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Guidebook:

How to develop a Climate Action Plan (CAP) in Southeast Asia-Malaysia

A Practical Guide for Malaysian Local Governments

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Abstract

The Global Covenant of Mayors in Southeast Asia (GCoM SEA) supports Malaysian 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 voluntarily 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: access to energy (not developed in the current guidebook), climate mitigation and climate adaptation. In order to translate the political commitment into practical measures, GCoM SEA signatories have also to commit to elaborating and implementing a Climate Action Plan (CAP).

This guidebook has been prepared to assist Malaysian 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 Malaysian context. The Guidebook is coherent with the Global Covenant of Mayors Common Reporting Framework (CRF) even if the specific choice and sequence of actions can vary according to the policies and measures already in place. This flexibility allows Malaysian 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 Malaysia 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 Malaysian local governments in developing a climate action plans (CAPs) according to the general principles set out in the GCoM Common Reporting Framework (CRF).

Thanks to this exercise in resources mapping it has also been possible to reconstruct the chronological development of low carbon and climate change issues and consideration in Malaysia. Although concerns about climate change have been incorporated in Malaysia since 1980s[1], local authorities and State government still have to face many challenges to implement effective climate action plan. In particular, there is a gap between the higher level policies and local development planning, pointing to the urgency for local authorities in relying on clear guidance for localising and mainstreaming higher level climate actions into concrete local level development policies.

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.

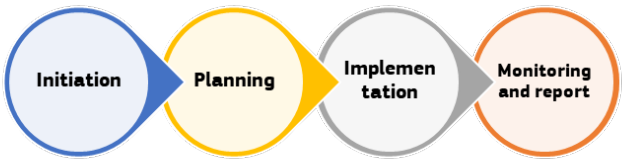
[1] The general policy of climate policy is sustainable development that has been incorporated into the national planning framework since the Third Plan of Malaysia (1976-1980).

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 Malaysian local authorities in their efforts to fight climate change and its adverse effects by means of the elaboration of local Climate Action Plans (CAP). 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.

According to the framework provided in the guidebook, a 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 own elaboration

- ***Initiation phase***: chapter 3 provides detailed guidance throughout the initiation phase on the commitment to address climate change mitigation and adaptation.
- ***Planning phase***: chapter 4 and chapter 5 provide detailed guidance on elaborating a CAP and its parts:
    - chapter 4.2 presents how to undertake a Baseline Emission Inventory (BEI) while chapter 5.1 focuses on setting objectives and targets;
    - chapter 4.3 shows how to undertake a Risk and Vulnerability Assessment (RVA);
    - chapters 5.2 and 5.3 illustrate respectively how to elaborate key mitigation and adaptation 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 setting (6 and 7).

An initial overview of the current state of Malaysian 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 8) 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.

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. The GCoM initiative is a voluntary commitment by **local governments** (regions, cities, towns) to implement measures on three **GCoM pillars**: climate change mitigation, adaptation and energy access.

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 climate mitigation, climate adaptation and energy access. 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 and meet ambitious and realistic energy and **climate targets** set by themselves, in line with GCoM requirements. This means that targets are at least as 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 voluntary commit to the implementation of a climate and energy action plan in their area of influence. They are also encouraged to define long-term vision actions towards a sustainable future based on the pillars of climate change mitigation and adaptation, and sustainable, affordable and secure Access to Energy.

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 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. Currently**,** two **reporting platforms** are officially accepted in the GCoM framework: My Covenant, historically developed in support of the European cities and the CDP/ICLEI's unified reporting system.

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;

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 tools which allow local governments to report on the GCoM requirements and achievements.

1.2 The Regional Covenant of Mayors Southeast Asia: Malaysia

The regional Covenant of Mayors in Southeast Asia (GCoM SEA) engages with cities and local governments in Malaysia, Indonesia, 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 Malaysia, Indonesia 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 Malaysia 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.

Box 2. GCoM SEA/Malaysia 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 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 Malaysia

Malaysia is a federal constitutional monarchy and it consists of 11 States in Peninsular Malaysia (Johor, Kedah, Kelantan, Malacca, Negeri Sembilan, Pahang, Perak, Perlis, Penang, Selangor, and Terengganu), two States on the island of Borneo (Sabah and Sarawak) and three federal territories (the Federal Territories of Kuala Lumpur and Putrajaya in Peninsular Malaysia, and the Federal Territory of Labuan of Sabah).

The local government is the lowest governance level in the three-tier system of government in Malaysia, after the Federal and the State levels. It has the power to collect taxes (in the form of assessment tax), to create laws and rules (in the form of by-laws) and to grant licenses and permits for any trade in its area of jurisdiction, in addition to providing basic amenities, collecting and managing waste and garbage as well as planning and developing the area under its jurisdiction.

Local governments (city councils, municipal councils, district councils and special or modified local government) in Malaysia are an exclusive "power of the States or territories" and therefore the precise nature of councils referred to as “local government” in this guidebook can differ among different states or territories. State-based departments oversee local council and often intervene in their affairs. There is a total of 155 local authorities in Malaysia (**Table 1**).

Table 1: Local authorities by type and state in Malaysia

State	Typology of Local Government					Total
	City	Council/	Municipal	District	Development	
Federal Territory	1		-	-	2	3
Johor	2		6	7	1	16
Kedah	1		4	6	1	12
Kelantan	-		1	11	-	12
Melaka	1		3	-	-	4
Negeri Sembilan	1		3	4	-	8
Pahang	-		3	8	1	12
Perak	1		4	10	-	15
Perlis	-		1	-	-	1
Pulau Pinang	2		-	-	-	2
Selangor	2		6	4	-	12
Terengganu	1		2	4	-	7
Sabah	1		2	22	-	25
Sarawak	3		4	19	-	26
Total	16		39	95	5	155

Source: UTM (Universiti Teknologi Malaysia) Elaboration

Box 3. Particularities of Local Governments in Malaysia

- Unlike the federal and state governments, the local governments in Malaysia are not elected but appointed by the state government.
- Local authorities in Malaysia are generally under the exclusive purview of the state governments and headed by a civil servant with the title Datuk Bandar (Mayor) for city halls/councils or Yang Di-Pertua (President) for municipal councils.
- Local government areas and boundaries are usually consistent with district boundaries but there are some places where the boundaries are not consistent and may overlap with adjoining districts especially in urbanised are

1.3.1 The role of CAPs in mainstreaming climate mitigation and adaptation policy in Malaysia

In Malaysia, development in cities is generally governed and shaped by spatial development policies and other non-spatial, primarily economic and social development policies at the Federal, State and local levels (**Figure 2**, **Box 4**). First, the national government develops strategic policies to determine the general directions and trends of the physical development of the nation. Second, the state governments prepare structure-plan that includes state policy, general proposals and land use and physical environment plans. Finally, local authorities prepare local plans as a detailed land-use plan (map) with written statements.[2]

Box 4. The urban planning system in Malaysia [3]

Spatial development policies and planning come under the Town and Country Planning Act, 1976 (Act 172).

Under Act 172, three statutory plans are to be prepared: the ***National Physical* Plan (NPP)** at the national level, the ***Structure Plan*** at the State level, and the ***Local Plan*** at the local level.

A local government functions as the ***Local Planning Authority (LPA***) for its area of jurisdiction. The LPA holds the traditional statutory role of planning and regulating development and use of land within its administrative areas under Act 172. The LPA is tasked with preparing, implementing and enforcing the Local Plan for guiding and regulating land use and development in the LPA area.

The Local Plan is required by law to take ***cognisance of and provide clear spatial articulation to higher-level development policies***, including the State level Structure Plan, the National Physical Plan as well other general development policies.

Since the Prime Minister of Malaysia made the pledge of voluntary reduction of the country's carbon emission intensity of GDP by up to 40% by 2020 based on the 2005 emissions level at COP 15 in 2009, a series of national-level climate change responses and low-carbon initiatives have emerged in the forms of policies, framework and guidelines (**Figure 3**). Apart from the earlier national climate change policies such as National Policy on Climate Change 2009, National Green Technology policy (2009), National Policy on Environment (2002), National Renewable Energy Policy and Action Plan (2010) and Green Neighbourhood Planning Guidelines (2012), more recent policies include the Green Technology Master Plan 2017-2030 and the Low Carbon Cities Framework (LCCF) and Assessment System (Version 2, 2017).

However, these policies and guidelines have yet to find their way into the lower-level development policies, that are more effective in guiding and regulating physical-spatial development but are hitherto largely 'carbon blind' (**Figure 2**). Reducing energy and carbon emission intensity of rapid growth has to date not been an agenda of these plans and policies.

This points to the importance of having concrete climate action plans (CAPs) at the local government level that serves the "critical link" between the Local Plan and national and global climate change responses and initiatives. The CAPs will provide a concrete basis for the eventual mainstreaming into the Local Plan, thus localising global and national climate policies into concrete implementable development projects at the local level.

Multiple levels of governance (i.e., global, federal, state and local) affect the way cities impact and are impacted by local and global environmental issues. This is particularly important for multi-sectoral environmental issues that require the participation of various levels and departments, such as policies to tackle climate change. For example, decisions about the energy supply in Malaysian cities, which are key to addressing climate change, are primarily made by the national government, not local or state authorities. Thus, building mechanisms for intergovernmental relations among the different organizations in a State is crucial to coordinate environmental management and policy.[4]

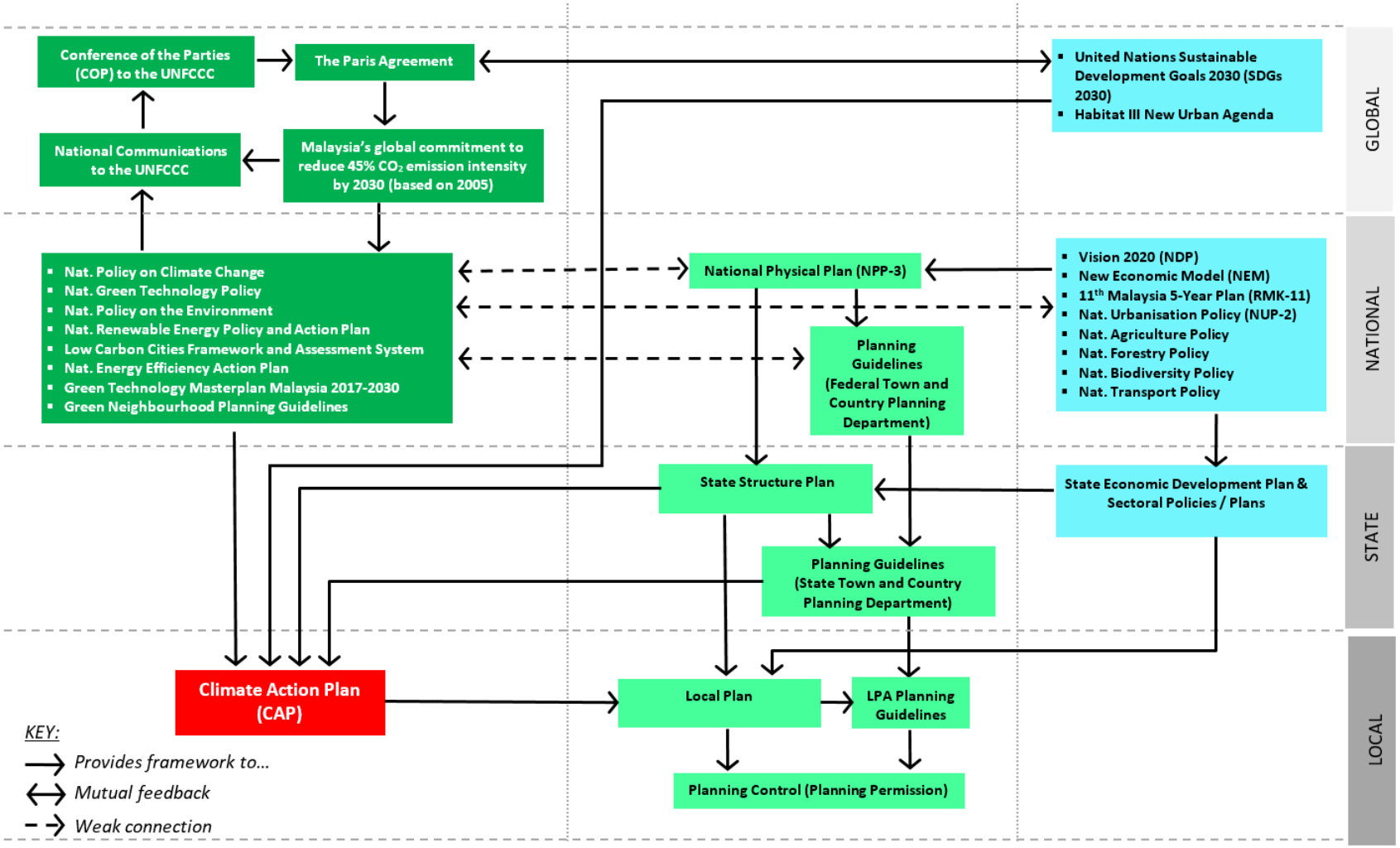
Malaysia has a good and strong foundation in terms of statutory, policy and institutional framework for climate actions. However, there is an obvious gap between the higher level policies and local development planning, pointing to the urgency of having clear guidance for localising and mainstreaming higher level climate actions into concrete local level development policies.

[2] Ahmad et al., "MALAYSIAN DEVELOPMENT PLAN SYSTEM:ISSUES AND PROBLEMS ONE DECADE AFTER ITS REFORM (2001-2011)."

[3] Khailani and Perera, "Mainstreaming Disaster Resilience Attributes in Local Development Plans for the Adaptation to Climate Change Induced Flooding: A Study Based on the Local Plan of Shah Alam City, Malaysia."

