Guide for Local Climate Change Adaptation Planning in the Baltic Sea Region

CBSS CliMaLoc
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COUNCIL OF THE BALTIC SEA STATES

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Contents

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Foreword

THE GUIDELINES FOR PREPARING and drafting the climate change adaptation plan for local governments in the Baltic Sea Region (BSR) were prepared by Valdur Lahtvee, Advisor to the Council of the Baltic Sea States (CBSS). They are the output of the "Climate Mainstreaming Locally in the Baltic Sea Region" (CliMaLoc) project, which was co-financed by the Swedish Institute's Seed Fund.

The CliMaLoc project aimed at supporting local authorities in the BSR countries to mainstream climate action and establish partnerships for cooperation on the issue. This includes integrating climate aspects into local development plans, better aligning to the 2030 Agenda, and supporting the efforts of the EU Strategy for the Baltic Sea Region (EUSBSR) to promote low-carbon economies across sectors and policies. The CliMaLoc project took place between June 2021 to November 2022.

According to the 6th Assessment report of the International panel for Climate Change (IPCC AR6), **risk** can arise from the dynamic interactions among climate-related hazards, and the exposure and vulnerability of affected human and ecological systems. The risk that can be introduced by human responses to climate change is a new aspect considered in the risk concept. The report itself identifies 127 key risks posed by climate change.

The **vulnerability** of exposed human and natural systems is a component of risk, but also, independently, an important focus in the literature on climate change. Approaches to analyzing and assessing vulnerability have evolved since previous IPCC assessments. Vulnerability is widely understood to differ within communities and across societies, regions, and countries, also changing through time.

Adaptation plays a key role in reducing exposure and vulnerability to climate change. Adaptation in ecological systems includes autonomous adjustments through ecological and evolutionary processes. In human systems, adaptation can be anticipatory or reactive, as well as incremental and/or transformational. The latter changes the fundamental attributes of a socio-ecological system in anticipation of climate change and its impacts.

Resilience in the literature has a wide range of meanings. Adaptation is often organized around resilience as bouncing back and returning to a previous state after a disturbance. More broadly the term describes not just the ability to maintain essential function, identity and structure, but also the capacity for transformation.

Preparing for risks posed by climate change and planning for adaptation at local government and community levels is essential for the safety and security of the society, as well as for its economic, environmental, and social well-being. Changes in the climate are often reflected by floods, heatwaves, droughts, coastal erosion, and other impacts that have been identified across the globe, which pose threats to life, property, economic well-being and to ecosystems.

The UN Intergovernmental Panel on Climate Change (IPCC) has projected that global warming from past anthropogenic emissions will persist for centuries to millennia and will continue to cause further long-term changes in the climate system such as sea level rise, with associated impacts.

Obligation to assesses some of the climate risks and / or take climate risks into account while planning municipality actions are imposed in most countries of the Baltic Sea region. Mainly on water management (specifically related to implementation of the European Directive 2007/60/EC on the assessment and management of flood risks), emergencies and natural disasters as well spatial planning. Obligation to prepare (mandatory) Climate Change Adaptation strategy or Action Plan for Local Government has been imposed only in one of eleven countries in the region.

Table 1. Local government responsibilities on adapting to climate change.

Policy measure Country	National CCA Strategy	LG-s role specifically determined in NCCAS	Requirement for Local CCA Strategy or Action plan	Requirement for LG climate risks assessment	LG-s networking on CCA	Guidance for LG-s in nat. lang. on CCA	CCA Funding for LG-s	CCA information web-portal for LG-s
Denmark	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Estonia	Yes	Yes	No	No	No	No	Yes	No
Finland	Yes	No	No	Yes	Yes	Yes	No	Yes
Germany	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Iceland	No	No	No	No	No	No	No	No
Latvia	Yes	Yes	No	No	No	No	Yes	No
Lithuania	Yes	No	No	No	No	Yes	Yes	No
Norway	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Poland	Yes	No	No	No	Yes	Yes	Yes	No
Russia	Yes	No	No	No	No	No	No	No
Sweden	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes

The International Standard Organization (ISO) has prepared several standards related to climate change adaptation:

— ISO 14090:2019 Adaptation to climate change — Principles, requirements, and guidelines.
— ISO/TS 14092:2020 Adaptation to climate change — Requirements and guidance on adaptation planning for local governments and communities.
— ISO 14091:2021 Adaptation to climate change — Guidelines on vulnerability, impacts, and risk assessment.

The ISO/TS 14092 document presents guidance for local governments and communities on how to prepare for such threats and the associated risks. The document recognizes that the impacts posed by climate change vary widely from region to region. They directly affect communities and their well-being, as well as local governments including the public services they offer, and the safety and security of individuals within their jurisdiction. It is the responsibility of local governments and communities to provide leadership in planning and preparing to manage these risks.

The standard also describes how to develop an adaptation plan at the local government and community levels. The planning process details why and how to establish an appropriate (well-structured and collaborative) governance structure and the elements of the adaptation planning and implementation processes. These details include establishing a facilitation team, assessing risks, and developing an effective plan, monitoring the progress of adaptation implementation, and evaluating its achievement with the aim of improving the plan. The step-by-step process presented enables tailoring of the local adaptation plan to suit the climate, environmental and societal conditions in each case. Following this document will lead to developing a robust, effective adaptation plan that can be implemented, promoting appropriate climate action today and in the future.

It is important to note that the climate is changing and planning and implementing adaptation is a continual learning and improvement process that requires sustained attention and action. This document will help local governments and communities in taking initial action to create a safe, socially, and economically secure and sustainable society that is resilient to current and future impacts of climate change.

