040 as a "compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle". The results of LCA studies are strongly dependent on the system boundaries within which they are conducted. The technique is intended for relative comparison of two similar means to complete a product. The approach considers the overall life cycle of the fuels/electricity. This includes all emissions of the energy chain that also take place outside the territory (such as transport losses, refinery emissions or energy conversion losses). It is particularly suitable for assessing potential trade-offs between different types of environmental impacts associated with specific policy and management decisions, as it includes the emissions from the whole supply chain and not only from the final combustion. This is of special relevance for biofuels and biomass.

Activity based approach

In the activity-based approach, all the direct GHG emissions or indirect emissions (due to consumption of grid supplied energy) are included. The GHG emissions are directly estimated from the carbon content of the fuel, though a small amount of carbon is un-oxidized (less than 1 %). It is the approach used for the national reporting in the frame of UNFCCC. Most of the GHG emissions are CO_2 emissions, whereas emissions of CH_4 and N_2O are of secondary importance for the combustion processes in the residential and transport sectors.

In order to ensure the consistency of the time-series, the local authorities using national/global EFs shall apply the same emission factors to all inventories (base year and monitoring years), in order to identify 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.

Table 4. Steps of the activity data collection

STEP	ACTION
1	Getting data for municipal/institutional buildings and facilities
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

Source: JRC analysis.

Table 5. Emission factors for Indonesia

Fossil Fuel		EF (tCO_2/TJ)
Oil Fuel	Gasoline RON-88 *)	69.67
	Gasoline RON-90	69.29
	Gasoline RON-92	69.04
	Gasoline RON->95	68.91
	Kerosene	72.43
	ADO CN-48	73.28
	ADO CN-51	72.93
	ADO-CN-53	72.85
	Industrial Diesel Oil	74.52
	Marine Fuel Oil	77.90
	LPG	65.40
Natural Gas	Gas Pipe	57.64
	LNG	57.27
Coal	Low calorie (< 5,100 kcal/kg)	106.48
	Medium calorie	100.58
	High calorie	94.72
	Very high calorie	95.06

Source: Pusat Penelitian dan Pengembangan Lemigas ([12])
Pusat Penelitian dan Pengembangan Tekmira ([13])

([12]) https://www.lemigas.esdm.go.id/web/site/index/id Study results of 2020 for oil fuel, 2017 for natural gas and LPG
([13]) http://www.tekmira.esdm.go.id/ Study results of 2016 for coal

3.3 Prepare the Risk and Vulnerability Assessment (RVA)

The Climate Change Risk and Vulnerability Assessment (RVA) enables local authorities to identify their exposure to current, and future climate hazards, vulnerabilities, potential climate change impacts, and risk as well as understand the main city specificities that contribute to aggravating the consequences of a specific climate hazard.

Similar to the Baseline Emission Inventory, the RVA defines the basis for setting the priorities of adaptation action and investment and monitoring the effectiveness of implemented adaptation measures for a specific region or sector. To this end, an assessment of climate vulnerability and risk has to be undertaken – based on available data - and regularly monitored and evaluated versus a baseline scenario.

Climate change risk and vulnerability assessment had been done in several regions of Indonesia such as Strengthen Climate Resilience of Rural Communities (SPARC) in East Nusa Tenggara (NTT), Vulnerability and Climate Risk Assessment in East Java, Regional Climate Change Adaptation Action Plan (RAD API) in Malang City. For the projection of rainfall, temperature (average, maximum, and minimum), Indonesia had developed modelling which use RCP4.5 and RCP8.5 scenario (Fagih, 2016).

To assess the vulnerability, Indonesia has developed vulnerability assessment tool called Vulnerability Index Data and Information System (SIDIK; http://sidik.menlhk.go.id) which present data and information on vulnerability index up to village level. Therefore, this report uses SIDIK to assess vulnerability and risk.

The following sections include the main concepts around climate risk proposed by the IPCC and the requirements outlined in the GCoM common reporting framework, followed by recommendations on preparing an RVA and potential sources of information.

Box 14 Key regional risks from climate change in Indonesian urban areas

Risk of reduced water supply highly occur in Indonesian urban area. At the same time, the risk of drought is also high in central Java, northern Sumatera, and Nusa Tenggara. Therefore, this condition could threaten urban area that requires constant water supply.

Besides, flood risk is very high in the retention area, coastal urban area, riverbank, such as cities that are located in big river in Java Island; East Sumatera; West, South, and East Sulawesi, and South Papua.

Local change of temperature due to the effect of urban heat island also become the key regional risk in Indonesian urban area specifically in the area with less green space with dense population and built environment.

Source: National Action Plan for Climate Change Adaptation (RAN-API)

3.3.1 Impact of climate change in Indonesia

Decadal variability affects the mean temperature condition in Indonesia. In the last 3 decades (1981-2010), various region in Indonesia has experienced increase in temperature. The level of increase in temperature is varied between region with range between 0.01oC and 0.06oC (MoEF, 2020). The observation of rainfall for the last 30-year showed upward trends of decadal rainfall. Rainfall condition was drier in early 1980s and 1990s due to the impacts of strong and moderate El Nino events, but at the end of 2000s the rainfall condition was wetter due to La Nina which occurred in 2010. There are some regional variances of rainfall trend. In the northern regions, the total rainfall has increased, but decreased in the southern regions. The frequency and intensity of disasters particularly hydro meteorological disasters such as floods, droughts, landslides, also affected by climate change and showing an increasing trend within the past few years (Bappenas, 2021).

Temperature in Indonesia is projected to increase up to 20C by 21002. According to RCP 4.5 scenarios, extreme temperature change (range from 28oC – 30oC) in 2021-2050 will occur in several provinces namely Riau, South Sumatera, Lampung, northern coastal part of Java, West Kalimantan, Central Kalimantan, and Papua1. Annual rainfall is most likely projected to increase for Indonesia on the national level ranging from -1% to +5% by 2100 with large variations per season. During the onset of the dry season (April-June), Indonesia on the national level may experience a rainfall increase of 10% by 2050, whereas during the peak of the dry season (July-September) the rainfall is expected to decrease by 10-25% with peak decreases up to 75% by 2050. Therefore, the lower rainfalls in dry season, which may lead to drought event is expected to occur. The spatial analysis shows indication that in general the future annual rainfall tends to be drier during dry season and wetter during rainy season and transition period (GoI, 2017). The average sea temperature is projected to increase by 0.25oC/decade for the period 2006-2040 under RCP4.5. The rate of sea level rise is projected to increase varies

from 0.6cm/year to more than 1.2 cm/year. Summary of climate change impact projections in Indonesia can be seen in Box 15 below.

Box 15.Climate projection in Indonesia

Temperature: Temperature in Indonesia is projected to increase up to 2oC by 2100.
Rainfall: Lower rainfalls in dry seasons which may lead to drought event, and higher rainfalls in wet seasons which may lead to flood event
Sea temperature: average sea temperature increases by 0.25oC/decade
Sea level rise: sea level rises between 0.6 – 1.2 cm/year
Water salinity level: water salinity level increases by 0.3 ± 0.2 psu/decade

Tidal wave level: tidal wave level increases to <1 m and could reach >1.5 m

Source: Third National Communication, 2017; Updated NDC 2021; Roadmap NDC for climate change adaptation, 2020

Increase in temperature and changing rainfall pattern poses significant risks in water supply and demand for agriculture, households, and other economic activities. Four main priority sectors in Indonesia that affected by climate change are marine and coastal, water, agriculture, and health. In the agriculture sector, changing in temperature and water supply may decrease in commodity production. In the marine and coastal sector, the various risks are abrasion, which may change in coastal slope and bring damage to coastal and marine ecosystem; the marine safety particularly small boats endangered by high waves; and decrease the fisheries production. In the health sector, change in temperature and rainfall increase the number of climate-related diseases cases such as vector-borne diseases (i.e. dengue haemorrhagic fever and malaria), water borne disease (i.e. diarrhoea and leptospirosis) and heat stress particularly in urban area.

Potential economic loss due to negative impact of climate change in four priority sectors in Indonesia can be seen in the table below.

Table 6. Potential economic loss in four priority sectors due to climate change in Indonesia

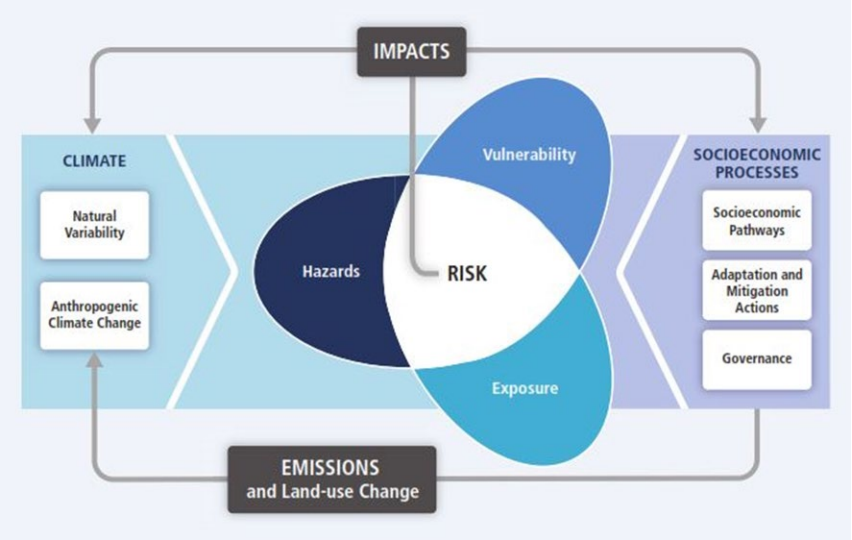
Sector	Year (Trillion IDR)				
	2020	2021	2022	2023	2024
Marine & Coastal	81.30	81.43	81.57	81.69	81.82
Water	3.83	4.74	5.61	6.45	7.29
Agriculture	11.20	13.40	15.59	17.77	19.94
Health	6.03	6.15	6.26	6.37	6.48
Total	102.36	105.72	109.03	112.29	115.53

Source: Climate Resilience Development Policy 2020-2045 (2021)

3.3.2 RVA Main concepts

The fifth Assessment Report of the IPCC (AR5) focuses on the concept of climate risk and proposes a framework for its assessment (Error! Reference source not found.). Risk is defined as a function of the hazards, system vulnerability, and exposure. Vulnerable system with high level of exposure will possess high potential impact. Thus, risk of climate-related impacts resulted from the interaction of climate-related hazards (including hazardous events and trends) with the vulnerability and exposure of human and natural systems (potential impact). Changes in both the climate system (left) and socioeconomic processes - including adaptation and mitigation (right) - are drivers of hazards, exposure, and vulnerability.

Figure 9. Illustration of the core concepts of the WGII AR5



Source: IPCC, 2014 (Field et al. 2014)

Box 16 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.

Impacts: Effects on natural and human systems. In this report, the term impact is used primarily to refer to the effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes. The impacts of climate change on geophysical systems, including floods, droughts, and sea level rise, are a subset of impacts called physical impacts.

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. In this report, the term risk is used primarily to refer to the risks of climate-change impacts.

Adaptation: The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.

Resilience: The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

Maladaptation: Interventions and investments in a specific location or sector that could increase the vulnerability of another location or sector, or increase the vulnerability of the target group to future climate change. Maladaptation arises not only from inadvertent badly planned actions, but also from deliberate decisions focused on short-term benefits ahead of longer-term threats, or that fail to consider the full range of interactions, feedbacks and trade-offs between systems and sectors arising from planned actions.

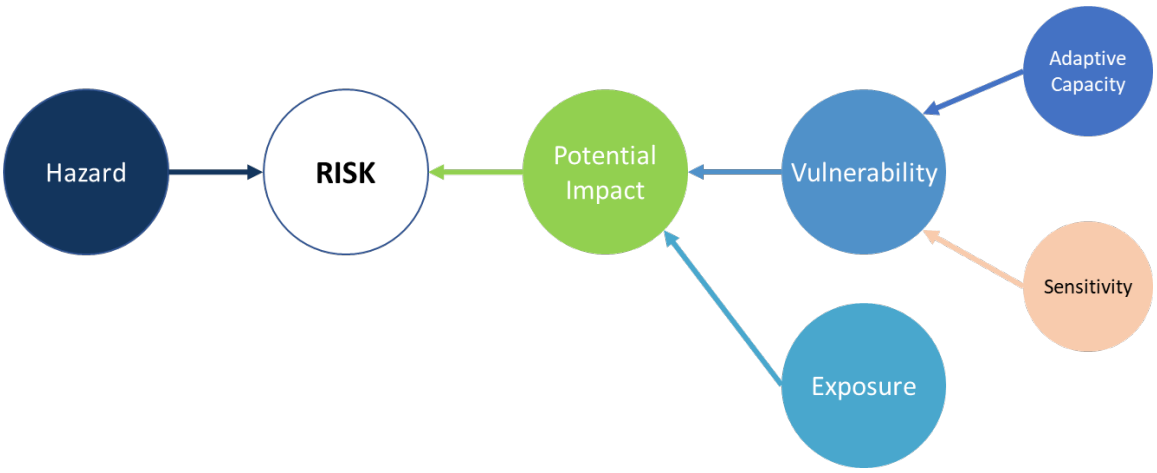
Source: Field et al. 2014

3.3.3 Climate Change Risk and Vulnerability Assessment

A Risk and Vulnerability Assessment (or Risk and Potential Impact Assessment (RPIA)) determines the nature and extent of risk by analysing potential hazards and assessing the potential impact that could pose a potential threat or harm to people, property, livelihoods, and the environment on which they depend. This can take the form of a single assessment or various assessments undertaken per sector.

RVAs / RPIAs are the most commonly used tools for identifying, quantifying, and prioritising key risks of a system to climate change. However, before giving more details on how to prepare an RPIA as well as its indicators and objectives to be included in the CAP, it is worth noting that not all issues that emerge from vulnerability assessments can be addressed, mainly due to budgetary limitations.

Figure 10. Methodological approach of the Risk and Potential Impact of Climate Change Assessment



Source: Authors analysis

Therefore, to identify the optimal level of adaptation, assessing 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 is required. 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 17 Reporting elements of the Risk and Vulnerability Assessment

All signatories shall prepare a RVA/RPIA within two years after committing to the GCoM SEA.

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

Many tools and methods exist for undertaking vulnerability and adaptation assessments, both qualitative and quantitative. 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 7 summarises the strengths and weaknesses of three methodological approaches: indicator-based, model-based, GIS-based, and participatory.

Further details on indicator-based approach are provided in Figure 11, which shows the sequence of steps and main activities for the indicator-based risk and potential impact assessment

Table 7. 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.	Produce measurable output 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. A range of tools for participatory vulnerability assessment exist, including cognitive mapping, interviews, surveys, vulnerability matrices, stakeholder engagement.	Recognise the local or context-specific knowledge that exist 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 included in the process.

Source: JRC Guidebook 113786 (Palermo et al., 2019)

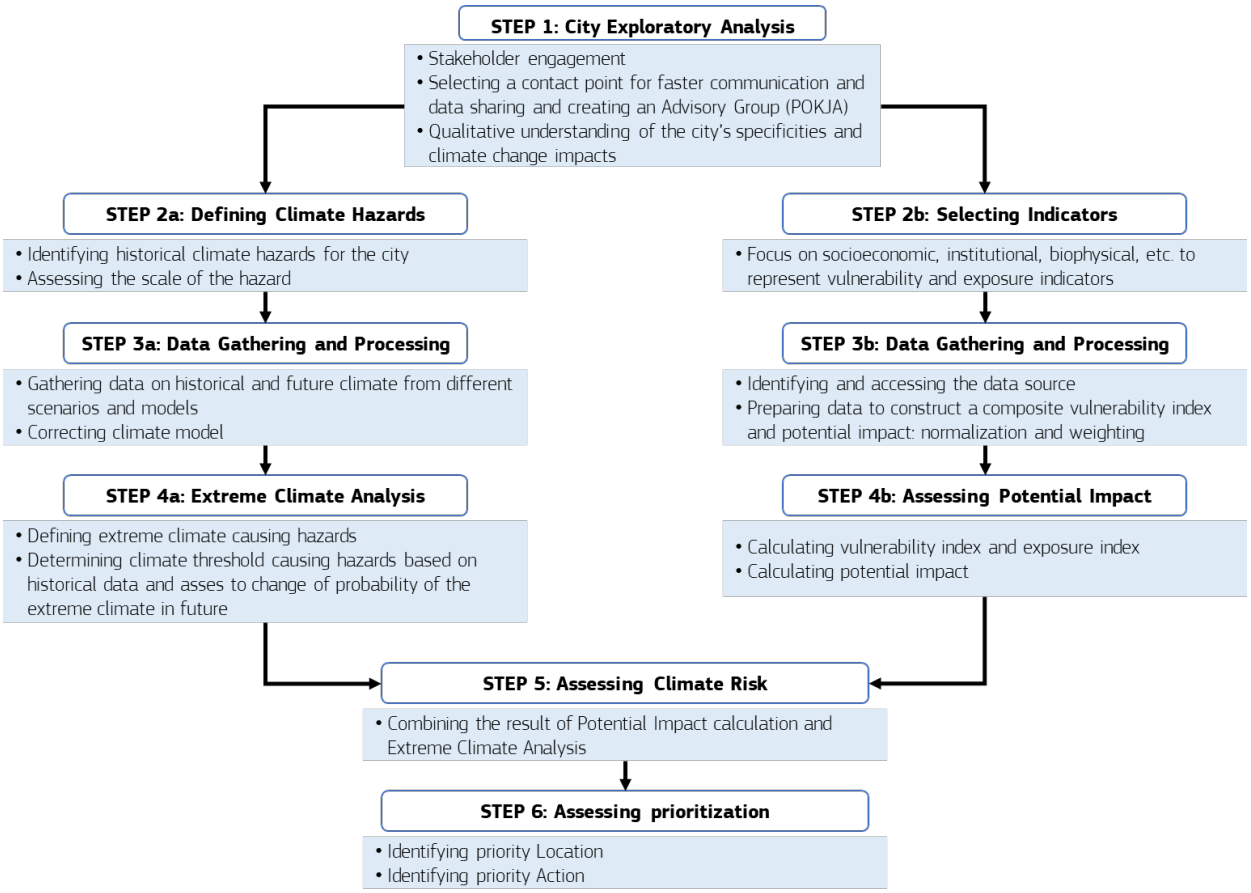
The steps reported in the figure are essential to fill in the Risk and Potential Impact Assessment Reporting Framework Template.

STEP 1: City exploratory analysis. This step includes a kick-off meeting with city stakeholders to contextualize the assessment, understand needs and expectations, identify instances of climate change impacts, select a contact point from the environment or planning department, and clearly explain the RVA approach and the required data. Develop Advisory Group consists of local government agencies, relevant experts from academia, NGOs, and the private sector, to help construct sound and policy-relevant indicators and select the best scale of analysis (e.g., sub-district or village). Input from city decision-makers and local institutions steers the project towards actionable results. The contact point at the local government agencies should be entrusted with facilitating the communication between the parties and fostering data sharing.

STEP 2a: Defining Climate Hazards. This step aims to determine frequent climate hazards in the region. This step includes gathering historical disaster data from governmental institutions such as National Disaster Agency (BNPB), official news, and the internet. Besides collecting historical disaster data, the information on the impact of the disaster on humans or infrastructure is also analysed to determine the scale of the hazard (probability, impact, intensity, and frequency of hazard).

STEP 2b: Selecting indicators. Determination of the potential impact indicators based on the issues and problems in the region. These issues and concerns become the background to identifying collected data that will be used in the potential impact assessment. In the field, these data do not directly represent those problems and issues; thus, other data sources are used to describe the problem more precisely.

Figure 11. The sequence of steps and main activities for the indicator-based risk and potential impact assessment.



Source: Authors analysis

Box 18 Criteria for determining the level of impact	
High	The impact of the disaster caused human death and heavy damage to buildings.
Moderate	The impact of the disaster has not caused human death but gave heavy damage to buildings.
Low	The impact of the disaster has not caused human death and heavy damage to buildings.

STEP 3a: Data Gathering and Processing (climate). Gather data about current and future climate-related impacts from Meteorology, Climatology, and Geophysical Agency (BMKG) and climate-related disaster data sources from National Agency for Disaster Management's (BNPB) Disaster Database (DIBI) and official news.

STEP 3b: Data Gathering and Processing. Extract socioeconomic, institutional, and biophysical data from Statistics Indonesia's (BPS) and local government agencies' (OPD) existing databases (potential village data, Sub-district in figure).

Data processing. Categorised data into sensitivity ([14]) and adaptive capacity indicator (vulnerability indicator) and exposure indicator. Then, the indicators are integrated by assigning weighting values depending on their importance in shaping vulnerability and potential impact. The process includes normalizing the indicator's data so that the index value ranges from 0 to 1.

([14]) Sensitivity refers to internal conditions of the system that represent degree to which a system will respond to a change in climatic conditions.

Box 19 Sources of information for the adaptation pillar in Indonesia

Biophysics and Socio-economic data

Biophysics and socio-economic data represent the exposure, sensitivity, and adaptive capacity condition of the region. The data is obtained from the village potential data (PODES([15])) and sub-district in figure (kecamatan dalam angka) from the Statistics Indonesia (BPS) and related local government agencies (OPD).

Climate data

Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) (http://chg.geog.ucsb.edu/data/chirps/)

CHIRPS is a combination of data from station's observation data and satellite data to create gridded rainfall time series. Indonesia uses CHIRPS data with spatial resolution 0.05° × 0.05° (approximately 5 km).

Climatic Research Unit (CRU) v3.22 (http://www.cru.uea.ac.uk/data)

Temperature data (average, maximum, and minimum) obtained from CRU with spatial resolution 0.5° × 0.5° (approximately 50 km).

Future projection data

The projection of rainfall, temperature (average, maximum, and minimum) data and climate extreme condition follows assessment from Faqih et al. (2016) which use RCP4.5 and RCP8.5 scenarios (Moss et al. 2010). The projection data is corrected by using method from Piani et al. (2010) with scheme and correction process explained in Jadmiko et al. (2017). The period of the projection is divided into 3 periods: 2016-20140, 2046-2070 and 2075-2099 with 1981-2005 as the baseline.

Extreme climate

Extreme climate condition analysed by using two Expert Team on Climate Change Detection and Indices (ETCCDI; Karl et al. 1999; Peterson et al. 2001) to represent extreme rainfall conditions, which are highly related to flood and drought phenomenon. Those two indices are Consecutive Dry Days (CDD) and Maximum consecutive 5-day precipitation (RX5DAY). Consecutive Dry Days could cause drought and longer consecutive dry days will cause higher potential of drought in the region. RX5DAY is defined as daily maximum rainfall within 5 consecutive days in a year. RX5DAY illustrates climate change impact on flood.

Besides those two indexes there are also several climate extreme indices that can be seen in http://www.energy-a.eu/71-climate-extreme-indices-in-1-dataset/

Climate-related disaster data

Climate-related disaster data such as flood, drought, landslide, tornado, forest fire and land fire are from Data and Information of Indonesia's Disaster (DIBI) downloaded from official website of National Disaster Agency (BNPB) http://dibi.bnpb.go.id/. DIBI is the database of disaster information, which consists of the data such as number of people who are injured, bruised, and dead due to disaster; heavily damaged house and infrastructure (health facility, education facility, bridge, factory, and kiosk); damaged road; and damaged crop.

STEP 4a: Extreme Climate Analysis. By utilizing climate data to determine the potential of flood and drought. The potential of the flood is determined by the maximum consecutive 5-day precipitation (RX5DAY), and the potential of drought is determined by the consecutive dry days (CDD). These thresholds could illustrate probability changes of drought and flood potential.

STEP 4b: Assessing Potential Impact. Data is selected to represent exposure, sensitivity, and adaptive capacity level. This data is then calculated and integrated into two indices: the Vulnerability Index (VI) and Exposure Index (EI). VI and EI are directly proportional to potential impact. Those two indices calculate the potential impact level using a matrix system.

STEP 5: Assessing Climate Risk. Combine the potential impact and extreme climate analysis to risk.