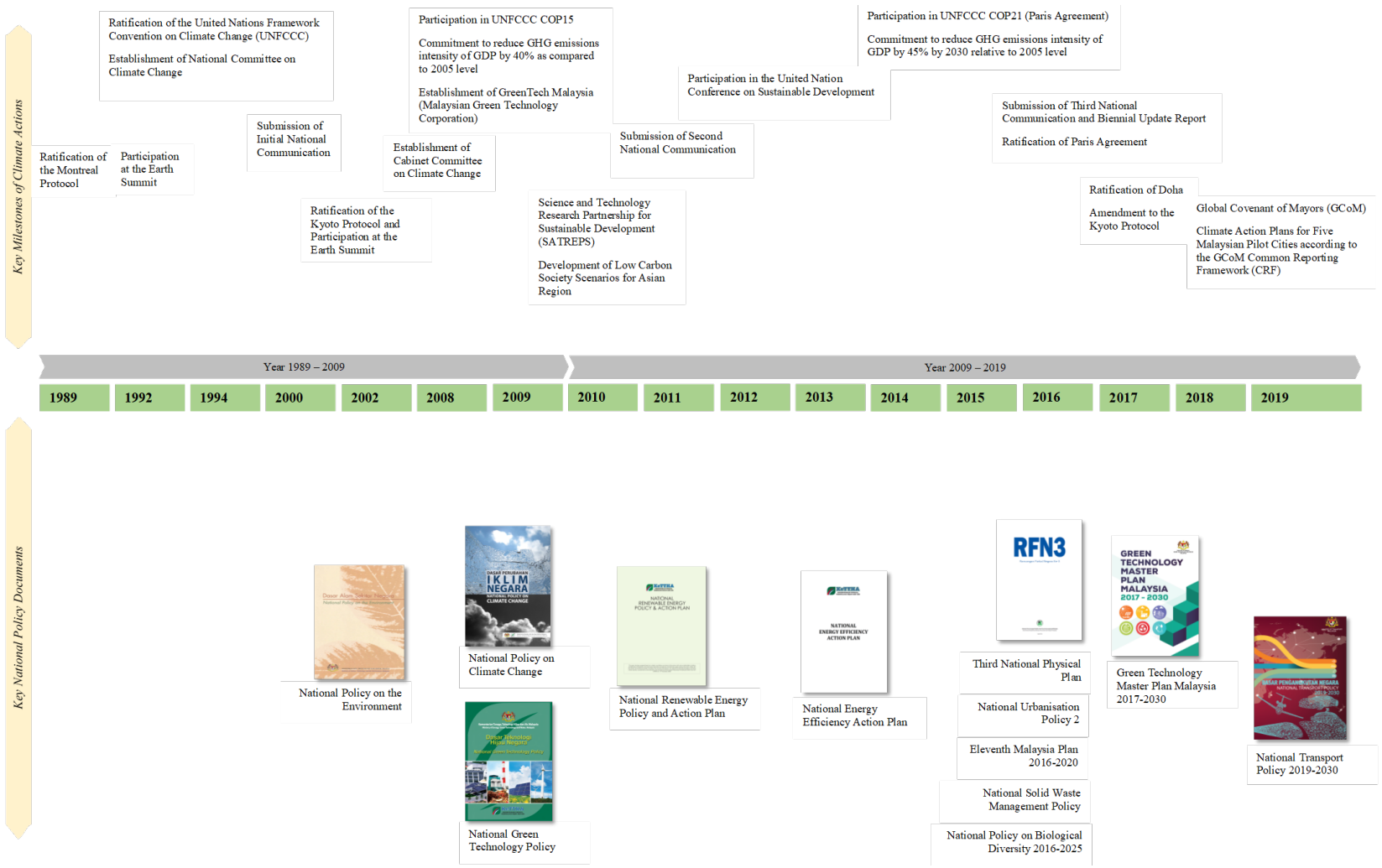
[4] Puppim de Oliveira, "Intergovernmental Relations for Environmental Governance: Cases of Solid Waste Management and Climate Change in Two Malaysian States."

Figure 2. The bridging role of CAPs in the Malaysian policy contexts



Source: UTM (Universiti Teknologi Malaysia) Elaboration

Figure 3. Key Climate Policy Documents and Key Milestones of Climate Actions in Malaysia



Source: UTM (Universiti Teknologi Malaysia) Elaboration

1.3.2 Current Development of Local Climate Action Plans in Malaysia

In response to the national aspiration in addressing climate change (**Box 5**), several local governments voluntary initiated their local climatic action plan (**Table 2**). Among the earliest plans, it can be mentioned the CAP from the Iskandar Malaysia Low Carbon Society Blueprint 2025 (2012), formulated by the Iskandar Regional Development Authority (**Box 6**).

Box 5. National Policy on Climate Change in Malasya[5]:

- to Identify the energy sector as a major contributor of GHGs to the atmosphere;
- to promote of energy efficiency among industries, buildings and transport sector;
- to implement public awareness programs to promote energy efficiency, recycling and the use of public transport; maintenance of an effective forest management and conservation program to preserve biodiversity and sinks for GHGs;
- to ensure food sufficiency by obtaining detailed information on the supply and demand gaps in food production and supported by research projects;
- to formulate a coastal vulnerability index (CVI) that could serve as the basis for recommending proactive measures on sea level rise.

Since a decade, after the inception of national climate change policy (2009), the awareness of climate change from local government has been steadily increasing. Across the existing local climatic action plans, there is a wide spectrum in term of geography, approach and methodology. Some plans are formulated to the citywide region of local government, while some are being defined on the selected study area. Besides, the current practices are mainly focused on the climate change mitigation (reducing GHG emissions) rather than the climate change adaptation (adjusting and expecting the forthcoming climate).

Further, it is also noted that a few methodologies have been adopted for accounting the GHG emissions. Both Asian-Pacific Integrated Model (AIM) and City Inventory Reporting and Inventory System (CIRIS) are seen to base on the 2006 IPCC guidelines for greenhouse gases inventory. Meanwhile, the Low Carbon Cities Framework (LCCF) is a localised accounting method prepared by Malaysian Government (Ministry of Energy, Green Technology and Water).

Despite of an increasing efforts, it has to be noted that there is still a large variability in the frameworks adopted for formulation of local climatic action plan and to date, no common framework has been adopted by the Malaysian local governments. Such a lack of common CAP formulation once more shows how the local climate change action plan is generally disconnected with the content of National Climate Change Policy. These are the gap needed to be address urgently for the sake of more effectively coordinated policies.

Box 6. Iskandar Regional Development Agency (IRDA)

Established in 2007, IRDA, jointly managed by the Johor state and the federal government, is tasked with planning and advising on the strategic directions for the development of Iskandar, the tip of the peninsular Malaysia (and part of Johor state)[6].

Among other things, IRDA has been involved in initiatives for "low-carbon" development in the Iskandar region. Even though IRDA has little coercive power and funds, it helps to coordinate the actions among the different stakeholders in the Iskandar region, particularly bringing together the local, state and federal governments[7].

[5] Khailani and Perera, "Mainstreaming Disaster Resilience Attributes in Local Development Plans for the Adaptation to Climate Change Induced Flooding: A Study Based on the Local Plan of Shah Alam City, Malaysia."
[6] Bong et al., "Review on the Renewable Energy and Solid Waste Management Policies towards Biogas Development in Malaysia."
[7] Ho et al., "Low Carbon Urban Development Strategy in Malaysia – The Case of Iskandar Malaysia Development Corridor."

Table 2. A List of Local Climate Action Plans in Malaysia

Local Government	Climate Action Plan (Publication Year)	Geography	Approach	Methodology
Iskandar Regional Development Authority	Iskandar Malaysia Low Carbon Society Blueprint 2025 (2012)	Citywide	Mitigation	Asian-Pacific Integrated Model (AIM)
Putrajaya Corporation	Putrajaya Green City 2025 (2012)	Citywide	Mitigation	Asian-Pacific Integrated Model (AIM)
Kuala Lumpur City Hall	Kuala Lumpur Low Carbon Society Blueprint 2030 (2017)	Citywide	Mitigation	Asian-Pacific Integrated Model (AIM)
Pengerang Municipal Council	Pengerang Low Carbon Society Blueprint 2030 (2018)	Citywide	Mitigation	Asian-Pacific Integrated Model (AIM)
Muar City Municipal Council	Muar Climate Action Plan (2020)	Citywide	Adaptation; Mitigation	Climate Risk and Vulnerability Assessment (CRVA); City Inventory Reporting and Information System (CIRIS)
Hang Tuah Jaya Municipal Council	Hang Tuah Jaya Climate Action Plan (2020)	Citywide	Adaptation; Mitigation	Climate Risk and Vulnerability Assessment (CRVA); City Inventory Reporting and Information System (CIRIS)
Kampong Bharu Development Corporation	Kampong Bharu Climate Action Plan (2020)	Designated District	Adaptation; Mitigation	Climate Risk and Vulnerability Assessment (CRVA); City Inventory Reporting and Information System (CIRIS)
Penampang District Council	Penampang Climate Action Plan (2020)	Citywide	Adaptation; Mitigation	Climate Risk and Vulnerability Assessment (CRVA); City Inventory Reporting and Information System (CIRIS)
Tawau Municipal Council	Tawau Climate Action Plan (2020)	Citywide	Adaptation; Mitigation	Climate Risk and Vulnerability Assessment (CRVA); City Inventory Reporting and Information System (CIRIS)

Source: UTM (Universiti Teknologi Malaysia) Elaboration

1.3.3 Capacity of Local Governments in Climate Action Planning

The central government has played a major role in the policy agenda-setting process of climate action and green growth in Malaysia. 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.

A cursory observation of local government functions and operation in Malaysia reveals that most local governments lack the capacity in the above enabling conditions with respect to climate change mitigation and adaptation planning. It is only among the relatively more advanced local governments that some limited finance, human resource and IT infrastructure can assure the different levels of readiness needed for advancing local climate action planning. These local governments include among others (non-exhaustive):

In terms of human resources, the more advanced local authorities mentioned above have units, divisions, and/or specific personnel tasked to address climate change. Administratively, some local governments have even set up standing and/or ad-hoc committees and special taskforces for addressing climate change (**Box 7**).

In terms of infrastructure, local governments have performed variably in leveraging ICT resources and knowledge for addressing climate change, including the developing of platforms for e-government, e-services, digital town hall, online stakeholder engagements etc. Many advanced local governments also have formulated and promoted some form of Smart Cities Initiatives as well as plans for providing green and blue infrastructure in their city.

In terms of local government climate finance, possible sources may come from:

- Local government assessment tax, parking charges, processing fees, special budgets (e.g. Five-year Malaysia Plan).
- Local government's development and operational budgets.
- State budget (allocation by State according to municipality type).
- External sources (climate change related) may include incentives, financing schemes (GTFS, GCoM GAP Fund etc.).
- Other financing modes which include the local government entering into PPPs (Public Private Partnerships) or promoting PFIs (Private Finance Initiatives).

Box 7. Examples of "Green Council" in Malaysian Local Governments

- Melaka Green Technology Council

The Melaka green technology council was set up to formalise and coordinate the implementation of climate change mitigation and adaptation policies at state and city levels, as well as to coordinate cross-sector green city initiatives[8].

- Penang Green Council

In Penang, the state government has created the Penang Green Council (PGC), a semi-autonomous government funded organization, to advance the agenda of sustainable development in several areas, including climate change. The PGC focuses on raising public awareness, which has positive impact on citizens' behaviour towards sustainable practices[9].

- Kota Kinabalu Green Council

Green Council was constituted to ensure vertical linkages climate priorities and plans. A steering committee and other technical working groups were also constituted to develop the Kota Kinabalu Green City Action Plan.

[8] Zen, Al-Amin, and Doberstein, "Mainstreaming Climate Adaptation and Mitigation Policy: Towards Multi-Level Climate Governance in Melaka, Malaysia."

[9] Puppim de Oliveira, "Intergovernmental Relations for Environmental Governance: Cases of Solid Waste Management and Climate Change in Two Malaysian States."

2 Climate Action Plan (CAP)

The CAP defines concrete measures for climate mitigation and adaptation, with timeframes and assigned responsibilities, translating the long-term strategy into action.

The CAP is both a strategic and an operational document. It uses the results of the Baseline Emission Inventory (BEI) to identify the best fields of action and opportunities for reaching the local authority's greenhouse gases (GHG) emissions target. It is based on the climate change Risk and Vulnerability Assessment (RVA), which identifies the most relevant city climate hazards and vulnerabilities.

The Climate Action Plan (CAP) is the key document that sets the strategies, plans and actions for a sustainable and low greenhouse gas (GHG) emission development while including climate adaptation actions in response to the current and future impacts of climate change in the territory.

The CAP shall lead to climate change mitigation and adaptation 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 climate related plans, it should prepare a CAP as a natural extension of the ongoing activities and measures.

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.

The CAP is defined by three main aspects:

- Principles: the criteria defining the scope, boundaries and sector coverage of the plan (**chapter 2.1**).
- Elements: the components of a well-designed CAP, from political support to well-designed actions (**chapter 2.2**).
- Process: different phases to be followed to develop an integrated local climate action plan (**chapter 2.3**).

2.1 CAP Principles

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

2.1.1 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). In some cases, there may be a non-emission instead of a reduction. 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.

Planning in detail for such a long time span is difficult; hence, the local authority may distinguish between:

- A vision, with long-term strategy and goals until 2030 and/or beyond, including firm commitments in areas like land-use planning, transport and mobility, public procurement, standards for new/renovated buildings etc.
- Detailed measures for the next 3-5 years, which translate the long-term strategy and goals into real actions.

Both the long-term vision and the detailed measures shall be an 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.

2.1.2 Sector coverage

Local governments shall report GHG emissions from at least three main sectors: stationary energy, transportation and waste. They should also report GHG emissions from Industrial Processes and Product Use (IPPU) and Agriculture, Forestry and Other Land Use (AFOLU) sectors where these are significant. 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.

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.
- Description of expected future impacts.
- Expected intensity, frequency, and timescale of the hazard.
- At least all relevant five 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

Local governments shall develop plans for both climate change mitigation and adaptation (climate resilience) and for access to energy, which may be presented in separate plans or an integrated plan. All actions of priority sectors (identified from GHG emissions inventories and risk/vulnerability assessments) shall be included in the plan.

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.

For low emission development / climate change mitigation, action in the following sectors is mandatory in the CAP: building subsector including: municipal, residential and tertiary buildings (belonging to stationary energy sector), and urban transport sub sector (belonging to transportation sector).

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.

2.1.3 Elaboration of the document

Local authorities are advised to follow the recommended structure when preparing their CAPs, with the following content (**Figure 4**):

Figure 4. CAP Structure and Content

Source: JRC own elaboration

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 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.
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

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

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

1. Description
2. Department, person and/or company in charge of the implementation,
3. Timeline (start, end, major milestones)
4. Cost estimation (Investment and running costs)
5. Estimated energy savings and/or increased renewable energy production by target year (MWh/year)
6. Estimated CO_2 reduction by target year (tonnes/year)
7. Indicators for monitoring

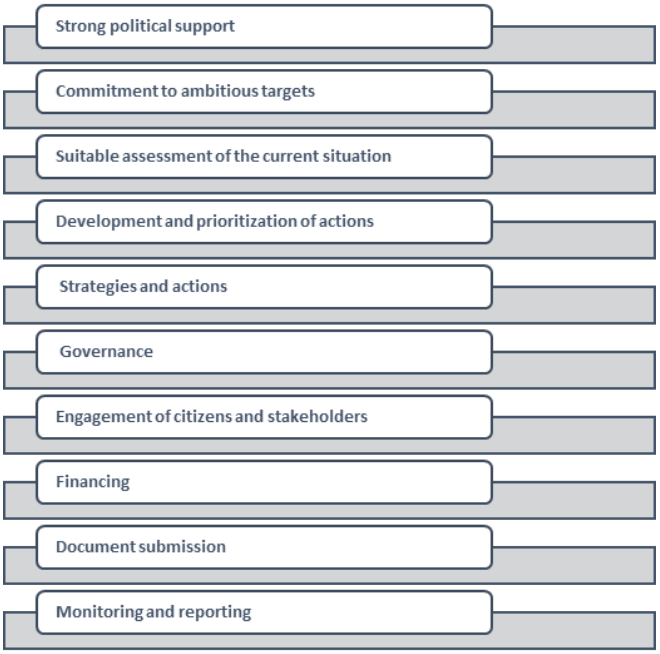
Adaptation actions and measures for the full duration of the plan. The actions should be coherent with outcomes of the city vulnerability and risk assessment (RVA). For each measure/action, please specify (whenever possible)

1. Sector
2. Title
3. Description
4. Responsible body/department/ and contact point
5. Timing (end-start, major milestones)
6. Action also affecting mitigation?
7. Stakeholders involved/advisory group
8. Impacts, vulnerabilities and risks tackled
9. Costs (LC) (Investment and running costs)
10. Indicators for monitoring

2.2 CAP Elements

The following elements are presented to guide signatories in the elaboration of their CAPs. These steps are linked to the commitments taken by the Covenant signatories and constitute key ingredients of success (**Figure 5**).