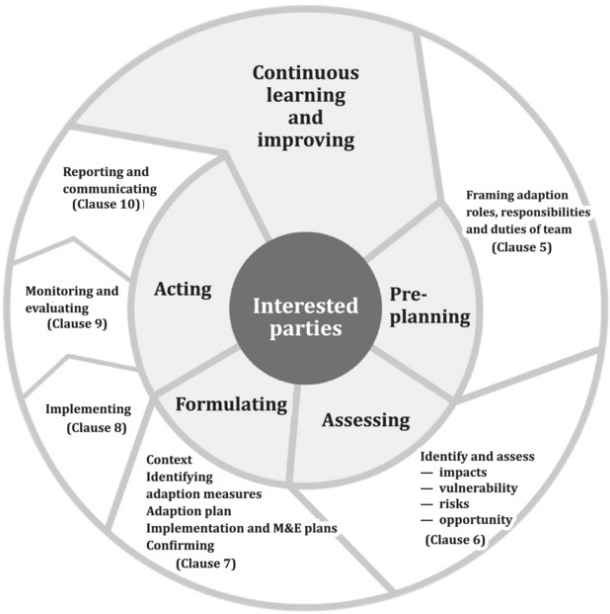

Figure 1. Logical framework approach by ISO/TS 14092:2920

To keep the process of the preparation of a municipality adaptation plan as a separate exercise or part of ageneral or strategic planning preparation that is structured but simple, current guidelines will follow the logical framework approach presented in ISO/TS, divided into 10 steps described further below.

There is no 'one-size fits all' approach for communities to anticipate, plan, and adapt to the changing climate. Projected climate impacts are not expected to be the same in every region of the county. Local awareness of climate change vulnerabilities differs even in one country. Available resources to assess and adapt, financial and technical, vary. Still, following the 10 steps described below, gives municipalities a robust but tangible framework to assess local climate risks and prepare adaptation actions suited to very local conditions. The examples of the selected cities Climate Change Adaptation plans, described in or attached to current guidelines, should also provide support for those who prepare their first action plan.

Step 1: Assess Local Climate Data and Trends

In the BSR countries, local climate trends are usually monitored and recorded by the national hydrometeorological services ,and data is freely available on request from authorities or directly from official websites of relevant institutions. As required by the EU Climate Adaptation Strategy, all EU member States had to prepare National Climate Adaptation Strategies which also include a thorough description of current climate trends, prognoses of climate change until the end of the century, and vulnerability assessments. Access to those reports is available through national climate knowledge portals (see list with weblinks below) or via the EU Climate-ADAPT portal county profiles: https://climate-adapt.eea.europa.eu/countries-regions/countries.

Since the major negative impact, in the BSR, is increased precipitation and fluvial floods, a good source for assessing the floodings in one's area is to look at national flood maps. Mapping floods is a requirement for EU Member States, as laid out in the Floods Directive (2007/60/EC). Flood maps of all EU Member States are available from the respective national sources. Updated flood data is also compiled into the European flood atlas, available at https://www.efas.eu/en.

Here is a list of national climate adaptation knowledge or climate data portals in the BSR:

- Denmark: https://en.klimatilpasning.dk/
- Estonia: https://keskkonnaagentuur.ee/analuusid-ja-indikaatorid/analuusid/ilmaandmed-ja-kliima
- Finland: https://www.climateguide.fi/frontpage/
- Germany: https://www.klivoportal.de/EN/Home/home_node.html
- Iceland: https://en.vedur.is/climatology/iceland/
- Latvia: https://videscentrs.lvgmc.lv/lapas/latvijas-klimats
- Lithuania: https://klimatokaita.lt/
- Norway: https://www.miljodirektoratet.no/klimatilpasning/
- Poland: https://klimat.imgw.pl/
- Sweden: https://www.klimatanpassning.se/en

Under this step, the current state of the climate in the territory of the municipality and how various climate aspects have evolved over the last decades are described. The description should also include listings of major extreme weather events that occurred in the past and caused damage to people, the environment and infrastructure, and that disrupted business operations and availability of services.

Parameters of climate change can include the following: average and peak temperature (sea and atmosphere); precipitation; humidity; sea level rise; wind speed and direction; and freeze-thaw cycles.

The chapter should also describe the sources of the data and information used, the criteria for the selection of data and also a statement of limitations and uncertainties related to used data.

Step 2: Create a Climate Risk and Vulnerability Assessment

Use fresh data and prognoses of climate impact

Staying up to date with the newest climate data and long-term prognosis of climate change risks and consequences will help with preparing assessments. At the global level, the IPCCC 6th Assessment Report is a good resource.

In the BSR, a thorough assessment of climate change impacts was carried out during 2011-2012 by the partners of the BALTADAPT project in the format of 14 BALTADAPT Climate Info Bulletins, while preparing the Baltic Sea Region Climate Adaptation Strategy and Action Plan.

According to the conclusions of the BALTADAPT project, most climate change simulations reveal strong changes in the air temperature in the BSR. The simulated **increase of mean air temperature** is already statistically significant in the nearest few decades compared to the most recent past decades. The changes are largest in winter and most so in the north-eastern part of the domain, where a coupling to a reduction in snow and sea ice is evident. **Temperature extremes** are projected to change more than long-term averages. In winter this implies that cold extremes in today's climate will get very unusual in a future warmer climate, while summertime hot extremes are expected to be more intense than those today.

Simulated changes in precipitation in the BSR are large and indicate a **wetter climate** in the future. The projected increases are largest and most consistent during winter. In summer the scenarios generally show more precipitation in the north and less in the south but there are large uncertainties in this, even concerning the sign of change. Also, **precipitation extremes** are projected to change with time and models show increasing amounts of precipitation associated with extreme events, also in areas that may experience decreases in seasonal mean precipitation.

Climate change simulations reveal a large spread in changes in wind speed in the Baltic Sea region. Most projections show an **increase of wind speed** over the Baltic Sea in a future warmer climate, but the uncertainty is large.