STEP 6: Assessing Prioritization. Priority locations are determined by combining the level of climate risk with historical disaster events. High-priority locations are villages at increased risk for potential disaster events, and historically climate disasters have occurred in that location. At the same time, the tagging process carries out

([15]) PODES (Village Potency) – which is published regularly by the Bureau of Statistic every 3 years. Information on PODES publication can be found at: https://www.bps.go.id/publication/2022/03/24/ceab4ec9f942b1a4fdf4cd08/statistik-potensi-desa-indonesia-2021.html

priority actions by looking at the program/ activities that significantly improve regional conditions regarding climate change and the potential impacts that will be experienced.

3.3.4 Indicators

There are no single and unanimously adopted criteria to quantify vulnerability. For example, Eriksen and Kelly (2007) provide an assessment of the different types of vulnerability indicators developed for climate policy assessments and highlight the fact that some approaches emphasize the physical more than the social aspects and vice versa. In Indonesia, indicators used for representing the exposure and vulnerability of villages relate to data released by BPS. Nevertheless, cities/region can also use data available in the respective SKPD agencies (Sectoral offices or '*Dinas*') to replace the village potency data if the data better describes the region's condition.

Table 8. presents indicators used at the national level to represent the exposure and vulnerability of village.

Table 8. Indicators used for representing the exposure, sensitivity, and adaptive capacity from village potency data

I	Indicators representing the level of **exposure** of villages	
1	Topography	Indicates the topography condition of villages (e.g., high altitude/slope, valley, and plateau. Villages located at high altitudes/slopes have a high level of exposure.
2	Population Density	Indicates the number of people who can potentially be affected by a hazard. Villages with higher population density will have a higher level of exposure.
II	Indicators representing the level of **sensitivity** of villages	
1	Source of drinking water	Indicates households' access to drinking water such as piping system (provided by drinking water company PDAM), electric pump, well, spring, rainfall, and others. Households connected through a piping system will be less sensitive than those without. During periods of drought, they can still access drinking water.
2	Poverty	Indicates the ratio between poor households and the population size of the village. Villages with a higher poverty index are more sensitive.
3	Primary Source of Income	Indicates the sensitivity of household income to climate hazards. Villages where the primary source of income is very climate-dependent, such as agriculture, are more sensitive.
4	The primary source of fuel for cooking	Indicates the type of material that is used for cooking by most families in the village.
5	Toilet facilities	Indicates the condition of toilet facilities (own toilet facility, shared toilet facility, public toilet facility, no-toilet facility). Villages in which most households' toilet facilities will have lower sensitivity.
6	Garbage disposal	Indicates the number of garbage disposal systems in the village. A village with fewer garbage disposal units will have higher sensitivity.
III	Indicators representing the **adaptive capacity** of villages	
1	Electricity	Household access to electricity indicates the level of wealth. Wealthier families are assumed to have a higher adaptive capacity.
2	Education facilities	Indicates the ability and capacity of a community to manage the risk. The higher the village's education level, the better their adaptive capacity.
3	Health facilities	Indicates communities' access to health facilities (such as polyclinics, child and health community services, midwives, and medical doctors' clinics). The better the health facilities in a village, the better the adaptive capacity, as this ensures community members have good access to immediate treatments whenever a hazard strike.
4	Health coverage	Indicates the presence of a healthcare system (health insurance)

5	Road Infrastructure	Indicates the primary road surface type, which affects the transportation system's condition and ensures safe and timely aid distribution, evacuation, etc. Villages with asphalt roads have a higher adaptive capacity than villages with gravel or soil road infrastructure.
6	Credit Facility	Indicates the presence of micro-credit facilities (micro-credit etc.) from the government, which affects the community's capacity to conduct economic activities. The village that has micro-credit facilities will have better adaptive capacity.
7	Financial Institution	Indicates the presence of financial facilities such as banks. This entity raises funds from the public in deposits and distributes it to the public to improve the living standard of the people. The village that has more bank systems will have better adaptive capacity.
8	Small-scale and micro industry	Indicates the presence of small-scale or micro industries in the village (e.g., home industries). Villages that have more small-scale industries will have better adaptive capacity.
9	Environment conservation activity	Indicates the presence of environmental conservation activities. Activities in question can be the planting/maintenance of trees on critical land, mangrove planting, etc. Villages that have more conservation activities will have better adaptive capacity.
10	Social activity	Indicates the level of activity of the community in working together (gotong royong) to support other community members in the village. A village with high social activity will have a high adaptive capacity.
11	Institutional	Indicates the presence and activity of extension workers and community-based organizations. Villages with active extension workers and community organizations will have better adaptive capacity.
12	Communication	Indicates the presence and the condition of a communication system in the village (e.g., TV, radio, etc.). A village that has a good communication facility will have a high adaptive capacity.
13	Economic facility and infrastructure	Indicates the presence of economic facilities such as markets, shops, etc. The village that has more market facilities will have a higher adaptive capacity.

Please note that the data selected from PODES for representing the vulnerability indicators is available in more than 80% of the villages.

3.4 Access to energy

Monitoring energy access is a challenging task. Energy Access Indicators are the quantitative and/or qualitative measures derived from a series of observed facts that can reveal a country, community or person's relative status in modern energy access (OECD, 2008). Energy access indicators can be single (one-dimensional), a set of individual non-aggregated indicators (dashboards), or composite (multidimensional). To conduct the assessment on the energy access and poverty pillar a set of global and regional indicators is provided, referring to three interconnected dimensions of Energy Access, namely Security, Sustainability and Affordability ([16]).

Considering the complexity of energy issues and limitation of local authority, local governments can

- Develop the actual Final Energy Supply and Energy Consumption Report. This report contains energy supply by type of energy, energy transformation (power plants, oil refineries, LNG refineries, LPG refineries), final energy consumption, energy prices, distribution patterns, energy tariffs (subsidized and non-subsidized), and energy issues that occurs in urban areas. The report can be used as a material for discussion among the relevant agencies to help them understand the role of energy in the municipality.
- Develop a Sustainable Energy Strategy. This strategy is carried out by coordinating energy planning in accordance with the city's energy vision and setting realistic targets for implementing energy efficiency activities and utilizing renewable energy.
- Develop an Action Plan. An action plan is needed to map out how the target will be achieved and explore technical opportunities to overcome energy poverty in poor households, as well as the necessary policy challenges, funding support, promotion, and implementation of action plans.

3.4.1 Data Management

The pattern of electricity consumption per city can be described according to the conditions of each city. Electricity consumption data per city can be obtained from the PLN Branch or Local Area Statistics (if any), or through the City or Provincial Statistics in Figures ("*Kota or Provinsi Dalam Angka*"). Electricity consumption per sector in these statistics is described according to customer groups, namely households, industry, business, social, government office buildings, and public street lighting.

The city government can also conduct a survey of electricity consumption by type of equipment to determine the level of electricity consumption per equipment and the potential for mitigation. The Ministry of Energy and Mineral Resources (ESDM), as the regulator, has set regulations on Energy Saving Sign Labels. According to this regulation, every electrical equipment sold must include the Sign Label. Currently there are five regulations that have been issued for every electrical equipment circulating in the country, both domestic and imported, including swaballast lamps, air conditions, refrigerators, rice cookers, and fans.

If local data is not available, the survey conducted by CLASP ([17]) can be used. CLASP (non-profit research centre) conducted a survey of 5,443 households in all provinces in Indonesia in both urban and rural area in collaboration with Directorate General of New and Renewable Energy and Energy Conservation, Ministry of Energy and Mineral Resources (MEMR). The survey team interviewed the key person in the household on appliance usage and the average monthly electricity and others fuel bills. Key information gathered in the survey included: ownership and specifications of the appliances, and time and duration of usage.

3.4.1.1 Access to secure energy

Table 9 shows the list of mandatory and not mandatory indicators for the Security attribute (as per GCoM CRF). Insights into data collection process, regionalisation and interpretation of each indicator is provided below.

Percentage of household with access to electricity. The number of electrified households can be obtained from City Statistics in Figures (Kota dalam Angka)([18]) or contacting PLN Branches in the regions. It is possible that there are household customers whose electricity supply is not obtained from the PLN electricity network, but from their own electricity network operated by the Private Power Utility. Customer data needs to be added up

([16]) GCoM Common Reporting Framework on Energy Access and Poverty – available at https://www.globalcovenantofmayors.org/press/the-global-covenant-of-mayors-launches-the-energy-access-and-poverty-pillar-of-the-common-reporting-framework/

([17]) "Compilation of Executive Summaries from Indonesia Rice Cooker, Refrigerator, Lighting, and Fan Market Study and Policy Analysis, and Indonesia Residential End Use Survey, June,8, 2020"

([18]) Bureau of Statistic (BPS) produces every year the City Statistics in Figures. The information can be accessed via the website. For example the Pontianak city: https://pontianakkota.bps.go.id/publication/2021/02/26/4840d52e39dc29f887f50c7a/kota-pontianak-dalam-angka-2021.html

and then divided by the number of households in the city as reported in the City Statistics in Figures to get the percentage of electrified household.

Average duration of available electricity. This data is reflected by total hours in a year (8760 hours) subtracted by average number of hours in a year with no electricity supply. The government plays a very important role in providing a variety of commercial energies so that people's energy needs can be fulfilled. The scarcity of energy supply can practically be overcome because state enterprises responsible for supplying fuel, natural gas, LPG, and electricity always have a Working Team when peak demand occurs, for example Christmas. Scarcity of supply when force majeure occurs can always be overcome because it has various alternative sources of energy supply options.

Average yearly energy consumption per capita. Information on final energy consumption in urban areas includes fuel and electricity consumption. Fuel consumption data can be obtained from fuel suppliers. The main suppliers of fuel oil are State Oil and gas Company (Pertamina) and a small number by business entities appointed by the government to distribute subsidized fuel and other business entities that sell fuel at fuel filling stations. LPG supplier is still Pertamina's monopoly. Natural gas suppliers can be obtained from Pertamina, State Gas Company (PGN) as a natural gas distributor, and other non-Pertamina natural gas producing business entities. Coal consumption data can be obtained directly from coal producers who supply industrial sector consumers. The data on electricity consumption per customer and on population can be obtained from City Statistics in Figures. The various data on sales of fuel and electricity must be collected by the city government through office of the supplier of the fuel located at the city or regional (provincial) level. The fuel supply data in each unit needs to be converted into kWh units by multiplying it by the Net Calorific Value (NCV) of each fuel (TJ/Gg) then the TJ unit is converted into kWh units (note: 1 TJ = 277.7 MWh. Especially for liquid fuel, it needs to be multiplied by the density value of each fuel (kg/m^3).

Estimated share of electricity consumed but not billed. To monitor estimated share of electricity consumed within the municipality but not billed (non-technical losses, illegal connections), City Government needs to coordinate local PLN as PLN regularly conduct inspection on region which is prone to illegal connections.

Average number of electric supply interruptions in a typical month (or year) is reflected by SAIDI (System Average Interruption Duration Index) and SAIFI (System Average Interruption Frequency Index). SAIDI is the duration of interruption multiplied by the number of sustained customer interruptions and divided by the number of customers served (hours / year). SAIFI is the total number of customers interruptions divided by the number of customers served (times/year). SAIDI and SAIFI tend to decrease due to effort of the PLN (State Electricity Companies) to improve electricity supply quality.

Box 20 SAIDI and SAIFI figures

In 2019 there was an increase in the value of SAIDI due to disruptions on the Ungaran and Pemalang 500 kV transmission side, which caused the transfer of electrical energy from the East to the West of Java Island failed and was followed by a generator trip on the central and western sides of Java Island. The level of SAIDI and SAIFI per electricity area differs due to technological factors, network systems, and public awareness to reduce disruption to the electricity distribution network (e.g. planting trees, playing kites near distribution networks). The number of SAIDI and SAIFI outside Java in 2019 is certainly higher than Java, reaching 28.38 hours/year and 18.61 times/year, respectively. However, nationally, the SAIDI and SAIFI figures in 2019 are 18.95 hours/year and 11.51 times/year, respectively ([19]).

Percentage of energy consumption per capita can be obtained based on data on sales of fuel per type of fuel and sales of electricity to consumers. The total consumption of fuel per type and electricity (MWh) is known. Thus, it can be calculated the percentage of energy consumption per capita from electricity, gas, coal, LPG, fuel oil.

([19]) Bureau of Statistic (BPS) at City produce every year the City Statistics in Figures.

Table 9. Global indicators for access to secure energy

Mandatory Global Indicator	Non-mandatory Global Indicators
Percentage of municipality population or households with access to electricity	Estimated share of electricity consumed within the municipality but not billed (non-technical losses, illegal connections)
Average duration of available electricity	Average number of electric supply interruptions in a typical month (or year)
Average yearly energy consumption per capita	Percentage of energy consumption per capita from -electricity -gas -other sources (please list)

Source: GCoM Common Reporting Framework on Energy Access and Poverty ([16])

3.4.1.2 Access to sustainable energy

Indonesia encourages the use of renewable energy in the provision of national energy as regulated in Government Regulation Number 79 of 2014 concerning National Energy Policy. In Government Regulation 79/2014, the energy mix target for 2025 is set to reach 23% of renewable in the total national energy mix. To meet the NRE ([20]) mix target, considered energy sources are hydropower (micro, mini, large), geothermal power, biodiesel, wind power, solar power, and the use of biomass (solid, liquid, gas) for power generation, and biomass for the boiler.

The high utilization of hydropower is due to the potential for national hydropower resources reaching 75 GW while the national geothermal resource potential reaches 24 GW [(21)]. A small portion of hydropower (micro and mini hydro) is used to meet the electricity needs of isolated areas, as well as solar power. All geothermal power plants (PLTP) are connected to the national interconnection network. One of the national policies on renewable energy that has also been enforced at the city level is the provision of a mixture of biodiesel in diesel oil with Cetane Number-48, which reached the 30% in early 2020 (known as B-30). The government has launched the use of the D-100, which is green diesel where its raw material is made from Crude Palm Oil (CPO). In mid-2020, PT Pertamina as the State Oil and Gas Company successfully tested the manufacture of Green Diesel at the Dumai Refinery.

At the city level, the person in charge of data needs to record the renewable energy utilization in the city, e.g. construction of solar power plant (PLTS) rooftops, public street lighting with PLTS source, and construction of ground-mounted PLTS on remote islands, use of biogas from livestock manure and industrial waste. Several city governments in Indonesia have also collaborated with business entities or regional-owned enterprises in the development and operation of micro hydro, landfill gas (Waste Power Plants), waste briquettes, and waste-based incinerator power plants, as well as the utilization of biogas from palm oil mid effluent (POME) and liquid waste from the pineapple and cassava processing industry. Utilization of various renewable energy potentials at the city level will increase energy sustainability while reducing greenhouse gas emissions.

Table 10 shows the list of mandatory and not mandatory indicators for the Sustainability attribute (as per GCoM CRF). Insights into data collection process, regionalisation and interpretation of each indicator is provided below.

Information about the installed capacity of renewable energy within the local boundary can be obtained from the regional planning and development agency (BAPPEDA), the provincial Energy Office, Regional Owned Enterprises (BUMD), regional PLN, private business entities as power plant operators. This data collection is intended to measure the value on installed capacity disaggregated per type of technology power plants (micro hydro, diesel, landfill gas, incinerator) in KW units or installed capacity of briquette plants, or installed capacity of biogas (animal dung, landfill gas).

Furthermore, from the same institutional source, the city government also needs to collect data on electricity production in MWh, briquette production in tons, and biogas production in m^3 from each of these technological

([20]) NRE - New and Renewable Energy (Energi baru dan terbarukan) - Government Regulation 79/2014
([21]) Laporan Hasil Analisis Neraca Energi Nasional 2021, Sekretariat Jenderal Dewan Energi Nasional

activities. This data is needed to find out how much production from renewable energy the activities in the city area use.

Box 21 Primary energy

Renewable energy production (kWh, tons, and m^3) need to be converted into primary energy by converting all production in kWh units and then dividing by the efficiency of each technology. The efficiency of micro hydro power plants can be assumed to be equal to the efficiency of diesel turbine power plants (PLTD) in oscillatory areas or equivalent to the average efficiency of all power plants connected to the electricity grid or assumed to be 100%. Primary energy from briquette production is calculated by converting briquette production in tons into energy (kWh) then divided by the efficiency of briquette technology. Primary energy from biogas production (m^3) is calculated by converting m^3 units to kWh and then divided by the efficiency of the biogas reactor. Primary energy from the production of POME waste electricity and industrial biogas is directly divided by the efficiency of the gas power plant (PLTG). In addition, the city government also needs to calculate how much final energy (fossil fuel or electricity) is consumed by the various renewable energy technologies, if there is a purchase of fossil fuel or electricity from the local electricity grid.

The source mix of thermal energy (heating and cooling) consumed in city (%) is calculated by converting all final energy used by various sectors (industry, transportation, household, commercial, and others), both fossil fuels, renewable energy fuels, and electricity into kWh units. Furthermore, the various final energy consumptions are divided by the total final energy consumption, so that the percentage final energy consumption per sector or per type of final energy is obtained. The data source used to calculate the percentage final energy consumption is the same as the data source when calculating access to secure energy in percentage/capita units above.

Furthermore, from the same data source, all final energy consumption, both fossil fuels and electricity, are converted to primary energy, so that the percentage primary energy consumption per type of energy can be calculated. This calculation is similar to the calculation when calculating the energy mix (primary energy) for energy use sought by the city government. The difference is only in a wider scope, not only primary energy pursued by the city government, but also including primary energy (fossil and renewable) which is sought by the central government for all sectors of energy users (industry, transportation, household, commercial, and industrial). Other). Thus, it can be seen the source mix of thermal energy (heating and cooling) consumed in your city.

Data related to the final energy consumption of the household sector, both fossil fuels and electricity, can be collected from various final energy producers or suppliers as described above. In addition, data related to the use of renewable energy sought by the city government (power generation and biogas) can be collected when calculating the consumption of renewable energy sought by the city government. Additional information that needs to be monitored is the consumption of firewood or rice husks that occur in urban areas. Since statistics on the consumption of firewood and rice husks are not available, local governments may conduct a survey. In case these are neglected or not estimated, access to clean cooking in the city area is generally considered to reach a minimum of 95%, therefore, it will be sufficient to consider data on consumption of fossil fuels (LPG, natural gas, kerosene, livestock biogas, waste briquettes) and electricity (either sought by the city government or purchased from the PLN electricity network).

Energy efficiency activities that can be carried out by the local government include the procurement of efficient electrical equipment by various regional apparatus organizations (OPD), policies on the use of public transport buses rapid transit / light rapid transit / mass rapid transit (BRT / LRT / MRT) and trains. Use of energy-efficient street lights and traffic lights, bicycle lanes, intelligent traffic systems (ITS) or area traffic control systems (ATCS), and the procurement of battery-based electric vehicles (BEV), rejuvenation of public transport, and mandatory emission testing for all vehicles registered in the area of the city.

The activities for utilizing renewable energy include the use of biogas (animal dung, landfill gas, POME, and industrial waste), micro hydro, waste as fuel (incinerator), garbage briquettes, rooftop PV, and PLTS on street lights. These various data can be obtained from BAPPEDA, OPD of the Department of Transportation, OPD of the Department of Environment and Hygiene, BUMD, private institutions in collaboration with the city government, and others.

Table 10. Global indicators for access to sustainable energy

Mandatory Global Indicator	Non-mandatory Global Indicators
Installed capacity of renewable energy within local boundary	Number of local energy efficiency programs
Total energy generated from renewable energy sources within local boundary	Number of local renewable energy programs
Energy consumption from renewable energy sources	
Source mix of thermal energy (heating and cooling) consumed in your city	
Percentage of households within the municipality with access to clean cooking fuels and technologies	

Source: GCoM Common Reporting Framework on Energy Access and Poverty ([16])

3.4.1.3 Access to Affordable energy

Nationally, energy affordability is the affordability of consumers to energy prices. The variation in income according to household category is the basis upon which the government sets the price of LPG and electricity for households which are partially subsidized by the government. The selling price of LPG for 3 kg tube is still subsidized by the government, while the selling prices for LPG 6 kg and 12 kg which are used for cooking in households and restaurants are sold according to market prices.

Some households still use kerosene for cooking, as the implemented conversion program has not covered all the households (See Box 8). This is especially the case in parts of eastern Indonesia (NTT, North Maluku, Papua, and West Papua).

Total PLN electricity customers in 2021 reaches 82,543,980 customers with total household electricity customers reaches 91.72% % of the total PLN electricity customers. Approximately 97.29% of household electricity customers are class R-1 with installed power of 450 watts, 900 watts, 1,300 watts, and 2,200 watts. Remaining are customers class R-2 (2,200 < R-2 < 6,600) about 2.29%, customers class R-3 (> 6,600 watt) about 0.42% ([22]). The R-1 electricity tariff with installed power for all customers with 450 watts and 900 watts (especially lower-income households) are subsidised by the government. Households with an installed power of 900 watts, including well-off households, including R-1 1,300 watts and R-1 2,220 watts, do not receive electricity subsidies from the government. The number of R-1 household customers with a power of 450 watts is around 34.09%, while the number of household customers R-1 of 900 watts, including underprivileged households, is around 10.41% of the total household customers.

Data on population facing energy poverty is not directly available, but data on the low-income households is available in each local government. This data can be obtained at BAPPEDA or OPD Social Service or Health Office. The Central Government has 10 social assistance programs to address welfare and health problems for lower-income families. Data on the number of households and/or the number of residents receiving the social assistance program are available. This information is useful to map low-income households that may face energy poverty. However, this will only cover partially the real number of families that may face energy poverty, despite being under the poverty threshold. Surveys may support local authorities in collecting necessary data.

([22]) Statistik PLN 2021

Box 22 Indonesian social assistance programs

The ten programs include:

- The Smart Indonesia Card for school-age children,
- National Health Insurance,
- Family Hope Program,
- Rastra Social Assistance Program and Non-Cash Food Assistance,
- Poor Handling Program,
- Free Immunization Program,
- Vitamin A Provision Program,
- Deworming Medicine Program,
- The Supplementary Feeding Program for Infants and Pregnant Women, as well as
- The Disease Assistance Program, Social Issues, and Nutrition Monitoring.

Source: President Instruction Number 7/2014: https://peraturan.bpk.go.id/Home/Details/77386/inpres-no-7-tahun-2014

The percentage of households within the municipality experiencing heating or cooling discomfort will differ according to cities located in the lowlands especially near the coast and cities located in mountainous areas. For urban areas in the lowlands, a useful metric can be the number of households using air conditioning. This data is recorded in the National Economic Survey conducted by the Central Statistics Agency (BPS), or may also be available in the Village Potency Statistics (PODES).

Information on clean energy investments at local level going to low and moderate-income households, can be obtained from the BAPPEDA office (Badan perencanaan pembangunan daerah, Local Development Planning Agency), OPD (Local Sectoral Organization or Organisasi Perangkat Daerah) Customary Health Office, OPD Social Service. This data is needed to calculate the percentage of households that receive investment assistance from the local government to the total households in the city.

The selling price of electricity is all set by the central government. However, for city governments that have green electricity activities (rooftop PLTS, ground mounted PLTS, micro hydro, landfill gas generation, PLTG POME (Gas Electricity Generation Plant – Palm Oil Mills Effluents) and PLTG industrial liquid waste) then the electricity tariff can also be set by the city government as long as it does not violate the applicable laws and regulations.

Table 11 Global indicators for access to affordable energy

Mandatory Global Indicator	Non-mandatory Global Indicators
Percentage of households or population within the city boundary that face energy poverty --- Threshold used for energy poverty	Percentage of households within the municipality experiencing heating or cooling discomfort

Source: GCoM Common Reporting Framework on Energy Access and Poverty *([16])*

4 Climate Action Plan (CAP) Process: Setting objectives and targets

Local authorities should establish a long-term vision with clear SMART ([23]) objectives. In the context of energy access, Local Authorities need to create a long-term vision related to secure energy, sustainable energy, and affordable energy. The vision shall be tackled as the guiding principle of the CAP work, pointing out the direction that the municipality 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 CAP work is a systematic approach to gradually get closer to the vision.

