



RESIN

SUPPORTING DECISION –
MAKING FOR RESILIENT CITIES

USER GUIDE: THE RESIN DECISION SUPPORT TOOLS FOR CLIMATE CHANGE ADAPTATION

USER GUIDE: THE RESIN DECISION SUPPORT TOOLS FOR CLIMATE CHANGE ADAPTATION

Deliverable D4.3, Work package 4



This document has been prepared in the framework of the European project RESIN – Climate Resilient Cities and Infrastructures. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 653522.

Author: Eleanor Chapman (ICLEI – Local Governments for Sustainability)

Co-author: Albert Nieuwenhuijs (TNO)

Contributors: Veronica Rebollo (ICLEI - Local Governments for Sustainability), Maddalen Mendizabal, Efrén Feliu (Tecnalia), Erich Rome (Fraunhofer), Matt Ellis (Greater Manchester Combined Authority), Eva Streberova (Bratislava City), Miguel Augusto Gonzalez Vara (City of Bilbao)

Reviewers: Jeremy Carter, Angela Connelly (University of Manchester), Matt Ellis (Greater Manchester Combined Authority), Peter Bosch (TNO), Clara Grimes (ICLEI - Local Governments for Sustainability)

Freiburg, September 2018

CONTENTS

1. Introduction	4
2. The RESIN tools and e-Guide – a snapshot	8
3. The e-Guide: taking you through the adaptation cycle	11
4. European Climate Risk Typology	13
5. IVAVIA (Impact and Vulnerability Analysis)	14
6. Adaptation Options Library	16
7. Need more?	18

1. INTRODUCTION

CLIMATE CHANGE ADAPTATION: THE NEED FOR LOCAL-LEVEL SUPPORT

Urban areas are known to be among the main contributors to our changing climate worldwide – responsible for an overwhelming majority of energy consumption and resulting carbon dioxide emissions production: ca. 78% of energy consumption and 60% of emissions as of 2011¹. At the same time, having relatively high concentrations of population, infrastructure, and economic activity and often being located close to bodies of water, they are especially at risk from the impacts of climate change.

04

European cities are no exception, with many already experiencing climatic changes and growth in the incidence and severity of extreme weather events in recent years: whether increased precipitation, mudslides, flooding, more intense and frequent storms, or more periods of extreme heat or cold. There is a growing recognition that climate change is here for the

long term, and that action is needed not just to mitigate the contribution of human activity to climate change, but also to adapt to the impacts that we can expect to see now and in the future.

The need to adapt has been recognised Europe-wide, with the release of the EU strategy on adaptation to climate change in 2013 advocating action at all levels of government. The strategy supports development of local adaptation plans, and offers guidance to produce them, for instance through the Climate-ADAPT platform. However, at the time of writing, about one third of European cities still have no adaptation plan², and many of those with plans in place are only just beginning to address the challenges related to implementing them. In this context, it is clear that support for adapting to climate change at the local level is needed.

¹ UN-HABITAT, 2016. *World Cities Report 2016 Urbanisation and Development: Emerging Futures*. New York, United Nations.

² Reckien, et al., 2018. How are cities planning to respond to climate change? Assessment of local climate plans from 885 cities in the EU-28, *Journal of Cleaner Production*, Volume 191, Pages 207-219.

RESIN: CLIMATE RESILIENT CITIES AND INFRASTRUCTURES

The RESIN project team has developed three practical tools and methods, along with an overarching decision support framework, to aid cities in understanding climate risk, and in designing and implementing climate adaptation strategies for their local contexts:



- ▶ The **RESIN urban adaptation e-Guide**: an online platform that supports the entire process of developing and implementing an adaptation plan



- ▶ The **European Climate Risk Typology**: an interactive map that helps you to visualise, describe, compare and analyse climate risk in European cities and regions



- ▶ **IVAVIA: a risk-based impact and vulnerability analysis methodology** to assess climate-related risks and their effects (along with related Impact Chain Editor Plus [ICE+] and IVAVIA Workflow Support tool)



- ▶ The **Adaptation Options Library**: a database of all kinds of adaptation measures, covering climate risks including flooding, heat stress and drought (and related prioritisation and adaptation pathway design approaches)

All of the tools, methods and guidance outlined above were developed through knowledge brokerage between researchers and cities, including the partner cities Paris, Bilbao, Bratislava and Greater Manchester.