Figure 5. CAP Elements



Source: JRC own elaboration

(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.

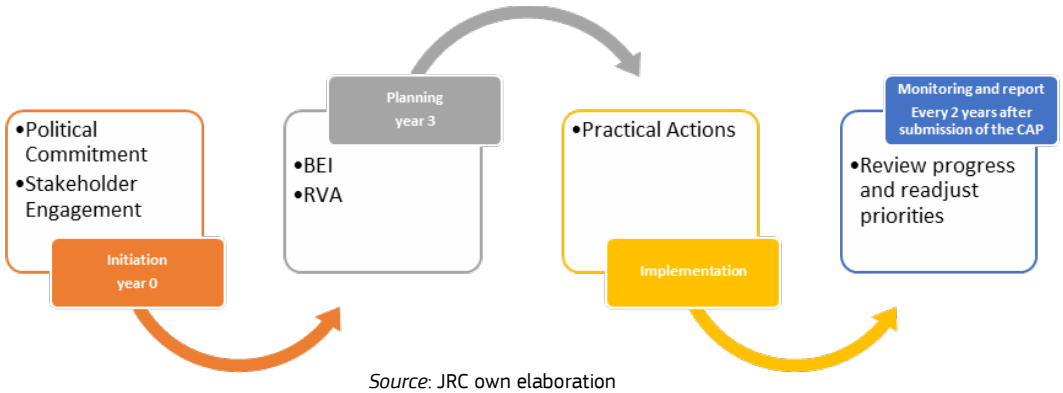
Box 8. Key principles for a successful CAP

- 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: 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.

2.3 CAP process

The CAP process includes several phases: initiation, planning, implementation and monitoring and reporting. **Figure 6** illustrates the main phases within the Climate Action Plan elaboration process, including each of the phases with milestones and time frame.

Figure 6: The CAP process: main phases, milestones and timeframe.



Source: JRC own elaboration

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.

3 Climate Action Plan (CAP) process: initiation phase

3.1 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.

3.2 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 use interns (Masters or PhD students can do much of the work associated with the collection of data and entry into a GHG calculation tool to produce the BEI or to develop a RVA). 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.

Box 9. Multi-level climate governance in Melaka City[10]

Melaka City has been playing an active role in linking organisations and agencies at global and regional levels in order to achieve carbon emission reductions.

Melaka pursues a multi sector, multi-actor and multidimensional process while also deploying the 'good practice' of multi-level climate governance.

The Melaka green technology council was set up to formalise and coordinate the implementation of climate change mitigation and adaptation policies at state and city levels, as well as to coordinate cross-sector green city initiatives.

Several cross-sectoral initiatives representing a combination of sub-national and local governance.

For example, the core government agencies responsible for the Melaka Green City Action Plan are:

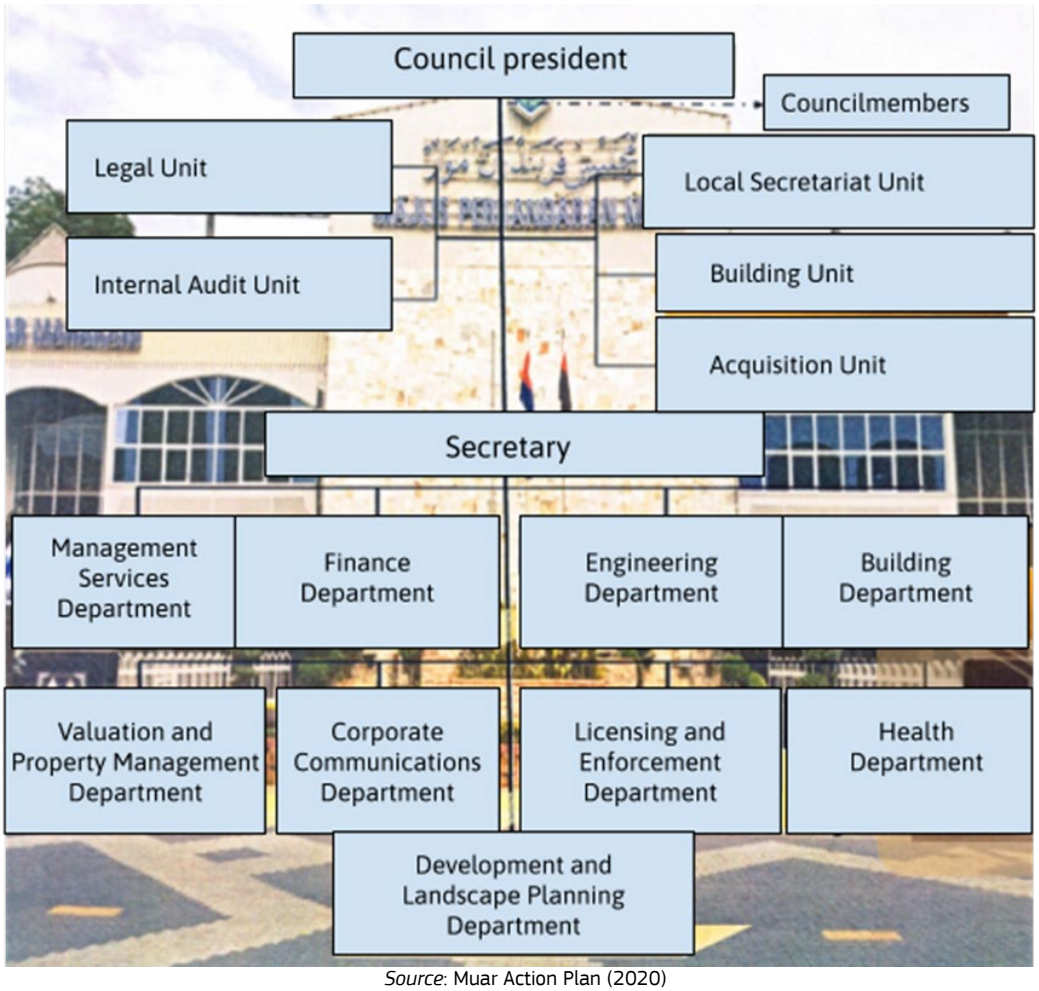
- The Melaka Green Tech (Melaka Green Technology Corporation);
- The Economic Planning Unit (EPU) of the Prime Minister's Office;
- The National Solid Waste Consortium;
- Southern Waste Management (SWM);
- The Solid Waste and Public Cleansing Corporation (PPSPPA);
- The Department of Environment (DOE);
- The Green City Action Plan Committee;
- The Department of Irrigation and Drainage (DID);
- The Department of Agriculture

[10] Zen, Al-Amin, and Doberstein, "Mainstreaming Climate Adaptation and Mitigation Policy: Towards Multi-Level Climate Governance in Melaka, Malaysia."

Box 10. Governance Structure in Muar District

Muar District is governed by the Muar Municipal Council, which is headed by the Council President, or Yang Dipertua (YDP). District governance operates according to the structure in **Figure 7**.

Figure 7: Governance Structure in Muar District



Source: Muar Action Plan (2020)

3.3 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 11. 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 summarized in **Table 3**: 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 3: 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 Malaysia.		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)[11]

[11] Palermo et al., "Guidebook: How to Develop a Sustainable Energy Access and Climate Action Plan (SEACAP) in Sub-Saharan Africa."

3.4 CAP Communication

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 12. 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

4 Climate Action Plan (CAP) process: planning phase

4.1 Assess current policy framework on mitigation and adaptation

This chapter provides general guidance for the elaboration of the Baseline Emission Inventory (BEI) and the Risk and Vulnerability Assessment (RVA).

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.

4.2 Baseline Emission Inventory (BEI)

4.2.1 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[12] 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 (LA) was at the beginning (in its baseline year), and the successive MEIs will show the progress towards the target set by the LA. 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 13. 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.

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

4.2.1.1 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 – 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.

4.2.1.2 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.

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 14. 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:

- 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.
- 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 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. Depending on where energy is generated, these emissions may occur inside or outside the city boundary

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 4**).

LAs should also report GHG emissions from Industrial Processes and Product Use (IPPU)[13] and Agriculture, Forestry and Other Land Use (AFOLU) sectors where these are significant.

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

Table 4. 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 own elaboration

4.2.2 Emissions inventories

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).

Box 15. How to calculate the GHG emissions from the activity data?

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.

- 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 (based on the detailed properties of the fuels used) or default (national/global) emissions factors, such as the IPCC (2006). Local authorities should use activity-based emission factors (also referred to as IPCC emission factors)[14], 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 16. 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.

[14] IPCC, *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.*

4.3 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, risks and potential climate change impacts, as well as understand the main city specificities that contribute to aggravating the consequences of a specific climate hazard.

Similarly 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 - on the basis of available data - and regularly monitored and evaluated versus a baseline scenario.

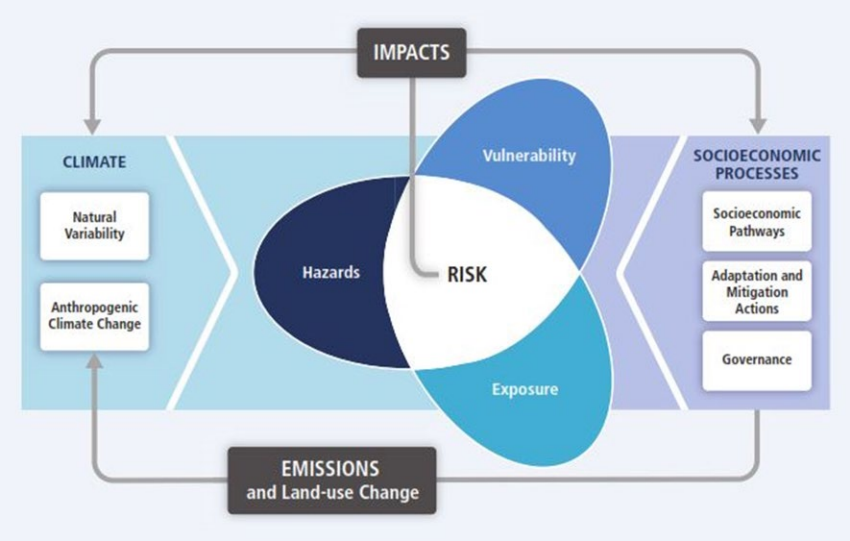
In the following sections, the main concepts around climate risk as proposed by the IPCC are included as well as the requirements outlined in the GCoM common reporting framework; followed by recommendations on how to prepare a RVA together with potential sources of information.

4.3.1 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 (**Figure 8** in this guidebook follows this framework). Risk is defined as a function of the expected potential impacts (hazards) of climate extremes, system vulnerability, and exposure.

Risk of climate-related impacts results from the interaction of climate-related hazards (including hazardous events and trends) with the vulnerability and exposure of human and natural systems. Changes in both the climate system (left) and socioeconomic processes - including adaptation and mitigation (right) - are drivers of hazards, exposure, and vulnerability.

Figure 8: Illustration of the core concepts of the WGII AR5



Source: IPCC 2014[15]

[15] Field et al., "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."

Box 17. RVA Definitions[16]

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 forcings 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 impacts 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.

[16] Field et al.

4.3.2 Climate Change Risk and Vulnerability Assessment

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

RVAs are the most commonly used tools for identifying, quantifying and prioritising key risks of a system to climate change. However, before giving more details on how to prepare a RVA 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.

Therefore, to identify the optimal level of adaptation it is required to assess the trade-off between the costs of investment in resilience and the expected benefits in terms of reduced losses and damages, versus a scenario of inaction. This cost-benefit analysis is a crucial step in developing adaptation plans, and cities are encouraged to undertake robust estimations of costs, benefits and uncertainties to the extent possible.

Box 18. Reporting element: RVA

All signatories shall prepare a RVA 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 5** summarizes strengths and weaknesses of three different methodological approaches: indicator-based, model and GIS based and participatory approach.

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

The indicator-based approach requires less resources and technical skills which makes this type of vulnerability assessment a viable option for small and medium cities. The approach is described in more details in the following paragraph.

Table 5: 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.

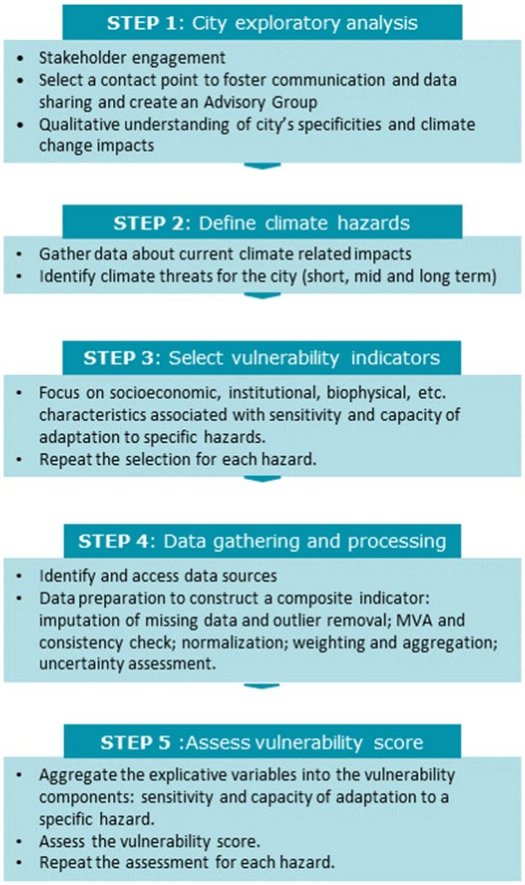
Source: JRC Guidebook 113786 (2018)[17]

[17] Palermo et al., "Guidebook: How to Develop a Sustainable Energy Access and Climate Action Plan (SEACAP) in Sub-Saharan Africa."

4.3.2.1 Indicator-based vulnerability assessment

Figure 9 shows the sequence of steps and main activities for the indicator based vulnerability assessment.

Figure 9: Sequence of steps and main activities for indicator based vulnerability assessment.



Source: JRC own elaboration.

STEP 1: City exploratory analysis. This step includes a kick-off meeting with city stakeholders in order to contextualize the assessment, understand needs and expectations, identify instances of climate change impacts, select a contact point in the LA (for example from the environment or planning department), and clearly explain the RVA approach and the required data. The main sources of information – such as city departments/agencies, civil protection, utility companies, and universities, among others – should be mapped. The contact point at the LA should be entrusted with facilitating the communication between the parties and fostering data sharing.

STEP 2: Define climate hazards. The macro-scale information should be calibrated through observed instances of climate-related impacts within the city. This information should be derived from data on the most relevant climate threats faced by the region. Also according to the GCoM common reporting framework (see Annex 3), local governments shall identify the most significant climate hazards faced by the community. For each hazard identified, the local authority shall collect the following information:

- current risk level (probability x consequence) of the hazard;
- description of expected future impacts;
- expected intensity, frequency, and timescale of the hazard;
- all relevant sectors, assets, and services that are expected to be most impacted by the hazard in future and the magnitude of the impact for each of them.