The vision should be elaborated with the local communities through citizen participation and discussion groups in order to allow for the unification of all the stakeholders.

Despite the fact that the vision needs to be compatible with the GCoM SEA commitments, it could also be more ambitious than that. Some cities already plan to become carbon neutral in the long run. Setting a longer-term target is considered a key success factor of CAPs as it clearly shows the local authority's political commitment and gives a strong message to citizens and stakeholders on how the local authority wants to develop in the future, paving the way for more substantial investment in sustainable infrastructure. The vision should be realistic but still ambitious and aligned with the national and international policy landscape. It should describe the desired future of the city and be expressed in visual terms.

Once the vision is well established, it is necessary to translate it into more specific objectives and targets, for the different sectors in which the local authority intends to take action. Such targets and objectives should follow the principles of the SMART acronym: Specific, Measurable, Achievable, Realistic, and Time-bound. The concept of SMART objectives became popular in the 1980s as an efficient management concept. To set SMART targets, use the following questions:

Specific (well-defined, focused, detailed and concrete): What are we trying to do? Why is this important? Who is going to do what? When do we need it done? How are we going to do it?

Measurable (kWh, time, money, %, etc.): How will we know when this objective has been achieved? How can we make the relevant measurements?

Achievable (feasible, actionable): Is this possible? Can we get it done within the timeframe? Do we understand the constraints and risk factors? Has this been done (successfully) before?

Realistic (in the context of the resources that can be made available): Do we currently have the resources required to achieve this objective? If not, can we secure extra resources? Do we need to reprioritise the allocation of time, budget and human resources to make this happen?

Time-Bound (defined deadline or schedule): When will this objective be accomplished? Is the deadline unambiguous? Is the deadline achievable and realistic?

([23]) The principles of the SMART acronym: Specific, Measurable, Achievable, Realistic, and Time-bound.

4.1 Mitigations Target Setting

Once the vision is well established, it is necessary to translate it into more specific objectives and targets. With regards to mitigation, all GCoM 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:

- Boundary (geographic coverage, sectors, and GHGs):

The 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. In case that the target boundary does not align with the inventory boundary, any additions or exclusions shall be specified and justified. In this case, all fuel sales in one city are assumed to be consumed by fuel consumers in that city, even though there are motorized vehicles from outside the city that buy fuel at gas stations in that city. This also applies to the opposite, so there is no need for a special study of fuel buyers from outside the city.

- Target type:

Local governments shall use baseline scenario target. 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 different from the NDC (e.g. due to a lack of data availability), this shall be justified. Different base year (Depok, Malang, Palembang: 2016, Denpasar: 2018, Makassar: 2010). In practice, base year in other cities will also be determined according to availability of data. To solve the problem of data incompleteness, *backcasting* method can be used or by considering the main parameters of each activity data.

- 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. However, the target setting must be accurate, so that the target can be achieved as much as possible.

- 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 $CO_{2\text{-eq}}$ 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. The target conditional is very much determined by the capacity of each region which is reflected in the historical performance, city policies, and national policies of the sector in implementing mitigation actions in certain sectors.

Box 23 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

Box 24 Mitigations Target Setting in Indonesia

Indonesia uses emission reduction targets with baseline emission target scenario.

Baseline year is suggested to be 2010, for availability of data and for accounting in the plan the efforts already put in place.

Box 25 MSW collection case.

As it is known, MSW of DKI Jakarta is discharged to Bantar Gebang SWDS which is located in Bekasi City, West Java Province. By system, DKI's waste GHG inventory will be calculated and reported by West Java Provincial Government. However, if the methane produced by Bantar Gebang SWDS is used as a mitigation action, for example PLTG landfill gas, then GHG mitigation will be recognized by DKI Jakarta Provincial Government. This occurs because the cost of mitigation action is the cost of DKI Jakarta Provincial Government and the SWDS land is owned by DKI Jakarta provincial government as well. This kind of condition similar to Bantar Gebang SWDS is also likely to occur in other cities.

However, in general, the emission reduction target follows the regional policies that have been and are being developed, the applicable national policies, and various possible technical considerations. In the National Energy Policy as regulated in Government Regulation Number 79 of 2014 states the potential for a reduction in energy efficiency of 1%. This shows that if the base year is 2010, the potential for emission reduction due to the use of efficient technology will be 20% of the baseline in 2030. As an illustration, in Indonesia's Nationally Determined Contribution document, it states that Indonesia will reduce the GHG emission by 29% on its own effort and by 41% with international supports. The total GHG mitigation targets include GHG mitigation targets in the energy sector.

As known, the GHG mitigation program that potentially occur in the city must be in line with the program activities planned in the Regional Development Plan and the Regional Spatial Plan. Mitigation activities can refer to regional planning documents and use nomenclature in the RPJMN, RPJMD, and RKP / RKPD. The mitigation action plan is expected to be integrated across sectors. Several policies are framing the formulation of climate change mitigation targets and actions (see Box 7).

4.2 Setting adaptation goals

At the national level, Indonesia's climate change adaptation goal is to reduce risks, enhance adaptive capacity, strengthen resilience, and reduce vulnerability to climate change in all development sectors ([24]). Climate change in Indonesia could negatively affect the basic life necessities (energy, food, health, and water) which equal to risk of loss around 0.66% - 3.45% of national GDP with average around 2.87% of national GDP by 2030 (MoEF 2020). Therefore, adaptation actions to achieve the adaptation goal are highly needed because potential

([24]) GoI, Government of Indonesia. 2021. Updated Nationally Determined Contribution Republic of Indonesia. Available at https://unfccc.int/sites/default/files/NDC/2022-06/Updated%20NDC%20Indonesia%202021%20-%20corrected%20version.pdf

economic losses due to climate change impact can be reduced through well-planned climate change adaptation actions ([25]).

Adaptation planning in Indonesia aims to reduce the risk of loss around 2.87% of national GDP by building resilience and increasing adaptive capacity. Three focus areas of resilience in Indonesia are economic, social & livelihood, and ecosystem & landscape. Moreover, without adaptation effort the GDP loss could reach IDR 24.43 thousand trillion, while implementation of adaptation effort could avoid GDP loss to IDR 24.49 thousand trillion in 2024. There are also several planned scenario and effort of climate change adaptation in Indonesia that will bring benefits such as reduce potential economic losses by 50.51% in 2024, protect water resources, avoid dengue fever cases due to climate change, avoid ship accident, protect fisheries production, maintain rice production, and protect residential areas in the coastal area (Table 12).

Table 12. target from the implementation of adaptation actions

Sector	Target
Economic	Reduce potential economic losses due to climate hazards by 50.51% in 2024.
Water	Protect at least 269.2 trillion m^3 water resource
Health	Avoid as many as 350828 cases of Dengue Fever due to climate change in 2024
Marine	Avoid as many as 43477 ship accident in all categories of ships
Fisheries	Save 1697.8 tons of capture fisheries production in 2024
Agriculture	Maintain production as much as 8,406.4 million tons
Coastal	Protect 413,209 ha of residential areas in the coastal area

Source: National Adaptation Plan Executive Summary 2019

At the regional or city level, local government should set climate change adaptation goal aligned with the national adaptation goal. Adaptation has also to be mainstreamed within urban development and urban governance. One way to set adaptation goals is to integrate adaptation into the everyday functioning of sectors so that their efforts are protected against the negative impacts of climate change. While this concept of 'mainstreaming' is not new, it is not taking place at the scale that is required. In some instances, adaptation is integrated into the policies and planning documents, but not implemented in action. Evidence-based research on what can enable implementation can help accelerate the uptake of mainstreaming. For example, local government could plan to implement adaptation actions that could reduce number of highly vulnerable villages/sub-districts by 50% in 2024. Each area in the villages/sub-districts contribute to certain percentage of GDP. Eventually, by reducing the vulnerability level, the potential loss of GDP could also be reduced.

Poor community in urban area needs special attention as they are one of the vulnerable groups to the impact of climate change. The climate action needs to be planned carefully so that it could give direct impact not only to climate change adaptation but also to poor community to prevent vulnerability and inequality. Government of Indonesia's policy and national program in several sectors focused on urban poor community such as adaptation action in water and sanitation, agriculture, and health. Therefore, planning and implementation of adaptation action needs to target to increase the adaptive capacity of poor community. The focus is not only giving solution for poor community to increase the adaptive capacity but also to transform them to face climate risk in the future. Five priority areas that are beneficial for poor people needs several supporting factors as a framework to strengthen resiliency of poor community. The interventions are in five priority areas namely social protection, health system, livelihood, settlement, and infrastructure are very important to secure and protect resiliency of urban poor community in Indonesia ([26]).

([25]) Bappenas, National Development Planning Agency. 2019. Available at http://lcdi-indonesia.id/wp-content/uploads/2020/05/Executive-Summary-NAP.pdf

([26]) National Adaptation Plan Executive Summary 2019 (Ministry of National Development Planning/Bappenas 2021

Box 26 Example of target in the water sector

Adaptation goal / target in water sector: % of households with safe drinking water

Local government could set the share of households with safe drinking water as one of their indicator targets (adaptation goal) in water sector. For example, from vulnerability analysis it is found that access of safe drinking water one of the factors causing city vulnerability as poor communities still rely on ground water (wells). Groundwater is very prone to flood as it could get contaminated, and the household will not have safe drinking water. The adaptation goal could be set to increase the percentage of households with safe drinking water by improving clean water processing facility and expanding water pipe system to flood prone area.

4.3 Setting the targets for energy access

Under the GCoM framework, the local authorities commit to improving the access to energy and reduce the level of energy poverty within the area of their responsibility. The set of global and regional energy access and poverty indicators developed by the GCoM serves as a foundation for the development of an energy access and poverty assessment. Indicators are determinants, along with the assessment of the current status, to allow to monitor the progresses of energy access and energy poverty related actions. On the basis of the indicators and requirement previously described, LAs can choose and declare their energy access and energy poverty goal. The Common Reporting Framework update on this third pillar under publication provides further description and guidance over requirements for setting an energy access and poverty goal. This approach enables to keep a high level of flexibility which supports the consideration of local circumstances. 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. The following box reports the SDG7 main goal and targets.

Box 27 Sustainable Development Goal 7 (SDG7)

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

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

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

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

— 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

— 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).

Increasing access to clean energy by the city government can be implemented according to their authority, for example, public street lighting using PLTS, PLTS rooftop, utilization of methane gas due to landfilling, and others. National policies on access to clean energy are under the authority of the central government and should be supported and endorsed by the city government, for example the kerosene substitution program with LPG, increasing the mix of biodiesel in diesel, and others.

5 Climate Action Plan (CAP) process: elaboration of the plan

Plan elaboration – that is, breaking the target down into actions the local authority will undertake in the sectors addressed – serves several functions as well as translating the city's vision into practical actions assigning deadlines and a budget for each of them. It outlines what the city will look like in the future in terms of energy, mobility, resilience infrastructure and land use, population, consumption patterns and climate projections while also communicating the plan to stakeholders. In addition to generating a roadmap of specific, scheduled, budgeted actions, roles and responsibilities, CAP serves as a reference during implementation and monitoring.

The following characteristics may be useful to develop sound CAP actions:

- Measurable: Design actions based on the indicators used for the BEI and the RVA.
- Thorough: Elucidate actions in depth to get a clear and realistic sense of requirements and results (resources, budget, timeframe, policy integration, etc.). All actions adopted in the CAP should be carefully designed and properly described, including timing, budget, responsibilities and sources of financing.
- Realistic: Assess action implementation requirements against available capacity and resources.
- Appropriate: Actions depend on the specific context of each local authority and the quality of the assessment of the existing local, regional and national policy framework.

For each action explored, consider also where chief responsibility lies (whether or not they are addressed by the local administration and/or require coordination with higher or national authorities), what instruments will be used (regulation, financial support, communication and information, demonstration, etc.) and the impact on energy production and consumption patterns (energy efficiency of equipment, buildings, cars; behavioural change such as turning off lights, using public transportation; cleaner energy such as renewable energies, biofuels) and or vulnerable sectors.

More specifically, for each action included in the action plan, the local government should provide the following:

- Brief description of the action/action area/sector
- Assessment of energy saving, renewable energy production, and GHG emissions reduction by action, action area or sector (only applicable to mitigation actions).
- Financial strategy for implementing the action/action area/sector
- Implementation status, cost and timeframe
- Implementing agency(ies)
- Stakeholders involved in planning and implementation
- Prioritization of actions
- Policy instrument(s) to implement the actions

Most local authority activity concerns buildings and transport, the use of renewable energy sources to produce energy locally, urban and land-use policies, and public procurement. In most countries, however, these policies are decided at regional and national levels and local authorities are not always part of the decision-making. In assessing existing policies, concentrate on the local authorities' capacity to go beyond national policies in the territory under their responsibility and to ensure resources and financing for the proposed actions.

Box 28 CAP actions: best practices

- Catalogue existing activity/policy; Analyse best practices;
- Set priorities based on the results of pre-assessment;
- Carry out risk analysis;
- Specify timing, responsibilities, budget and financing;
- Seek approval and funding;
- Review/Update and communicate CAP regularly.

5.1 Modes of governance

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 as well as of adaptive capacity. This understanding provides a basis upon which political leadership instigates 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 mobilize action for local energy generation investments through several approaches, including the four modes of urban climate governance, described by Kern and Alber (2009):

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

The modes of urban energy and climate governance are relevant for both mitigation and adaptation policies and measures. Common policy instruments framed within GCoM have been linked to the four modes of urban governance to highlight the role of local authorities in achieving the climate and energy targets and to address common barriers (Palermo et al. 2020). Individual measures are often based on a combination of several modes, as it is often necessary to combine multiple modes of governance to reinforce and align methods for specific objectives.

5.2 Actions with co-benefits

The benefits of policies that are implemented for various reasons at the same time are numerous. Most including climate change mitigation 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).

Immediate needs (such as high levels of unemployment, poverty, high crime rates, and infrastructural backlogs) compete with climate change for political attention and resources, so any action must have development co-benefits.

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 in the mandatory and non-mandatory sectors on one hand and to enhance climate vulnerability and risk reduction on the other hand.

5.3 Transversal actions: Information and awareness raising measures

Public awareness and social engaging play a pivotal role for successful climate action. Measures to induce behaviour change and increase awareness significantly contribute to reducing energy consumption through social and non-technological approaches that must be included in policies that support energy efficiency and energy savings. Moreover, awareness raising on climate change impacts, adaptation, reaction to extreme events allows increasing community's acceptance of climate strategies and plans, as well as inducing increasing resilience over time.

The most common tools on which these measures may rely include:

- web based platforms, whose popularity is growing;
- mass info campaigns: In general, the scope and messages to be communicated are extremely varied. There is a need to tailor-made targeted messages for specific audiences. However, they must target specific areas of society, and the message need to be repeated to be effective
- based on active communication on-line tools: to calculate CO_2 reduction or energy savings estimations.
- database containing examples of energy efficiency applications: illustrated examples of energy renovated houses, energy efficient expert list. These kinds of measures targeting users with previous knowledge on the topic may be very effective.

- energy days, dedicated moments and spots to specific topics enable to raise the attention of public on themes that may be daily neglected (helpdesk and info points).
- "Training measures" may have a great impact on community since they target more enthusiastic or empathic audience (students, energy related workers). However, these measures are not very common, because they are more difficult to set and organize, requiring specific skills. Three most common training measures are:
    - General training to adults, targeting sectors or general ones
    - Education and awareness raising at schools
    - Ecodriving, general (adults, students) or professional (drivers, energy related workers) ones.

The effectiveness of information campaign relies mostly on the effectiveness of delivered messages. They must be simple, adequate to the targeted group, easy to understand and inspiring. Three main aspects need to be considered (Barr et al., 2005):

a) Emotions and rational arguments: Emotions are a very appropriate way to raise awareness. Once the target group is aware of the problem (e.g. motorised transport) and also of their own role, it makes sense to provide also rational arguments that support a change of behaviour.

b) Tone: pessimistic and catastrophic messages are not translated in a positive behavioural change. Experience shows that the message needs to be funny and must engage the audience. It needs to be tailored, positive and based on principles of cooperation and self-responsibility. The main pillars of this type of communication are: information, consultation, cooperation and self-responsibility. Moreover, the message must clearly reach the audience, so it might have to be disseminated in local languages.

c) Feasibility: Maybe the most important aspect to be addressed to ensure the effectiveness of measures. Citizens need to be informed and motivated, but they absolutely need to be able to adopt the measures. The role of the authorities is to provide opportunities for feasible actions. It should also be considered that only reliable information can enable the implementation of effective solutions.

Box 29 summarises key considerations for developing awareness raising actions. There is still a lack of knowledge among end-consumers of the existing economic and health potential associated with energy savings and solutions available. Furthermore, the low level of knowledge is not due to the inadequacy of available information. On the contrary, it depends on the way the information is provided. The social approach may drive information and awareness measures for changing the energy behaviour towards sustainable practices. Improvements are still necessary: people need to be inspired, to be engaged, to have fun when receiving the message. This must be carefully selected and keep as simple as possible.

Box 29 Overall recommendations on public awareness

City planners should consider:

- To emphasize energy use/Climate Change as a real, actual local and personal risk
- To facilitate more affective and experiential engagement (personal stories)
- To leverage relevant social group norms
- To frame policy solutions on what can be gained from immediate action
- To appeal to intrinsically valued long-term goals and outcomes

5.4 Elaboration of the plan: Mitigation actions

Mitigation actions aim at curbing carbon emissions. In the following chapters definitions, descriptions, and solutions for mitigation are reported per sectors in alignment with the CRF structure. 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 the GCoM SEA. Cities play a key role in achieving national energy sector mitigation targets. Local authorities can serve as spearheads for implementing top-down policies from the central government and ensuring national mandates are carried out. City governments can design solutions for climate change that are tailored to local needs and consistent with local policy priorities. The central government has introduced various policy and financial mechanisms to help achieve GHG mitigation targets, such as tax reductions, carbon taxes, and has enacted a Presidential Regulation on Carbon Economic Value whose derivative regulations are being finalized by the Ministry of Environment and Forestry. As a consequence, one of the key tasks of local government is policy support so that will ensure the implementation of national policies can be carried out at the city level. Moreover, everyone has a role to take. It is the responsibility of leaders in all areas of government, commerce, industry and civil society to promote action towards more efficient use of energy and renewable energy.

5.4.1 Buildings

The reduction of final energy consumption in the building sector contributes to Climate Change mitigation and to reduce the dependence on fossil energy sources.

First and foremost, the local authority itself assumes an exemplary role in the implementation of these actions. Committing to highly efficient buildings in their own facilities is a way local authorities can reduce emissions and lead by example, showing the community how to deal with the issue and results achieved. Public buildings do represent a field where large reductions in energy consumption can be achieved. By developing energy efficiency projects in their buildings, local authorities set an example to the local community, inspiring citizens to adopt sustainable and low-carbon practice.

Globally residential buildings show the highest energy consumption due to their predominance in terms of both number of buildings and surface area.

To achieve the carbon reduction goals, local authorities must work with national and regional/provincial governments, as well as with other stakeholders (e.g. building owners, energy utilities, energy service traders and banks) and design specific measures in the action plan that are also able to remove and addresses the main common barriers in the building sector. These may include: regulatory and institutional barriers, financial challenges, market inefficiencies, and, lastly, the lack of knowledge and know-how.

All the processes that are involved in the energy efficiency of buildings, from the design and the construction, to the renovation and operation, recognize the provision of healthy and comfortable environments to its occupants as the main purpose of any buildings. The 'sustainable comfort' can be defined as achieving good comfort conditions with no or limited use of resource energy and through the use of environmentally non-harmful materials. Local authorities can support the reduction of emissions in the building sectors through provision and regulations.

Box 30 Green Building regulation in Jakarta

The Governor Regulation of DKI Jakarta No. 38/2012 on Green Buildings regulates the planning, construction, utilization, maintenance, and deconstruction of buildings in Jakarta. It focuses on energy efficiency, water efficiency, indoor air quality, waste and soil treatment, and construction activities. It has been the first Green Building Code in Indonesia. Since 2012, the code has undergone numerous changes, including the extension to all sizes and types of buildings and incentives for private sector (i.e. property tax reduction or increase in gross floor area). Building on the positive impacts achieved, Jakarta has set up an ambitious target to become a Centre of Excellence in Green Building practices, embracing a new paradigm: “Green Building Grand Design”, as a blueprint for Green Building policy implementation until 2030. With the new implementation, it is estimated that almost 80% of energy compared to BaU scenario is saved.

Source: https://www.iea.org/policies/844-jakarta-regulation-no-382012-on-green-buildings

Presentation: “Jakarta Green Building Grand Design and the First GB Code Revision A Strategy to achieve 30:30 Commitment Target”, "Innovative solutions to meet green building trends”, Jakarta, October 12 2018

In Box 31 ten steps are suggested to improve the energy efficiency of buildings, which implies also adopting measures on both thermal and electric energy (e.g. through reducing the wall transmittance in the former and using efficient appliances in the latter). This approach leaves ample freedom to designers while supporting them in adopting solutions that also take into consideration local specificities of climate, culture, locally available materials.

Box 31 Ten steps for energy efficiency improvement

[1] Define explicitly the building objectives, with particular focus on the thermal comfort.
[2] Assess the microclimatic factors and intervene on the site layout and features which can affect the comfort indoor.
[3] Control the heat gains at the external surface of the building envelope.
[4] Control and modulate heat transfer through the building envelope.
[5] Control the internal gains from appliances and lighting.
[6] Allow for local and individual adaptation.
[7] Use passive means and strategies to deliver and remove thermal energy to/from the building.
[8] Use HVAC systems assisted by natural (and renewable) energy sources.
[9] Use high efficiency active conventional heating and cooling plants, if still necessary.
[10] Train building managers and occupants on how to use, monitor the performance of and adequately operate and maintain the building.

The first two points refer to the comfort requirements and the multiple interactions between indoor and outdoor environments. Steps 3 and 4 include all technologies and strategies associated with the building envelope from which the net thermal energy needs for heating and cooling depend. Steps 5 and 6 have to do with the way a building is used and occupied. Points 7, 8 and 9 provide sustainable approach to reach low levels of delivered (or final) energy consumption implementing appropriate system solutions. The last step includes all strategies needed to verify and adapt the building performance during the real-life operation.

5.4.1.1 Efficient buildings

There are different strategies, which, if used correctly and integrated with each other, allow considerable energy savings in the building sector. Among these, the most common ones aimed at increasing the energy performance of buildings, both for new construction and renewal, include the design of building envelope, the choice of the components and the control strategy of HVAC systems the implementation of renewables in building energy supply

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.

- Gains and losses of energy through windows are four to five times higher than the rest of the surfaces. Both daylight provision and gaining or protecting from solar radiation penetration must be taken into account in the choice of appropriate glazing. New technologies with decreased values of transmittance for glazing are available.
- Either internal or external thermal insulation of walls reduces their transmittance values according to specific needs and location of the buildings. Commonly-used types of insulation in building construction include: Fibreglass, Polyurethane foam, Polystyrene foam, Cellulose insulation and Rock wool. These materials also contribute to reduce the effect of thermal bridge and to improve sound insulation and thermal inertia.
- The abatement of cooling loads is achieved by reducing solar radiation penetration through the use of shading devices. These comprise: movable devices which can be controlled either manually or automatically; internal and external blinds which help control lighting level and uniformity, and allow stopping solar radiation before penetrating into the room when arranged externally.
- An increased energy performance of buildings is achievable by operating on the heating system. The overall efficiency of the space heating system includes the efficiency of the generator and the losses of distribution, emission and inaccurate control systems.

5.4.1.2 Building Energy Management Systems (BEMS)

The implementation of an energy management system requires to an organization of any kind to follow a series of pre-defined steps, which typically include establishing an energy policy, assigning responsibilities within the organization, identifying main energy users, setting measurable goals and targets, implementing actions to meet these goals, checking for success of actions, and a continuous review of the system.