The e-Guide decision support framework reflects the RESIN Conceptual Framework, pictured as two interlinked loops (see Figure 1). The Conceptual Framework positions the RESIN project as following a cyclical approach centred on assessing and reducing climate change risk.

The left hand loop captures the ‘urban system’ and reflects the process by which climate risks are generated and then prepared for / responded to – with the aim of building the system’s resilience to future climate hazards (e.g. a heatwave) and socio-economic drivers (e.g. a large population of elderly people whose health is more likely to be affected by extreme heat). The right hand loop reflects the ‘adaptation planning system’, which follows a process of first assessing risk, then developing adaptation objectives and corresponding options (measures) to be implemented. The aim of this process is to effect change within the urban system, in order to reduce climate risk and build resilience.

05

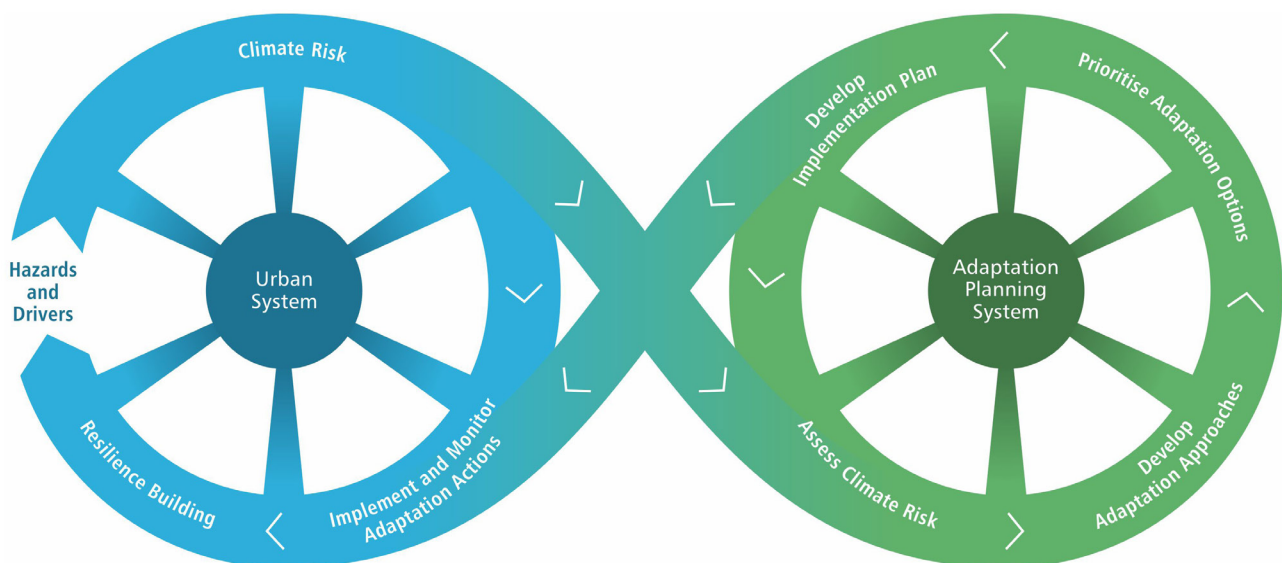


Figure 1: The RESIN Conceptual Framework.

THE ADAPTATION CYCLE

Adapting to climate change is widely recognised as an iterative, cyclical process (refer Figure 3). Within the e-Guide framework, the four phases within the cycle are conceived of as follows:

- Assess climate risk
- Develop adaptation approaches³
- Prioritise adaptation options
- Develop implementation plan

The e-Guide and the RESIN tools and methods are designed to help practitioners and leaders working in local government to make informed decisions throughout these four phases, and the corresponding steps within them.

06



Figure 2: Through the RESIN project, the city of Bilbao has made progress in assessing local climate risks and selecting corresponding measures to adapt to climate change. Photo by ICLEI Europe

³ An adaptation approach is the approach chosen to achieve your adaptation goals. This involves to a large extent political decisions: whether to invest in blue-green infrastructure or grey; to draw on public finance alone or involve the private sector; to set regulations or rather incentives