It is further recommended to identify the vulnerability for each hazard: Information on vulnerable population groups (e.g. poor, elderly, youth, people with chronic disease, unemployed, etc.) that are expected to be most affected by future hazards. This information can help the local government in having a better understanding of the vulnerability dimension of risks and in prioritizing their adaptation actions.

Besides the assessment of future hazards, the local government shall also assess the following information about major hazards that occurred in the past years:

- Scale of the hazard, including loss of human lives, economic losses (direct and indirect, if possible), environmental and other impacts;
- Current risk level of the hazards (probability X consequence);
- Intensity and frequency of the hazard;
- All relevant sectors, assets, or services most impacted by the hazard and the magnitude of impact for each of them;
- Vulnerable population groups most affected by the hazard (if available).

STEP 3: Select vulnerability indicators. In this step, it is necessary to correctly identify the indicators that drive urban vulnerability to the selected climate hazards.

STEP 4: Data gathering and processing. In this step, it is important to extract city socioeconomic indicators and information about the built environment and biophysical attributes from existing databases at local, regional and national level.

STEP 4: Assess vulnerability score. In this step, it is critical to calculate the sensitivity as well as the adaptation capacity for specific climate threats through different equations and aggregation approaches.

The GCoM common reporting framework asks cities to identify factors that will most affect its own and the city's adaptive capacity and enhance climate resilience. For each factor, the local government shall report the following information:

- Description of the factor as it relates to (supporting or challenging) the adaptive capacity
- Degree to which the factor challenges (as opposed to supports) the adaptive capacity and obstructs enhanced climate resilience

4.3.3 Adaptation indicators

There are no single and unanimously adopted criteria to quantify vulnerability. For example, Eriksen and Kelly[18] 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. **Table 6** serves the purpose of providing GCoM SEA signatories with some examples of vulnerability indicators.

Table 6: Examples of Adaptation Indicators

Vulnerability Type	**Vulnerability- related indicator**
Climatic	Number of days/nights with extreme temperature (compared to ref. annual/seasonal temperatures at day/night times)
Climatic	Frequency of heat/cold waves
Climatic	Number of days/nights with extreme precipitation (compared to ref. annual/seasonal precipitation at day/night times for each season)
Climatic	Number of consecutive days/nights without rainfall
Socio-economic	Current population vs. projections 2020/2030/2050
Socio-economic	Population density (compared to national/regional average in year X in country/region X)
Socio-economic	% share of sensitive population groups (e.g. elderly (65+)/young (25-) people, lonely pensioner households, low-income/unemployed households) - compared to national average in year X in country X
Socio-economic	% of population living in areas at risk (e.g. flood/drought/heat wave/forest or land fire)
Socio-economic	% of areas non-accessible for emergency / firefighting services
Physical & environmental	% change in average annual/monthly temperature
Physical & environmental	% change in average annual/monthly precipitation
Physical & environmental	Length of transport network (e.g. road/rail) located in areas at risk (e.g. flood/drought/heat wave/ forest or land fire)
Physical & environmental	Length of coastline / river(s) affected by extreme weather conditions / soil erosion (without adaptation)
Physical & environmental	% of low-lying or at altitude areas
Physical & environmental	% of areas at coasts or rivers
Physical & environmental	% of protected (ecologically and/or culturally sensitive) areas / % of forest cover
Physical & environmental	% of (e.g. residential/commercial/agricultural/industrial/touristic) areas at risk (e.g. flood/drought/heat wave/ forest or land fire)
Physical & environmental	Current energy consumption per capita vs. projections 2020/2030/2050

Source: JRC own elaboration

[18] Eriksen and Kelly, "Developing Credible Vulnerability Indicators for Climate Adaptation Policy Assessment."

5 Climate Action Plan process: development 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 19. 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 Setting objectives and targets

Local authorities should establish a long-term vision with clear SMART[19] objectives. 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?

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

5.1.1 Mitigations Target Setting

With regards to mitigation, all local governments and cities are required to set and report city-wide emissions reduction targets. The GCoM defines eight categories of requirements for target setting (see **Box 20 and 21**).

Box 20. Mitigations Target Setting

Boundary (geographic coverage, sectors, and GHGs): The emissions boundary shall be consistent with all emissions sources included in the GHG emissions inventory, with the possibility to exclude sources that are not controlled by the local government. In case that the target boundary does not align with the inventory boundary, any additions or exclusions shall be specified and justified.

Target type: Local governments shall use one of the following four target types: base year emissions target, base year intensity target, baseline scenario target, or fixed level target. 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.

Ambition: At a minimum, the target shall be as ambitious as the unconditional components of the NDC. Local governments should set targets that are more ambitious than the NDC.

Units: Targets shall be reported as a percentage (%) reduction from the base year or scenario year. The absolute emissions in the target year(s) in metric tonnes CO_2-eq shall also be reported.

The use of transferable emissions units is only permissible when a city's target ambition exceeds the NDC. Where this is the case, the local government shall report the target, with and without the transferable emissions units, as well as identify the source of the transferable emissions units.

Any conditional components included in the target shall be identified. Where possible the conditional components should also to be quantified. Conditional components include where cities set a stretch target, or where actions are identified for other key stakeholders beyond that which they have committed to themselves (for example, where a local government assumes a more ambitious reduction in the carbon-intensity of the national electricity grid than that committed to in the NDC or official government policy), if possible.

Box 21. 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

5.2 Elaboration of the plan: Mitigation actions

5.2.1 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[20] 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.

Further information on local climate governance are provided in the **Annexes 1-6.**

[20] Palermo et al., "Assessment of Climate Change Mitigation Policies in 315 Cities in the Covenant of Mayors Initiative."

5.2.2 Information measures and public awareness

Public awareness and social engaging play a pivotal role for successful climate action. Measures to induce behaviour change and to provide education significantly contribute to the decrease of energy consumption through social and non-technological approaches that must be included in policies that support energy efficiency and energy savings.

This chapter aims at guiding local authorities in the preparation and successful implementation of this kind of measures that allow improving the impact of their information and training campaigns.

The most common tools which the measures rely on 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 [21]:

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.

[21] Barr, Gilg, and Ford, "The Household Energy Gap: Examining the Divide between Habitual- and Purchase-Related Conservation Behaviours."

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 22** summarizes these considerations.

Box 22. 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

5.2.3 Buildings

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

Numerous actions planned will in the whole allow to achieve the targets set in the CAP. 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.

Box 23. Green City Action Plan Kota Kinabalu (2019)

Kota Kinabalu is the capital city of Sabah state, and is home to major commercial and industrial activities in the region.

Energy consumption in buildings is the highest contributor to GHG emissions in Kota Kinabalu City Hall. Adoption of renewable energy in industrial, commercial, and residential buildings can significantly reduce this demand. There is considerable potential for energy savings through the use of energy-efficient appliances in residential, commercial, and institutional buildings. Industrial energy consumption can be reduced by exploring avenues for adopting green building design to reduce lighting and cooling requirements. **Table 7** presents the list of strategic sustainable and green interventions for the building sectors implemented in Kota Kinabalu City Hall.

In 2017 Kota Kinabalu City Hall mandated that all the new building plans should incorporate energy-efficiency overall transfer thermal value (OTTV) and roof insulation codes. The main goal of an OTTV is to reduce the heat influx through the building envelope, minimizing the energy consumption

Source: Green City Action Plan Kota Kinabalu (2019)

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.

Malaysia's Green Building Index (GBI) is a green building rating tool that intends to promote sustainability in the buildings sector, while sensitizing industry stakeholders to adopt environment-friendly strategies and technologies. https://www.greenbuildingindex.org/

The overall objective of the GBI is to reduce electricity demand of buildings while adopting clean green, and efficient technologies and at the same time preserving national resources. Malaysia's GBI focuses on six elements—energy efficiency, indoor environmental quality, sustainable site planning and management, materials and resources, water efficiency, and innovation.

Table 7: Building sectors interventions in Kota Kinabalu

Sector Interventions	Potential Impacts	Potential Co Benefits
Construction of green affordable housing units for low-income households	Green buildings, low cost, and affordable construction	Sustainable development of city,particularly new development areas
Energy management system: Includes programming, commissioning, and training	Optimize energy usage in all publicbuildings	Low-carbon development
Replacement of electrical appliance (lights, fans, air conditioner, and refrigerator) in residential and commercial sectors	Lower energy bills; reduce GHG emission	Reduced consumption of natural resources
Building design: Implement shading systems to reduce solar glare and minimize solar heat gain in public buildings—utilize daylighting	Reductions in annual cooling energy consumption	Visual comfort by controlling glare and reducing contrast ratios
Energy-efficient buildings: Advance metering infrastructure in all KKCH public buildings	Improving the accuracy of meter reads, energy theft detection, and response to power outages	Improved data integrity
Adaptive measures: White rooftops, with a reflective surface, as a measureto prevent heat ingress from the roof, resulting in cooler interiors	Lower air conditioning costs	Lower levels of local air pollution
Regular energy auditing of all public buildings	Reduce energy costs; reduce GHG emission	Increased efficiency of energy use and saving financial benefits for other use
Enforcement of KKCH Green Building Policy: All new building submission (both residential and nonresidential) shall comply with MS 1525* on Overall Thermal Transfer Value and roof insulation	Construction of green buildings, reduction in energy demand from housing sector, savings on energy spending, health and well-being of people	Cost-effective for homeowners, sustainable housing models, public awareness
Assessment for identifying potential for district cooling	Reduction in energy consumption for space cooling and thereby GHG emissions reduction	Reduction in heat generated from multiple air conditioning units, reducing contribution to urban heat island effects

Source: Green City Action Plan Kota Kinabalu (2019), ICLEI - Local Governments for Sustainability, South Asia and Southeast Asia

Box 24. Penampang District: actions in the building sector

Penampang District is located in Sabah's West Coast Division, with Donggongon Town as its capital and main town, where it functions essentially as a suburb of Kota Kinabalu.

The District Council is committed to a 45% reduction in emissions intensity of GDP in Penampang by 2030 relative to base year 2010, with a long-term goal of zero carbon emissions by 2050.

The District Council promotes sustainability practices (**Table 8**) such as promoting passive architecture, GBI (Green Building Index) for new buildings, energy conservation, GBI rating for new buildings, establish Repair and 3Rs centre, use of PV lighting, solar farm development, use of sustainable construction material and water harvest.

Source: Penampang Action Plan (2020) - https://uclg-aspac.org/wp-content/uploads/2021/02/IUC-Programme-IUC-Climate-Action-Plan.pdf

Table 8: Mitigation actions in the building sector - Penampang District

Action	Responsible department	Key partners
Promote adoption of passive architecture in new buildings (natural ventilation, shading, and lighting)	District Council, Enforcement	Sabah Housing and Real Estate Developers Association (SHAREDA)
Promote the use of sustainable materials in construction	District Council, Enforcement, Development	Sabah Housing and Real Estate Developers Association (SHAREDA)
Promote the use of the Green Building certification (CASBEE, GBI, GreenRE, etc)	District Council, Development	Sabah Housing and Real Estate Developers Association (SHAREDA)
Encourage solar water heaters in new developments	District Council, Development, Enforcement	Sabah Housing and Real Estate Developers Association (SHAREDA)

Source: Penampang Action Plan (2020)

5.2.3.1 Measures for energy efficient buildings

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.

In this framework, 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:

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 to 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.

5.2.3.2 Improvement of the envelope and other aspects

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.

5.2.3.3 Lighting

The most common mitigation measure is the replacement of lamps with more efficient ones (lower consumption with the same performance). Moreover, correcting the misuse of the lighting appliances shows to be a significant contribution in the saving options. 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 which implies a limited selection of measures to be implemented and a chance to increase the energy access to this aim. However, despite being accessible, there is a number of barriers that limits the implementation of efficient lighting. Among these, the unawareness of saving potentials and the higher initial cost of efficient lighting systems.

5.2.3.4 Other measures in buildings

Other simple measures may contribute in 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 could be a good way of motivating action; 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…).

5.2.3.5 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 realization 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.

5.2.3.6 Building Energy Management Systems (BEMS)

The implementation of an energy management system requires to an organization of any king 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 have been existing for quite some time now, especially in energy-intensive buildings, where a fine monitoring of the energy flows is of a greater importance.

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.

5.2.4 Infrastructure lighting

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

5.2.4.1 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.

5.2.4.2 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.

Box 25. Green interventions for the street lighting in Kota Kinabalu

Kota Kinabalu City Hall is responsible for the procurement, installation, and maintenance of the street lighting system. **Table 9** presents the list of strategic, sustainable, and green interventions for the street lighting

Street lighting is one of most vital components of urban infrastructure. It is a basic facility provided by local governments to ensure better visibility, safety, and security in the city at night-time. The streetlights in Kota Kinabalu City are operated by three local- and state-level entities, Kota Kinabalu City Hall (KKCH), Sabah Electricity Sdn Bhd (SESB), and Public Works Department (JKR).

Electricity consumption of the street lighting system in Kota Kinabalu is quite high due to an inefficient system that is not designed to standards. Street lighting was identified as a vulnerable sector in the KK GCAP. This is primarily due to system and operational fragility, which warrants urgent action from the local government. Interventions that address street lighting were identified as high priority interventions in the KK GCAP.

This ranking is based on overall mitigation potential, resilience potential, socioeconomic and technical feasibility, and resilience impact. The project is packaged to include a comprehensive audit of the street lighting infrastructure and an assessment of a mix of technology replacement options, based on the strategic development interests of the local and state governments.

Typical technology replacement options include LED luminaires that are stand-alone systems without any digital connectivity or LED systems with point-to-point or group digital connectivity. Both systems can be deployed with or without dimming capability. Automatic timer technology can also be introduced—either photo sensor- based timers or mechanical timers can be introduced, either at each individual streetlight pole or at the feeder panel level. Smart feeder panels could also be introduced.

Source: Green City Action Plan Kota Kinabalu (2019, ICLEI - Local Governments for Sustainability, South Asia and Southeast Asia, in partnership with Green Growth Asia Foundation for Kota Kinabalu City (DBKK), with funding support from the Asian Development Bank.

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.

Table 9. Modernization of the street lighting system in Kota Kinabalu City Hall[22]

Sector Interventions	Potential Impacts	Potential Co-Benefits
Option 1: LED fixtures—no digital connectivity—10-year warranty option. Meters installed at the feeder panel are used for energy monitoring	Reduce electricity consumption and related GHG emissions	Potential long-term cost savings; increased public awareness
Option 2: LED fixtures—individual point-to-point digital connectivity, addressability and control through GSM technology hardware and software for network infrastructure with 10-year warranty	Reduce electricity consumption and related GHG emissions	Potential long-term cost savings; increased public awareness
Option 3: LED fixtures—group digital connectivity control and voltage dimming at smart feeder panel (Group connectivity). Hardware and software for network infrastructure with 10-year warranty	Reduce electricity consumption and related GHG emissions	Potential long-term cost savings; increased public awareness
Option 4: 150 W HPS, 250 HPS, and 400 W luminaires are replaced by dimmable LED fixtures with point-to-point digital connectivity and 10-year warranty option	Reduce electricity consumption and related GHG emissions	Potential long-term cost savings; increased public awareness

Source: Green City Action Plan Kota Kinabalu (2019, ICLEI)

[22] ICLEI, "Green City Action Plan Kota Kinabalu ICLEI - Local Governments for Sustainability, South Asia and Southeast Asia, in Partnership with Green Growth Asia Foundation for Kota Kinabalu City (DBKK), with Funding Support from the Asian Development Bank."