Building energy management systems (BEMS) are computer-based control systems generally applied to the control of systems such as heating, ventilation, and air-conditioning (HVAC). BEMS use software to control energy-consuming equipment or the full buildings' energy consumption, and can monitor and report on the buildings' performance, allow for dedicated controls and energy sub-metering by the individualization of energy flows by energy carrier and the type of use or equipment.

BEMS are generally composed by:

- Controllers, sensors (temperature, humidity, luminance, presence…) and actuators (valves, switches…) for different types of parameters distributed in various zones of the buildings;
- HVAC central system with local controllers for each area or room in the building (zoning) and central computer assisted control;
- Central control hardware and software (with general control, monitoring functions) Monitoring through energy consumption measurement devices

With the advent of the smartphone and the massification of personal computers all over the world, being connected to the internet has passed from a work-related need to an almost basic need. This has allowed for the development of the "smart" ecosystem, especially within the residential market. With the roll-out of smart meters, an increasing development of smart grid projects, a growing Demand Response market and the access to fast internet, has potentiated the development of the Home Energy Management Systems.

The most important feature of Building/Home management systems is probably the ease of access of information that is being delivered to the final energy consumer or the energy managers within organizations, giving them an actual tool to act upon this information and potentiate energy savings in the long run.

5.4.1.3 Lighting and appliances

The replacement of lamps and appliances with more efficient ones (lower consumption with the same performance) is a common and easy to implement measure. Moreover, correcting the misuse of the lighting appliances shows to be a significant contribution in the saving options. In this perspective, the systems that can control and modulate the light sources (presence detectors, brightness sensors, dimmers, lighting systems) have a large impact on total lighting energy use.

The lighting influence on energy consumption varies according to the types of buildings. In particular, tertiary buildings and offices show the highest energy consumption due to lighting and, hence, may be the target where implement saving strategies to yield more efficient results. On the contrary, lighting in residential buildings have a lower impact on the overall energy consumption.

Indonesia is improving the efficiency of its equipment and appliances through energy efficiency standards and labels, market-based programs including bulk procurement models, and for the manufacture of efficient appliances. Several regulations regarding the production and import of electrical equipment that can be supplied to meet domestic needs and are affixed with standards and labels are self-ballasted lamps, fans, air conditions, refrigerators, rice cookers. Various other household electrical appliances such as irons, televisions, washing machines, water pumps, exhaust fans, LED lights, blenders, vacuum cleaners, microwave ovens, toasters, electric stoves, electric kettles, and others will follow. Electrical equipment that has been labelled and standard is affixed with an asterisk between 1 to 5 stars. Electrical equipment that has a 5 stars label is the most efficient electrical equipment. The labelling and standards for electrical equipment refer to the Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia Number 14 of 2021 concerning Minimum Energy Performance Standards for Energy Utilization Equipment. The determination of labels and standards for electrical equipment is in accordance with the agreement between the Ministry of Energy and Mineral Resources and the production party of electrical equipment. Furthermore, gradually, the regulation of electrical equipment related to labels and standards will be revised in accordance with the production capabilities of the national industry.

The city government, in accordance with its authority, can instruct the use of electrical equipment that has regulated labels and standards for buildings (commercial, household, and industrial). Even the city government can require that all OPDs who wish to provide electrical equipment must be efficient electrical equipment whose energy-saving marking label is more than one star. For this reason, the city government needs to regulate the procurement mechanism in the APBD.

5.4.1.4 Energy Audits and measurements

An energy audit is defined as a systematic inspection of energy use and energy consumption of a site, building, system or organisation with the objectives of establishing energy flows, identifying the potential for energy efficiency improvements and reporting them to the energy user.

The purpose of energy audits is to perform an analysis of energy flows in buildings or processes that allows understanding how efficient the use of energy is. In addition, it should propose corrective measures in those areas with poor energy performance. Energy audits are generally carried out in public and tertiary buildings in order to understand the current state of the energy consumptions and implement methods and actions to improve the overall energy performance of building (including behaviour issues and appliances). The characteristics of the building or equipment to be audited, as well as the energy consumption and performance data, are collected by means of surveys, measurements or energy consumption bills provided by utilities and operators or simulations performed, using validated software. As measurement and data acquisition are an important issue in energy-efficiency projects, the way to do it has to be planned in advance.

Some benefits arising from the realisation of energy audits may include the identification of the greatest opportunities for energy savings, thus offering the opportunity to reduce the energy costs of buildings and organizations, improving profitability and investment capacity. Energy audits also can identify potentials for improvement in business and production processes and, thereby, contribute to improved productivity, help organizations reduce the environmental impact of their activities and project a positive image to costumers and the wider community.

5.4.1.5 Other measures in buildings

Other simple measures may contribute to the reduction of energy consumption in buildings and in configuring sustainable buildings simultaneously. Some of the policies described below may need to be supported by specific political strategies adopted by the local authorities.

Behaviour and building management: adequate behaviour of building occupants may also generate significant savings. Information and motivation campaigns could be organised in order to get support of the occupants. In such cases, it is important that a good example is also given by the hierarchy and by the authorities in charge of the building management. There are numerous social approaches that may help in achieving a behaviour change: Sharing the savings between occupants and the local authority; cooperating to reach a common environmental goal (families in the same building can work together); competitive approaches provide motivation among occupants especially if publicly recognised. Publicly displaying the energy certificate of the building is an example of sharing that may induce the mentioned approaches among citizens.

The management of technical installations in buildings may lead to energy savings: make sure heating is turned off during week-ends and holidays, make sure lighting is off after work, fine tuning of the heating/cooling operation, adequate set points for heating and cooling. For simple buildings, a technician or an energy manager could be appointed for such tasks. For complex buildings, the help of a specialised company may be necessary. Therefore, it may be necessary to renew or set up a new contract with a competent maintenance company with adequate requirements in terms of energy performance. Be aware that the way the contract is drafted could highly influence the motivation of such a company to effectively find out ways of reducing energy consumption.

Retro-commissioning: improve the efficiency of equipment and systems in existing buildings. It frequently addresses issues developed throughout the building's life. It consists in the adaptation and regulation of the technical installations to the current uses and owner's requirement (bring equipment to its proper operational state, improve indoor air quality, increase equipment lifespan, and improve maintenance operations…).

5.4.2 Infrastructure lighting

Local authorities can establish specifications for outdoor lighting and infrastructure lighting including standards for lighting fixtures and requirements for light levels.

5.4.2.1 Traffic Lights

The availability of compact LED packages on the market boosts the replacement of incandescent lamps in traffic lights with more energy-efficient and durable LED ones. This action yields a significant reduction of energy consumption. A LED array is composed by many LED unities. The main advantages of LED traffic lights are:

- The light emitted is brighter than the incandescent lamps, which make LED traffic lights more visible in adverse conditions.
- A LED's lifespan is 100 000 hours (about10 times more than incandescent bulbs). This implies a significant reduction of maintenance costs.
- The energy consumption reduction is higher than 50 % with respect to incandescent bulbs.

5.4.2.2 Public lighting

Public lighting is an essential municipal service. It offers significant potential for energy efficiency, in particular through the replacement of old lamps with more efficient ones, such as low pressure, high pressure lamps or LED. Over the years the efficiency of lamps has improved significantly. The high-pressure mercury lamp is the most frequent in public lighting. It has been used since 1960s and is extremely energy in-efficient. High-pressure sodium and Metal Halide lamps are very energy efficient ones and commonly used recently.

Replacing lamps is the most effective way to reduce energy consumption. However, some improvements, such as the use of more efficient ballast or adequate control techniques, are also suitable measures to avoid the excess of electricity consumption. In addition, the use of autonomous public solar street lighting systems powered by PV panels with energy storage battery is spreading across cities.

Other measures may be implemented to achieve significant energy reduction:

- Take into consideration the use of the public area (parking, pedestrian, dangerous intersection) in order to provide the appropriate kind of lamp and level of lighting.
- Electronic photo-switches can contribute to the electricity savings in public lighting by reducing night burning hours (turning on later and turning off earlier).
- A tele management system enables the lighting system to automatically react to external parameters like traffic density, remaining daylight level, road constructions, accidents or weather circumstances. Even if a tele management system doesn't reduce the energy consumption in lighting by itself, it can reduce traffic congestion or detect abnormalities. Tele management systems can be used to monitor failed lamps and report their location. Maintenance expenses can be reduced by considering the remaining life of nearby lamps that might be replaced during the same service call. Finally, data collected by the tele management system that tracks the hours of illumination for each lamp can be used to claim warranty replacement, establish unbiased products and supplier selection criteria, and validate energy bills.

5.4.3 Transport

Transport is one of the most important sectors which needs to be addresses in order to reduce GHG emissions. While providing essential services to society and economy, transport is also an important part of the economy and it is at the core of a number of major sustainability challenges, in particular Climate Change, air quality, safety, energy security and efficiency in the use of resources.

There are various levers where local authorities can shape the energy consumption and the sustainability of urban transport systems through infrastructure, service and policy decisions. In the following, key areas for local policy and planning interventions holistically focused on the urban transport system are reported. These address transport planning, transport activity, the modal structure, the energy intensity and the fuels and energy carriers. Table 13 summarises actions and benefits of four general actions for low carbon mobility. The first two lines comprise actions that have influence on the transport demands by reducing the need of mobility. On the

contrary, the second two lines regard vehicles and their efficiency, on which actions have no influence on the demand side. Further recommendations can be found on the website of the MobiliseYourCity initiative, which focuses on the development of sustainable urban mobility plans in developing countries at the national and local levels (http://mobiliseyourcity.net/?lang=en_us).

Table 13. Summary of sustainable urban mobility actions and potential benefits

Actions	**Benefits/synergies**
Focus on Activity and flows : **Reduced distances, mixed use development, compact neighbourhoods**	Reduced travel times; improved air quality, health, safety and access
Focus on the structure **Modal shift to more energy efficient modes: Bus Rapid Transits, cycle paths**	Reduced urban congestion and increased accessibility, improved air quality
Focus on Intensity **Transition to more efficient modern vehicles**	Improved energy security, productivity and affordability
Focus on fuel **Technological switch to ensure the use of less pollutant fuels**	Diversification of the fuels used contributes to climate, air quality and/or energy security objectives

Source: JRC, adapted from JRC 113786 (2018)

The following table summarises various common measures in transport sector.

Table 14. Examples of urban transport policies

Urban Access Regulation	Low emissions zones Restricting access to certain areas of a city, normally the city centre, can have a direct effect on local air quality noise pollutions and traffic safety in this area.	Urban Road Tolls/congestion charges Congestion charging systems have been operating in numerous cities to manage the roads of city centres. The implementation of such measures can boost the use of public transport, on which the investments need to be directed.
Private vehicle presence	Parking management Parking management and pricing can help discouraging the use of a privately owned car and raise revenue to fund public transport, walking and cycling infrastructure and improve public spaces. Parking management schemes lead to a reduction in the number of cars entering the city, which can reduce congestion and can encourage the use of public and non-motorised transport	Car and bike sharing Owning a car is increasingly recognised as uneconomical. A well-developed network and integrated car sharing system can complement the public transport network, while reducing the presence of cars in the more central areas.
Walking and cycling	Cycling and walking modes of transport Cycling and walking can take a substantial share of the urban transport sector, in particular on short distances. Cycling policies are successful when developed as part of an integrated transport policy	Safe and convenient cycle friendly environment. Separate crossing signals, cycle lanes, well-marked lanes and crossing, and buffers between road and lane, well maintained routes, with appropriate lighting, direct and integrated network, covered parking.
Up-take of clean vehicles	Replacement of municipal fleet Electrify the municipal fleets is a way of leading by example. Replacing the fleet allows reducing emissions and operating costs while improving service to the community. The development of the charging infrastructures can be integrated across department and partnered with utilities.	Fuel switch Biodiesel can be used for transport applications, either in pure form or blended with fossil diesel. Use in blends below certain thresholds does not require any modification of the engine. Pure vegetable oils can also be used but engines have to be adapted. Ethanol can be used in gasoline engines either at low blends, in high blends in Flexible Fuel Vehicles or in pure form in adapted engines.

Source: JRC Analysis

5.4.3.1 Mass public transport and sustainable transportation

The city government can carry out procurement activities for mass-public transportation (BRT/LRT/MRT), ATCS, and bicycle lanes to ensure the smooth flow of community traffic. This activity can be carried out by the city government because it is still within the scope of its authority, as happened in the City of Jakarta (BRT/LRT/MRT) and various other cities related to BRT, ATCS and bicycle lane activities. This activity will reduce the consumption of gasoline and ADO, so that in addition to having an impact on reducing GHG emissions and air pollution, it also supports the development of sustainable transportation facilities in urban areas.

Especially for BRT/LRT/MRT activities require a large investment, so it is necessary to cooperate with private business entities as well as financial support from the Ministry of Transportation related to ticket subsidies for urban mass transit passengers.

5.4.3.2 Integrated urban planning

Integrated land-use planning focuses on higher densities, mixed use and the integration of public transport and non-motorised transport infrastructure (Banister, 2011). Combined, these factors can reduce travel distances, can enhance the role of non-motorised modes and can improve accessibility and efficiency of public transport. Smart land-use planning only takes effect over longer time scales, but impacts are lasting. Local authorities can largely influence future travel patterns.

Integrated land use planning is also a strategy to prevent climate impacts like flooding, drought, water scarcity and heat stress, as well as to avoid exposure of valuable elements to risks. Climate impacts can be prevented when changing land use in a way that it positively affects the regional water balance, which influences the evapotranspiration process through infiltration, the soil water redistribution process, and surface roughness, which controls overland flow velocity and floodplain flow rates. Afforestation, forest transformation, sustaining wetlands, avoiding bare soil during precipitation season, modified vegetation cover, and introducing drought/flood-tolerant crops can also reduce flood and drought risk. Measures to avoid exposure of valuable elements to risks generally involve zoning, building codes, such as minimum floor heights and water proofing, as well as land use permits.

Thereby, land-use planning decisions of today can ease the traffic management task in the future. Cities can limit the increase in car use with mixed-use developments that play an important role in improving the efficiency of the transport system, by reducing the need to move. The integration of land use and transport is, indeed, a strategy that improves the connectivity and the accessibility, providing a better mobility service and making closer people and places. As part of this, cities may want to consider integrating fares, infrastructure and operations for integrated public transport planning, and create easy connections with non-motorised transport.

5.4.4 Solid waste management

In Indonesia, from an institutional perspective, waste management is a concurrent activity, which is a joint venture of the Central Government, Provincial Government, and City/Regency Governments. The Central Government, through the Regional Settlement Infrastructure Centre (BPPW) of the Ministry of PUPR and the Directorate General of Waste Management of the Ministry of Environment and Forestry, assists the City/Regency to develop infrastructure and to monitor waste management activities. The provincial government also plays a role in providing infrastructure and monitoring waste management activities on a smaller scale, as well as managing waste infrastructure that serves two or more cities/districts, for example the Regional Waste Final Dump Site (TPA). Meanwhile, waste management operations are carried out by the City/Regency Government through the Environmental Office. Private parties may participate in waste management activities with a permit from the City/Regency Environmental Offices.

Data collection and information on waste management in each City/Regency is carried out by the Director General of Waste Management at the Ministry of Environment and Forestry through the National Waste Management Information System (https://sipsn.menlhk.go.id/sipsn/). The Central Bureau of Statistics (through the National Socio-Economic Survey) and the Ministry of Health (through Basic Health Research) also collect data on domestic wastewater treatment and disposal through direct interview surveys to households.

Technical aspects of solid waste management in Indonesia include storage, collection, temporary storage, transportation, and final processing. Regulation of the Minister of Public Works of the Republic of Indonesia Number 03/Prt/M/2013 concerning the Implementation of Waste Infrastructure and Facilities in the Handling of Household Waste and Waste Similar to Household Waste is a technical reference used in waste management. Waste reduction is regulated by the City/Regency Government, for example through restrictions on the use of

plastic and guidance to producers. The informal sector (used goods collectors) also contributes to the reduction of waste generation in Indonesia.

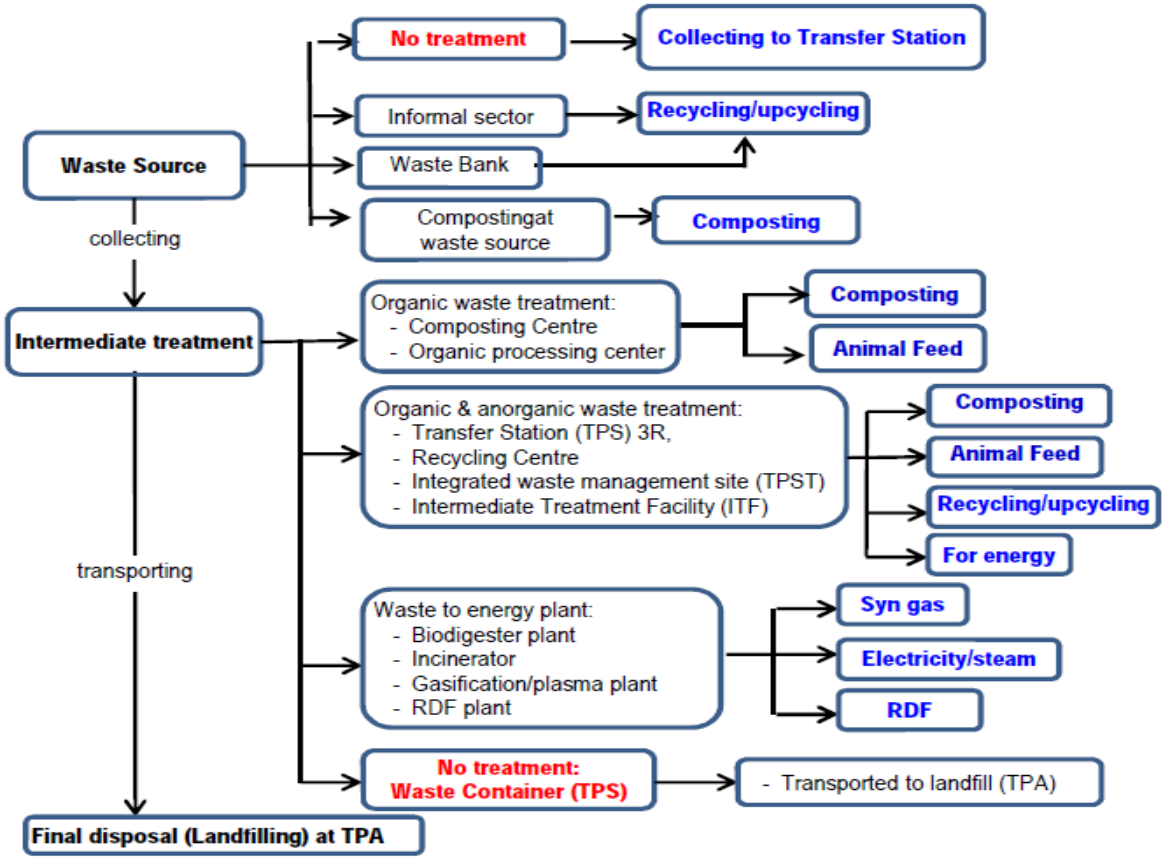
5.4.4.1 Waste Reduction through Reduce, Reuse, and Recycle (3R)

Presidential Regulation of the Republic of Indonesia Number 97 of 2017 concerning National Policies and Strategies for the Management of Household Waste and Waste Similar to Household Waste (Jakstranas) targets a 30% reduction in waste, through Reduce, Reuse, and Recycle (3R). These restrictions and 3Rs of waste have an effect on reducing methane emissions in the landfill due to anaerobic (biodegradable) waste degradation, and reducing CO_2 emissions due to open burning of waste (containing fossil carbon). Based on data from the National Waste Management Information System (https://sipsn.menlhk.go.id/sipsn/#, viewed July 04/2022), of the estimated waste generation of 27,780,389.07 tons of waste per year, 65.53% of managed waste and 34, 47% of the waste is still not managed (generally due to the large service area in the Regency area which is difficult to reach by the manager). Waste reduction was recorded at 15.92%.

5.4.4.2 Construction of Semi Aerobic Landfill

Solid waste disposal site (SDWS) is one of the largest sources of emissions in the waste sector (besides domestic and industrial liquid waste). Most of the domestic waste will be transported to the final waste processing site (TPA), which is carried out using the landfilling method. The majority of landfills in Indonesia are built with a semi-aerobic landfill model, where the leachate distribution pipe is connected to a vertical gas vent (and permeable intermediate cover soil). Thus, oxygen can circulate within the landfill cells, and not all waste decomposes anaerobically (and produces methane). IPCC Refinement (2019) sets MCF = 0.5 – 0.7 for semi-aerobic landfills (compared to MCF = 1.0 for anaerobic landfills, where all degradable waste decomposes anaerobically). Construction and operation/maintenance of a semi-aerobic landfill is one of the potential mitigation actions in this sector (with the baseline being an open dumping solid waste disposal site which has an MCF = 0.8) Figure 12. Most landfills in Indonesia have a depth of more than 5 meters, so (under baseline conditions) are categorized as Un-managed Deep SWDS (with MCF = 0.8).

Figure 12. Waste Management Flow in Indonesia



Source: Expert analysis

5.4.4.3 Biological Waste Management

Biological processing of organic waste (generally composting) is carried out at:

(a) Market/office/school household sources, through environmental-scale composting activities;

(b) Transfer station or treatment plant, through composting activities in the Composting Centre, Organic Processing Center (POO), Transfer Station (TPS 3R), Recycle Centre, and Integrated Waste Disposal Site (TPST)

Most of the composting is done by involving oxygen (with the windrow composting model, or with the help of a blower), so it has a small emission factor, and is a mitigation action that has been implemented in Indonesia (methane emissions avoided from dumping waste at a solid waste disposal site). Besides being made into compost, organic waste (especially food scraps) is often processed into animal feed. In areas that have pig farms (only in some areas in Indonesia such as Palangkaraya, Kupang, etc.), vegetable/food waste from the market is directly purchased by the farmers. Meanwhile, in many other areas, leftover food is used as feed for Black Soldier Fly (BSF), and maggot produced from raising BSF is used as animal feed. Some Integrated Waste Disposal Sites or Transfer Stations (TPS 3R), have poultry. Composting is also carried out to treat industrial solid waste, for example from the pulp & paper industry and the palm oil industry (Empty Fruit Bunch). Bio digestion of waste is not widely carried out in Indonesia, and generally, it is still on a pilot project scale, both at universities and in public facilities.

Box 32 Waste Transfer Station

Waste Transfer Station with Reduce, Reuse, and Recycle Facility at Kalidoni District, Palembang City ("TPS 3R Kalidoni") is an initiative of the Kalidoni Sub-District Head who is concerned about the initial condition of the TPS, which is full of waste, and creates an unpleasant odor for local residents. Municipal Solid Waste (MSW) at the TPS 3R Kalidoni 3R has been developed into various derivative products that have added value, for example: biofloc catfish cultivation, hydroponics, fuel from plastic, organic fertilizers, and BSF maggots, so that waste that was previously considered a problem, can be transformed into waste as a potential. Estimation of GHG emission reduction is done by comparing GHG estimates on:

a. Baseline emissions, namely CH4 which is emitted when organic waste (vegetables/food waste) which is processed at TPS 3R Kalidoni is dumped and decomposes under anaerobic conditions in landfill, and

b. Project emissions, namely emissions that emitted when composting and recycling is carried out.

5.4.4.4 Thermal Treatment & LFG Recovery

Waste to energy, either by processing waste thermally or by Landfill Gas (LFG) Recovery, is not widely carried out in Indonesian landfills. Some incinerator facilities, plasma, waste gasification, and LFG Power Plants are being built in several cities in Indonesia. Presidential Regulation No. 35 of 2018 concerning the Acceleration of Development of Waste Processing Installations into Electrical Energy (PLTSa) Based on Environmentally Friendly Technology states that the acceleration of PLTSa development can be carried out by Regional Governments: DKI Jakarta Province, Tangerang City, South Tangerang City, Bekasi City, Bandung City, Semarang City, City of Surakarta, Surabaya City, Makassar City, Denpasar City, Palembang City, and Manado City. Table 6 shows the status of (solid) waste to energy activities in several cities in Indonesia. In addition to these large-scale waste to energy activities, there are several landfills that use LFG for cooking fuel.