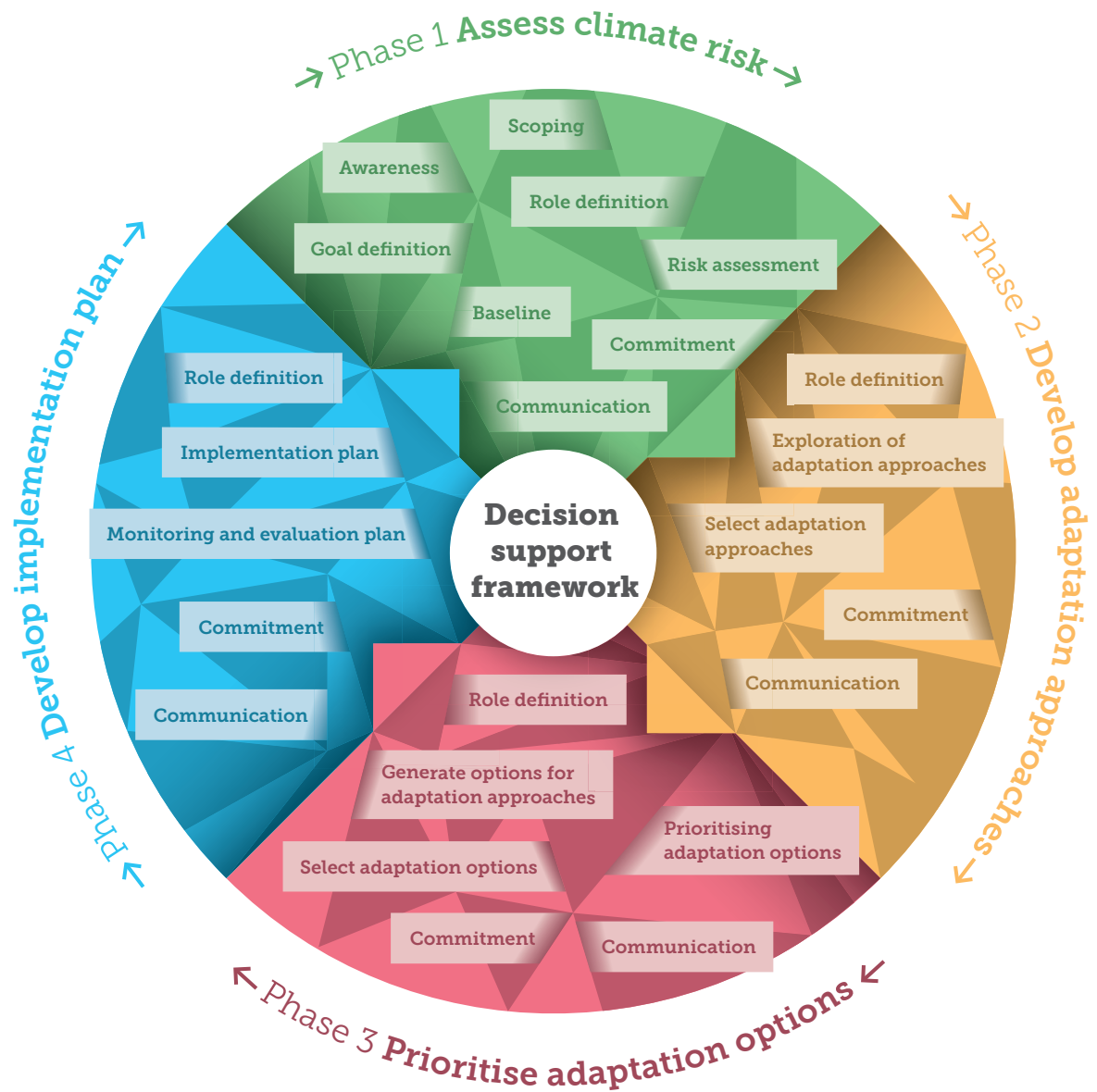


Figure 3: The e-Guide decision framework – phases and steps

2. THE RESIN TOOLS AND e-GUIDE – A SNAPSHOT

WHO ARE THE TOOLS FOR?

All the RESIN tools, methods and guidance are intended for use by practitioners and decision-makers involved in planning and implementing climate change adaptation and disaster risk reduction measures, including urban planners, risk managers, engineers and operators of critical infrastructure. While the tools generally target the city level of planning and governance, they may be of use to those working at regional, national and European levels too.