The projected regional climate change will have the largest effect on the **rising sea level** in the Bothnian Bay, the Gulf of Finland and the Gulf of Riga. The total rise will be much larger in the southern and south-eastern parts of the Baltic Sea while the northern part will be less affected. The consequences of rising sea levels will differ along the coastline where lowland areas and densely populated regions are more exposed. On a shorter timescale the sea level in the Baltic Sea is affected by the local meteorological conditions which may cause an **extreme sea level rise and flooding**. The frequency of such events in the future climate is unpredictable.

The wave climate in the Baltic Sea is changing because of the largescale atmospheric circulation. Model simulations in the Baltic Sea show an increase in maximal wind speed and frequency of extreme events. Following these changes in wind conditions, the **wave height and frequency of highest waves are also increasing**. Consequently, the **number of erosion events in the shallow areas is increasing** as well.

All scenario simulations display **increasing water temperatures**, both for the volume average and for the sea surface. The largest change is obtained in the Bothnian Bay in summer. In winter the largest increase is found in the Gulf of Finland. Changing water temperatures will have an impact on the occurrence and distribution of various species in the Baltic Sea. In summer, cyanobacterial blooms may be enhanced. In areas where late winter convection normally takes place an increased temperature may change the density distribution in such way that the deep convection is affected.

Substantial changes in the Baltic Sea ecosystem are expected in the coming 100 years. The **sea will become more brackish, warmer** and the sea level will rise in the southern part. Biological communities inhabiting the Baltic will change dramatically. Fewer species will be present in general and **more freshwater species will penetrate the Baltic** on expense of the marine/saltwater species.

Eutrophication may increase due to the expected increase in precipitation in the catchment area unless political action and proper management measures are taken. Increased plankton production and further reduction in oxygen concentration may cause even larger desert-like areas in the deeper parts of the Baltic, devoid of macroscopic benthic fauna and increase the areas where the species composition of today is changed. The increased plankton production and biomass in the surface layer will reduce light penetration and by that affect eelgrass meadows and seaweed forests on reefs and rocky shores.

In the Northern Baltic Sea, the expected **lack of or reduced ice cover over the winter season** will affect populations of birds and at least the ringed seal and may have secondary impacts on numerous links in the ecosystem as cold-adapted species are replaced by freshwater species tolerating warmer water. Potentially large-scale functional changes in the ecosystem can be foreseen.

Infrastructure in the Baltic Sea region will be affected by climate change in various ways. Rising temperatures,

decreasing sea ice cover, sea level rise, changing precipitation and storm patterns directly impact infrastructure such as coastal protection, maritime traffic, ports, and tourism infrastructure. Indirect effects of climate change such as shifts in tourism or changes in demand will have further consequences for the maritime sector. Also, economic sectors like forestry, agriculture, construction, energy production and transport will be affected by climate change.

A report from the CBSS-initiated CASCADE project, "**Overview of climate risk drivers and hazards**", published in 2021, is a useful reference for understanding the links between potential drivers, hazards, and their potential impacts of climate change – direct, indirect, and even cascading – on society. The inventory accompanies the integrated risk assessment methodology as an appendix. To exemplify the hazards, examples from the Baltic Sea Region (BSR) are used when available. Furthermore, references to whether and how these hazards were included in National Risk Assessments or similar documents in specific countries in the BSR region is included. Examples are brought from national risk assessment related documents from Denmark (DEMA 2017), Finland (Finnish Ministry of the Interior 2019), Norway (DSB 2014), and Poland (RCB 2015) and Sweden (MSB 2013).

To provide a better understanding of the effects of climate change in the Baltic Sea, Baltic Earth and HELCOM have recently published the first Baltic Sea Climate Change Fact Sheet. The publication compiles the latest available science in the region on what has now become a global emergency. Fact sheet is freely downloadable at https://helcom.fi/media/publications/Baltic-Sea-Climate-Change-Fact-Sheet-2021.pdf.

The BALTEX and Baltic Earth Assessments of Climate Change for the Baltic Sea basin were compiled to assemble, integrate, and assess available knowledge of past, current, and expected future climate change and its impacts on the environments of the Baltic Sea basin. BACC was published in 2008, BACC II in 2015, as textbooks by Springer: BACC II is Open Access and freely downloadable. From April 2022, the Baltic Earth Assessment Reports (BEAR) can be downloaded as Open Access papers from the Earth System Dynamics (ESD) web page https://esd.copernicus.org/articles/special_issue1088.html.

For quick access to city/municipality specific climate change the Swedish Meteorology and Hydrology Institute SMHI together with WMO and WCRP have developed tools to get site specific climate data based on IPCC long-term climate change prognoses. An open access service, it provides instant summary reports of climate change for any site on the globe, and easy access to many pre-calculated climate indicators, based on state-of-the-art in climate science, of the past, present and future and Guidance on how to link global changes to local observations.

Some BSR Countries have more precise maps, data and publicly available tools on local climate vulnerabilities/indicators like Danish National risk map of coastal areas up to 2120 (see link https://xn--kystplanlgger-cgb.dk/) , Swedish Advanced Climate Change Scenario Service (see link https://www.smhi.se/en/climate/future-climate/advanced-climate-change-scenario-service/met/sverige/medeltemperatur/rcp85/2071-2100/year/anom), German Climate Knowledge Portal climate projections (see link https://climateknowledgeportal.worldbank.org/country/germany/climate-data-projections) etc.

Municipalities are also advised to check from national authorities whether updated data or prognoses are available.

The municipality should assess and describe, in its adaptation strategy, all current and future impacts of climate change in its territory. The assessment should include both impacts of usual seasonal weather as well as sudden and extreme weather events. Focus should be on the impacts which may have significant in the area, sector or systems and operation based on municipality divisional structure and location, like forestry, fisheries, agriculture, and food security; water resources and flood protection; terrestrial and marine ecosystems; urban environment incl. sports and recreational areas; energy resources, production and supply; busies and industry incl tourism; transport infrastructure and services; ICT and telecommunication; social infrastructure; human health, including health and social care systems, government and community services; financial services etc.