Table 15. (Solid) waste to energy activities in Indonesia

Local government	Location of activity	Technology	Notes	Source
DKI Jakarta Province	Bantar Gebang Landfill	LFG Power Plant	Operating at capacity 1,8 MW.	Direktorat Inventarisasi Gas Rumah Kaca dan Monitoring, Pelaporan, Verikasi (2019). Profil Pemanfaatan Gas Metan di Tempat Pemrosesan Akhir. Direktorat Jenderal Pengendalian Perubahan Iklim. KLHK.
DKI Jakarta Province	Bantar Gebang Landfill	Incinerator with Power Plant	Completed Construction with a capacity of 100 tons per day.	Pembangkit Listrik Tenaga Sampah (PLTSa). Retrieved from: https://upstdlh.id/tpst/pltsa
DKI Jakarta Province	Bantar Gebang Landfill	RDF Plant	In the construction phase with a capacity of 1000 tons per day for fresh waste, and 1000 tons per day for landfilled waste.	from various sources
Tangerang City	Jatiuwung	Incinerator with Power Plant	In the planning stage with a capacity of 12 MW.	Tangerang City Environmental Agency (2022). Pengolahan Sampah Menjadi Energi Listrik Kota Tangerang [PowerPoint slides]
Surabaya City	Benowo Landfill	LFG Power Plant	operating at capacity 1,65 MW.	
Surabaya City	Benowo Landfill	Gasification Power Plant	operating at capacity 12 MW.	PLTSA Pertama Di Indonesia Siap Beroperasi Di Surabaya, Mampu Hasilkan Listrik 12 Megawatt (August 20,2022). Retrieved from: https://surabaya.go.id/id/berita/56606/pltsa-pertama-di-indonesia-siap
Solo City	Putri Cempo Landfill	Gasification Power Plant	Not yet operating with a capacity of 8 MW.	PLTSa Putri Cempo. Retrieved from: http://simpulkpbu.pu.go.id/project/read/183/pltsa-putri-cempo
Semarang City	Jatibarang Landfill	LFG Power Plant	Under construction with a capacity of 0.8 MW	Direktorat Inventarisasi Gas Rumah Kaca dan Monitoring, Pelaporan, Verikasi (2019). Profil Pemanfaatan Gas Metan di Tempat Pemrosesan Akhir. Direktorat Jenderal Pengendalian Perubahan Iklim. KLHK.
Palembang City	Sukawinatan Landfill	LFG Power Plant	Operasional belum optimal. Kapasitas: 0,25 kW. Memerlukan peningkatan kualitas cover soil dan penambahan sumur gas.	Kota Palembang-GCoM-CCROM (2020). Inventarisasi Emisi dan Rencana Aksi Mitigasi Gas Rumah Kaca (GRK) Kota Palembang.
Palembang City	Karya Jaya Landfill	Incinerator with Power Plant	In the planning stage, with a design capacity of 1000 tons of waste per day.	from various sources
Cilacap Regency	Jeruk Legi RDF Plant	RDF Plant	Operating at capacity 140 tons of waste per day.	Tingkatkan Kapasitas RDF, Pemkab Cilacap Gandeng Investor. Retrieved from: https://jatengprov.go.id/beritadaerah/tingkatkan-kapasitas-rdf-pemkab-cilacap-gandeng-investor/
Malang City	Supit Urang Landfill	LFG for cooking	Operating at capacity 300 households connection	Direktorat Inventarisasi Gas Rumah Kaca dan Monitoring, Pelaporan, Verikasi (2019). Profil Pemanfaatan Gas Metan di Tempat Pemrosesan Akhir. Direktorat Jenderal Pengendalian Perubahan Iklim. KLHK.
Kulon Progo Regency	Banyuroto Landfill	LFG for cooking	Operating for internal purposes of the landfill.	Direktorat Inventarisasi Gas Rumah Kaca dan Monitoring, Pelaporan, Verikasi (2019). Profil Pemanfaatan Gas Metan di Tempat Pemrosesan Akhir. Direktorat Jenderal Pengendalian Perubahan Iklim. KLHK.
Madiun City	Winongo Landfill	LFG for cooking	Operating at capacity 200 households connection	Kemandirian Energi Melalui Pemanfaatan Gas Metan Sampah (October 30, 2016). Retrieved from: https://jatim.antaranews.com/berita/186597/kemandirian-energi-melalui-pemanfaatan-gas-metan-sampah
Probolinggo Regency	Seboro Landfill	LFG for cooking	Operating	Gas Metan Di TPA Seboro Dimanfaatkan Sebagai Sumber Energi (January 21, 2022). Retrieved from: https://probolinggokab.go.id/gas-metan-di-tpa-seboro-dimanfaatkan-sebagai-sumber-energi/
Trenggalek Regency	Srabah Landfill	LFG for cooking	Operating	Gas Metan TPA Srabah Manfaatkan Dapur Warga (March 07, 2017). Retrieved from: https://www.trenggalekkab.go.id/article/berita/gas-metan-tpa-srabah-manfaatkan-dapur-warga
Balikpapan City	Manggar Landfill	LFG for cooking	Operating at capacity 20 households connection	Direktorat Inventarisasi Gas Rumah Kaca dan Monitoring, Pelaporan, Verikasi (2019). Profil Pemanfaatan Gas Metan di Tempat Pemrosesan Akhir. Direktorat Jenderal Pengendalian Perubahan Iklim. KLHK.

Source: Expert analysis

Box 33 Siantan Biomass power plant

In the agro industry, the gasification process is carried out to generate electricity from industrial solid waste, for example: the Siantan Biomass Power Plant (PLTBm) in Siantan district. The Siantan PLTBm with a Capacity of 15 Megawatts (MW), is estimated to supply 10 MW of electricity to the equatorial interconnection system. The Siantan PLTBm uses gasification technology with fuel from oil palm shells, wood, rice husks, corn cobs, bagasse, sawdust and other agricultural wastes. In addition to energy (boiler fuel, bioethanol), agro-industrial waste is also processed into compost, mushroom cultivation, etc.

PLTBm Siantan, PLT Biomassa Swasta Pertama di Kalimantan Barat. Retrieved from: https://www.esdm.go.id/id/berita-unit/direktorat-jenderal-ebtke/pltbm-siantan-plt-biomassa-swasta-pertama-di-kalimantan-barat

5.4.5 Wastewater Treatment and Discharge

5.4.5.1 Domestic Wastewater Treatment and Discharge

Domestic wastewater treatment and disposal are also concurrent affairs of the Central Government, Provincial Government, and City/Regency Governments. Starting in 2009, Cities/Regencies have prepared the Residential Sanitation Development Acceleration Program (PPSP) related to improving wastewater services (also regarding waste management), and produced City Sanitation Strategy documents and Sanitation Program Memorandums. The Central Government through the Regional Settlement Infrastructure Centre (BPPW) of the Ministry of PUPR assists in the provision of wastewater (and solid waste) infrastructure, based on the City Sanitation Strategy and Sanitation Program Memorandum prepared by the City/Regency. Data on achievements (facilities and infrastructure) of wastewater management are collected by the Public Works Department. The Central Bureau of Statistics (through the National Socio-Economic Survey) and the Ministry of Health (through Basic Health Research) also collect data on domestic wastewater treatment and disposal through direct interview surveys to households.

The Provincial Government (through the Department of Housing and Settlement Areas) also assists in providing these sanitation facilities. City/Regency Governments, apart from providing infrastructure (through the Public Housing & Settlement Service and/or Public Works Office), are also supervisors (through the Health Office and the Environment Agency) and operators in domestic wastewater management. However, not so many City/Regency governments have become operators in the management of domestic wastewater (because the majority of treatment is done offsite/individually through septic tanks). City/Regency Governments often only provide and manage Sludge Treatment Installations (IPLT) to accommodate sludge removal activities in community septic tanks. In several cities, which have centralized wastewater treatment plants, the City Government has formed regional companies that manage wastewater, such as in DKI Jakarta Province and Banjarmasin City. Several other cities mandated Regional Drinking Water Companies (PDAMs) to manage wastewater, such as in Bandung City, Cirebon City, and Medan City. Others, such as the WWTP Sewon Jogajakarta and WWTP Suwung Bali are managed by the Provincial Public Works Department.

The majority of domestic wastewater treatment in Indonesia is carried out offsite (individually), with septic tanks. In some urban slum areas, septic tanks are made for several houses, known as Communal Septic Tanks (which are made with an anaerobic baffled reactor system), often combined with shared toilets. Some cities (Bandung, Medan, Jogjakarta, Bali) have urban WWTPs, although they do not serve the entire city area. Several other cities have WWTPs on a Regional Scale (Cirebon, Banjarmasin). Several other cities are building City Scale Centralized WWTPs (Pekanbaru, Palembang, Makassar). Since wastewater treatment is still carried out individually (offsite), generally using a septic tank (which is anaerobic) and emits methane gas, several mitigation actions that can be taken, related to domestic wastewater treatment, are:

- Periodic dredging of sewage sludge
- Urban WWTP construction and operation (Scale) with aerobic or anaerobic systems equipped with methane flared/recovery (for high density metropolitan cities).
- Off site or communal WWTP with aerobic system

In contrast to the existing black water treatment facilities (mostly with individual systems/septic tanks), grey water (from washing food, bathing, laundry, etc.) is still integrated with the drainage channel. Ideal drainage standards, which are separate from the grey water sewerage system, are still difficult to achieve. A significant increase in funding is required to separate drainage channels and all types of waste water (black water & grey

water), as mandated by the Minister of Public Works Regulation No: 12 /PRT/M/2014 concerning the Implementation of Urban Drainage Systems and PUPR Ministerial Regulation No: 04 /PRT /M/2017 concerning Implementation of Domestic Wastewater Management System. New paradigms of wastewater management need to be explored, such as increased control at source, decentralized treatment (regional scale), and a more pragmatic incremental approach to strategic sanitation planning. As a control, Minister of Environment and Forestry Regulation No. 68 of 2016 regulates Domestic Wastewater Quality Standards.

5.4.5.2 Industrial Wastewater Treatment and Discharge

Waste treatment and disposal must be carried out by the industry, so that the wastewater effluent complies with the Regulation of the State Minister for the Environment Number 03 of 2010 concerning Wastewater Quality Standards for Industrial Estates. The Waste Water Treatment Plant (WWTP) facilities and infrastructure are provided by the industry, and supervised (both at the planning, construction, and operation stages) by the Environment Agency.

Industrial WWTP in the City area uses an aerobic system, and produces little methane, but has emissions (direct and indirect) from energy consumption. Meanwhile, industries located in remote areas, especially agro-industry (e.g. Palm Oil Plant and Tapioca Plant), process liquid waste into a series of biological ponds (some of which are anaerobic ponds), and produce high methane. In some locations of agro-industrial WWTP, methane is captured to be used as energy (electricity). In several other locations, bio digesters were built to process domestic liquid waste into energy (electricity). Methane capture activities (at WWTP agro-industry) for energy, include:

- Biogas Power Plant (PLTBg) Sungai Terlung, Cengkong Abang Village, Bangka Regency, with a capacity of 2 Mega Watt (MW). This PLTBg uses POME, with methane capture technology, as its primary energy source.
- Biogas Plant owned by Asian Agri Grup (5 unit di Sumatera Utara, 3 unit di Riau, dan 2 unit di Jambi)
- Biogas Plant owned by M.P. Evans Group PLC (di Kerasaan, Kota Bangun, Bangka)
- Biogas Plant at tapioka mills at Lampung Province
- Other small scale biogas plant for processing tofu and tempe.

5.4.6 Local Energy Production

All energy production (fossil fuels and electricity) is regulated by the state. However, the city governments have opportunity to produce energy (fuel and electricity), if there are potential resources in its area through cooperation with private business entities or forming Regional Owned Enterprises (BUMD), that manage micro hydro (if there is sufficient river flow potential) or utilize methane gas produced by domestic waste generation in landfills (landfill) or using domestic waste as fuel in incinerators to generate electricity. Some examples for locally produced energy include:

1. Micro hydro: The city government can also undertake the development of micro hydro and distribute the electricity either off the grid through the mini grid or on grid with the PLN electricity network in the vicinity. For micro hydro connected to the mini grid, the electricity tariff is determined by the BUMD as the executor of the development. Micro hydro operators can be directly carried out by BUMD or third parties. It is different with micro hydro which is connected to the PLN electricity network, the electricity tariff is set according to the applicable laws and regulations.

2. Landfill gas power plants and incinerators: For cities with large populations, waste generation will be generated in landfills that produce methane gas which can be used as fuel for gas power plants (PLTG). Waste generated in the TPA can also be burned directly in the incinerator to generate electricity. Several cities that have built and operated PLTSa and PLT incinerators are Denpasar and Surabaya. The selling price of electricity from these two power plants is determined in accordance with the applicable laws and regulations.

3. Solar roof-top: The policy on the use of solar roof-tops to generate electricity has been regulated by the Ministry of Energy and Mineral Resources. City governments can partner with business entities or use APBD funds to build solar roof-tops on government buildings. The city government can also encourage the community or business entities (industry and commercial buildings) to use solar roof-tops in their buildings. For this reason, the city government needs to coordinate across sectors and if possible can provide incentives for people who use roof-top solar, for example building tax relief, and others, in accordance with the available budget capabilities.

5.5 Elaboration of the plan: Adaptation actions

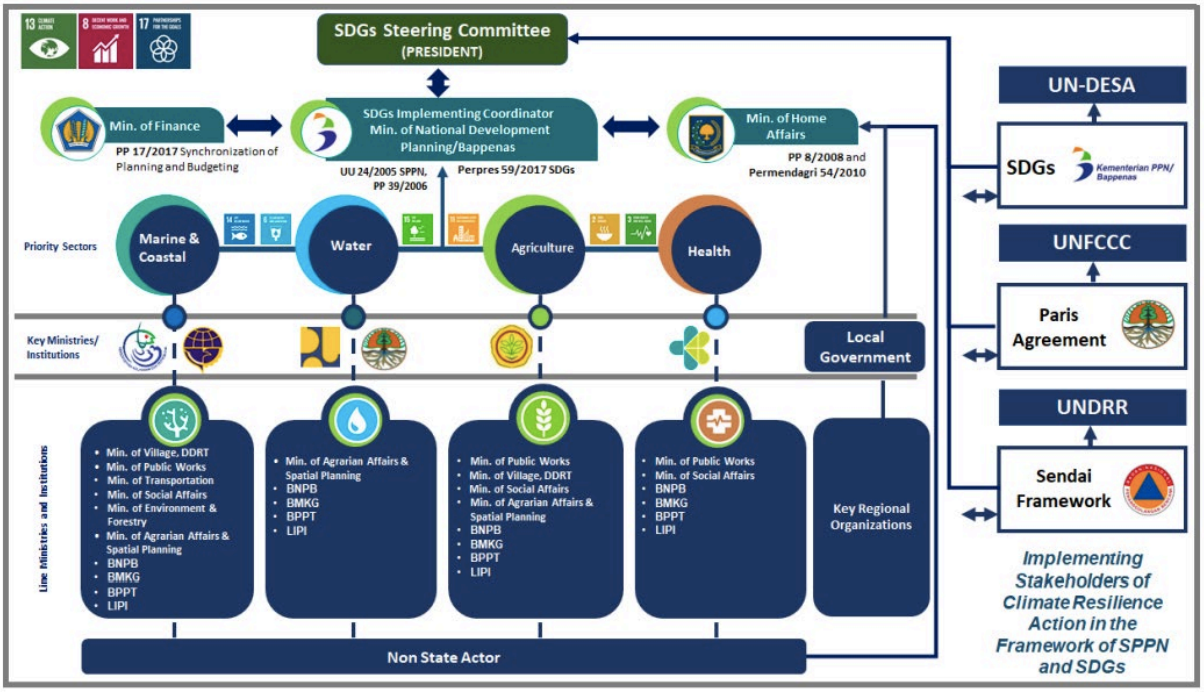
5.5.1 Indonesia commitment to adaptation: towards a multilevel climate governance

Adaptation to Climate Change requires a multilevel approach involving local, regional, national levels. In particular, adaptation to Climate Change is a shared competence between local and regional authorities and should be defined according to a city´s peculiarities and needs, which might be neglected by a solely large-scale national framework in managing future risks and potential loss from climate change.

The planning system in Indonesia is regulated by the Town and Country Planning Act of 1976 (Act 172) which provides the legal basis for the development of plans, including the national physical plan, state structure plans, district local plans and action area plans. The task of preparing for disasters is generally included in district local plans and action-area plans.

As defined in section 2.2, the mandate for coordinating climate change governance and implementing climate change convention at national level is assigned to the Ministry of Environment and Forestry (MoEF) under the Directorate General of Climate Change as stipulated in the Presidential Regulation No. 16/2015. The implementation of climate change adaptation (CC) is integral part of implementation of sustainable development (SD) and disaster risk reduction (DRR) commitment. Therefore, coordination between the key institutions and sectoral ministries and local governments is crucial for ensuring the effectiveness of the implementation of actions toward climate resilience. The coordination between related sectoral ministries and other stakeholders is illustrated in the figure below.

Figure 13. Governance structure for climate adaptation



Source: Book 2 institutional arrangement for Climate Resilience (Ministry of National Development Planning, 2021)

Table 16 reports measures to enforce a multi-level governance in the climate adaptation process. At city level is recommended to:

a) *Define a horizontal governance to foster inter-agency and cross-sector collaboration on adaptation, define accountability and leaderships, avoiding policy trade-offs and spill-over effects, and improve use of resources;*

b) *Create a local/regional platform (or/and communication channels) to share knowledge and data about Climate Change impacts and vulnerabilities across different sectors, with higher resolution available (downscale to local context);*

c) *Foster participatory processes with local communities (especially the most affected and vulnerable by Climate Change impacts) and private sector actors increasing their engagement in decision-making processes and data/knowledge exchange;*

Table 16. Recommended measures to improve multi-level governance

Actor	Recommended Measures
International level	Define a coherent framework to help mainstream adaptation into national and regional policies, helping to optimize possibilities of synergies with other policy areas and exploiting co-funding opportunities. Develop a common reporting system for national, regional and urban projects on adaptation to Climate Change by defining the list of indicators, criteria and standards for reporting and assessment, among others Further explore the possibility of leveraging private sector investments within cities
National level	Establish clear coordinating procedures between national and subnational governments (vertical governance) and coherent national legal frameworks in order to enable local adaptation actions Include the spatial aspect of Climate Change impacts (e.g., according to administrative units) in national strategies (usually shaped according to policy sectors) Use national budgets to support local adaptation and provide technical support to access financing mechanisms Establish national communication programmes on Climate Change and support national data sharing and good-practice exchange on adaptation issues Improve mainstreaming adaptation into country sectoral strategies (e.g., health, transport, water management, among others), in order to optimize synergies and explore further funding opportunities (horizontal governance across sectors)
Regional level	Define a regional legal framework to coordinate inter-municipal adaptation strategies Support smaller cities to develop their adaptation strategies through capacity building, regional data sharing and participatory processes with a broad range of local and regional stakeholders from public and private sectors thus pooling capacities and resources
City level	Define a horizontal governance to foster inter-agency and cross-sector collaboration on adaptation, define accountability and leaderships, avoiding policy trade-offs and spill-over effects, and improve use of resources Create a local/regional platform (or/and communication channels) to share knowledge and data about Climate Change impacts and vulnerabilities across different sectors, with higher resolution available (downscale to local context) Foster participatory processes with local communities (especially the most affected and vulnerable by Climate Change impacts) and private sector actors increasing their engagement in decision-making processes and data/knowledge exchange

Source: JRC analysis

5.5.2 Key adaptation measures for climate hazards

The adaptation pillar of CoM covers the following types of climate hazards that could potentially affect negatively societies, its 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. Indonesia is focusing on four main sectors that are affected by climate change which are marine and coastal sector, agriculture sector, water sector and health sector. A preliminary list of adaptation actions identified in related sectors that could be prioritised are reported in the table below

Table 17. Adaptation actions by sector

Sectors	Action Group	Action / Main activity
Coastal subsector	The provision of coastal protection structures/vegetation	Construction of coastal protection hybrid structures
		Construction and rehabilitation of coastal protection soft structures with an ecosystem-based adaptation approach (e.g. mangrove protection and restoration)
	The provision of flood control structures	Construction of automatic floodgates to reduce flooding in the coastal areas
	The area management and housing, as well as the settlement relocation	Reconstruction of adaptive residential settlements, public and social facilities in the coastal areas
	The provision and protection of aquaculture production facilities	Distribution of superior fish seed with high temperature and high salinity resistance
	The provision of early warning systems	Provision and implementation of extreme weather early warning systems (flood, tidal flood information)
	The development of coastal protection technology	Development of innovative designs for sturdy and environmental-friendly seawalls
	The enhancement of the regulation on coastal areas	Preparation of disaster risk maps in the coastal areas
	The provision of innovative financing Mechanisms	Development of innovative and accessible financing mechanisms for coastal aquaculture businesses
Water sector	The provision of water storage buildings	The construction of dams
		The development and adjustment of rainwater storage media for drought resilience
	The application of water recycling and reclamation technology	The application of Sea Water Reverse Osmosis (SWRO)
	Flood mitigation	The development and adjustment of water resource infrastructure for flood disaster resilience
Health sector (with focus on dengue haemorrhagic fever disease)	The improvement of residential environmental health	The construction of integrated residential areas which are in harmony with nature and taking into account the aspects of climate change
		The construction of sanitation facilities and infrastructure in the settlements
		The construction of clean water facilities and infrastructure
		The utilization of simple technology to prevent the development of mosquito larvae

Source: List of Priority Locations and Climate Resilience Actions (Ministry of National Development Planning/Bappenas, 2021) ([27]).

Adaptation actions that can be implemented at local level are:

- enhancing climate literacy,
- strengthening local capacity,
- improving knowledge management,
- mainstreaming climate change adaptation and disaster risk reduction policy, and
- application of adaptive technology.

([27]) For the full list of actions can be accessed through https://lcdi-indonesia.id/wp-content/uploads/2021/11/1_List-of-Priority-Locations-Climate-Resilience-Actions.pdf

5.6 Elaboration of the plan: Access to energy actions

The plan delivering the energy access pillar can be a stand-alone document or it can be integrated with the other two pillars. As previously indicated the target year for energy access is 2030, as per the target year for Indonesia's NDC.

Box 34 Energy challenges faced by cities

Local Governments in cities need to be prepared to deal with several energy challenges:

- how to meet increasing demand for energy services caused by high population growth and rapid urbanisation, while addressing inadequate supply and system inefficiencies;
- how to increase access to clean, affordable, and reliable energy; in a model of development that slows the growth of carbon emissions and that is not fossil fuel dependant.

The growing urban population will need access to energy. The challenge for municipal authorities is to make sure that this energy use is as sustainable as possible. Because defining a local strategy to address energy poverty and provide modern energy services coherent with sustainable development, will not only promote local economic development and enhance resilience (Setyowati, 2020) but it will also save money for cities, business and households. It would also:

- Reduce global warming emissions.
- Improve energy security, by increasing the share of domestically available alternative or renewable energy sources.

Stimulate household welfare: poor households often have limited access to modern, safe, clean energy sources such as electricity, or cannot afford them even when they are available. This leads to continued dependence on polluting and unsafe fuels such as paraffin, coal or wood.

Promote equity: the poor often are burdened with inadequate, unsafe and inconvenient energy sources while wealthier, particularly urban people consume high levels of energy and are inefficient in their use of energy.

Local environment/local air quality: In addition to local (indoor/outdoor) air quality, the use of traditional biomass impacts the local environment. High demand from urban centres coupled with unregulated charcoal industries result in deforestation lowers the resilience of communities to cope with natural disasters such as flooding.

Improve financial efficiency: Current inefficient energy use patterns mean that countries, cities and people have to spend more money than necessary for the energy service required (e.g. cooking, lighting, water heating etc.). Many more efficient and cost-effective appliances and practices are available, including modern energy cook stoves, efficient lighting, using solar water heaters and constructing buildings in a way that reduce the use of energy for cooling and lighting.