08

Generally some level of prior knowledge of climate risks and at least basic computer skills are required, however the necessary levels of expertise vary depending on the tool and how it is used. For instance, a complete quantitative risk assessment with IVAVIA is intended to be led by a coordinator or manager with considerable expertise in disaster risk reduction or climate change adaptation. However, some of the early steps (e.g. developing an impact chain⁴) can involve people with limited knowledge of climate risk and impact. On the other hand, the European Climate Risk Typology can be used by climate change experts and beginners alike to increase their understanding of climate risks in European cities and regions. The e-Guide will guide you in selecting which tools you need and when (see Figure 4 for an overview), as well as the level of knowledge and expertise needed for each.

Local knowledge is a key prerequisite for using most of the tools, and this may be held by different individuals dispersed among different organisations or departments. The more local knowledge from diverse disciplines that can be pooled as part of developing an adaptation plan, the more likely it is that the plan will encompass a comprehensive range of interests and needs – and the higher its chances of success.

HOW DO THEY SUPPORT ADAPTATION?



The **RESIN urban adaptation e-Guide** supports the entire process of developing and implementing an urban climate adaptation plan, as part of an integrated approach. Rather than laying down rules and limitations, it offers information, guidance and insight to help you develop your own unique plan, as well as direction on which of the RESIN tools to use and at what stage in your process.



The **European Climate Risk Typology** can support the phases of climate change risk assessment and development of adaptation approaches in European cities and regions, as well as aiding peer-to-peer learning and network development.



As a next step, the **IVAVIA risk-based impact and vulnerability analysis methodology** comprehensively supports the climate risk assessment phase. It can help you to prepare, gather, and structure data for a risk assessment; to quantify and combine vulnerability indicators; to assess risk; and to present outcomes.



Once climate risks have been identified and spatially located, the **Adaptation Options Library⁵** (and related prioritisation and adaptation pathway design approaches) supports the subsequent phases: to develop adaptation approaches, and to identify and prioritise options.

⁴ An impact chain describes the cause-and-effect relationships driving risk in a system. A set of impact chain diagrams is the result of using IVAVIA to conduct a qualitative assessment, structuring the components of risk for a preselected combination of hazard and exposed objects. IVAVIA also includes a subsequent (optional) quantitative assessment. See more on page 14.

⁵ Currently, the Library has information covering climate risks related to heat, drought and/or flooding only.