5.2.5 Urban 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.

This part of the guidelines summarises key actions to decarbonise urban transport and to promote low-carbon solutions to contribute to sustainable cities and opportunities for synergies of sustainable development and Climate Change objectives.

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 10** 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.

Table 10. Summary of sustainable urban mobility actions and potential benefits

Mobility actions	Emission reduction potential	Benefits/synergies
Activity and flows (short distances, mixed use, compact cities)	Potential to reduce energy consumption by 10 to 30%	Reduced travel times; improved air quality, health, safety and access
Structure (shift to more energy efficient modes)	Potential for energy efficiency increases varies greatly, but for example Bus Rapid Transit (BRT) systems can deliver up to 30% reductions at a cost of $1-27 M/km	Reduced urban congestion and increased accessibility
Intensity (vehicle fuel efficiency)	Efficiency improvement of 40-60% by 2030 feasible at low or negative costs	Improved energy security, productivity and affordability
Fuel (switch to other fuels)	Changing the structure of the energy consumption, but not necessarily overall demand.	Diversification of the fuels used contributes to climate, air quality and/or energy security objectives

Source: JRC Guidebook 113786 (2018)

More 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).

Box 26. Hang Tuah Jaya actions for Sustainable Transport and Logistic

Hang Tuah Jaya is a municipality in the State of Melaka. Hang Tuah Jaya is committed to contributing to the national mitigation target of 45% reduction in emissions intensity of GDP by 2030 relative to the base year 2010 emissions level.

As Hang Tuah Jaya is a highly urbanized local authority served by fairly good network of public buses, it is important to integrate the network with pedestrian and cyclist lane to promote sustainable public transport system. Transit-oriented development (TOD) is defined as compact, mixed-use, higher-density development within walking distance of a bus / transit facility.

Planned actions (see

Table 11) such as development of activity area at pedestrian zones, walkable city facilities, free parking for low carbon vehicles and real time online information for bus arrival are important low carbon measures. One of quick win actions is by the converting municipal owned vehicles to low carbon vehicles (hybrid, electric or use of Natural gas or Biofuel). Table 10 reports for each action also the departments involved in the Key partners and the time horizon.

Source: Hang Tuah Jaya Action Plan (2020), https://www.iuc-asia.eu/wp-content/uploads/2021/01/IUC-Programme-IUC-Climate-Action-Plan.pdf

Table 11: Planned actions related to transport sector in Hang Tuah Jaya Municipal Council (2020)

Action	Responsible department	Key partners
Implement Transit Oriented Development (TOD)	Town Planning. OSC Engineering Green Technology	JKR
Provide comprehensive public transport network	Town Planning. Green Technology	JKR
Providereal-timeonline information about bus locations andarrivals	Engineering Green Technology	Bus operators
Provide user friendly pathways for pedestrians and cyclists	Town Planning. Green Technology Landscape	PLANMalaysia @ Melaka
Increase potential activity centres for pedestrian zones	Town Planning. Green Technology Landscape	JKR
Providea'Park-and-Walk /Cycle' zone as aninitiative fordriversto parkoutside commercial areas	Town Planning. Green Technology Landscape	JKR
Run District buses on recycledoilfrom foodcourts	Engineering Town Planning. Green Technology	Private sector, NGOs
Promote cycling as a healthy and environmentally friendly form of transport	Engineering Town Planning. Green Technology	NGOs, Cycling Clubs
Convert Districtvehicle fleettohybridand electric	Corporate Green Technology	Private sector
Establish unlimited free parking for low-carbon vehicles	Engineering Green Technology	Private sector

Source: Hang Tuah Jaya Action Plan (2020)

Box 27. Tawau: Walkable City - Pedestrian first

The concept of walkable city is a popular alternative green urban mobility that fits well into sustainable development and sustainable transportation.

Walkable city Tawau should focus on pedestrian and cyclists first. Implementation of walkable city Tawau in hot tropical condition is challenging due to hot sun and heavy rain. Hence the supporting facilities and amenities such as pedestrian zone, safe walkway, covered or tree shading and safe crossing are important. Walkable city concept will also help the promotion of public transport which will improve the modal split of Tawau where the usage of private vehicles is currently very high. Improving quality of bus service such as expanding bus network and online bus real time information on arrival can be useful to reduce carbon emission on transport sector when modal split improves (see **Table 12**).

Source: Tawau Action Plan (2020, https://www.iuc-asia.eu/wp-content/uploads/2021/01/IUC-Programme-IUC-Climate-Action-Plan.pdf

Table 12: Actions in the Walkable City – Tawau

Action	Benefits	Responsible department	Key partners
Plant trees to increase shade in downtown areas	Mitigation and Adaptation	Development & engineering	NGOs
Identify links between existing green spaces for future land acquisition	Mitigation and Adaptation	Development & engineering, Rural development	NGOs
Create dedicated bike lanes in downtown areas to promote cycling as healthy and environmental mode of transport	Mitigation	Development & engineering	Ministry of Transport, NGOs
Design and establish pedestrian zones in downtown area	Mitigation	Development & engineering	Ministry of Transport
Establish privileges for pedestrians and cyclists at crossings	Mitigation	Development & engineering	Ministry of Transport
Evaluate and expand bus network	Mitigation	Development & engineering	Ministry of Transport
Provide real-time online information about bus locations and arrivals	Mitigation	Development & engineering	Ministry of Transport
Convert MPT's vehicle fleet to low carbon vehicles (Bio fuel, NGS, hybrid or electric)	Mitigation	Municipal Council, Development & engineering	Municipal Council

Source: Tawau Action Plan (2020)

5.2.6 Local Energy Production in Malaysia

Energy is the main source of GHGs in Malaysia, accounting for 76% of the total emissions, followed by waste with 13.6% (2000 as the base year)[23]. Malaysia's federal government has relied mostly on technological approaches to improve energy efficiency and renewable energy. The states and the local governments have little direct involvement in climate change policies, because the main drivers of emissions, such as energy are under control of the federal government.

This chapter aims at providing an overview of the key municipal policies and strategies to promote local energy generation, ranging from decentralised renewable energy in buildings to centralised options for promoting integrated and sustainable energy systems at the urban level. **Annex 7** summarizes the key measures to promote local energy generation by renewable energy source or technology.

Box 28. Renewable energy (RE) in Malaysia[24]

Solar energy: the Feed-in Tariff (FiT) mechanism

The tropical climate in Malaysia is favourable to provide practically unlimited solar energy. The FiT mechanism was launched in end of 2011 and allowed companies and house owners to produce RE from four sources (solar, biogas, biomass and mini hydro) and sell it back to TNB (Tenaga Nasional Berhad) through the national grid at a favourable rate. Solar power is seen as a major beneficiary from this scheme as solar PVs are easy to install and basically maintenance-free, and under this scheme, anyone can be a solar power producer.

Policy measures give direction to increasing the valorisation of local opportunities in the context of local characteristics and available measures. This section is intended to provide a collection of key measures to promote the uptake of renewable sources and integrated urban energy systems.

In this context, there is increasing interest in the decentralisation of the energy supply with more local ownership. Local energy supply options can take the form of local power generation utilities and energy services companies (ESCo). Local authorities can be in whole or partial owners of these utilities and promote community partnership.

- Decentralised renewable energy technologies offer the possibility to produce energy with a much lower impact on the environment when compared to conventional energy technologies. Distributed electricity generation allows to reduce electricity transport and distribution losses and to use micro-cogeneration technologies while increasing the penetration of low-scale renewable energy technologies. The electricity grid must be able to distribute this energy to the final consumers when the resources are available, and rapidly adapt the demand, or cover the energy that is required using more adaptable technologies when the former are not available, such as hydropower or biomass.

- Centralised options include cogeneration power plants. Cogeneration (or CHP – Combined Heat and Power) offers an efficient way of producing electric power and thermal energy for cities. Cost-effective policies that maximise efficiency benefits should focus on measures targeting areas with high heating and cooling densities.

Box 29. Sustainable Energy Development Authority (SEDA)

As example of renewable energy and energy efficiency measures implemented alt local level, **Table 13** reports the actions undertaken in Kota kinabalu City Hall. It is expected that the energy demand of Kota Kinabalu City will continue to increase. Kota Kinabalu, intends to realize the federal government's target of having 20% renewable energy in the nation's power generation mix by 2030. It should be noted that one of the key partners is the Sustainable Energy Development Authority (SEDA). The other partner is the Sabah Electricity Sdn. Bhd (SESB).

To further promote renewable energy sector, the government established **Sustainable Energy Development Authority (SEDA)** in 2011 which was formed under the Sustainable Energy Development Act 2011. SEDA is tasked to ensure sustainable energy plays an important role in Malaysia's economic development and to assess new potential sustainable energy solutions as well as to advocate sustainable development to the public[25].

[23] Puppim de Oliveira, "Intergovernmental Relations for Environmental Governance: Cases of Solid Waste Management and Climate Change in Two Malaysian States."

[24] Oh et al., "Energy Policy and Alternative Energy in Malaysia: Issues and Challenges for Sustainable Growth – An Update."

[25] Yatim et al., "Energy Policy Shifts towards Sustainable Energy Future for Malaysia."

Table 13: Energy sectors interventions in Kota Kinabalu

Sector Interventions	Potential Impacts	Potential Co-Benefits	Lead Agency
Preparation of a citywide energy efficiency strategy and action plan	Streamlined action plan for implementation of energy efficiency and renewable energy measures	Economic benefits from energy conservation	SEDA, SESB, KKCH
Grid Connected Large Scale Deployment of Solar Photovoltaic (PV) System	Use of renewable source of energy supply; reduces electricity bills; low maintenance costs; reduces GHG emissions	Save money on energy bills; increased public awareness	SEDA, SESB, KKCH
Installing units of 5–15 kW solar PV systems in various municipal office buildings categorized according to their monthly bills falling in the range of <1,000 kWh, 1,000–2,000 kWh and 2,000–5,000 kWh.	Use of renewable source of energy supply; reduces electricity bills; low maintenance costs; reduces GHG emissions	Save money on energy bills; increased public awareness	SEDA, SESB, KKCH
Installing solar PV systems in 56 municipal schools	Use of renewable source of energy supply; reduces electricity bills; low maintenance costs; reduces GHG emissions	Save money on energy bills; increased public awareness	SEDA, SESB, KKCH
Replacement of LPG-fueled cooking stove to solar cooker	Use of renewable source of energy supply; reduces electricity bills; low maintenance costs; reduces GHG emissions	Save money on energy bills; increased public awareness	SEDA, SESB, KKCH

Source: Green City Action Plan Kota Kinabalu, ICLEI - Local Governments for Sustainability, South Asia and Southeast Asia (2019).

5.2.7 Solid waste management in Malaysia

In Malaysia solid waste management was under the purview of municipalities until 2007, when the waste sector was centralized by the SWPCM Act, 2007 under the coordination of SWCorp, the regulatory agency, which also contracts and monitors the private operators[26].

Box 30. Intergovernmental Waste Management in Malaysia

Muar is a district located in the northwest of Johor, Malaysia's southernmost state. Johor state government has mostly withdrawn from waste management, leaving it to the federal government through SWCorp and SWM Environment (the private operator).

The federal government has two kinds of contracts. One between the federal government and state and municipal governments ("tripartite agreement") for the transfer of responsibilities and funds and another contract between the federal government and the firms who receive the concession for waste management in a particular area.

Municipalities are not involved in daily direct waste management activities, though they held regular meetings (~monthly) between the local branch of SWCorp in Johor and the 15 municipalities so as to coordinate pending tasks, address issues, suggestions or complaints. **Table 14** shows the Muar 'actions, planned for the period 2020-2030, in the waste sector.

Despite the transition to the more centralized waste management system, local waste management strategies could play a decisive role in enabling the minimization of the amount of waste generated. Three key actions are particularly relevant:

- Waste prevention.
- Utilization of environmentally-conscience waste-to-energy options.
- The diversion of waste from landfills through recycling, reuse, and composting.

Box 31. Waste Management Examples in Malaysia

Penampang District: Development of Low carbon society

Development of Low carbon society for Penampang is important strategy to promote community-based composting, eco-life challenge campaign for schools, waste separation and banning single practice use at community level. The main actions adopted are:

- To require city-wide waste separation with relevant incentives and penalties and distribute bins to - residential areas (in collaboration with local NGOs).

- To construct waste-to-energy plant (private sectors partnership).

Tawau District. Planned actions related to low carbon economy

- To promote Waste to Energy (WtE) for existing agro industries such as palm oil industry (Partner with private sector to construct waste-to-energy plant /Incinerator).

- To promote oil palm companies in using their waste to generate energy.

- To require city-wide waste separation with relevant incentives and penalties and distribute bins to residential areas.

Kota Kinabalu City Hall: action planned in the waste sector

- To have a holistic waste management strategy addressing solid waste from all sources and characteristics.

- Intensive household-level segregation and collection of waste by involving self- help groups and official worker.

- Biomethanation Plant and Materials Recovery Facility to use high calorific value waste in the cement industry and recycling.

[26] Puppim de Oliveira, "Intergovernmental Relations for Environmental Governance: Cases of Solid Waste Management and Climate Change in Two Malaysian States."

Box 32. Biomass residues for electricity generation in Malaysia

Biomass is the earliest adoption of RE source in the country as there are copious of agriculture residues from plantations such as palm oil, sugarcane, cocoa, wood and timber, which are high potential biomass residues for electricity generation.

Palm oil in particular is seen as the single largest residue contributor to the biomass generation as Malaysia is the second largest palm oil producer in the world after Indonesia with oil palm plantations taking up 71% of total agricultural land as in 2014 thus ensuring ample amount of palm oil waste supplies.

Table 14: Muar Waste Sector: actions planned for the period 2020-2030

Action	Responsible department	Benefits	Key partners
To introduce Waste to Wealth program in residential areas (e.g. used cooking oil)	Department of Development and Landscape Planning	Mitigation	Local residents, NGOs
To implement smart bin program that promotes 5R2C (Rethink, Reduce, Reuse, Recycle, Replace, Compost, Close the Loop) to increase waste collection efficiency in community	Department of Development and Landscape Planning	Adaptation and Mitigation	Building Owners, SWM Environment
To promote the use of waste from industrial (i.e. wood chips) and agricultural activities for generating biomass energy	Engineering Department	Mitigation	SEDA, TNB
Build an integrated solar farm with landfill gas recovery in Bukit Bakri landfill	Department of Development and Landscape Planning	Mitigation	SEDA TNB

Source: Muar Action Plan (2020)

5.3 Elaboration of the plan: Adaptation actions

5.3.1 Impact of climate change in Malaysia

Projections of the future changes indicate that the rise of the average annual surface temperature will range from 1.9 to 2.1°C by the end of the century. The magnitude of change of average annual precipitation is expected to range from 14% to 25%, while the sea levels are projected to continue rising about 0.73 meter by the end of the 21st century[27]. **Figure 10** shows the areas most affected by the consequences of the climate change. Within the Malaysian context, flooding is the most pressing hazards and has become the national issue since billions of ringgits have been spent for recovery and aid. Kelantan and Terengganu are the two states in Malaysia that suffer the most from flood hazards[28].