5.6.1 Role of local authorities

5.4.2.1. Local authorities key players

Energy in the city is essential for almost every activity and function in urban areas: cooking, cooling, heating water, industry, offices, lighting, transportation, construction, housing (Perwithosuci et al. 2022). Local authorities have a big influence within their boundaries over current and future energy use patterns through building regulations, urban layout, transport planning, bylaws, standards & codes, air quality control measures and electrification. In Indonesia, the city government is not responsible for managing the distribution of fossil energy and electricity. For electricity, this is the responsibility of national power agencies and companies under the supervision of the Ministry of Energy and Mineral Resources. However, the city government has an important role to join with the national authorities to integrate and articulate the energy planning.

For planning the construction of RE power plants carried out by local BUMDs that are connected to the PLN electricity network, local authorities coordinate with PLN so that the local plan and strategy can be included in the General Plan for the Provision of Electricity (RUPTL). The technical implementation of the construction of the RE power plant as well as the policy and selling price of electricity follow the applicable laws and regulations.

“Energy governance” refers to actors, institutions, and the process of making energy supply decisions. Some actors related to energy include: government, NGOs, civil society groups, companies, citizens, and public-private partnerships (PPPs). In addition, the basis for decision-making and the process of agenda setting, negotiation,

implementation, monitoring and enforcement of energy-related regulations is also needed. It is well known that the energy sector is very complex when compared to other sectors that do not allow for simple governance, cooperation or regulation.

5.6.2 Actions

5.6.2.1 Access to electricity

To increase access to electricity, the city government can carry out several activities as follows:

- Mini Grid: City governments can build mini grids to electrify isolated and scattered homes with power plants built by the city government.
- Solar home systems (SHSs): SHSs can supply electricity to scattered isolated households to be connected via mini-grids. However, SHS has a limited capacity, which is only sufficient for lighting, television, and refrigerator. In addition, electricity from SHS plus mini grid is more expensive than PLN electricity tariff. Another obstacle faced by SHS is that the battery is damaged more quickly due to over consumption due to increased electricity demand and the theft of solar panels. SHS is an attractive solution in sparsely populated rural areas and its use can bring fundamental economic and non-economic benefits.

Box 35 Use of RES in Bali

In the context of implementing the energy transition towards the use of low-carbon energy, the government encourages the use of renewable energy, including rooftop solar panels. This policy is regulated by the Regulation of the Minister of Energy and Mineral Resources Number 26 of 2021 concerning PLTS roofs that are connected to 'the Electricity Network of Business License Holder' that provide electricity for the public. The regulation replaces the Minister of Energy and Mineral Resources Regulation Number 49 of 2018. This policy will certainly encourage increased access to sustainable energy. For example, the Bali Province Government has carried out socialization and evaluation policies for the use of rooftop solar panels at the end of September 2022 which was attended by 70 participants from the Bali Provincial Government OPD, the Bali Governor Expert Group, Regency/City Regional Secretaries throughout Bali, academics, business entities, banks and associations. With this activity, a broader understanding of the Bali Governor's Regulation Number 45 of 2019 concerning Bali Clean Energy, and the Bali Governor's Circular Letter Number 5 of 2022 regarding the use of rooftop solar panels will be gained. There has been a significant increase in the utilization of rooftop PLTS in the Province of Bali with the incessant construction of rooftop PLTS stockists in order to welcome the grand event of the G20 Presidency, from 4 MWp to 10 MWp peak.

In the Circular Letter of the Governor of Bali Number 5 of 2022, it is regulated that the installation of PLTS systems or other solar technology is at least 20% of the installed electricity capacity or the roof area of central and regional government buildings in the Bali area. As for commercial, industrial, social and household buildings with a floor area of more than 500 square meters, it is recommended to install a rooftop PLTS system or other solar technology at least 20% of the installed electricity capacity or roof area.

To implement the policy of the Bali Provincial Government, PT PLN as the holder of electricity distribution throughout Indonesia is ready to support by serving PLTS applications in accordance with applicable procedures and provisions. Even PLN has given an example by installing PLTS roofs on PLN office buildings scattered throughout Bali.

Source: https://www.baliprov.go.id/web/dorong-pemanfaatan-ebt-pemprov-sosialisasikan-penggunaan-plts-atap

*5.6.2.2 **Clean cooking fuels and technologies***

Actions on Clean cooking fuels and technology led by local governments particularly in remote areas lacking access to LPG and kerosene, include:

- The use of biogas from livestock manure

Biogas is produced from anaerobic processes from organic materials such as animal waste, agricultural residues, and human waste. Biogas generally in the form of methane gas is not a commercially marketed fuel because of its potential in rural households that have a sufficient number of livestock that are at a certain temperature and altitude to ensure sufficient methane gas production for household needs. Construction of biogas reactors is quite expensive and requires some financial support even for high- and middle-income rural

households. In addition, proper operation and maintenance of biogas reactors is required so that biogas production is as planned.

- Solar cooking.

Solar cooking is a solar cooker technology that converts solar radiation into energy. Sources of solar radiation can be obtained free of charge, but the use of solar energy for cooking requires high levels of solar radiation which can vary seasonally or daily. Therefore, the use of solar cooking which can only take place during the day is a major obstacle in its implementation.

5.6.2.3 ***Partnership and awareness campaigns***

To promote energy access to remote communities, it is necessary to support local communities and local business entities. City governments can motivate citizens, offer increased pride in their communities, and provide greater energy independence, energy security, jobs and social cohesion.

Table 18. What can I do to contribute? Raise awareness

Individual	Ride bicycle instead of motorized vehicle; 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 cook stoves 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 cook stoves 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 e.g.: cleaning; Harvest rainwater; Support local actions e.g.; planting trees; Compost organic waste to set up community garden

Source: JRC Analysis from State Climate Change Action Plan ([28])

5.6.2.4 Policy recommendations

To carry out the various the activities mentioned above, the city government needs to establish the following policies:

- Prioritization policy or budget monitoring for the use of efficient electrical equipment technology, SHS, ATCS, bicycle lanes, PJU-saving PV mini-grid, and biogas production proposed by the relevant OPD.
- The policy of establishing BUMD Energy as a company engaged in the production of electricity (PLTSa, PLTBg, PLTM) and fuel (waste briquettes).
- The policy of establishing BUMD Transportation as a company engaged in mass transportation (BRT/LRT/MRT).
- Policy on collaborative activities between the city government and relevant ministries and/or private business entities.

To fulfil secure energy, sustainable energy, and energy affordability, the city government should:

- Establish BUMD or cooperate with private business entities to build and operate various types of renewable energy plants that have the potential to be developed in urban areas.
- Establish BUMD or cooperate with private business entities to build and operate mass transportation (BRT, LRT, MRT, commuter line).
- Cooperating with the Ministry of Transportation to obtain BRT grant assistance, ATCS, and the buy service program for public transportation.
- Establish a working group on climate change whose members consist of related OPD, BAPPEDA, fuel and electricity supply companies, BUMD, and related private institutions.
- Financing energy efficiency activities (bicycle lanes, energy-saving PJU) and small-scale renewable energy activities (livestock biogas, solar light PJU).
- Conducting energy surveys, especially related to household consumption of biomass
- Increase the capacity of human resources in calculating energy efficiency, GHG emission inventory, and mitigating GHG emissions
- Make a policy for the procurement of efficient electrical equipment whose energy saving label is more than 1 star for all OPD and BUMD

([28]) State Climate Change Action Plan

6 Implementation

The implementation phase takes the longest time, the most efforts and the largest portion of financial resources. It requires the involvement of all stakeholders, including national authorities, industry and citizens. Whether a thoughtful, effective CAP is successfully implemented largely depends on the human factor. Staff involved in CAP implementation needs to be empowered with clear responsibilities, sufficient resources and good communications. Shortcomings and mistakes should be considered as chances to learn, improve and expedite results. Local authorities should consider pilot and/or demonstration projects to test innovative ideas on a small scale.

Furthermore, during the implementation phase, it will be essential to ensure good internal and external communication between the different departments of the local authority, the associated public authorities and all the persons involved as well as with citizens and stakeholders. This will contribute to awareness-raising, increase the knowledge about the issues, induce changes in behaviour, and ensure wide support for the whole process of CAP implementation.

Monitoring and communicating progress on energy and CO_2 emissions reductions as well as climate vulnerability/risk reduction and increasing access to energy should always be integral components of CAP implementation. The local authority should decide on key indicators on mitigation, adaptation and access to energy for monitoring progress (such as percentage of compliance with deadlines, percentage of budget deviations, and percentage of emissions reduction with the actions already implemented and decisions already taken regarding adaptation and resilience).

Moreover, frequently informing the municipal council (or equivalent body) and other stakeholders is a good way to involve them in the success of the project. Similarly, networking with other signatories developing or implementing a CAP, will provide additional value towards meeting the targets by exchanging experience and best practices, and establishing synergies.

Tips for putting the CAP 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 Monitoring the progresses

Monitor the evolution and impacts of the actions included in the CAP and update it regularly allows to ensure continuous improvement in the process. The GCoM SEA signatories must submit a Progress Report every second year following the submission of the CAP for evaluation, monitoring and verification.

It is mandatory:

- To submit monitoring reports every two years after submitting the action plan(s);
- To provide information about the implementation status of each action/action area/sector contained in the action plan;
- To 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. Table 19 shows the overall reporting time for GCoM SEA, coherent with GCoM recommendations. 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, signatories will be asked to submit the first group of documents the latest two years after; while within year 3 they must submit the CAP.

Table 19. 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***
(*) Every two years after submitting the CAP						

Source: JRC analysis

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 consistency. 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. Through the reporting, a deeper understanding of the results delivered by the CAP is provided and corrective and preventive measures when this is required can be defined.

PART 2 – Reporting data and financing climate action

8 Reporting

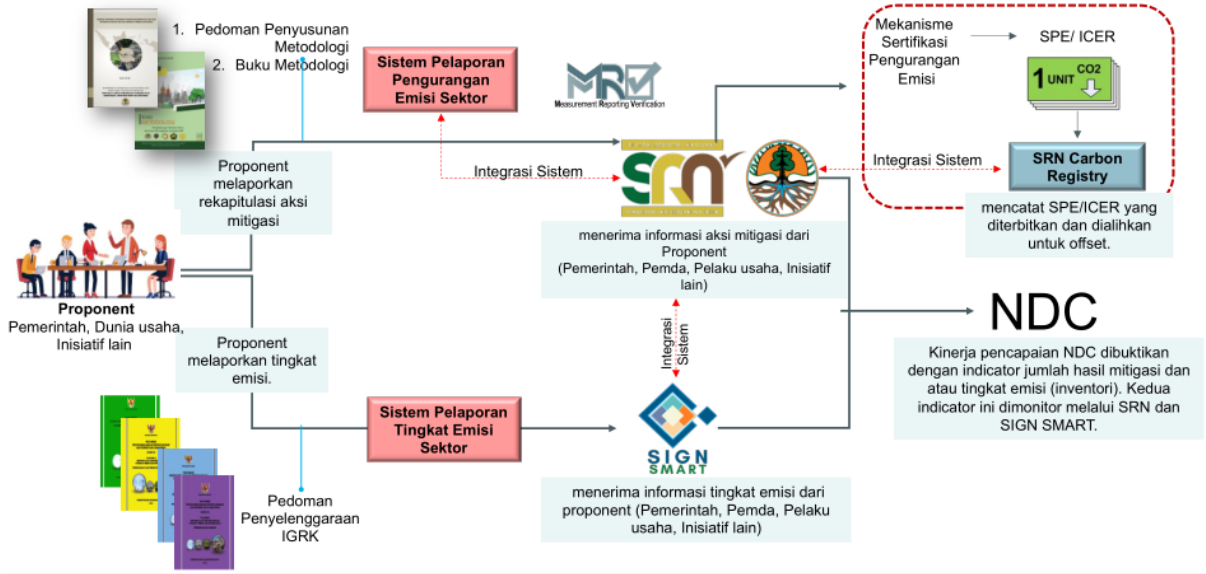
Within the national framework, Indonesia reports climate action in national communications, which includes information on GHG inventory, adaptation, mitigation actions and their impacts, constraints and gaps, support needed and received, and other relevant information. National communications are submitted every four years, while BUR is submitted every two years. Indonesia as a Non-Annex I Party to the UNFCCC, reported: (a) First National Communication in 1999, (b) Second National Communication (SNC) in 2010, (c) BUR Report 2016, (d) Third National Communication (TNC) 2017, (e) Second BUR Report 2018, and (f) Third BUR Report 2021.

8.1 Reporting on GHG emissions and mitigation actions

In Indonesia, there are two reporting mechanisms (web-based) to support the Nationally Determined Contribution (NDC) and the development of Indonesia Certified Emission Reduction (ICER). Proponents (Central/Local Government, business, or other initiatives) report (Figure 14):

- Annual GHG emission level through SMART SIGN, and
- Implementation of mitigation actions through the National Registry System (SRN)

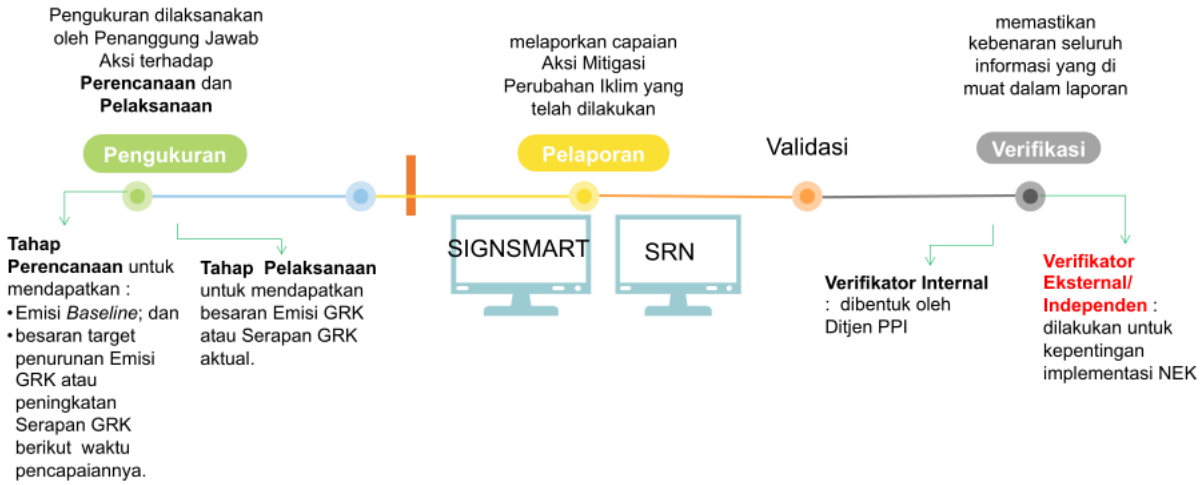
Figure 14. GHG Inventory for NDC and Development of Indonesia Certified Emission Reduction



Source: (KLHK, 2022)

SRN and SIGN Smart are online platforms currently being developed and used by the Ministry of Environment and Forestry to support the transparency framework in Measurement, Reporting, and Verification of GHG Inventories and Implementation of Climate Action (Figure 15). An explanation of reporting emission levels through the SIGN SMART and reporting of mitigation actions through the SRN is developed below.

Figure 15. Transparency Framework in GHG Inventory and MRV



Source: (KLHK, 2022)

Based on the sector emission level reported through the SIGNSMART system, a reduction in sector emissions can be estimated, namely by comparing the actual emissions (in the SIGNSMART) with the baseline emissions (in the NDC or Regional Action Plan), within the scope of the same emission source. On the other hand, proponent can report emission reductions based on the mitigation actions taken (in SRN). Ideally, the reduction in emission levels (compared to baseline emissions), is linear with the number of mitigation actions taken. The integration of these two reporting systems needs to be carried out to see the impact of mitigation actions on reducing emission levels, to: ensure that mitigation actions are within the same boundary as the GHG emission levels reported in the SMART SIGN, and exclude unrelated factors to climate action.

Information on mitigation actions in SRN from proponent, can be continued to the Emission Reduction Certification Mechanism to obtain Indonesian Certified Emission Reduction (ICER), and registered in the SRN Carbon Registry system. Along with reporting the actual emission level in the SIGNSMART, the number of mitigation results (registered in the SRN) becomes part of the verification of the performance of Indonesia's NDC achievements.

8.1.1 Measurement and reporting of GHG Emissions (and Removals) by Source through the National GHG Emissions Inventory

- Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.73/Menlhk/Setjen/Kum.1/12/2017 regulates Guidelines for the Implementation and Reporting of the National Greenhouse Gas Inventory. This guideline is intended to provide a reference in the implementation of GHG emission inventories at the national, provincial, and/or district/city levels, which contains:
- Implementation of the Greenhouse Gas Inventory refers to the 2006 IPCC Guideline for National Greenhouse Gas Inventories, and/or its amendments.
- The report contains the level, status, and trend of changes in GHG emissions from various emission sources and their absorbers.
- GHG inventory reporting is carried out by GHG inventory organizers, which include Regency/City Governments; Provincial government; Relevant Ministries and/or Non-Ministerial Government Institutions; and KLHK as National Focal Point for Climate Change;
- Regency/City level GHG inventory organizers report GHG inventory results to provincial level administrators. Furthermore, the organizer of the GHG inventory at the provincial level submits a report to the Minister c.q. Director General as National Focal Point for Climate Change;
- The GHG Inventory Report is submitted at least once per year, accompanied by a quality control and quality assurance process.
- Reporting and access to information to the public regarding the level, status and trend of GHG emissions can be accessed by the public through the National GHG Inventory System (SIGN). The Simple, Easy,

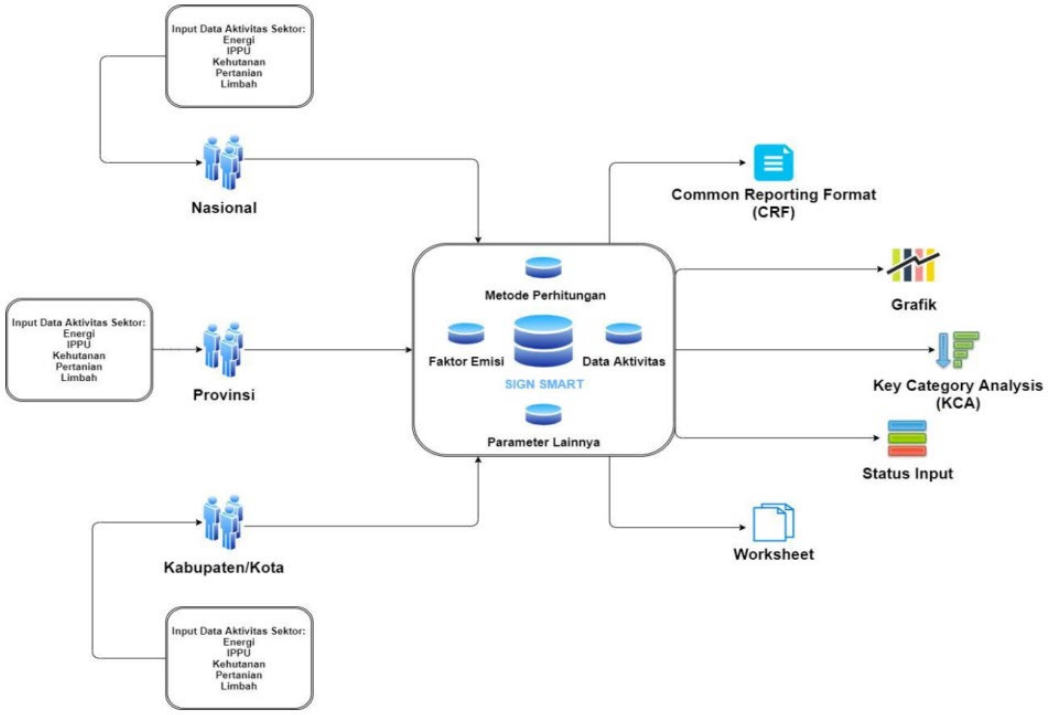
Accurate, Concise and Transparent National Greenhouse Gas Inventory System (SIGN-SMART) can be used by City/District and Provincial Governments to report data related to GHG emissions.

8.1.2 Information Technology-based National GHG Inventory System

The Simple, Easy, Accurate, Concise and Transparent National Greenhouse Gas Inventory System (SIGN SMART) was built by the Ministry of Environment and Forestry since 2015, and can be accessed at https://signsmart.menlhk.go.id/v2.1/app/. SIGN SMART is a database system for activities and local emission factors submitted by related Ministries/Agencies, Provincial Governments, and City/Regency Governments. SIGN-SMART displays data and information on the status, level and trend of decreasing or increasing greenhouse gas emissions from related sectors, namely: energy; industrial processes and product uses; agriculture, forestry and land use; and waste.

SIGN-SMART is a one stop service (Figure 16), starting from: (a) data input, (b) emission level analysis, (c) national GHG distribution, (d) data and information on status, level and trend of emission reduction or increase GHG in Indonesia. SIGN-SMART follows the IPCC Guidelines 2006 and its supplements, updates and refinements.

Figure 16. Operational System of SIGN-SMART



Source: Kementerian Lingkungan Hidup dan Kehutanan (2019) ([29])

The GHG inventory is reported annually, through a web application, based on Presidential Regulation 98/2021 Article 12 (KLHK, 2022), through the following mechanism:

- Business actors report to the regent/mayor, governor, or relevant minister, in accordance with the technical approval obtained no later than March.
- The Regent/Mayor submits a report on the results of the GHG Emissions Inventory to the Governor no later than March.
- The Governor submits a report on the results of the GHG Emissions Inventory to the Minister no later than June.
- Submit a report on the results of the GHG Inventory to the Minister no later than June.

([29]) Kementerian Lingkungan Hidup dan Kehutanan. Direktorat Jenderal Pengendalian Perubahan Iklim. Direktorat Inventarisasi GRK dan Monitoring, Pelaporan, Verifikasi (2019). Panduan Sistem Inventarisasi GRK Nasional Sederhana Mudah Akurat dan Transparan (SIGN SMART) 2019.

8.2 Reporting Implementation of Climate Actions

In addition to the GHG inventory reporting mechanism (annual), there is a reporting mechanism for the implementation of climate action. Climate action implementation reports are conducted to:

- Monitoring the implementation of activities, and
- Obtain regular information to understand factual conditions, constraints, obstacles and the development of mitigation actions in the context of reducing GHG emissions.

Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.72/Menlhk/Setjen/Kum.1/12/2017 regulates Guidelines for the Implementation of Measurement, Reporting and Verification of Climate Change Mitigation, Adaptation, and Controlling Actions. This guide contains the following:

- Every Action and Resource for Climate Change Control (implemented by Ministries/Agencies and Non-Institutions, Provincial/City/Regency Governments, and the private sector) can be registered by the Minister as a form of Government recognition.
- Measurements are carried out by the Person in Charge of Action on the planning; and implementation of climate action, to obtain: (a) baseline emissions; and (b) the amount and timing of achieving the target of reducing emissions or increasing GHG removals.
- The Person in Charge of Action is required to compile a report on the achievement of the Climate Change Mitigation action, and submit it to the Minister for validation and verification.

Regarding Climate Change Adaptation Action, this guideline contains:

- Climate Change Adaptation Actions are carried out through the stages of monitoring, reporting, and verification.
- Monitoring (conducted at least once a year), includes suitability of the selected actions with the level of vulnerability; the period for achieving the adaptation goal; and the achievement of objectives by comparing the indicators in the planning with the results of implementation.
- The Person in Charge of Action shall prepare a report on the results of monitoring the Climate Change Adaptation action, and submit it to the Minister for validation and verification.
- Meanwhile, monitoring, reporting and verifying the use of resources include:
- Monitoring, reporting, and verification of the suitability of resource use with mitigation actions, adaptation and other supporting activities, which involve; funding, capacity building, technology transfer; and/or experts.
- Monitoring and verification of funding is carried out on funds sourced from; APBN, APBD, foreign/domestic grants and donations, and other funds.