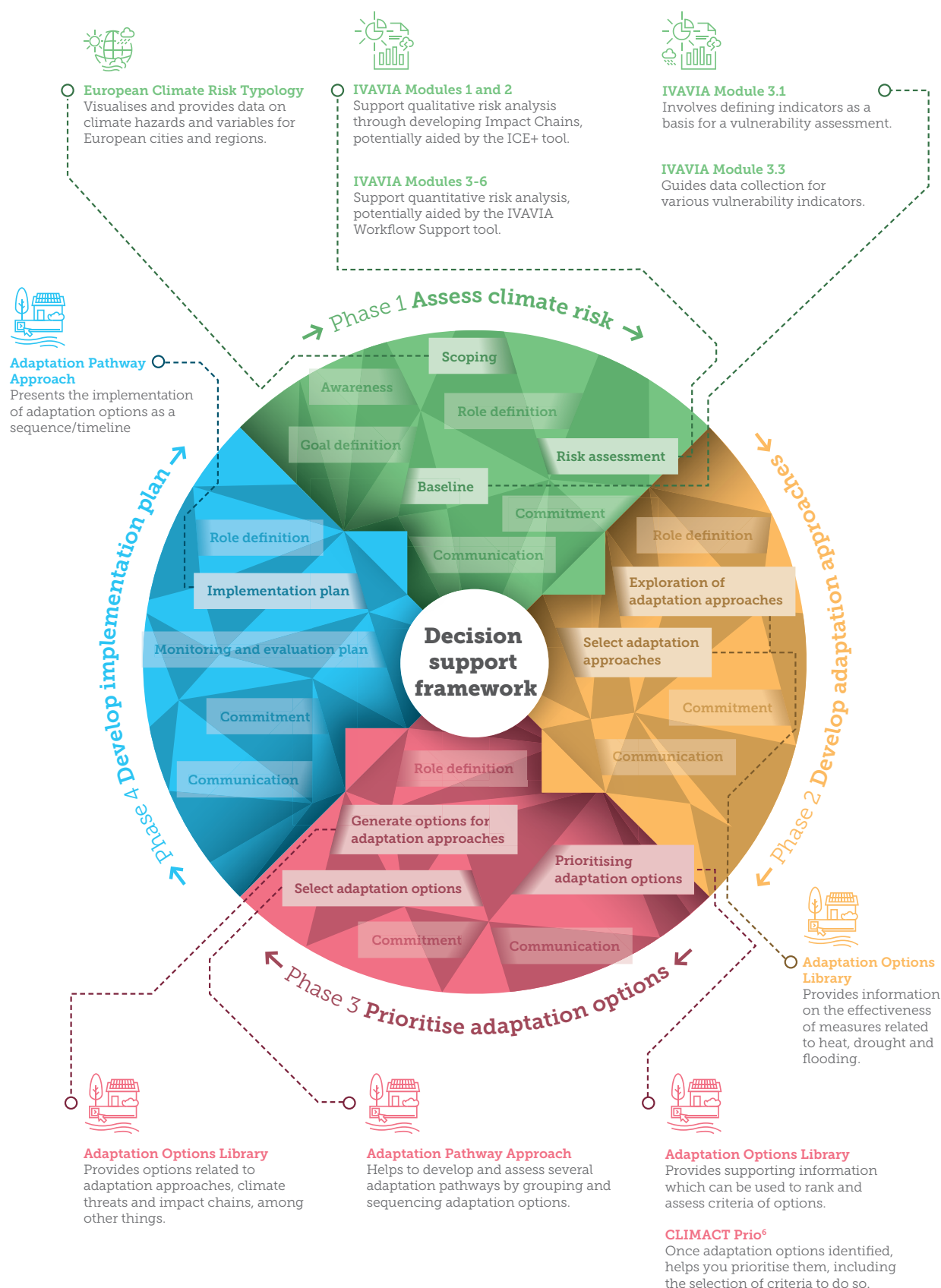


Figure 4: The e-Guide decision framework – where the RESIN tools fit in

6 Not a RESIN tool, the Climate Actions Prioritisation MCA tool (CLIMACT Prio) is a climate awareness, decision support and capacity building tool for the prioritisation and assessment of climate mitigation and/or adaptation options at a local level, developed by Erasmus University's Institute for Housing and Urban Development Studies (IHS), Rotterdam. A box-ticking method can be used instead if a simpler process is preferred - see page 17.

WHAT CAN THEY DO FOR MY CITY?



“The Adaptation Options Library is an easy-to-use and educational tool for both developing an adaptation strategy and implementing it. On the one hand, it can be used by practitioners such as architects and landscape planners for different small-scale projects (at the building level), and on the other, by urban planners and resilience officers to design an adaptation strategy and select the right measures. We are translating the library into Slovak, so that it will be available in future for staff of all ages, working in different administration units of the municipality and its boroughs.”

Eva Streberova
Office of the Chief City Architect,
City of Bratislava



“We developed an impact chain using IVAVIA Module 2 to explore the effects of pluvial flooding on a major road. A workshop in November 2016 was attended by stakeholders including Greater Manchester’s floods and water manager, its Civil Contingences and Resilience Unit, and Transport for Greater Manchester. The workshop revealed the awareness-raising potential of IVAVIA. Bringing stakeholders together who don’t often talk to each other builds a better shared understanding of complex extreme weather events and climate change impacts, and reveals areas of common ground between departments to take forward collaboratively. The outputs (and impact chain diagram in particular) have informed Greater Manchester’s *Preliminary Resilience Assessment*, produced as part of its participation in the Rockefeller Foundation’s 100 Resilient Cities initiative.”

Matt Ellis
Greater Manchester Combined
Authority



“We used IVAVIA to map risk exposure to climate threats at a detailed neighbourhood scale, and the Adaptation Options Library (in combination with CLIMACT Prio) to identify and rank 63 adaptation actions. This information will be used in our local adaptation strategy, to be launched later this year.”

Miguel Gonzalez Vara
City of Bilbao

Images, clockwise from top left: Bratislava skyline, by QQ7, licensed for use from Fotolia. Manchester City Centre Skyline, by corinaldo, licensed for use from Fotolia. Zubizuri Bridge, copyright Ayuntamiento de Bilbao.

3. THE e-GUIDE: TAKING YOU THROUGH THE ADAPTATION CYCLE



OVERVIEW

The RESIN e-Guide decision framework supports you at every phase of your adaptation planning and implementation cycle with guidance, checklists, practical examples, and advice on supporting tools and measures – pooled from the fields of climate change adaptation and disaster risk management. The e-Guide was developed to build on and complement existing online resources by 1) providing access to them via a single portal and 2) reviewing and incorporating selected information from such resources, where relevant.