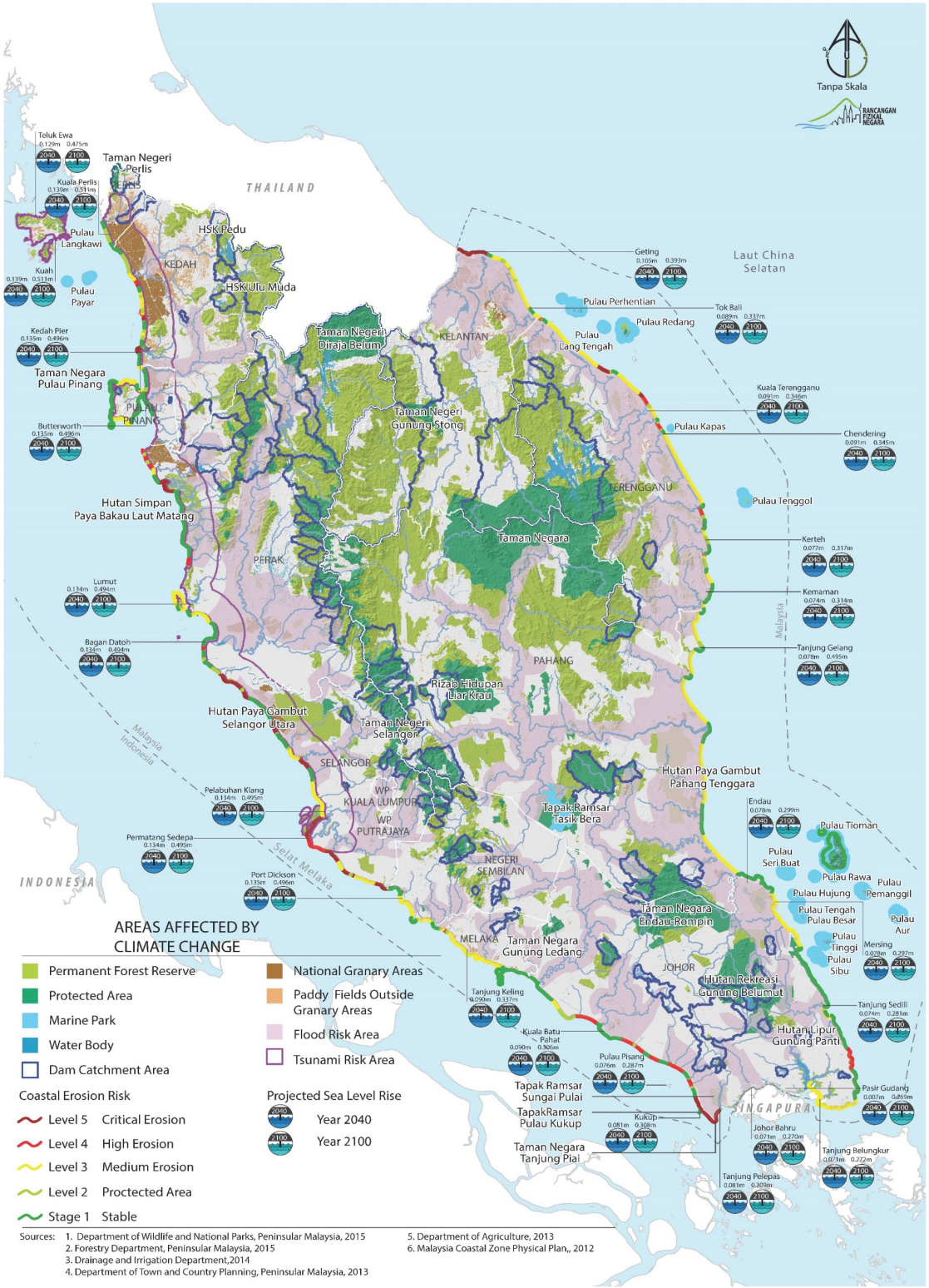
Flash floods are the most common natural hazard in Malaysia, especially in the eastern part of the Peninsular Malaysia where heavy rainfall from November to January causes some devastation almost in every year. As much as 9% of the total land area in Malaysia (29,000 km2) and 23% of the total urban area are flood prone and as many as 2.7 million people have become victims during 1956–2007[29] .

The impact of climate change has been identified in several key sectors in Malaysia: agriculture, coastal resources, public health, water resources and forestry.

- **Coastal resources:** Climate change is foreseen to aggravate high flow in the watersheds of Kelantan, Terengganu, Pahang and Perak during the Northeast monsoon and substantially reduce flow in the Selangor and Klang water-sheds during the Southwest monsoon, between 2025 and 2050. The change in flow has implications on properties, for instance structural damage caused by heavy rainfall, flooding and rainfall-induced landslides.
- **Energy Consumption:** Climate change also impacts energy consumption on cooling of air-conditioned office building. An increase of cooling load by 2.96%, 8.08% and 11.7% is projected respectively in 2020, 2050 and 2080 from the baseline of 2000.
- **Public health:** Climate change is also known to affect public health by increasing the transmission of mosquito-borne diseases such as dengue and expanding the affected zone[30].
- **Mangrove Forests:** The mangrove forests along the coastline are exposed to sea level rise due to the increase in temperature and changes in rainfall patterns.
- **Granary Areas:** Studies have shown that out of 40 planting seasons at the MUDA Agriculture Development Authority (MADA) area, 10 planting seasons will experience water shortage due to drought.
- **Water Supply**: A 2009 study by the National Hydraulic Research Institute of Malaysia (NAHRIM) projects that in the existing facilities (Klang Gates Dam, Batu Dam, Sungai Selangor Dam, Tinggi Dam and downstream catchment from Sg. Selangor Dam up to the Batang Berjuntai water intake, excluding the Pahang-Selangor water transfer project), approximately 28 months (almost 12%) of the 240-month survey period will face water supply disruptions[31].

[27] NDC, "Malaysia First NDC (Updated Submission)."
[28] Norizan, Hassan, and Yusoff, "Strengthening Flood Resilient Development in Malaysia through Integration of Flood Risk Reduction Measures in Local Plans."
[29] Khailani and Perera, "Mainstreaming Disaster Resilience Attributes in Local Development Plans for the Adaptation to Climate Change Induced Flooding: A Study Based on the Local Plan of Shah Alam City, Malaysia."
[30] Tang, "Climate Change in Malaysia: Trends, Contributors, Impacts, Mitigation and Adaptations."
[31] NPP, "Third National Physical Plan (2021-2025)."

Figure 10: Areas affected by Climate Change in Malaysia



Source: Malaysia NPP, "Third National Physical Plan (2021-2025)," 2021

5.3.2 Malaysia commitment to adaptation: towards a multilevel climate governance

Malaysia has shown commitment toward climate change and disaster management by adopting National Policy on Climate Change to reduce energy consumption and sea-level rise vulnerability[32]. Malaysia is already a signatory to the then Hyogo Framework for Action (HFA) 2005–2015 and the subsequent Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030.

The implementation of climate change adaptation in Malaysia focuses on the management of water resources and security, coastal resources, agriculture and food supply, urban and infrastructure resilience, public health, forestry and biodiversity and key adaptation cross sectoral areas[33].

Malaysia has shown commitment to mainstreaming disaster risk reduction and management in the national development framework. At the national level, the current Third National Physical Plan (NPP-3) has incorporated policy directions that promote disaster resilience in disaster-prone areas across the nation[34].

The Twelfth Malaysia Plan (2021-2015) presents a strategy to increase resilience against climate change and disasters. Malaysia intends to mainstream climate resilience into urban planning, in fact a national policy on disaster risk management and multi-level disaster resilience plans as well as a national adaptation action plan will be developed. These will be integrated into the local, structural and sectoral development plans to improve planning and implementation of appropriate measures.

Box 33. Twelfth Malaysia Plan (2021-2015): Strategy to Increasing Resilience against Climate Change

Implementing Evidence-Based and Risk-Informed Actions

Adopting Integrated Approaches for Climate Adaptation and Disaster Risk Reduction

Enhancing Early Warning Systems and Disaster Response

Enhancing Disaster Preparedness and Recovery

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 Malaysia 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.

Table 14 reports measures to enforce a multi-level governance in the climate adaptation process. At city level is recommended to:

- *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;*

[32] Karki, "Flood Resilience in Malaysian Cities: A Case Study of Two Towns in Johor State."
[33] NDC, "Malaysia First NDC (Updated Submission)."
[34] Norizan, Hassan, and Yusoff, "Strengthening Flood Resilient Development in Malaysia through Integration of Flood Risk Reduction Measures in Local Plans."

Table 15. 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 own elaboration

5.3.3 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.

A preliminary list of adaptation actions identified from the international literature and the best available practices are presented in **Table 16**, for three main sectors. Actions could be framed as strategic actions, related to alert and communication and as technical measures. Additional measures, depending also on the local needs and the national situation, would be necessary. However, these actions represented in the table below can be considered as a very good starting point.

Table 16: Adaptation actions by sector

Sector	Actions	
Public health and quality of life	Strategic actions	Regularly improve monitoring systems in order to ensure that any disease development or any strong disturbance in public health shall be detected and efficiently addressed in its early stages. Improve sheltering capacities by ensuring that the cities have well-established air-conditioned facilities (hospitals, city halls, mosque, etc.) that can protect citizens who do not have the necessary infrastructure to protect themselves from extreme weather events (heat waves, storms, floods)
	Alert and communication	Develop and regularly maintain an early warning system that can alert citizens ahead in case of extreme weather events. Such systems should be set up as early as possible and connected to National systems to be able to transmit the message in the most efficient and quick way to the citizens Regularly conduct educational and awareness raising campaigns to inform people about possible health impacts of heat waves, floods, vector borne diseases and how to address them
	Technical measures	Regularly improve water quality that can serve to cover the basic needs of citizens during heat waves Improve the quality control of sewage, waste dumps, dormant waters and draining systems to avoid the high risk of being serious diseases reservoirs Identification of potential hot spots for the development of vector borne diseases
Infrastructure management	Strategic actions	Develop good systems to ensure the proper management of water flux especially in case of heavy waves that might overpass absorption capacities of cities Improve infrastructure monitoring to anticipate problems related to extreme events such as floods and heat waves and quickly fix problems that may arise Develop smart models to predict demand and electricity supply to avoid blackouts in times of heat waves
	Alert and communication	Develop early warning systems to alert citizens in case a part of the infrastructure has been or expected to be severely damaged Regularly conduct awareness raising campaigns to increase people's awareness and advise them on how to save water and use the electricity efficiently
	Technical measures	Develop efficient and sustainable drainage systems Establishment of underground water reservoirs Building desalination plants based on the best available technologies Establish or upgrade flood defence systems near affected facilities
Biodiversity	Strategic measures	Establish a fire management plan Elaborate an integrated coastal management plan
	Technical measures	Improve or develop beach nourishment or replenishment

Source: JRC own elaboration

In the following session a set of adaptation action from Malaysian CoM signatories will be presented and discussed.

5.3.3.1 Climate Responsive Infrastructure

Climate change impact requires to rethink the design of green infrastructure. Green and resilient infrastructure in Tawau (**Box 34**) focuses on minimizing the impact from storm and flooding. Provision of conservation areas such as river and coastal reserves will help to reduce the impact of flood, storm and storm surge. Protection of existing green areas that are linked with one another can be useful for effective retention ponds to mitigate flooding and make recreational areas more functional. Green parks can and water bodies (ponds or lakes) can also protect fauna and flora in the urban areas[35].

Box 34. Green and resilient infrastructure in Tawau

Adaptation Goal: The Municipal pledges to reduce property damage due to rainstorm and flooding by 50% by 2030 compared to 2010 levels. In addition, Tawau also aims to reduce downtime of utilities caused by tropical storms by 30% by 2030 compared to 2017.

Sectors: The most widely affected assets and services are emergency services and food and agriculture, followed by transportation and residential.

Vulnerable populations: Low-income households and persons in sub-standard housing have been identified to be particularly affected overall in Tawau District.

Key Actions:

To protect all existing green spaces and establish new multi-purpose green spaces that cannot be developed.

To protect existing conservation zones (river buffer and coastal reserve) by gazette.

To organize 'One Resident, One Tree' program.

To promote educational campaign on flood readiness.

Source: Tawau Action Plan (2020)

Heavy monsoon rainfall has triggered floods and caused great damage in Penampang area (**Box 35**). The rain also caused Moyog River to rise and spill over to nearby villages and caused landslide in many steep slopes. A comprehensive river basin study needs has be planned to formulate a holistic green infrastructure solution to solve this flooding problem. Green policies to protect existing green spaces and increase green covers to reduce surface run off for future development. Other solutions to sustainable flood management include the use of retention ponds, deepening of channels and flood defences options to reduce impact of flooding. Penampang has planned to improved flood warning system and flood response plans for communities in flood prone areas[36].

Box 35. Heavy monsoon rainfall has triggered floods and caused great damage in Penampang area.

Adaptation Goal: Penampang District pledges to reduce property damage due to rain storm and flooding by 50% by 2030 compared to 2017 levels. Unregulated hill cutting and deforestation will be completely eliminated by 2030. Penampang aims to reduce downtime of utilities caused by tropical storms by 30% by 2030 compared to 2017 levels.

Vulnerable populations: persons living in sub-standard housing, closely followed by low-income households and marginalised groups, have been identified to be particularly affected overall in Penampang District.

Key Actions:

To protect all existing green spaces and establish new multi-purpose green spaces that cannot be developed.

To prepare a complete a comprehensive hydrology study of the Moyog River area and develop and execute a drainage plan.

To prepare flood response plans for communities in flood prone areas.

Source: Penampang Action Plan (2020)

In the case of Hang Tuah Jaya (**Box 36**) the green infrastructure related to flood mainly refers to water storage (retention ponds) and drainage system, existing forest, urban green and street trees. Hang Tuah Jaya embraces the effective planning and design of green urban spaces and water body provide benefits through

[35] IUC, "CLIMATE ACTION PLAN DEVELOPMENT IN INDONESIA, MALAYSIA, AND VIETNAM."
[36] IUC.

ecosystem services in regulating microclimate of urban areas. This is be done through monitoring and development control on the flood prone area. Provision of green area, landscaping and tree planting to increase green cover will improve shade and also provide thermal comfort. Hang Tuah Jaya planned to work with premises/ homes owners on flood prone areas on flood response plan to reduce impact[37].

Box 36. Hang Tuah Jaya green infrastructure Hang Tuah Jaya

Adaptation Goal: The Municipality pledges to reduce property damage due to monsoon and flooding by 50% by 2030 compared to 2010 levels. In terms of drought, Tawau city aims to reduce the number of days of water rationing caused by drought by 50% by 2030 compared to 2017 level. In addition, Tawau city aims to reduce the number of dengue cases by 50% by 2030 compared to 2017 level

Sectors mainly affected by floods: transportation, food, agriculture and emergency services.