8.2.1 Information Technology based National Registry System (SRN)

The MoEF launched the National Registry System of Climate Change (NRS-CC) in 2016 that manages and provides data and information (online) on mitigation, adaptation, and resource actions. The NRS-CC realizes the mandate of the Minister of Environment and Forestry Regulation No. 71/2017 for the National Registration System and MoEF Regulation No. 72/2017 for MRV Implementation Guidelines. The web-based NRS-CC (https://srn.menlhk.go.id) is useful for (KLHK, 2016):

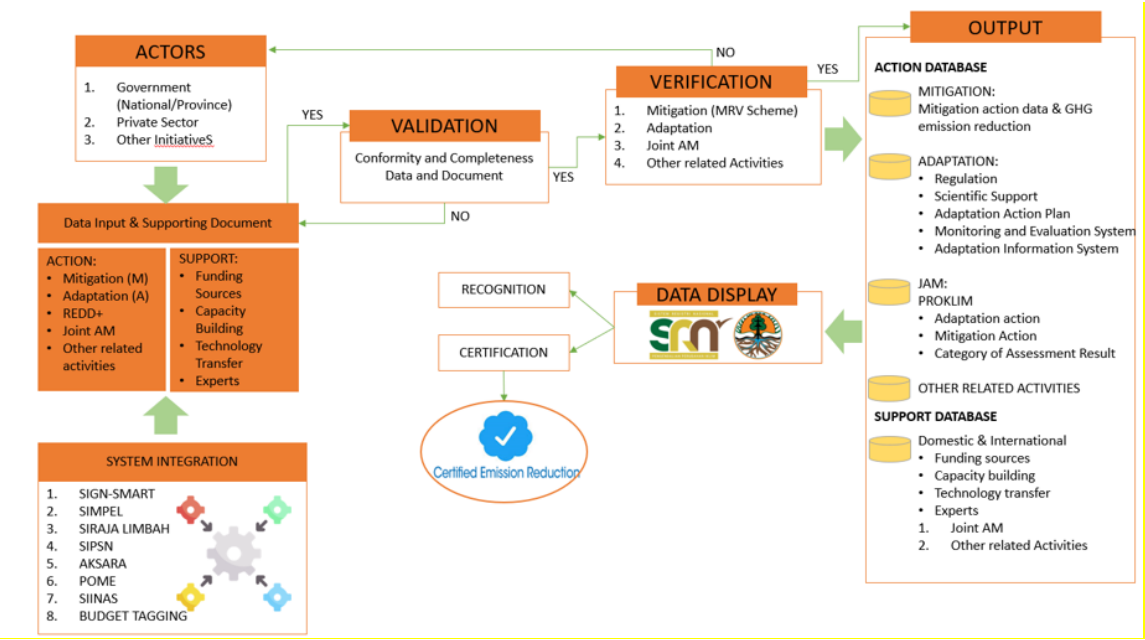
- Data collection on climate change actions and resources.
- Provision of data and information to the public.
- Coordination and assessment tools.
- Improved accountability and public services.
- Entry point for target evaluation.
- Prevention of duplication, overlap and double counting of actions.

- Prevent the occurrence of asynchronous climate action with resource requirements, as part of the implementation of the principles of clarity, transparency and understanding (CTU).
- A form of government recognition for the contribution of various parties to efforts to control climate change.

The NRS-CC workflow includes (Figure 17):

- Relevant stakeholders register climate action (adaptation, mitigation, etc.), including supporting resources received (funding, capacity building, technology, expertise, etc.)
- The data is validated and verified through desk review by the NRS-CC team (for mitigation actions carried out with the methodology panel). Verifiers conduct field visits as needed.
- After the validation and verification process is completed, the information will be made public on the NRS-CC website, and the relevant stakeholders will receive an acknowledgment or certification.

Figure 17. National Registry System for Climate Change (NRS CC) Workflow



Source: National Registry System for Climate Change (NRS CC)

9 Financing Climate Action Plans

9.1 Current State of the Green Technology Financing and Incentives in Indonesia

In 2017, Government of Indonesia developed a mechanism for the management of environmental funds outlined in Presidential Regulation No. 77/2018. The regulation states that the Environmental Fund is a system and mechanism for financing environmental protection and management efforts.

To manage environmental funds the Environmental Fund Management Agency (Badan Pengelola Dana Lingkungan Hidup/BPDLH([30])) was officially created in September 2019 and launched in October 2019.It is operationalized under the Minister of Finance of the Republic of Indonesia. The BPDLH allows to bring multiple sources of funding together to be deployed through a variety of instruments across a number of different sectors (including forestry, energy and mineral resources, carbon trading, environmental services, industry, transport, agriculture, marine and fisheries). BPDLH is an environmental funding (EF) mechanism for channelling and distributing environmental and climate funds to support Indonesia's vision to meet emission reduction targets and the Sustainable Development Goals (SDGs).

Based on the MoF Regulation No.124/PMK.05/2020 on Procedures for Managing Environmental Fund, funds collected by BPDLH can come from management of pollution and/or environmental damage and restoration funds, as well as conservation grant funds. Funds for the management of pollution and/or environmental damage and restoration funds can be sourced from state budget, regional budget, or other legal and not-binding sources of funds in accordance with the provisions of the regulations. Other sources of funds can be in the form of cash surpluses, donations/charities, corporate social responsibility, carbon trading profit sharing, loan returns, loans, government program funds related to the environment, or others. Currently, several other sources of fund of BPDLH comes from international grants, green bonds, DBHDR (Dana Bagi Hasil Sumber Daya Alam Kehutanan-Dana Reboisasi - sharing fund from reforestation fund).

Box 36 BPDLH funds

BPDLH can invest and unused fund in the BPDLH account for propagation of the fund either through short-term or long-term investment. The investment can be done on financial instruments such as banking instrument, share market instrument and other financial instruments accordance with provision of laws and regulations

Distribution of Pollution and/or Environmental Damage and Restoration Funds, as well as conservation grant funds can be used for (i) climate change actions, (ii) sustainable forest management, (iii) forest and land fire control and peatland restoration, (iv) social forestry and environmental partnerships, (v) forest and land rehabilitation activities and other supporting activities, (vi) conservation of biodiversity and ecosystems, (vii) control of pollution and/or environmental damage, (viii) increasing the competitiveness of natural resource-based industries; (ix) treatment of solid, liquid, and toxic hazardous wastes, (x)use of environmentally friendly and low-carbon materials and technologies, (xi) increasing the application of energy efficiency, renewable energy, and energy conservation, (xii) reduction of disturbances, threats, and violations of law in the field of environment and forestry; and (xiii) other environmental protection and management activities in accordance with the provisions of laws and regulations.

9.2 CAP funding and financing

CAPs elaboration and implementation require tailored dedicated financing. The achievement of the sustainable targets often implies big investments at local and national level. 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 CAP process and available schemes and mechanisms. The need of financing support may arise for different stages of the CAP process: capacity buildings and trainings, technical and legal studies, feasibility assessments, assistance with financial studies for actions and their implementation.

To advance in the implementation of climate related projects, cities can focus on financing modelling and development of bankable projects, but also on financing options ranging 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, socio-economic) to feasibility studies, from legal studies to financing studies and stakeholder engagement. Therefore, local

([30]) https://bpdlh.id/about-bpdlh/

authorities should at first identify at which stage of the process and for which activity they need financial support. Subsequently, available schemes, financial mechanisms and resources at the local, regional, national and international level should be defined.

Multiple funding sources are needed to fund climate change responses in cities since available resources may not be sufficient. Local authorities' budget is only one component of the financing structure. Due to the great involvement of stakeholders, CAP implementation will also require a strong institutional coordination to ensuring coherent and effective budgeting. In this context, local authorities may have to take into consideration the role of private actors in developing climate related projects. CAP actions could be partially co-financed by the private sector and part of the projects may receive grants support.

- Funding: refers to how a project is paid for over time.
- Financing: refers to how debt or equity is raised to pay for immediate capital investment.

This section will attempt to describe the most common financing mechanisms and funding opportunities available to the GCoM SEA signatories in Indonesia region. Links and examples are provided as a general guidance to local authorities and stakeholders.

9.3 Challenges for local authorities

Numerous barriers impede the development and implementation of sustainable actions in cities. Local authorities may face a number of challenges when considering the implementation of the actions planned in their CAP. Some common barriers faced by Local Authorities when dealing with financing mechanisms and funding opportunities are listed below:

Box 37 Common barriers for local authorities

Local Authorities lack knowledge of all the options of financing schemes available. There are existing initiatives that try to tackle this problem by providing comprehensive information about the different financing options available.

Local Authorities financial autonomy. Frequently LAs lack knowledge regarding the share of tax revenues transferred to the local authority. This also extends to a lack of mandate and systems in place to facilitate financial autonomy.

Absence of capacity to present projects that can be financed. Local Authorities do not possess the proper manpower, professional training and experience to choose the most suitable instrument, to prepare application for the funding, to make the project eligible. The access to financing instruments, especially non-grant instruments, for climate action is often challenged by the difficulty in demonstrating the 'bankability' of the planned investments. Moreover, time constraints seriously challenge local authorities in developing documents for submission. There are funding opportunities oriented to increase the technical skills on this aspect and to support in the preparation of applications and documents.

Climate investments are often small or scattered to attract investors. Moreover, these programs are hardly designed to be financially viable and replicable. Options to aggregate small projects should be explored.

Lack of trust impeding private sector investment. Private sector involvement could be fostered by transparency and clearly defined risks. In parallel, LAs show low or no trust in private sector, which ends up with a scarce private involvement in action planning and implementation.

Weak institutions and legal frameworks and underdeveloped capital markets harm the access of LAs to long-term finance. Financial intermediaries, including national, regional and international development banks, can play an important role in promoting urban finance, basing upon the experience of developed countries.

9.4 Financing mechanisms

Investment projects in the area of climate and energy for cities show many similarities in principles and models with other (more traditional) investment projects. Understanding these aspects would be an important step for local authorities who will have to decide the most effective approach to implement the actions contained in their CAPs. More advanced tools are available, and depending on the local context these mechanisms may have significant potential to finance actions. Moreover, through the development of tailored market mechanisms the private sector is more involved and incentivised to invest in the climate action. However, due to the complexity of these instruments, special consideration should be given in the planning and implementation phases, to avoid potential pitfalls with adverse effects on the local population. The paragraphs below describe frequent mechanisms that can be used to support key actions in cities.

9.4.1 Local Authorities' own financial resources

Municipal budget is a short term funding option for local climate action. These resources may come from grants (national or external), local taxes (houses, business, income-producing sources), borrowing in terms of debt financing and loans. However, these last options are limited due to the lack of an adequate legal framework, difficulties for local authorities to be solvent and transparency issues. Green bonds and climate bonds are spreading among local authorities as a viable tool to sustain local climate projects.

9.4.2 Grant programs

Investment grants or interest rate subsidies are often provided by governments to support the upfront cost of energy efficiency projects that may entail too high investment costs and long amortisation periods. Investment subsidies increase the financial rate of return on investment, increasing investors' demand for investment. In addition, investment subsidies improve cash flow and thus increase investors' access to debt finance (Bertoldi and Rezessy).

Public grant programmes are used in order to support Energy Efficiency projects that contribute to energy and social policies and meet other public policy goals. The advantage of public grant programmes is that subsidies can be an important factor in raising the general awareness and trust in sustainable projects.

On the contrary, the great disadvantage is that in times of squeezed budgets, it is often difficult to put aside the necessary budget for subsidies to realise the policy goals. This often places subsidy programs in a stop-and-start operational mode, which may actually delay project implementation encouraging potential project proponents to wait for better grant conditions or for the next funding call.

Box 38 Small Grant Program in Indonesia (SGP Indonesia)

The Small Grant Program in Indonesia (SGP Indonesia) is a collaborative program between the ASEAN Center for Biodiversity (ACB) and the Government of Indonesia through the Ministry of Environment and Forestry (MoEF) in the form of a Small Grant Program that includes biodiversity and livelihood conservation programs. In Indonesia, Penabulu Foundation as Service Provider is contracted by ACB provides handholding assistance/service to small and micro grants. The objectives SGP Indonesia Programme are:

- To enhance biodiversity protection in line with the interests of local populations that are directly dependent on specific AHPs and adjacent areas;

- To improve the livelihoods of people who are directly dependent on resources in and around AHP; and

- To strengthen the role of ACB in promoting biodiversity protection among ASEAN member states.

SGP Indonesia's support is aimed at civil society in carrying out activities aimed at increasing local participation, strengthening law enforcement, and linking habitat management with efforts to sustainably use of biodiversity.

Source: https://sgp1idn.grantmanagement.penabulufoundation.org/en/

Box 39 GEF Small Program

GHG mitigation activities supported by the GEF Small Program related to energy sector have taken place in Indonesia. This GEF small grant program activity is carried out by a number of organizations through various development agencies, such as UNDP, UNEP, World bank, etc. An example of the GEF small grant energy sector program activities coordinated by the United Nations Development Programs (UNDP) such as Enhancing Readiness for the Transition to Electric Vehicles in Indonesia (ENTREV), Advancing Indonesia's Lighting Market to High Efficient Technologies (ADLIGHT), Integrated Microhydro Development and Application Program (IMDAP), Wind Hybrid Power Generation (WHyPGen) Marketing Development Initiatives etc. Basically, UNDP assists the MEMR in supporting the use of energy efficiency in buildings, the use of electric vehicles, and the use of renewable energy. All of these activities lead to a reduction in energy consumption and the use of renewable energy that supports the energy transition to low-carbon energy (https://www.thegef.org/projects-operations/database)

Source: https://www.thegef.org/projects-operations/database

9.4.3 Soft loans

Soft loan schemes which offer below market rates and longer payback periods, and loan guarantees, which provides buffer by first losses of non-payment, are mechanisms whereby public funding facilitates/triggers investments in Energy Performance Contracting (EPC) ([31]). They give long-term financial coverage to help bridge the pre-commercialisation financing gap for EE projects by direct subsidies on interest payments, by risk premiums (e.g. a state can guarantee a certain amount of loans), or by capital gains to a revolving fund. They are commonly used for energy efficiency measures. Loan conditions include:

- extended payback periods;
- low or zero interest rates;
- short-term interest deferral periods and/or inclusion of payback grace periods.

9.4.4 Green Bonds

A green municipal bond is a fixed-income financial instrument for raising capital through the debt capital market. Bond markets can be a source of low-cost capital for cities and municipalities. 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 ([32]).

In the Association of Southeast Asian Nations (ASEAN) countries, the number of green bonds issued to fund green building projects is projected to increase. Green buildings are recognized as a legitimate project that may be financed through green bonds under the International Capital Market Association Green Bond Principles (ICMA GBP) and the ASEAN Green Bond Standards (GBS) ([33]).

9.4.5 Public-private partnerships (PPPs)

Governments have difficulties in meeting the demand for services and implementing climate projects by acting alone. As a consequence, cooperation between the local authority, local investors, and local citizens are deemed to be vital factors of success for realizing ambitious projects in the adaptation and mitigation framework. The public-private partnership (PPP) is one of such collaboration, based on the awareness that both the public and private sectors can benefit by combining their financial resources, know-how and expertise. PPPs are a concession mechanism whereby the local authority acquires financing from the private sector, with certain obligations. Numerous stakeholder groups have a legitimate interest in sustainable actions development. The leadership of local authorities usually have a crucial role in forging partnerships and pooling resources across the public and private sectors. When identifying all the stakeholders that might contribute to the partnership, their level of participation and potential conflicts of interest must be taken into account.

([31]) Energy Performance Contracting (EPC) is a contractual arrangement between a beneficiary and an Energy Service Company (ESCO) for energy efficiency improvements.

([32]) 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

([33]) Kapoor et al., "The Viability of Green Bonds as a Financing Mechanism for Energy-Efficient Green Buildings in ASEAN: Lessons from Malaysia and Singapore."

As an enabler, local authorities have the capacity to steer policies in support of niche innovations that are new to the market as well as technologies that offer multiple social benefits. For instance, public administration promotes the construction of a zero-emission swimming pool, or a district heating and cooling installation, by allowing a private company to run it revolving the profits on the initial investment.

9.4.6 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. The funds remain available to finance continuing operations, because they are replenished with the revenues earned. These funds are very important when liquidity is scarce. They can be established as a bank account of the owner or as a separate legal entity. The interest rate generally applied in the capitalisation of revolving funds is lower than the market one. Typically, several parties are involved and the owners can be public or private companies, organisations, institutions or authorities. The operator of the fund can either be its owner or an appointed authority. External donors and financiers provide contributions to the fund in the form of grants, subsidies, loans or other types of repayable contributions. The borrowers can either be the project owners or contractors. The advantage of revolving funds is that they are less dependent on external investors. If they are operated effectively, revolving fund can contribute to a permanent financing structure for energy efficiency investments, which is separate from political influence. A revolving fund can complement to the Energy Services Companies (ESCO).

9.4.7 Crowdfunding

Crowdfunding distinguishes itself from more traditional mechanisms, in which a small number of investors provide large sums of money to finance sustainable development projects. In crowdfunding, the approach is subverted. It is based on individuals' efforts to support other's initiatives or projects by investing small sums of money. The main channel to gather money is internet: projects seeking funding are displayed in an online accessible portal. Once the project reaches the funding target, it can be commissioned to provide returns to investors. Crowdfunding offers a possible funding solution for energy efficiency projects, where established banks do not offer loans or not at attractive conditions compatible with project needs. Debt Crowdfunding is the most frequently used modality as a crowdfunding loan is relatively simple in its design and can be easily communicated to potential investors. Equity crowdfunding consists of selling a stake of business to a number of investors in return for investment.

Box 40 Debt Crowdfunding for Commercial Building Energy Efficiency in Indonesia

A large international hotel in Indonesia planned to replace all its lighting with LED with a total planned investment of about € 45,000 and total energy savings estimations of 120,000 kWh per year (about €9,730) plus an estimated €3,954 for reduced maintenance and replacement costs. The dynamic payback period for the project (investment/annual revenues) was 3.7 years. An ESCO took care of the implementation but faced difficulties raising the necessary debt finance from banks. Hence, the ESCO sought debt financing through crowdfunding for a 7-year and 8% p.a. interest rate loan, with a balloon payment in year 7. Total revenues in terms of energy cost savings (net of regular operating costs), amount to €94,065 over 7 years. These revenues are distributed in the following way: 10% to the building owner, per shared savings agreement with the ESCO; 43.4% to the crowd lenders in form of interest and principal payments; and the balance of 46.6% to the ESCO. From its income, the ESCO has to cover its own costs and also the cost of using the CFP (13% of the €31,636 raised through crowdfunding) The energy efficiency measures and the crowdfunding approach were found to be financially viable. The Internal Rates of Return (IRRs) are attractive at up to 50%. The project could generate CO_2 reductions without relying on government subsidies. To the private sector, additional funding coming through crowdfunding would offer opportunities to expand the Energy Service Company (ESCO) business and tap into energy efficiency and cost savings potential where currently owners have no willingness to invest own money. In addition, involving the crowd can lead to greater public awareness and support for energy efficiency measures. Serious challenges need to be addressed to implement crowdfunding for energy efficiency (i) legal uncertainty because regulations are missing or are inappropriately adopted from existing pre-crowdfunding legislation; (ii) missing institutional capacity and support services, (iii) possible 'competition' in the future from donations or government subsidies.
Source: GIZ (2016) CF4EE - Crowdfunding for Energy Efficiency

In North America and Europe, crowdfunding has emerged as a promising alternative for entrepreneurial finance. Crowdfunding platforms are increasingly targeting the development and commercialization of clean

technologies in developing countries. Beyond monetary gains, crowdfunding helps to increase the visibility and transparency of a company, which in turn increases its perceived trustworthiness with customers, investors and partners.

The Financial Services Authority (OJK) in Indonesia announced plans to issue crowdfunding regulation in 2016 (http://www.fintechasia.net/ojk-indonesiafintech-plans). This will help to create greater legal certainty for potential platforms and investors.

9.4.8 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 (such as comprehensive building energy retrofits). High financing costs may be expected to reflect the fact that the debt is registered on another entity's balance sheet. The interest rate is, however, only one factor among many that should be considered to determine the suitability of a third-party financing vehicle. In the region, almost all the countries have allowed for third party access (Bertoldi and Rezessy).

9.5 Energy services companies (ESCOs)

Energy Service Companies (ESCOs) are one of the most well-defined third-party financing mechanisms for energy-related initiatives. ESCOs provide the opportunity to reduce greenhouse gas emissions through increased energy efficiency in a variety of sectors. ESCO remuneration is based on the amount of energy saved through the project, thereby the ESCO usually finances the energy-saving projects without any up-front investment costs for the local authority. The energy savings achieved during the contract period recovers the investment costs and pays a profit. The contract guarantees the local authority a certain energy savings and saves the city investment in an unknown field. Once the contract has expired, the city owns the efficient project. ESCO regulation in Indonesia was issued quite recently in 2016. In this regulation, the ESCOs require a Letter of Acceptance from the government to run their businesses. ESCOs can also collaborate with financial institutions to arrange finance (Nurcahyanto et al. 2020).

10 Conclusion

The main goal of the present guidebook was to assist Indonesian local governments in developing Climate Action Plans (CAPs) according to the Global Covenant of Mayors Common Reporting Framework (CRF). Even if the guidebook has been prepared to ensure the coherence of the CAPs with the general CRF principles, the sequence of actions have been chosen to allow the Indonesian local governments to be consistent with their specific circumstances. Throughout the eight chapters, the guidebook has provided a step-by-step guidance, reporting relevant examples of climate measures already implemented in Indonesia and suggesting possible measures to be put in place.

First of all, this guidebook has presented an overview of the current state of Indonesian local governments resources in climate action planning, pointing out the major issues that the Indonesian local authorities may encounter in developing a local climate plan (chapter 1). Funding, human capital, infrastructure and information technology, have been recognised as the principal barriers which could prevent local authorities to implement effective mitigation and adaptation measures. Thus, the guidebook continues (chapter 2) providing local authorities with a general perspective on the CAP: principles, elements and processes are illustrated and discussed. In chapter 3, the CAP planning phase is illustrated, including the main steps for developing the GHG emission inventory / Baseline Emission Inventory (BEI), the Risk and Vulnerability Assessment (RVA) and overviewing the main energy access and poverty characteristics. To target and goal setting is dedicated chapter 4, while throughout chapter 5, a structured guidance for elaborating mitigation adaptation and energy access measures, tailored to the characteristics of the Indonesian local authorities and in accordance with the current national and international context is provided. The chapters 6 and 7 have then presented how to implement the planned actions and the available reporting systems in Indonesia. Chapter 8 shows how to monitor the progress towards the target setting and finally, chapter 9 has reported some insights on how to finance the action plans.

In general, the present guidebook has been developed to have a dual function: on the one hand it can be used by local authorities as a technical tool to rely on when preparing the CAPs; on the other hand, the guidebook contains insights into climate local policies (annexes 1-7), which are the results of experience gained in other regions of the world (i.e. at European level), and which could serve as example and inspiration for the Indonesian local authorities.

To conclude, we would remark the role that this guidebook could play in mainstreaming climate mitigation and adaptation policy, towards a multilevel climate governance. In fact, although in Indonesia climate change has long been incorporated in the national policy, there is still a gap between the higher level policies and local development planning. The CAPs could provide a concrete basis for the mainstreaming of the higher level policies, thus localising both global and national climate policies into concrete implementable development projects at the local level.

11 References

Adiputra, IMP, Utama, S, Rossieta, H. 2018. Transparency of local government in Indonesia. Asian journal of accounting research 3(1): 123-138. Available at https://www.emerald.com/insight/content/doi/10.1108/AJAR-07-2018-0019/full/pdf.

Banister D. (2011). "Cities, mobility and climate change". Journal of transport geography, 19, 1538-1546.

Bappenas, National Development Planning Agency. 2019. Available at http://lcdi-indonesia.id/wp-content/uploads/2020/05/Executive-Summary-NAP.pdf.

Bappenas, National Development Planning Agency. 2021. Executive summary of Climate Resilience Development Policy 2020-2045. Available at https://lcdi-indonesia.id/wp-content/uploads/2021/11/0_Executive-Summary.pdf.