Identify sectoral and cross-sectoral risks and vulnerabilities

On basis of historic data and actual situation of major business activities in your municipality, identify which areas of social and economic activities, infrastructure, and services, are vulnerable to the effects of climate change, both today and in the foreseeable future. Pay attention to those climate aspects which have caused damage in the past and which are expected to significantly change in the future. The municipal climate change adaptation strategy and action plan should focus on aspects and vulnerabilities assessment cover only those which are under control and/or influenced by the municipality.

The report and the **Guidelines for integrated climate change and risk reduction management for local authorities** are downloadable at CASCADE project website at https://www.cascade-bsr.eu/toolbox/guidelines .

SMHI, WMO and WCRP climate data tool: https://climateinformation.org/dap

Impacts maid be direct and indirect. Direct impacts may include floodings and storm surges; water scarcity; changes in human health, safety, and security; and heat-wave mortality. Indirect impacts maid be loss and damage of infrastructure and services depending on that infrastructure; changes in land cover and use; change in provision of ecosystem services; change in productivity of crops and livestock, food supply, fuels supply etc.

The consequences of the impacts can lead to the collapse of vital services due to the disruptions of the electricity supply. In extreme cases, there may be a need to evacuate people and to provide shelter and existential supplies to evacuees.

By assessing the characteristics of the impacts (magnitude, likelihood, and urgency), vulnerabilities should be prioritized to make planning of adaptation measures easier as municipalities often have limited budgets.

Identify future and potential vulnerabilities

After assessing the exposure, sensitivity and adaptive capacity under the current climate trends and variability of climate events, it is recommended to also assess how the magnitude and frequency of extreme weather events will change over a foreseeable timeline, and to identify whether new risks and vulnerabilities may occur.

Climate risks and vulnerability assessment of the local government should at the very least include the following:

— preparing the list of potential impacts of climate change on activities, assets, and services of the local government as result of climate change,
— identifying the exposure of activities, assets, and services of the local government to changes in climate,
— determining the sensitivity of activities, assets, and services to changes in climate change and in consequences of negative impacts of climate change,
— considering the ability of local government to adjust, take advantage or to respond to these changes and consequences.

Local governments should engage interest groups and their stakeholders in preparing climate risks and vulnerability assessment, for instance by conducting questionnaire surveys and/or participatory workshops with interested parties to identify and explore the perception of various groups towards climate change and the needs of those groups for adaptation measures.

The CASCADE project "Guidelines for integrated climate change and risk reduction management for local authorities" are annexed.

Depending on the selected approach, following the C40 Cities Climate Change Risk Assessment Guidance maid be also relevant (see https://resourcecentre.c40.org/resources/assessing-risks-in-cities).

For climate risks assessments, we recommend using the CASCADE guidelines: https://www.cascade-bsr.eu/sites/cascade-bsr/files/publications/cascade_guidelines_0.pdf

We also recommend using the various tools prepared by the Danish authorities for local governments, organizations and households for assessing vulnerability and planning adaptation to climate change at https://en.klimatilpasning.dk/tools/

Prepare data for visualizing with GIS/maps

To help prioritizing both vulnerabilities and possible adaptation actions, presenting information in map formats will allow stakeholders to better understand complex data in a visual and comprehensive manner. Layers of climate risks and adaptation action maps could be part of the general plan of local government, and are great tools for communicating climate change impacts and risks to interested parties.

Below (Figure 2) is an example of a specific local climate risks and adaptation action in GIS by the Danish web-tool Kystplanlægger.

Some interactive maps from the ClimWatAdapt, ESPON Climate, JRC-IES and ENSEMBLES resources and containing observations and projections of climate change impacts, vulnerability and risks are accessible via https://climate-adapt.eea.europa.eu/knowledge/european-climate-data-explorer/.

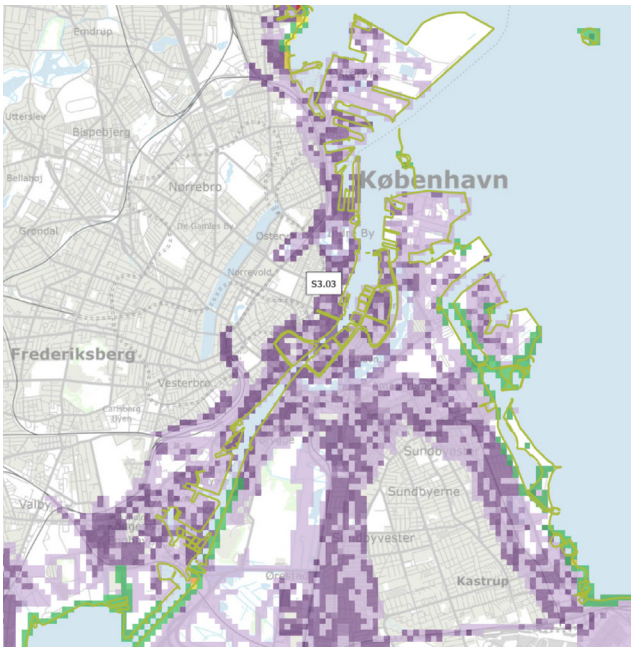

Figure 2. Danish web-tool Kystplanlægger. Source: https://xn--kystplanlgger-cgb.dk/kort-om-webgis/

Step 3:
Review current plans and priorities

Local governments face ever more complex urban development challenges. Some urban planning decisions can lock a neighbourhood or a city into a long-term physical shape that may prove suboptimal over time when it comes to the effects of climate change. Planning for the short-term, medium-term, and long-term, with an integrated, multi-sectoral approach is essential when intervening in the urban system. Doing so is efficient, can ensure co-creation of plans and may lead to cross-sectoral co-benefits.

Integrated urban planning considers the interrelations among housing, transportation, economic development, education, environmental sustainability, and other policy areas including climate change. This comprehensive planning must be strategic and consider the local context, needs and challenges while responding to the roles and mandates of all levels of government to enable action.