Vulnerable populations: In terms of the vulnerable populations affected by these climate hazards, low-income households have been identified to be particularly affected overall in Hang Tuah Jaya Municipality.

Key Actions:

To improve monitoring and development control around Flood risk areas.

To promote measures to make homes safer in flood conditions.

To encourage premises in flood prone areas to create response plans for flash flooding.

To protect all existing green spaces and establish new multi-purpose green spaces that cannot be developed.

To plant trees to increase shade in downtown areas.

To launch corporate sector adoption of green spaces.

Source: Hang Tuah Jaya Action Plan (2020)

[37] IUC.

5.3.3.2 Conservation of Biodiversity

Table 17 shows the adaptation action planned in Muar to protect the forest reserves and the coastal wetlands. Biodiversity conservation is important to protect the rich ecosystem and to enrich the sustainable aquaculture program in Muar River and coastal areas.

Table 17: Muar's adaptation actions for biodiversity conservation

Action	Benefits	Responsible department
Gazette mangrove forest especially along Muar River and coastal area of Straits of Malacca	Adaptation and Mitigation	Forestry
Improve river basin management	Adaptation	Department of Development and Landscape Planning
Apply Environmentally Sensitive Area (ESA) framework as a basis for development planning and control	Adaptation and Mitigation	Department of Development and Landscape Planning
Promote "Stop Open Burning" especially in areas near permanent forest campaign to prevent forest fire and pollution	Adaptation and Mitigation	Health Department
Provide access to alternative water supplies such as underground water	Adaptation	Engineering Department
Establish a special action plan for Muar River	Adaptation	Department of Development and Landscape Planning

Source: Muar Action Plan (2020)

Water security is expected to become an important issue in the near future and protection of existing water sources (river and underground) from pollution is vital in Muar[38].

[38] IUC.

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 and reporting

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 18** 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, they will be asked to submit the first group of documents the latest two years after; while in year 3 they must submit the CAP.

Currently, two reporting platforms are officially accepted in the GCoM framework: My Covenant- the European one and CDP/ICLEI's unified reporting system.

Table 18: 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 own elaboration

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

8 Financing Climate Action Plans

8.1 Current State of the Green Technology Financing and Incentives in Malaysia

Malaysia's National Policy on Climate Change (2009) provides the general framework to mobilize and guide government agencies, industry, community groups and other major stakeholders to address the challenges of climate change. The Renewable Energy Act (2011) and its incentives such as the improved feed-in tariff (FiT) rates for renewable energy producers, and the Green Technology Financing Scheme (GTFS) have boosted the development of the local renewable energy industry, contributing to emission reduction[39]. The Renewable Energy Act, 2011, implements the FiT mechanism to speed up renewable energy (RE) such as solar photovoltaic (PV), biomass, biogas and mini hydro in Malaysia's electricity generation mix.

The Green Technology Financing Scheme (GTFS) was established during the period 2010-2017 to channel RM 3.5 billion towards green technology innovations in the industry. The scheme channels financial support to GreenTech Malaysia-approved initiatives in the energy, water, construction, transportation, waste and manufacturing sectors. An extension of GTFS, known as GTFS 2.0, was approved in March 2019 with a budget of RM (Ringgit Malaysia) 2.0 billion for the period to the end of 2020. The Credit Guarantee Corporation (CGC) provides a guarantee of 60 % of the approved financing amount and a 2 % rebate on the interest rate charged by the participating financial institutions. In addition to the GTFS, the government also offers several tax incentives. For instance, renewable energy generators are offered a 100 % statutory income tax exemption with pioneer status for 10 y with investment tax allowance for 100 % of the capital expenditure within the first five years. Other fiscal means of promoting green growth include import duty and sales tax exemptions for all imported and locally procured green technologies[40].

Box 37. Green government procurement in Malaysia[41]

Green government procurement (**see Annex 6**) in Malaysia can play a vital role as a catalyst for green growth. Public procurement in Malaysia represents about 12 % to 15 % of gross domestic product (GDP) and public expenditures are projected to grow in future). Green public procurement does not only benefit greening government but also provides a financing source for the production and deployment of green goods and services that markets may not offer, especially at the early stages of new green technology.

Government green procurement can also contribute to the development of financial instruments such as credit lines and revolving funds specifically tailored for cleaner production investments. In sum, the formulation of sustainable development policies and regulatory measures need to consider a comprehensive finance, technology and capacity building support to ensure successful implementation of green growth in Malaysia.

Finally, in recent years, green bond has emerged as one of the debt markets instruments to fund projects that have positive environmental and/or climate benefits.

Box 38. Green bonds issued in Malaysia since 2016[42]

- Energy efficiency – Green buildings to fund gateway@klia2, a green building issued by Segi Astana , 2018

- Renewable energy to fund a solar PV plant in Perak, issued by Mudajaya Group Berhad (Sinar Kamiri), 2018

- Renewable energy to fund a solar project in Sabah, issued by Tadau Energy, 2017

[39] Ibrahim et al., "A New Framework for Integrated Climate Finance and Inclusive Responses to Sustainable Development in Malaysia."
[40] Yatim P., Ngan L., and Lam H.L., "Financing Green Growth in Malaysia."
[41] Yatim P., Ngan L., and Lam H.L.
[42] Kapoor et al., "The Viability of Green Bonds as a Financing Mechanism for Energy-Efficient Green Buildings in ASEAN: Lessons from Malaysia and Singapore."

8.2 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.

The C40 report[43] shows how the type of assistance needed by cities to advance in the implementation of climate related projects not only focused on financing modelling and development of bankable projects. On the contrary, it ranges from capacity development activities (such as capacity building, best practices, finance training) to implementation (such as organisational structuring, risk management, operational study), from technical studies (Impact assessment, socio-economic) to feasibility studies, from legal studies to financing studies and stakeholder engagement. These financing options are oriented at supporting capacity building of actors involved in the process, who will then be able to seek and apply for funding autonomously. Therefore, local 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 Malaysia region. Links and examples are provided as a general guidance to local authorities and stakeholders.

[43] Moro and Lonza, "Electricity Carbon Intensity in European Member States: Impacts on GHG Emissions of Electric Vehicles."

8.3 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 39. 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.

8.4 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.

8.4.1 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.

Box 40. Local Authorities funding scheme

Muar District's finances are relatively stable, with earnings increasing annually from 2015 to 2018. Strong revenue from both tax and non-tax sources has created a significant and growing surplus revenue in 2018. The City Climate Change Working Group (CCCWG) proposes funding the current Climate Action Plan with 10% of the surplus revenue (Source: Muar Action Plan, 2020).

The Municipal Council of Hang Tuah Jaya funds itself local-level projects such as tree planting, drainage maintenance, street lighting, building of pedestrian walkways, and solid waste management. State funding will be sought for larger infrastructure projects, and the Council will apply for national and international co-financing for more ambitious initiatives (Source: Hang Tuah Jaya Action Plan, 2020).

Penampang District financing scheme for the Climate Action Plan:

3-5% of the district's income and revenue will be channelled into low carbon and green technology projects.

Private Finance Initiatives (PFIs) and Public Private Partnerships (PPPs), particularly for flood-related adaptation projects.

International sources of funding such as the European Union, UN Agencies (UNEP, UNIDO, UN Habitat, Global Environment Facility, World Bank, JICA, ADB, UK Prosperity Funds), other UN Climate Green Finance, Newton-Ungku Omar Fund, other funding from individual countries committed to financing climate-related projects and programmes.

Federal Government funding such as Ministry of Environment and water (MESTECC), MITI, KPKT, KATS.

(Source: Penampang Climate Action Plan, 2020)

8.4.2 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[44].

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[45].

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

[45] Bertoldi and Rezessy.

8.4.3 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)[46]. 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;
- sort-term interest deferral periods and/or inclusion of payback grace periods.

Box 41. Solar Panel Financing Scheme - Public Islamic Bank Bhd

Public Islamic Bank Bhd (PIBB) has taken green energy one step further with its solar panel financing for residential houses. Launched on Nov 12, the financing scheme will go on until Dec 31, 2021 and it is for existing PIBB and Public Bank Bhd house financing customers. The financing rate is from base rate (BR) +2% per annum (currently BR is at 2.27% per annum with effect from July 10, 2020) with tenure up to 10 years. (Source: Malaymail, 2020)

8.4.4 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[47].

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).[48]

Box 42. The green sukuk[49]

In 2016 the World Bank Group Global Knowledge and Research Hub joined a Technical Working Group with the Central Bank of Malaysia and the Securities Commission in supporting the Malaysia Green Finance Program, leveraging our experience and expertise in green financing. The program aims to encourage investments in green or sustainable projects through the development of green Islamic finance markets; initially in Malaysia, and subsequently, in the ASEAN region.

The program has supported the launch of the first green sukuk in the world on June 27, 2017. The sukuk is a green Islamic bond, where the proceeds are used to fund a specific environmentally-sustainable infrastructure project, such as the construction of renewable energy generation facilities.

Green bonds have become the go-to asset class for investors looking to fortify their portfolios with sustainable finance options. Despite being structured like a traditional debt instrument, these bonds are fashioned so that investors are doubly assured — that their capital is protected and they are helping to make a difference. Green bonds have surged as an investment category since the World Bank Group came up with the concept more than 10 years ago. New issues this year are expected to reach about US$250 billion globally — a more than 20% increase from a year ago.

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

[47] 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

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

[49] Keshminder, Abdullah, and Mardi, "Green Sukuk – Malaysia Surviving the Bumpy Road: Performance, Challenges and Reconciled Issuance Framework."

8.4.5 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.

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.

8.4.6 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).

8.4.7 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. 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 help to increase the visibility and transparency of a company, which in turn increases its perceived trustworthiness with customers, investors and partners.

8.4.8 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[50].

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

8.5 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.

ESCOs often offer a performance "guarantee", which can take several forms. The guarantee can revolve around the actual flow of energy savings from a retrofit project. Alternatively, the guarantee can stipulate that the energy savings will be sufficient to repay monthly debt service costs. Measurements and verification of the energy savings are decisive for all the parts involved. Energy Performance Contracting (EPC) is a contractual arrangement between a beneficiary and an Energy Service Company about energy efficiency improvements or renewables installations. Normally an ESCO implements the measures and offers the know-how and monitoring during the whole term of the contract. Essentially the ESCO will not receive its payment unless the project delivers energy savings/production as expected[51].

[51] Bertoldi and Rezessy.

9 Conclusion

The main goal of the present guidebook was to assist Malaysian 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 Malaysian 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 Malaysia and suggesting possible measures to be put in place.

First of all, the guidebook has presented an overview of the current state of Malaysian local governments resources in climate action planning, pointing out the major issues that the Malaysian 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 initiation phase (on how to address the climate commitments) has been also presented, meanwhile chapter 4 has illustrated the main steps for developing the Baseline Emission Inventory (BEI) and the Risk and Vulnerability Assessment (RVA). Throughout chapter 5, the guidebook has provided a structured guidance for elaborating mitigation and adaptation measures, tailored to the characteristics of the Malaysian local authorities and in accordance with the current national and international context. The chapters 6 and 7 have then presented how to implement the planned actions and how to monitor the progress towards the target setting. Finally, chapter 8 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 on climate local policies (annexes 1-7) which are the results of experience gained in other regions of the world, for example at European level, and which could serve as example and inspiration for the Malaysian 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 Malaysia 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.

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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

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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[52] 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

[52] Palermo et al., "Assessment of Climate Change Mitigation Policies in 315 Cities in the Covenant of Mayors Initiative."

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 biowaste 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 Communi-cation 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 cataster
	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 zootechnical 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 biowaste
	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. Malaysia Nationally Determined Contribution

In the present annex it is reported the Malaysia 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/Malaysia%20First/Malaysia%20NDC%20Updated%20Submission%20to%20UNFCCC%20July%202021%20final.pdf

MALAYSIA'S UPDATE OF ITS FIRST NATIONALLY DETERMINED CONTRIBUTION

In accordance with paragraph 2(b) of decision 1/CP.19, Malaysia submitted its Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat on 27th November 2015. The submitted INDC was registered as Malaysia's Nationally Determined Contribution (NDC), following Malaysia's ratification of the Paris Agreement on 16th November 2016. Malaysia hereby communicates its updated NDC in accordance with paragraph 24 of decision 1/CP.21 to contribute to the implementation and achievement of the goals of the Paris Agreement.

Malaysia intends to reduce its economy-wide carbon intensity[1] (against GDP) of 45% in 2030 compared to 2005 level. The updated NDC includes the following increased ambition:

(a) The 45% of carbon intensity reduction is unconditional;

(b) This target is an increase of 10% from the earlier submission; and

(c) The GHG coverage is expanded to seven (7) greenhouse gasses (GHG): Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbon (PFCs), Sulphur hexafluoride (SF_6) and Nitrogen trifluoride (NF_3).

Malaysia's accounting approach will strive for transparency, accuracy, consistency, comparability, and completeness (TACCC), and promotes environmental integrity. Continuous improvement will be undertaken to achieve these requirements.

The information for clarity, transparency, and understanding are outlined below and the accompanying information on adaptation is outlined in Annex 1 to this submission.

Further information necessary for clarity, transparency, and understanding (ICTU) of Malaysia's NDC

1. Quantified information on the reference point, including, as appropriate, a base year	
a. Reference year(s), base year(s), reference period(s) or other starting point(s);	Base year: 2005
b. Quantifiable information on the reference indicators, their values in the reference year(s), base year(s), reference period(s) or other starting point(s), and, as applicable, in the target year;	Quantification of the reference indicator will be based on national GHG inventory reported in the NC and BTR submissions and may be updated due to the improvements in the GHG inventory.

[1] Carbon intensity throughout the document refers to GHG intensity from all the seven GHGs.

c. For strategies, plans and actions referred to in Article 4, paragraph 6, of the Paris Agreement, or polices and measures as components of NDCs where paragraph 1(b) above is not applicable, Parties to provide other relevant information;	n/a
d. Target relative to the reference indicator, expressed numerically, for example in percentage or amount of reduction;	Economy-wide carbon intensity reduction (against GDP) of 45% in 2030 compared to 2005 level.
e. Information on sources of data used in quantifying the reference point(s);	The reference indicator will be quantified based on national GHG emissions and removals, and GDP in 2005.
f. Information on the circumstances under which the Party may update the values of the reference indicators.	The national GHG emissions and removals in 2005 may be updated and recalculated due to continuous improvements of the GHG inventory. The GDP for the year 2005 would be re-based to the current constant price year available. Information on these updates, if any, will be included in the BTR.