Barr, S., Gilg, A, and Ford, N. (2005). The Household Energy Gap: Examining the Divide between Habitual- and Purchase-Related Conservation Behaviours. Energy Policy 33, 1425-1444.

Bertoldi and Rezessy, Financing Energy Efficiency: Forging the Link between Financing and Project Implementation. [Online] Ispra: Joint Research Centre of the European Commission.

Common Reporting Framework. Available at https://www.globalcovenantofmayors.org/our-initiatives/data4cities/common-global-reporting-framework/.

Eriksen and Kelly (2007). Developing Credible Vulnerability Indicators for Climate Adaptation Policy Assessment. Mitigation and Adaptation Strategies for Global Change, 12: 495–524 C Springer DOI: 10.1007/s11027-006-3460-6.

Faqih, A. (2016) Proyeksi Iklim menggunakan Luaran GCM CMIP5: Statistical Bias Correctionfor Climate Scenarios (SiBiaS) versi 1.1 [Panduan Pengguna]. Departemen Geofisika danMeteorologi, Fakultas Matematika dan Ilmu Pengetahuan Alam, Institut Pertanian Bogor).

Field et al. (2014). 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.

GoI, Government of Indonesia. 2017. Third National Communication. Available at https://unfccc.int/sites/default/files/resource/8360571_Indonesia-NC3-2-Third%20National%20Communication%20-%20Indonesia%20-%20editorial%20refinement%2013022018.pdf

GoI, Government of Indonesia. 2021. Updated Nationally Determined Contribution Republic of Indonesia. Available at https://unfccc.int/sites/default/files/NDC/2022-06/Updated%20NDC%20Indonesia%202021%20-%20corrected%20version.pdf.

IPCC (2006), 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme. Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (Eds). Published: IGES, Japan. Available at Https://Www.Ipcc-Nggip.Iges.or.Jp/Public/2006gl/Vol2.Html.

Jadmiko, S.D., Murdiyarso, D., & Faqih, A. 2017. Climate Changes Projection for Land and Forest Fire Risk Assessment in West Kalimantan. IOP Conf. Series: Earth and Environmental Science 58 (2017): 1-8. doi:10.1088/1755-1315/58/1/012030

Kapoor, A., Teo, EQ., Azhgaliyeva, D., Liu, Y. (2021). The Viability of Green Bonds as a Financing Mechanism for Energy-Efficient Green Buildings in ASEAN: Lessons from Malaysia and Singapore. In: Liu, Y., Taghizadeh-Hesary, F., Yoshino, N. (eds) Energy Efficiency Financing and Market-Based Instruments. Economics, Law, and Institutions in Asia Pacific. Springer, Singapore. https://doi.org/10.1007/978-981-16-3599-1_12.

Karl, T.R., N. Nicholls, and A. Ghazi, 1999: CLIVAR/GCOS/WMO workshop on indices and indicators for climate extremes: Workshop summary. Climatic Change, 42, 3-7.

Kementerian Lingkungan Hidup dan Kehutanan. Direktorat Jenderal Pengendalian Perubahan Iklim. Direktorat Inventarisasi GRK dan Monitoring, Pelaporan, Verifikasi (2019). Panduan Sistem Inventarisasi GRK Nasional Sederhana Mudah Akurat dan Transparan (SIGN SMART) 2019.

Kern, K., Alber, G. (2009). Governing Climate Change in Cities: Modes of Urban Climate Governance in Multi-level Systems. The international conference on Competitive Cities and Climate Change, Milan, Italy, 9 - 10 October, 2009.

KLHK (2016). User Manual Sistem Registri Nasional Pengendalian Perubahan Iklim. Jakarta: Direktorat Jenderal Pengendalian Perubahan Iklim.

KLHK (2022). Penyelenggaraan Inventarisasi Gas Rumah Kaca Nasional NDC dan LTS-LCCR [PowerPoint slides], Juli 20, 2022.

Laporan Hasil Analisis Neraca Energi Nasional 2021, Sekretariat Jenderal Dewan Energi Nasional.

MoEF, Ministry of Environment and Forestry. 2020. Roadmap Nationally Determined Contribution (NDC) on Climate Change Adaptation. Available at http://ditjenppi.menlhk.go.id/reddplus/images/adminppi/adaptasi/dokumen/Roadmap_NDC_API_opt.pdf.

MoEF, Ministry of Environment and Forestry. 2020. Roadmap Nationally Determined Contribution (NDC) on Climate Change Adaptation. Available at http://ditjenppi.menlhk.go.id/reddplus/images/adminppi/adaptasi/dokumen/Roadmap_NDC_API_opt.pdf.

Moss, R.H., Edmons J.A., Hibbard, K.A., et al. 2010. The next generation of scenarios for climate change research and assessment. Nature 463: 747-756. doi:10.1038/nature08823

National Adaptation Plan Executive Summary 2019 (Ministry of National Development Planning/Bappenas 2021 Ministry of National Development Planning/Bappenas, 2019; https://lcdi-indonesia.id/wp-content/uploads/2020/05/Executive-Summary-NAP.pdf)

NRE - New and Renewable Energy (Energi baru dan terbarukan) - Government Regulation 79/2014.

Nurcahyanto, Yeliz Simsek, Tania Urmee, (2020). Opportunities and challenges of energy service companies to promote energy efficiency programs in Indonesia, Energy, Volume 205,117603,https://doi.org/10.1016/j.energy.2020.117603.

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.

Palermo, V., Bertoldi, P., Apostolou, M., Kona, A., Rivas, S. (2020)Assessment of climate change mitigation policies in 315 cities in the Covenant of Mayors initiative, Sustainable Cities and Society, 60. 102258, https://doi.org/10.1016/j.scs.2020.102258.

Perwithosuci et al. (2022). Carbon emission and urbaization in Asean-5 countries. Jurnal Ekonomi dan Pembangunan 12:203-212 (http://journal2.uad.ac.id/index.php/optimum/article/view/6582/3088).

Peterson, T.C., and Coauthors: Report on the Activities of the Working Group on Climate Change Detection and Related Rapporteurs 1998-2001. WMO, Rep. WCDMP-47, WMO-TD 1071, Geneve, Switzerland, 143pp.

PODES (Village Potency): https://www.bps.go.id/publication/2022/03/24/ceab4ec9f942b1a4fdf4cd08/statistik-potensi-desa-indonesia-2021.html.

Presidential Regulation 98/2021.

Setyowati, AB. (2020). Mitigating energy poverty: Mobilizing climate finance to manage energy trilemma in Indonesia. Sustainability 12, 1603; doi:10.3390/su12041603.

Statistik PLN 2021. https://web.pln.co.id/statics/uploads/2022/03/Statistik-PLN-2021-Unaudited-21.2.22.pdf

Usman (2001). Indonesia's decentralization policy: initial experience and emerging problems. Available at https://smeru.or.id/sites/default/files/publication/euroseasexperience.pdf

UUD 1945 constitution. Available at https://www.dpr.go.id/jdih/uu1945

List of abbreviations and definitions

AC	Air Conditioning
AFOLU	Agriculture Forestry and Other Land Use
ASEAN	Association of Southeast Asian Nations
BEI	Baseline Emission Inventory
CAP	Climate Action Plan
CCS	Carbon capture and storage
CRF	Common Reporting Framework
CH_4	Methane
CHP	Combined heat and power
CO_2	Carbon dioxide
CO_2-eq	CO_2-equivalents
CoM SEA	Covenant of Mayors in Southeast Asia
CoM	Covenant of Mayors for Energy and Climate
EC	European Commission
EF	Emission Factor
EFDB	Emission Factor Database
ELCD	European Reference Life Cycle Database
EPLCA	European Platform on Life Cycle Assessment
ESCOs	Energy services companies
FiT	Feed-in Tariff (FiT) mechanism
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)
GPG	Good practice guidance
GTFS	Green Technology Financing Scheme
GWP	Global Warming Potential
HPS	High-pressure sodium lamps
ICLEI	Local Governments for Sustainability
ILCD	International Reference Life Cycle Data System
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre of the European Commission
LA	Local Authority
LCA	Life Cycle Assessment
LDC	Least developed countries
LED	Light emitting diodes
LEP	local energy production
LHC	Local Heat Consumption
LPA	Local Planning Authority

LCCF	Low Carbon Cities Framework
LULUCF	Land Use Land Use Change and Forestry
NPP	National Physical Plan
MEI	Monitoring Emission Inventory
N_2O	Nitrous Oxide
NCV	Net calorific value
NDCs	Nationally Determined Contributions
PFIs	Private Finance Initiatives
PPs	Public-private partnerships
PVI	Solar photovoltaic installation
RES	Renewable energy sources
RVA	Climate Change Risk and Vulnerability Assessment
SEDA	Sustainable Energy Development Authority
SDG	Sustainable Development Goals
TNB	Tenaga Nasional Berhad
UNFCCC	United Nations Framework Convention on Climate Change

List of boxes

List of figures

List of tables

Annexes

Annex 1. Local policies to support Climate Action Plans

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 instigates 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 mobilize 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 a policy matrix that summarizes the scope of each mode along with the main tools, the barrier that requires being addressed and exemplary actions to support local energy sustainability is provided. The modes of urban energy and climate governance (Palermo et al., 2020) 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.

Municipal self-governing

Local Authorities have the capacity to govern their own activities and undertake strategic investments in municipality-owned assets, which include investments in energy efficiency and local energy generation based on renewable energy sources. The main tools that are used by local authorities in this capacity are energy audits, demonstration projects in public facilities and public procurement, which can be used to better manage the local authority estate. Through these tools, local authority can provide technical validation and stimulate energy efficiency and demand for renewable energy and/or its purchase from district networks. Moreover, this mode of governance also relies on reorganisation and institutional innovation. Awareness raising among public servants and transversal communication among different departments are key measure to implement CAPs and progress towards sustainability.

Municipal enabling (governing through enabling)

As a facilitator, the local authority has an active role in enabling cooperation between community actors, including those that lead to the launch of public-private partnerships to promote local energy generation. Moreover, the involvement of a range of different partners increases the democracy of the processes. The LA also has a crucial role in engaging in awareness and capacity building campaigns that promote energy efficiency in buildings, sustainable transport and behaviour, utilization of renewable energy sources and the deployment of local energy generation technologies. These tools can be actively used within the capacity of local authorities to overcome any lack of business models to leverage financial resources as well as inadequate knowledge and skills.

Governing through provision

The Local Authority is a provider of urban services and as such, has control or influence over infrastructure development. Within this capacity, the LA can effectively guide development in a way that increases energy efficiency in all urban sectors, support transition to sustainable transport and promote local energy production

Regulation and planning (governing by authority)

In addition to capacities as implementer, enabler, and provider, local authorities govern by authority through setting regulations and putting forth urban planning principles.

Among other tools, local authorities can revise building codes to promote the improvement of energy efficiency in buildings, impose road charging to reduce congestion as well as incentive the use of renewable energy in the building stock for distributed generation. In the context of local energy generation, this mode of governing involves setting requirements on the mandatory use of renewable energy and ruling on strategic energy planning decisions. Based on such tools as ordinances and strategic energy planning, local authorities can assist in addressing certain shortcomings for supporting niche markets and emerging technologies as well as insufficient guidance to inform decision-making for local energy generation

Public Procurement

Public procurement refers to the process by which public authorities, such as government departments or local authorities, purchase work, goods or services from companies. Public procurement and the way procurement processes are shaped and priorities are set in the procurement decisions, offer a significant opportunity for local authorities to improve their overall energy efficiency.

Green public procurement is the process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured. This means that public contracting authorities take environmental considerations into account when procuring goods, services or works. Sustainable public procurement goes even further and means that the contracting authorities take into account the three pillars of sustainable development – the effects on environment, society and economy - when procuring goods, services or works.

Energy efficient public procurement allows improving energy efficiency by setting it as relevant criteria in the tendering and decision-making processes related to goods, services or works. It applies to the design, construction and management of buildings, the procurement of energy consuming equipment, such as HVAC systems, vehicles and electrical equipment, and also to the direct purchase of energy, e.g. electricity, gas. It includes practices such as life-cycle costing, the setting of minimum energy-efficiency standards, the use of energy efficient criteria in the tendering process, and measures to promote energy efficiency across organisations.

Energy-efficient procurement offers public authorities, and their communities, social, economic and environmental benefits:

- By using less energy, public authorities will reduce unnecessary costs, and save money;
- Some energy-efficient goods, such as light bulbs, have a longer lifespan and are of higher quality than their cheaper alternatives. Purchasing them will reduce valuable time and effort involved in frequently replacing equipment;
- Reducing CO_2 emissions as a result of energy-efficient procurement will help public authorities to decrease their carbon footprint;
- Through leading by example, public authorities help to convince the general public and private businesses of the importance of energy efficiency and support the development of green economy.

Green Electricity Purchasing: In order to ensure that the electricity supplied comes from a renewable energy source, consumers have the possibility to request guarantees of origin certificates of the electricity. The supplier has also the possibility to provide independent proof of the fact that a corresponding quantity of electricity has been generated from renewable sources, or produced by means of high-efficiency cogeneration. Price differences between conventional and green electricity depend on the status of liberalisation, the features of the national support schemes and the existence of green electricity suppliers. Green electricity has proven to be a product group which is available for public procurement on a competitive basis.

Annex 2. Municipal self-governing mode of urban climate governance

Mode of urban climate governance	Tools	Barrier addressed	Action examples
Municipal self-governing: Strategic investments in municipality-owned assets to increase local energy generation	Energy management of local authority estate	Lack of transparent and consistent monitoring and control of energy use; Disincentive for energy efficiency efforts in budget; Difficulty for public entities to contract and manage energy service providers.	Establish standards for monitoring and management of energy to improve efficiency in a systematic and sustainable way; Adopt high-energy efficiency performance standard for public buildings.
	Demonstration projects in public facilities	Need for technical validation and demonstration of performances.	Town halls with solar energy façades and PV powered schools Counter of emission avoided publicly shown; Showcases of obtained results to raise citizen awareness.
	Green public procurement	Need to stimulate demand for energy efficiency renewable energy and/or the purchase of district heating/cooling; Need for National implementation of core criteria as a reference for green public procurement procedures; Deficiency in national and regional platform of public procurement.	Green public procurement for purchasing energy efficient appliances and clean vehicles; Low-carbon, distributed energy supply in public buildings and schools; Municipal purchases of certified green electricity; Clean and sustainable procurement of the LA fleet.
	Institutional reorganisation	Allocation of competencies split in different departments.	Allocation of competencies split in different departments.

Annex 3. Municipal enabling mode of urban climate governance

Mode of urban climate governance	Tools	Barrier addressed	Action examples
Governing through enabling: Facilitating co-operation among stakeholders and awareness building	Labels and certificates in the building sector	Lack of reliable and credible advice on the building performance and awareness of energy savings potential.	Implement all national and/or regional provisions; Promote the adoption of additional voluntary schemes.
	Partnership with transport service providers	Fragmentation of modes	Integrated ticketing and charging.
	Public-private partnerships	Lack of business models to leverage financial resources; Budget constraints in LA.	Public-private partnership for anaerobic digestion of bio-waste for CHP-based district heating; Co-financing between local and regional authorities and private investors for public energy upgrading.
	Awareness raising/training	Inadequate knowledge and skills that may hinder undertaking renewable energy projects. Need for capacity building of LA staff.	Promotional and Communication campaigns to promote behavioural changes; Effective communication on public transport; Promote competitions, awards and contests for climate protection and GHG reduction efforts; Provide guidelines for energy efficiency improvement; Networking with other LA, regional / national authorities, universities to ease the access to funding opportunities; Showcases of obtained results; Appropriate training activities for LA staff.
	Community cooperatives for local energy projects	Need to overcome perceptions of risk as a barrier to citizen involvement.	Supporting tools and information sessions for citizen empowerment

Annex 4. Governing through provision mode of urban climate governance

Mode of urban climate governance	Tools	Barrier addressed	Action examples
Governing through provision: Providing services and financial resources	Public sector financial management and procurement policies	Split incentives and difficulties to access them; Fragmentation in processes and actors of the building trade; Budget constraints.	Revise budgetary rules to allow retention of energy cost savings for other justified public spending; Revise public procurement rules (GPP) to allow for contracting of energy service providers and adopt EE purchase requirements.
	Direct infrastructure investments for transport	Congestion and high energy consumptions and related emissions due to private transport modes; Low-density territories.	Reliable and affordable public transport infrastructure (light rail system and bus rapid transit); Fine tune public transport to the characteristics of the territory (density, type of fluxes).
	Financial incentives in transport	High cost and low financial sustainability of electric mobility;	LA incentives for purchasing clean vehicles and electric bikes.
	Direct energy infrastructure investments	Insufficient energy infra-structure to provide access to renewable energy;	Investments in electric net-works; Minimum quotas for renewable energy supply or co-generation provided by LA owned utilities; Renewable energy sources in public housing.
	Incentives and grants to local energy generation	Insufficient financial incentive; Constrains of local budget; Competition with other investment priorities; Presence of market failures for related technological options.	Use public funds (also national) to leverage private and commercial investments; Third party financing; ESCOs; City Council subsidies for renewable energy.

Annex 5. Governing through regulation and planning

Mode of urban climate governance	Tools	Barrier addressed	Action examples
Regulation and planning: Requirements and guidance in support of energy efficiency and local energy generation	Mandatory standards and building codes	Fragmentation and gaps in the regulatory action of public planning; Urban planners lacking of skills to include energy and climate issues in their work.	Prepare a comprehensive plan to improve energy efficiency in buildings; Develop building codes that addresses energy efficient buildings with minimum energy requirements; Introduce subsidies and bonus; Establish a supporting program to assist in the retrofitting of buildings; Capacity building on climate and energy for urban planners.
	Regulation, controls and sanctions		
	Zoning, urban regeneration and mixed used developments	Sprawl and brownfields.	Creating mixed-use developments; Review the public transport considering mobility patterns of different types of users; Smart intermodal mobility planning; Encourage renovation of existing buildings.
	Regulation and pricing in the transport sector	Difficulty in promoting the use of public and collective transport; Congestion.	Road pricing and congestion charges; Parking management;
	Ordinances on the mandatory use of renewable energy	Lack of support for niche markets or emerging technologies.	Incentivise the installation of solar water heating/solar PV systems in new buildings; Construction of nearly or net-zero-energy buildings.
	Revision of administrative procedures for energy projects	Uncertainty of administrative procedures.	Advantageous conditions to projects in the "Public Interest".
	Strategic energy planning to support local energy generation	Insufficient guidance and access to data to better inform decision-making.	Local maps with heat demand density and industrial waste heat; Land use planning for large-scale solar plants and wind turbines.

Annex 6. Examples of energy-efficient measures proposed in high-priority product groups

Product group	Examples of Public procurement requirement
Public transport	Purchase low-emission buses and public fleet vehicles. The buses have to be equipped with driving-style meters to monitor fuel usage.
Electricity	Increase the share of electricity from renewable sources going beyond national support schemes.
IT products	Purchase of environmentally friendly IT goods that meet the highest standards for energy performance, such as Energy Start. Provide training to users on how to save energy using their IT devices.
Building construction/ renovation	Use of localised renewable energy sources (RES) Impose high efficiency standards that reduce the building's energy consumption. Energy efficient lighting. Using energy efficient cooling equipment or making use of natural ventilation instead of expensive cooling systems.

Annex 7. Key measures to promote local energy generation by renewable energy source or technology

Area of intervention	Policy measure
Local electricity generation:	Municipal financing and ownership of PV pilot plants on public buildings (rooftop PV and building-integrated PV systems)
Photovoltaics	PV installations on the roofs of bus sheds or parking lots
	Construction of a PV park on ground of municipal property at a former landfill site
	Concession of surface rights and renting of rooftop areas in public buildings for PV
	PV installations in public buildings based on collaboration with the ESCo and third-party financing for PV systems in school buildings
	Public-private partnership for Photovoltaic Solar Park
	Mandate for PV system installations equal to a given share of the total installed power in the city
	LAs bonus for photovoltaic and solar thermal installation on citizen's roof
	Interest-free loans for associations or schools for PV panel installations
	PV systems that supply electric vehicle charging stations
	Awareness building and supporting tools Solar land registry for roof-top photovoltaic or solar thermal installations Solar chart for identifying preferable areas for solar energy technologies Solar roof inventory
	Real time electricity generation data on PV systems of the City Council and visual consoles on CO_2 reductions
	Public awareness to reach annual increase targets for PV in the private buildings
	City supported photovoltaic campaign
	Land use planning for utility-scale photovoltaic plants in the city
Local heat generation:	Solar collectors on rooftops of municipal buildings, swimming pool facility, sport buildings and schools (including flat-plate and parabolic solar collector installations)
Solar thermal	Replacement of electrical heaters and boilers in public buildings
	Ordinance for installing solar collectors Solar collectors in all buildings in the health care sector Solar thermal systems in 100% of schools that include south-facing facades and terraces
	Purchasing groups to allow widespread diffusion of solar thermal technology
	Targets to increase the area of solar thermal in the city
Local electricity generation:	Wind and solar farm with citizen cooperation
Wind energy	Installation of wind power farms Promotion of locally owned wind turbines

	Public procurement of municipal wind turbines
	Co-ownership of wind-power plants (municipal company)
	Attraction of companies that want to generate electricity from wind energy
	Prioritized case handling and licencing of wind turbines
	Land use planning for wind turbines
Local electricity generation:	Mini-hydro plants on municipal waterworks
Hydroelectric power	Attraction of investment to realize an in-stream tidal hydro power plant
	Run-of-river hydroelectric plants
	Produces the amount of electricity needed for public building and public lighting loads
	Hydroelectric power plant construction
Bioenergy	Biogas cogeneration plant for electricity and thermal energy provision based on anaerobic digestion
	Biogas cogeneration based on zoo technical wastewater and silage cereals
	Biogas driven district heating network
	New anaerobic digestion plant in public waste recovery and treatment company
	Public-private partnership between the local authority and waste management utility for anaerobic digestion of bio-waste
	Recovery of methane gas from landfills to produce electricity based on gas engines
	Consortium for a cogeneration plant based on biomass certified as sustainable (waste produced locally or from local consortium companies)
	Installation of wood chip boilers
	Collection and recycling of used cooking oil for biodiesel production
Geothermal energy	Construction of a geothermal power plant
	Low enthalpy geothermal heating for municipal residential building
Renewable energy (other)	City Council grants and subsidies for renewable energy (PV, solar thermal, biomass, ground source heat pumps)
	Subsidy per square meter of solar thermal collector area
	Grants for solar collector and heat pump installations
	Subsidy to renewable heat sources in residential buildings
	Clean technology funds for renewables
	Promotion of distributed energy generation based on Urban Building Regulations and simplified building authorization procedures
	Public buildings that are self-sufficient based on on-site renewable energy
	Self-sufficient town hall based on bioenergy and PV
	Demonstrations of net or nearly zero energy building with renewable energy
	Net zero energy schools
	Pilot public school built according to the Nearly Zero Energy (NZE) Standard
	Co-financing of a near zero energy school building with local and national funds
	Public buildings with bioclimatic design principles and renewable energy utilization

	Public social building complex
	Energy renovation of public buildings including solar thermal collectors
	Brownfield urban development with renewables and sustainable districts
	Transformation of former port and industrial area into a new sustainable district
	Co-financing between local and regional authorities for public energy upgrading
	Co-financing of solar thermal systems on public buildings
	Purchasing of certified renewable power for public buildings and public lighting
	Joint framework agreement for purchasing 100% green electricity
	Onshore Power Supply with high-voltage
	Awareness building actions
	Experimental sessions on renewable energy for students
	Training campaigns organized by the local energy utility/agency

Source: Compiled from good practices of Covenant of Mayors EU

Annex 8. Indonesia Nationally Determined Contribution

In the present annex it is reported the Indonesia First NDC (Updated submission, 30/07/2021) in its original format.

The document can be downloaded at the UNFCCC NDC Registry at https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Indonesia%20First/Indonesia%20NDC%20Updated%20Submission%20to%20UNFCCC%20July%202021%20final.pdf

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