Current plans are usually reflecting existing development trends in the territory of the local government, and describe limitations to the development based on identified knowledge of conflicting interests.

A local government should review how existing plans and strategies (including budgets) consider the identified risks and vulnerabilities linked to climate change, and build adaptive capacity of local government to address the impacts of climate change. Adaptive capacity includes available human, technical, financial, informational, and other institutional resources.

The planning documents of a municipality usually contain longer-term strategies and plans like a development strategy, a general plan with various layers, and a shorter term, sector specific and/or operational planning documents such as plans on spatial development, energy and climate, transport development, waste management, or water management.

A review of current plans and priorities against identified climate risks and vulnerabilities may be helpful to identify and prioritize both adaptation goals and adaptive actions, while also providing insights into existing gaps and where a local government should allocate more resources. The existing planning review process explores the following questions with your existing strategic plan:

1. What has worked and what hasn't worked in the past?
2. What has and will be changed in your environment and operations due to climate change?
3. How climate considerations affect existing development objectives and priorities?
4. What do we take out and what new things must be put into the adaptation plan and how to revise strategic plan under scrutiny?

It is recommended to utilize collaborative approaches, particularly with the national authorities, neighbouring municipalities and with the private sector to co-design and co-develop the required capacities.

Step 4:
Identify your municipality hotspots

To facilitate policy decisions on mitigation and adaptation strategies, it is necessary to understand, quantify, and synthesize these climate-change impacts, considering their uncertainties. Crucial to these decisions is an understanding of how impacts in different sectors overlap, as overlapping impacts increase exposure, lead to interactions of impacts, and are likely to raise adaptation pressure.

Climate change "hotspots" are areas or functions of the local government that are particularly vulnerable to current or future climate impacts, and where single or combined climate events may create situation where, besides the assets and services, human health and even lives may be at risk. Such hotspots may for example be coastal areas where flooding can cause power and water supply disruptions, erosion, leakage of hazardous substances from otherwise contained storages and where elderly and disabled people cannot be evacuated without external assistance. Another example may be urban areas which are packed with concrete buildings and where surfaces are paved with tarmac with lack of shade-providing greenery. There, the impacts of extreme warm temperatures will create heat islands and, as cascading effects to the heat, a high demand in cooling may cause power and water supply disruptions leading to health problems and mortality of elderly and sick.

Figure 3 shows an example of a the challenges faced by a municipal hotspot published in the local adaptation plan of Yafo Tel Aviv, Israel.

Together with mapping hotspots affecting critical infrastructure and/or most vulnerable population groups one should not forget identifying hotspots of ecosystem service as most of the human activities are depending on the latter. At the same time, ecosystems can also assist in the mitigation of, and adaptation to, climate change. The mechanisms, potential and limits of such nature-based solutions to climate change need to be explored and considered while planning a community climate adaptation strategy. Nature-based solutions can mitigate climate change hazards and the amplifying effects of urban areas on those hazards. These strategies include enhanced vegetation cover and green space, construction of structures that restore natural hydrologic function such as stormwater ponds, bioswales, green roof and riparian zones; and restoring natural protective habitats along coastlines.

Figure 3. Municipal hot spots (challenges) in the local adaptation plan of Yafo Tel Aviv, Israel. Source: https://www.tel-aviv.gov.il/en/Documents/Climate%20Adaptation%20Action%20Plan.pdf

Step 5: Prioritize adaptation actions

Having identified a wide range of adaptation actions for potential implementation in the short and medium to long-term and based on your identified adaptation goals and objectives, the next step would be to prioritize your actions, before developing your adaptation action plans. This will help to identify the actions that are implementable in the current planning cycle (i.e., in the next 5 years), and, considering the evolution of climate risk, help to identify those that will be needed in the medium term (5–10 years) and long term (>10 years). The prioritization should also contain a selection of actions which can financially be afforded and benefit the largest number of people.

A simple method to classify the identified actions is to consider their social, technical, administrative, political, legal, economic, and environmental opportunities and constraints. The results of the assessment will help the planning team to decide on the benefits and disadvantages of each action and to determine which actions are best suited to current capacity and resources.

Actions can be divided into "no-regret", "low-regret" and "win-win" adaptation actions. "No-regret" actions are cost-effective now and under a range of future climate scenarios and do not involve hard trade-offs with other policy objectives. "Low-regret "actions are relatively low-cost and provide relatively large benefits under predicted future climates. "Win-win" actions contribute to adaptation whilst also having other social, economic, and environmental policy benefits, including in relation to mitigation.

These types of actions can be identified across a range of sectors. For example, reducing leakage from water utility infrastructure can both improve water efficiency and help address drought risk.

More detailed methodologies used for prioritizing strategies and actions are for instance the Cost-Benefit Analysis (CBA), Multicriteria Analysis (MCA) or Benefit-Cost Analysis (BSA).

A CBA is the process used to measure the benefits of a decision or taking action minus the costs associated

Table 2. Considerations and key questions for prioritizing adaptation action

Consideration	Key Questions
Social	Will the action be socially acceptable? Is it compatible with community values? Are special needs of vulnerable groups addressed?
Technical	Is the action technically feasible? Will the action reduce long-term loss? Are there any indirect effects? Does maintenance create additional long-term costs?
Administrative	Can the local authority meet the staffing and funding needs of the action, or does it need to be obtained elsewhere/outsourced?
Political	Are the objectives and actions in line with national/regional policy? Is there political support for the action? Is there enough public support to ensure the success of the action?
Legal	Does the local authority have the remit to implement the action?
Economic	Is the action cost-effective and likely to pass a cost-benefit analysis? What benefits will the action provide? Are there no cost or low-cost natural solutions available?
Environmental	How will the action affect the environment? Is the action consistent with environmental goals? Are nature-based solutions preferred over technical ones?

with taking that action. A CBA involves measurable financial metrics such as revenue earned, or costs saved because of the decision to pursue a project. A CBA can also include intangible benefits and costs or effects from a decision. The major steps in a cost-benefit analysis are:

— Step 1: Specify the set of options.
— Step 2: Decide whose costs and benefits count.
— Step 3: Identify the impacts and select measurement indicators.
— Step 4: Predict the impacts over the life of the proposed regulation.
— Step 5: Monetize (place financial values on) impacts.