2. Time frames and/or periods for implementation	
a. Time frame and/or period for implementation, including start and end date, consistent with any further relevant decision adopted by the CMA;	1st January 2021 – 31st December 2030
b. Whether it is a single-year or multi-year target, as applicable.	Single year target in 2030

3. Scope and coverage	
a. General description of the target;	Economy-wide carbon intensity (against GDP) reduction of 45% in 2030 compared to 2005 level.
b. Sectors, gases, categories and pools covered by the nationally determined contribution, including, as applicable, consistent with IPCC guidelines;	<u>Sectors</u>: Energy Industrial Processes and Product Use Waste

	Agriculture LULUCF. (The accounting contribution of LULUCF to Malaysia's target is determined as described in 5(e)). <u>GHGs</u>: Carbon dioxide (CO_2) Methane (CH_4) Nitrous oxide (N_2O) Hydrofluorocarbons (HFCs) Perfluorocarbon (PFCs) Sulphur hexafluoride (SF_6) Nitrogen trifluoride (NF_3)
c. How the Party has taken into consideration paragraphs 31(c) and (d) of decision 1/CP.21;	Malaysia's NDC is economy-wide and will strive to include all key categories of anthropogenic emissions and removals.
d. Mitigation co-benefits resulting from Parties' adaptation actions and/or economic diversification plans, including description of specific projects, measures and initiatives of Parties' adaptation actions and/or economic diversification plans.	n/a

4. Planning process	
a. Information on the planning processes that the Party undertook to prepare its NDC and, if available, on the Party's implementation plans, including, as appropriate: i. Domestic institutional arrangements, public participation and engagement with local communities and indigenous peoples, in a gender-responsive manner;	The NDC was developed through participatory process through inter-ministerial/agencies/NGOs /private sector/academia working groups and consultations. It has been endorsed by the National Steering Committee on Climate Change and approved by the Malaysian Cabinet.

ii. Contextual matters, including, inter alia, as appropriate: a. National circumstances, such as geography, climate, economy, sustainable development and poverty eradication; b. Best practices and experience related to the preparation of the nationally determined contribution; c. Other contextual aspirations and priorities acknowledged when joining the Paris Agreement;	The national circumstances of Malaysia had been reported through its National Communication and Biennial Update Report submissions. Stakeholder consultation is important in formulating an ambitious NDC. As a developing country, Malaysia needs to ensure a balance between its socio-economic development and low carbon agenda.
b. Specific information applicable to Parties, including regional economic integration organizations and their member States, that have reached an agreement to act jointly under Article 4, paragraph 2, of the Paris Agreement, including the Parties that agreed to act jointly and the terms of the agreement, in accordance with Article 4, paragraphs 16–18, of the Paris Agreement;	n/a
c. How the Party's preparation of its NDC has been informed by the outcomes of the global stocktake, in accordance with Article 4, paragraph 9, of the Paris Agreement;	n/a

d. Each Party with an NDC under Article 4 of the Paris Agreement that consists of adaptation action and/or economic diversification plans resulting in mitigation co-benefits consistent with Article 4, paragraph 7, of the Paris Agreement to submit information on: i. How the economic and social consequences of response measures have been considered in developing the NDC; ii. ii. Specific projects, measures and activities to be implemented to contribute to mitigation co-benefits, including information on adaptation plans that also yield mitigation co-benefits, which may cover, but are not limited to, key sectors, such as energy, resources, water resources, coastal resources, human settlements and urban planning, agriculture and forestry; and economic diversification actions, which may cover, but are not limited to, sectors such as manufacturing and industry, energy and mining, transport and communication, construction, tourism, real estate, agriculture and fisheries.	n/a

5. Assumptions and methodological approaches, including those for estimating and accounting for anthropogenic greenhouse gas emissions and, as appropriate, removals:	
a. Assumptions and methodological approaches used for accounting for anthropogenic greenhouse gas emissions and removals corresponding to the Party's NDC, consistent with decision 1/CP.21, paragraph 31, and accounting guidance adopted by the CMA;	In accounting for the NDC, the estimates of economy-wide emissions and removals will be reported in the inventory, and consistent with the inventory guidance contained in the Annex to decision 18/CMA1. The methodologies and metrics used are reflected in 5 (d).

b. Assumptions and methodological approaches used for accounting for the implementation of policies and measures or strategies in the NDC;	n/a
c. If applicable, information on how the Party will take into account existing methods and guidance under the Convention to account for anthropogenic emissions and removals, in accordance with Article 4, paragraph 14, of the Paris Agreement, as appropriate;	See (d)-(e) below.
d. IPCC methodologies and metrics used for estimating anthropogenic greenhouse gas emissions and removals;	IPCC Methodologies: Malaysia uses the 2006 IPCC Guidelines for National GHG Inventories to estimate anthropogenic GHG emissions and removals, IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, and the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. Metrics: The 100-year time horizon GWP values from the IPCC's Fifth Assessment Report or any future updates will be used to calculate the CO_2 equivalent emissions and removals in accordance with Decision 18/CMA.1.
e. Sector-, category- or activity-specific assumptions, methodologies and approaches consistent with IPCC guidance, as appropriate, including, as applicable:	Information provided in sections 5(e) and 5(f) are based on current policies and knowledge. Malaysia reserves the right to update the information as appropriate. Malaysia will apply the net-net accounting approach for the LULUCF sector.
i. Approach to addressing emissions and subsequent removals from natural disturbances on managed lands;	Currently, natural disturbances on managed lands are due to periodic incidence of forest fires. Emissions from natural disturbances that exceed the average emissions between 2001 to

	2020 caused by natural disturbances will not be accounted.
ii. Approach used to account for emissions and removals from harvested wood products;	Malaysia is undertaking a study to consider the relevant approach to account emissions and removals from harvested wood products.
iii. Approach used to address the effects of age-class structure in forests;	Activity data and emission factors would take into consideration the management type of forest land remaining forest land.
f. Other assumptions and methodological approaches used for understanding the NDC and, if applicable, estimating corresponding emissions and removals, including:	Malaysia will continue to improve its methodologies to account for historical emissions. Adopting future improvements may affect historical emissions, including 2005 emissions. For the LULUCF sector, the activity based methodology is applied.
i. How the reference indicators, baseline(s) and/or reference level(s), including, where applicable, sector-, category- or activity-specific reference levels, are constructed, including, for example, key parameters, assumptions, definitions, methodologies, data sources and models used;	Malaysia will follow the guidance in accordance with the 2006 IPCC Guidelines for National GHG Inventories consistent with decision 18/CMA.1 as appropriate. When information is not available, flexibility is to be applied. Malaysia will continue to improve its methodologies to account for historical emissions. Adopting future improvements may affect historical emissions, including 2005 emissions.
ii. For Parties with NDCs that contain non-greenhouse-gas components, information on assumptions and methodological approaches used in relation to those components, as applicable;	n/a
iii. For climate forcers included in NDCs not covered by IPCC guidelines, information on how the climate forcers are estimated;	n/a

iv. Further technical information, as necessary;	<u>LULUCF Categories</u>: Forest land Cropland Grassland Wetland Settlement (Emissions and removals from grassland and wetland will be accounted subject to the activities undertaken). <u>LULUCF pools</u>: Above ground Below ground Soil organic carbon (drained peatlands)
g. The intention to use voluntary cooperation under Article 6 of the Paris Agreement, if applicable.	Malaysia does not intend to use voluntary cooperation under Article 6 of the Paris Agreement to achieve its NDC.

6. How the Party considers that its NDC is fair and ambitious in light of its national circumstances	
a. How the Party considers that its NDC is fair and ambitious in the light of its national circumstances;	The oil and gas industry is an important sector of Malaysia's economy. The NDC will be achieved through domestic measures. In view of these, Malaysia's updated NDC is fair and ambitious.
b. Fairness considerations, including reflecting on equity;	Malaysia regards its NDC to represent its fair share of the efforts to achieve the global long-term goal of the Paris Agreement in view of its national circumstances and capabilities.
c. How the Party has addressed Article 4, paragraph 3, of the Paris Agreement;	Malaysia's updated NDC is unconditional and has increased its carbon intensity (against GDP) reduction by an additional 10%. Malaysia regards this target as progressive and reflects its highest possible ambition given that the mitigation actions will be undertaken domestically.

d. How the Party has addressed Article 4, paragraph 4, of the Paris Agreement;	Malaysia's NDC involves economy-wide carbon intensity reduction target.
e. How the Party has addressed Article 4, paragraph 6, of the Paris Agreement.	n/a

7. How the NDC contributes towards achieving the objectives of the Convention as set out in its Article 2	
a. How the NDC contributes towards achieving the objective of the Convention as set out in its Article 2;	Malaysia’s updated NDC takes into consideration the long-term global goal of the Paris Agreement and Article 2 of the Convention.
b. How the NDC contributes towards Article 2, paragraph 1(a), and Article 4, paragraph 1, of the Paris Agreement.	Malaysia is formulating its Long-term Low GHG Emission Development Strategies (LT-LEDS) which will contribute towards achieving Article 2, paragraph 1(a), and Article 4, paragraph 1, of the Paris Agreement.

ANNEX I

ACCOMPANYING INFORMATION ON MALAYSIA'S ADAPTATION STRATEGIES

1. The implementation of climate change adaptation in Malaysia focuses on the management of water resources and security, coastal resources, agriculture and food supply, urban and infrastructure resilience, public health, forestry and biodiversity and key adaptation cross sectoral areas. Based on the downscaled IPCC AR5 scenarios, projections of the future changes indicate that the rise of the average annual surface temperature will range from 1.9 to 2.1°C by the end of the century. The magnitude of change of average annual precipitation is expected to range from 14% to 25%, while the sea levels are projected to continue rising about 0.73 meter by the end of the 21st century.

2. In the Eleventh Malaysia Plan (2016-2020), RM7.24 billion was allocated for implementation to enhance climate-resilience and adaptation measures, and continuous support will be emphasised in the Twelfth Malaysia Plan (2021-2025). Malaysia is also developing the National Adaptation Plan (NAP) to ensure that climate change adaptation is mainstreamed into its development plan.

Management of Water Resources and Security

3. The climate change phenomenon poses challenges to Malaysia's water resources management and security. In this regard the Ministry of Environment and Water is responsible to ensure the sustainability of water resource management in Malaysia.

4. The Integrated Water Resources Management is strengthened with the implementation of the Integrated River Basin Management and Integrated Flood Management to ensure efficient water management. Emphasis will be given through gazettement of more forest water catchments to secure adequate and safe water supply.

5. Minimizing flood impacts by incorporating climate change factors into flood risk assessment and protection projects are important for Malaysia. In this regard, weather-flood forecasting and early warning system based on future climate conditions will be improved.

6. Malaysia continues to ensure water security against the impact of prolonged dry spell by increasing water supply reserve margin with the reduction of non-revenue water and implementation of the off-river storage structural forms. Malaysia plans to increase diversification and exploration of alternative water sources such as urban scale rainwater harvesting system, groundwater, recycled and reclaimed water for conjunctive use. Prioritisation of water demand management to reduce stress on water supply is high on the agenda.

7. These strategies are incorporated in the development of the Water Sector Transformation 2040. In the transformation, finance and technology are part of the strategies and implementation.

Protecting Coastal Resources

8. Sea level rise (SLR) poses threat to Malaysia's coastal resources. SLR and storm surge projections will be mainstreamed into the Integrated Shoreline Management Plan and for the planning of coastal protection and development projects.

9. Malaysia utilises the Coastal Vulnerability Index associated with SLR, as an essential indicator to evaluate the vulnerability and risk levels of shoreline. This will be embedded in mapping out vulnerability assessment of different socio-economic segments. Efforts will be focused on intensification of developing coastline SLR-based inundation maps.

10. Malaysia focuses on increasing coastal resilience against the impacts of SLR and management of storm surge impacted areas through rehabilitation and protection programs. Adoption of nature-based solutions and green-gray infrastructures will be continuously promoted.

Securing Agriculture and Food Security in Malaysia

11. The changing of climate patterns also pose risks to the agriculture and food security. Strategies will be implemented to increase the resilience and productivity of climate-vulnerable crops. Crops resilience to climate change will also be intensified through risk mapping and strategic pests and disease control management.

12. Research will be carried out to increase climate-tolerant species and varieties. These include augmenting the development of food crop types that can accommodate the demands posed by climate change.

13. The conservation of more major granary areas and expansion of future inland and coastal flood risk assessments on agricultural lands will be implemented to ensure the efficiency of food productivity and raise the self-sufficiency levels. Good and efficient agricultural practices will be further implemented in order to secure continuous agriculture and food supply. These can be achieved through the promotion of smart farming technologies and the implementation of diversification and integrated management.

Increasing Resilience for Infrastructure and Cities

14. In managing future risks and potential loss from climate change, Malaysia is mainstreaming climate resilience into urban planning and development of infrastructures. This will include emphasising infrastructure integrity assessments and revisions of the existing manuals and guidelines.

15. Future planning for waste and wastewater infrastructures will take into account its sustainability, efficiency and effectiveness whilst avoiding areas that are environmentally sensitive, flood-prone and categorised as water catchments. Adopting nature-based solutions such as constructed wetlands in facilitating wastewater treatments will be a priority.

16. Malaysia also aims to identify, implement and expand innovative and nature-based infrastructure design. Resilient and green city concept will be adopted to ensure future climate risks are managed efficiently.

Improving Public Health Resilience

17. Malaysia will expand public health management of future climate risks by adopting evidence-based decision making and improve the projection models in addressing the complex causal relation pathway of climate change and health. Disease management will adopt new models that utilises climatic data to predict changes and impacts of climate-sensitive diseases.

18. In addition, efforts are undertaken to strengthen surveillance and early warning systems to improve public health preparedness in predicting the future disease impacts. This will be implemented by incorporating weather forecasts into risk maps of climate-sensitive disease.

19. Critical healthcare facilities' adaptive capacity will be increased through improving resilience strategies, whilst sustaining essential functions and structures of the public health systems.

Enhancing Adaptation for Forestry and Biodiversity

20. Increasing forest catchment capacity and enhancing management are needed to accommodate expected increase runoff volume and peak flood flow due to higher projected rainfall. It is also crucial to gazette more forest water catchment area in order to maintain and sustain fundamental ecological functions, especially with respect to infiltration rate and soil-water storage capacity.

21. Preservation of vulnerable terrestrial and marine ecosystem and expanding protected areas, including fisheries zones within the marine and coastal protection corridors will be given priority. The ability to manage terrestrial ecosystem is essential and can be enhanced by increasing riparian area management units and reserving larger buffer areas around wetlands, peat swamps and mangroves. Moreover, efforts in establishing reserve to protect ecosystem diversity through enhancing structural and species varieties are also needed.

Cross Sectoral Efforts: Managing Disaster Risk

22. Malaysia has ratified the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030 on 18 March 2015 to reduce disaster risks and loss and damage for better management of socio-economic and environmental impacts. Malaysia will continue the efforts to strengthen the capacity and mechanism in disaster risk management. The integration of climate change adaptation and disaster risk reduction will be given the focus in the national development plan. Furthermore, Malaysia will continue to be more inclusive and mainstream gender, youth and vulnerable groups in adaptation and disaster risk reduction programs.

Cross Sectoral Efforts: Climate Financing Support, Technology Transfer and Capacity Building

23. Malaysia will continue the efforts to explore and optimise the financing mechanism, technology needs assessment and capacity development for climate change impacted sectors to enhance adaptive capacity. Successful implementation of adaptation activities will increase investment and funds from various sources including private sector.

Cross Sectoral Efforts: Establishment of Monitoring and Evaluation Mechanism

24. The Paris Agreement requires each Party to monitor, evaluate and learn from adaptation planning, policies, programs, and actions. Currently, there is no monitoring and evaluation (M&E) mechanism or framework established for adaptation. During the development of the National Adaptation Plan, the M&E mechanism will be incorporated and established to ensure successful implementation.

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