As an example, here is a CBA guide used by the EU: https://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/cba_guide.pdf

A Multicriteria Analysis (MCA) describes any structured approach used to determine overall preferences among alternative options, where the options accomplish several objectives. In an MCA, desirable objectives are specified, and corresponding attributes or indicators are identified. The actual measurement of indicators doesn't need to be in monetary terms but is often based on the quantitative analysis – er through scoring, ranking, and weighting – of a wide range of qualitative impact categories and criteria. Different environmental and social indicators may be developed side by side with economic costs and benefits. Multicriteria analysis or multi-objective decision making is a type of decision analysis tool that is particularly applicable to cases where a single-criterion approach (such as cost-benefit analysis) falls short, especially where significant environmental and social impacts cannot be assigned monetary values. MCA allows decision makers to include a full range of social, environmental, technical, economic, and financial criteria.

A short guide for MCA can be found here: https://ec.europa.eu/info/sites/default/files/file_import/better-regulation-toolbox-63_en_0.pdf.

The Benefit-Cost Analysis (BCA) is a method that determines the future risk reduction benefits of a hazard mitigation project and compares those benefits to its costs. The result is a Benefit-Cost Ratio (BCR). A project or activity is considered cost-effective when the BCR is 1.0 or greater.

The BCA methodology is explained at https://aisp.upenn.edu/wp-content/uploads/2015/09/0033_12_SP2_Benefit_Cost_000.pdf

Step 6: Develop an adaptation strategy

According to ISO/TS 14092:2020 the Local adaptation strategy shall include the following:

— the objectives and the scope of the local adaptation plan
— the ways and means the local government intend to achieve the objectives
— the actions that are to be implemented
— justification for the actions to be implemented
— the information, data and assumptions on which decisions are based
— period of validity and deadlines for actions to be implemented
— who is responsible for the implementation of actions.

The local adaptation plan should:

— state the rationale behind its formulation,
— state the sustainable development,
— describe the climate change, in the past, present and future thereby provide the basis for concern,
— identify the climate data and information considered, including their source and identification of projections, scenarios and models used,
— state the greenhouse gas emissions scenarios considered,
— state any other scenarios or projections used (e.g. socio-economic, demographic),
— state and clearly define baselines when applicable,
— describe the potential impacts, both positive and negative, and direct, indirect and cross-cutting (systematic) impacts that climate change poses to activities, assets and services of the local government,
— document how the most critical climate impacts identified are addressed,
— document how the adaptation opportunities identified are to be realized.
— document prioritized areas and sectors in reducing climate change risks and building capacities,
— description of the prioritization process and its outcomes,
— description of feasible approaches to reducing climate change risks, including a combination of green (ecosystem-based adaptation), soft (building adaptive capacity) and grey (infrastructure and technology) options as well as actions that are incremental or transformative,
— statement of how the climate adaptation process is to be embedded in the policies, strategies and plans of the local government.

In addition, the local adaptation strategy may refer to national policies and regulations that are relevant to or influence the adaptation process, describe how and when community will be informed about the local adaptation strategy, and how and when the strategy will be made publicly available.

The points above are to be used as a skeleton for drafting the strategy. The order, size and content may depend on the nature, size and location of the municipality (e.g. rural or urban). Other aspects may also be considered, such as whether an adaptation strategy will be prepared as separate document or as part of local sustainable energy and climate action plan, as is currently required by the Covenant of Mayors for Climate and Energy.

It is recommended to use the Logical Framework Approach (LFA) for the design of a local adaptation strategy, which will, in the later phases, also facilitates the monitoring and evaluation process of the implementation.

Step 7: Develop an adaptation action programme with a budget

An adaptation action programme is a prioritized list of adaptation actions that is drafted in table format. The list should include the title and description of the action, cost, financing source, period and deadline for implementation, people/structures responsible for implementation and measurable indicators for implementation. It should not only indicate the number of people approached and/or of sums spent for investing to protective and preventive measures, but also reflect the change achieved by each action.

Example of complex data related to adaptation actions from Estonian CCA action matrix:

— Number of actions
— Title of action
— Aim of the action
— Sub-objectives the action contributes
— Type of the action (regulation, economic incentive, information, investment, Planning, Study)
— What climate risks action addresses
— What climate impacts the action addresses
— Indicator of progress
— Base level
— Target level
— Is the action existing or new
— Interrelation with/dependency on other actions
— Relevance to legislative acts
— Institutions responsible for the implementation
— Source of financing (State Budget, Local budget, EU Funds, other)
— Impact to various groups: population, enterprises, public sector (5 big+,4 +, 3 neutral, 2 -, 1 big -)
— Impact on various sectors: social, business, environment (5 big+,4 +, 3 neutral, 2 -, 1 big -)
— Simplicity of Implementation (5 very simple-1 very complicated)
— Explanation of difficulties to implement
— Geographic scope of action (5 cross-border – 1 very limited
— Urgency of the action (5 very urgent-1 can be delayed)
— Explanation of urgency
— Cost of the action (5 very little cost-1 very big costs)
— Explanation of the costliness
— Score of CBA (from 10 to max 50).

Municipal action plans don't need to contain the level of detail as in the example above, but the preciseness of the action plan will be useful for the prioritization and selection of the actions. It will also facilitate their proper implementation. It will also help to guarantee that the actions are relevant and contribute to the objectives of the local adaptation strategy, and are sufficient to generate desired results.

Step 8: Implement

The local government should make sure that the local adaptation plan is embedded into the policies, strategies, processes and operational and administrative practices of all departments and sections which operate under it. The urban Adaptation Support Tool of the Covenant of Mayors suggests undergoing a self-check prior to the implementation of adaptation actions:

— The adaptation strategy and accompanying action plan are developed, consulted, and agreed upon
— Roles and responsibilities, timeframes and resources are allocated
— Existing sectoral policies are considered and mainstreamed, as relevant
— Interactions between mitigation and adaptation actions are considered.

Considering interactions and synergies between mitigation and adaptation actions is crucial to ensure that a municipality's spendings on increasing the resilience to climate change also reduces greenhouse gas emissions and vice versa. The EU's "Forging a climate-resilient Europe – the new EU Strategy on Adaptation to Climate Change" specifically states that "policy coherence must systematically consider adaptation to avoid inadvertently undermining it. Whenever relevant, EU and Member State policymaking should apply the following policy coherence principles: ensure that regulation and funding take into account disaster risk to avoid creating new exposure; reduce existing risk by building up resilience, prevention, and preparedness; manage residual risk. These principles should be integrated, for example, in calls for tender and selection criteria for EU-funded projects as well as taken into due account when designing policies more generally."

The CBSS, together with its partners within CAMS Project Platform, financed by INTERREG BSR programme, have developed "Guidelines for climate proofing energy efficiency projects: focusing on renovation of multi apartment buildings in the Baltic Sea Region". The guidelines can be downloaded here: http://trea.ee/cams/wp-content/uploads/2021/11/CAMS-Climate-proofing-guidelines_01_11_2021-draft.pdf.

The local government should also encourage the private sector under their jurisdiction or area to consider the adaptation strategy within their own risk management and adaptation planning, as well as taking part in the implementation of municipal adaptation strategy.

The implementation may be more successful if the municipality also checks its annual budget can stem the planned actions and if planned spendings on increasing the resilience to climate change do not have an adverse effect on society.

For example, the City of Oslo has developed a dedicated Climate Budget, which serves as a governance tool for its climate work. The Climate Budget presents reduction targets and mitigation measures which are being implemented in Oslo to reduce emissions within the municipality and describes important initiatives to achieve the targets set out in the Climate Strategy. The first City Climate Budget was adopted in 2016, and the 2022 Climate Budget is already the sixth in the series. The methods used for the assessments in the climate budget are continually being developed, and there is an ongoing need to further develop, update and improve the underlying knowledge base. Although the main focus of the activities of the Oslo climate budget is on reducing greenhouse gas emissions, the same approach is also valid for implementing adaptation actions.

The Climate budget for Oslo can be found here: https://www.klimaoslo.no/wp-content/uploads/sites/88/2022/03/Climate-Budget-2022-with-appendix.pdf.

Step 9: Monitor. Evaluate. Adjust.

Monitoring and evaluation are needed to assess, inform, and review the local adaptation plan so that satisfactory progress is confirmed, and indications of unsatisfactory progress are highlighted early enough, to allow corrective and/or additional action to be taken to achieve the objectives.

Compared to climate change mitigation, adaptation cannot be measured with a single metric such

as greenhouse gas emission reduction. Each CCA action has its own specific outputs and outcomes, requiring tailored indicators. Addressing this challenge, a set of indicators is provided with the guidelines prepared by Ramboll and the C40 Cities Climate Leadership Group: the Climate Change Adaptation Monitoring, Evaluation and Reporting (CCA MER) framework. The CCA MER framework assumes that the city has an existing Climate Risk Assessment in place and has already defined current and future climate hazards, taking into account both socio-economic trends and vulnerability, and focusing primarily on vulnerable populations and areas. The CCA MER framework uses the climate hazards faced by cities as a starting point. Hazards are characterized by their unpredictable nature and potential to shock society. The MER framework is built around the following climate change hazards: rainfall, storm surge and sea-level rise, heat, drought, and fires.

Monitoring, evaluating, and reporting on their CCA plan will help local government officials make the case for adaptation actions, in particular by communicating the results and demonstrating the benefits of climate adaptation. It also stands to enhance transparency and accountability towards stakeholders and citizens. Finally, MER can facilitate learning across municipalities on what works in different contexts and highlight lessons on effective adaptation actions and policies.

The MER Framework Guidelines are freely downloadable at https://resourcecentre.c40.org/resources/monitoring-evaluation-and-reporting .

The MER Framework Indicator matrix is annexed to current guidelines as an Excel file.

Topic	Indicator	Description and Notes	Starting Point / Current Situation	Desired Progress Direction
Cooling the city	Tree canopy in the city	Relative to the entire urban space	To be compiled by 2021	↗
	The average difference between the temperatures measured at the stations in the city and at a station outside the city	The difference in temperature is indicative of the extent of the urban heat island	To be compiled by 2020	↙
	Use of private cars to get to work/studies	A decline in traffic reduces the emission of heat	2017 – 54% used private cars	↙
	Buildings complying with the green building standard or buildings that underwent green retrofitting	Compared to all completed construction	To be compiled by 2021	↗
Water management	Ratio between hotline calls and rainfall	The number of calls is indicative of flood effects	To be compiled by 2021	↙
	Urban sealing index	Tracking infiltration potential in the city	To be compiled by 2022	↙
	Percentage of buildings that independently treat all the runoff on their lot	Pertains to new construction as of 2021	To be compiled by 2022	↗
	Average annual water consumption per capita (m^3)	An indicator of water consumption and savings	2019 = 65.3 m^3	↙
	Percentage of water supply depreciation		2018 = 10.8%	↙
	No. of irrigation months per year	The number of months in which the Municipality waters public gardens	2004 = 6 months 2019 = 10 months	↙
Improvement in the ecological infrastructure	Urban coverage percentage	Ratio between urban coverage and the open space	To be compiled by 2022	↗
	No. of trees chopped down per thousand trees	Ratio between the no. of trees chopped down for construction purposes and the inventory of trees	2019 = 8.74	↙

Figure 4. Presenting adaptation action monitoring results in the local adaptation plan of Yafo Tel Aviv, Israel. Source: https://www.tel-aviv.gov.il/en/Documents/Climate%20Adaptation%20Action%20Plan.pdf

A more detailed monitoring system is the Baseline Resilience Indexes for Communities (BRIC). The BRIC index uses a categories approach in providing an overall baseline assessment for monitoring existing attributes of resilience to natural hazards. The BRIC index uses 49 variables arrayed in the six broad categories of community resilience as follows:

1. Human Well-Being/Cultural/Social—physical attributes of populations, values and belief systems (educational attainment equality, pre-retirement age, personal transportation access, communication capacity, English language competency, non-special needs populations, health insurance , mental health support, food security, access to physicians)
2. Economic/Financial—economic assets and livelihoods (homeownership, employment rate, racial/ethnic income inequality, non-dependence on primary/tourism sector employment, gender income inequality, business size, large retail with regional/national distribution, federal employment)
3. Infrastructure/Built Environment/Housing—buildings and infrastructure (sturdier housing types, temporary housing availability, medical care capacity, evacuation routes, housing stock construction quality, temporary shelter availability, school restoration potential, industrial re-supply potential, high-speed internet infrastructure)
4. Institutional/Governance—access to resources and the power to influence their distribution (mitigation spending, flood insurance coverage, governance performance regimes, jurisdictional fragmentation, disaster aid experience, local disaster training, population stability, nuclear accident planning, crop insurance coverage)
5. Community Capacity—social networks and connectivity among individuals and groups (volunteerism, religious affiliation, attachment to place, political engagement, citizen disaster training, civic organizations)
6. Environmental/Natural—natural resource base and environmental conditions (local food supplies, natural flood buffers, energy use, perviousness, water stress).

The system has been developed by the University of South Carolina, USA and has been used to assess natural hazards risks and resilience at county level. See the report here: https://www.fema.gov/sites/default/files/documents/fema_national-risk-index_technical-documentation.pdf and the data platform here: https://experience.arcgis.com/experience/376770c1113943b6b5f6b58ff1c2fb5c%20/page/BRIC/.

The BRIC index system has been used to compare resilience of Norwegian communities by the Norwegian University of Science and Technology team. The article is downloadable at Science Direct https://www.sciencedirect.com/science/article/pii/S2212420918312032?via%3Dihub, and background datasets and replication instructions can be accessed here: https://data.mendeley.com/datasets/hg4f49jbfh/1.

Proper monitoring should provide an understanding of the outcomes of an intervention and the impacts that it has had. This can be challenging as there is a need to disentangle those outcomes which can be attributed to the intervention, as opposed to those resulting from a range of other variables. In the context of climate change, this can be made harder as there may be a long time period before outcomes can be assessed. In addition, the avoidance of negative consequences can be a successful outcome in adaptation yet can be hard to measure and assess, precisely because they have been avoided!

10. Report. Share. Communicate.

The local government shall communicate their climate change adaptation plan within, across and beyond their jurisdiction and area of responsibility. The purpose of the communication activity is to inform others of actions planned and being implemented, so that interested parties are aware of any effects, impacts, or the influence of the actions within the action plan on their own activities.

At the same time, the internal communication also ensures that all the departments and employees of the municipality are aware and engaged in the adaptation action.

It is recommended that the local government uses the communication means and tools that are best suited for reaching to target audience.

The following principles of values-based climate change communication developed by the Climate Outreach and Adaptation Scotland are fully valid and useful to follow also by local governments in BSR:

Pay close attention to your audience's values
Values are the bedrock on which attitudes to climate change are built. Use a values map to help identify the values of your audience that you want to engage with.

Frame your messages in the right way
Look for the overlap between the values that are important to your target audience and values such as 'protecting the environment' and 'helping others' that are crucial for building longer-term support for tackling climate change. Frame your messages so that they build a bridge between the values of the audience and the values of a more sustainable society.

Overcome the 'psychological distance' of climate change
Who are you trying to engage with? What are the things they are passionate about? How can you make climate change adaptation relevant to their lives? Identify the interests of your audience and think about how climate change affects them.

Don't focus on 'doom and gloom'
Emphasizing the benefits of climate adaptation policies is much more effective that pointing to the risks of not adapting.

Extreme weather can be a powerful opportunity to engage on climate change
People will not necessarily "join the dots" between extreme weather and climate change on their own. Use severe weather as an opportunity to discuss preparing for future events, and emphasize the benefits of adaptation using the powerful narratives of resilience, community pride and mutual caring that often emerge during the experience of severe weather events.

Promote the health benefits of adapting to climate risks
Connecting climate change with health problems which are already familiar and seen as important - such as heat-stroke, hypothermia or asthma - can make the issue seem more personally relevant.

Try to engage across the political spectrum
Skepticism about climate change is more common among political conservatives. But it doesn't have to be this way. Use language and narratives that have been designed to appeal to the "right", as well as the "left" of politics – for example by focusing on conserving the beauty of the countryside or improving the health and wellbeing of communities.

Harness the power of social norms and social networks
Representatives of diverse social communities can communicate with their own groups better than any politician or public figure. People respond well when they can see that 'people like them' are also taking climate adaptation seriously. Promote social norms on climate change wherever possible.

The full guide for Climate adaptation communication can be accessed at https://www.adaptationscotland.org.uk/application/files/9514/9200/9964/COIN-Sniffer_Communicating_Adaptation_Update2017_Final.pdf.

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Wolanin, J., Telak, O. Guidelines for integrated climate change and risk reduction management for local authorities. CASCADE, June 2021.

Annexes/Supporting documents

CASCADE Overview of climate risk drivers, hazards and consequences

HELCOM/Baltic Earth Baltic Sea Climate Change Fact Sheet.

CASCADE Guidelines for integrated climate change and risk reduction management for local authorities

C40 MER Framework Indicators matrix

Example of novel municipal resilience strategy: Veijle's resilience strategy, DK