The entire decision support framework is accessed through the Learning Centre page, where all four phases of the cycle are displayed. Supported by the Learning Centre, you can use My Workspace to create a profile, save and share information with others and track your progress – allowing you to effectively develop and implement an adaptation strategy with team members scattered across various departments and organisations. The pages Background Information, Supporting Tools and Methods, Glossary, and Frequently Encountered Challenges provide overarching guidance across all phases.

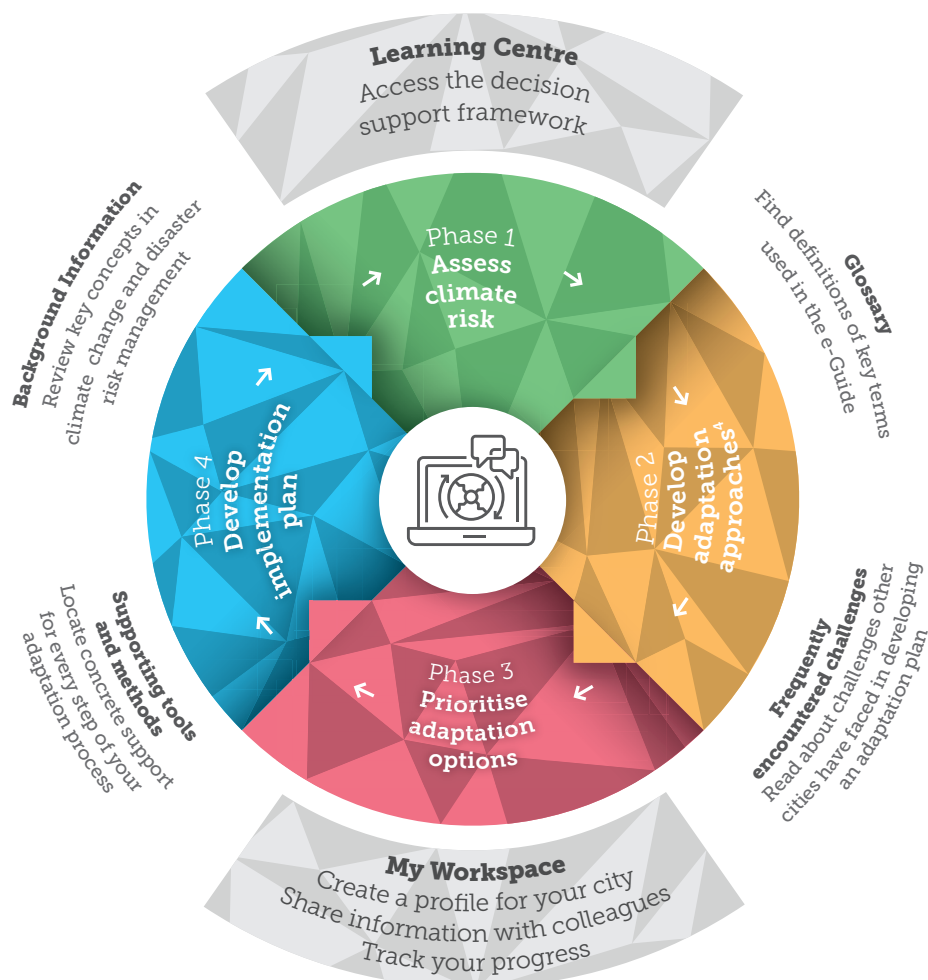


Figure 5: The e-Guide pages

Each phase of the cycle is divided into a group of related steps, for example, as shown in Figure 6 below. Each step in the e-Guide decision support framework describes everything you require to complete it successfully, enabling you to use the framework in a flexible way and enter and exit steps as required. The steps and sub-steps also give you detailed information on what needs to be done, including:

- Goal(s)
- Preconditions
- Outcomes
- Guidelines
- Experience (from other cities)
- Supporting tools and methods

Access the e-Guide at
www.resin-cities.eu/resources/e-guide

SUPPORT FOR COVENANT OF MAYORS REPORTING

If you work for a city that has signed up to the Covenant of Mayors for Climate and Energy (CoM), the e-Guide can help you report on selected components of your adaptation progress. The dynamic questionnaire in My Workspace, under 'focused scenario', will direct you to a guide explaining which information entered in your workspace can be used to answer which questions in the CoM reporting template. By using the e-Guide forms, the information in your workspace will automatically be in line with the CoM reporting template⁷.

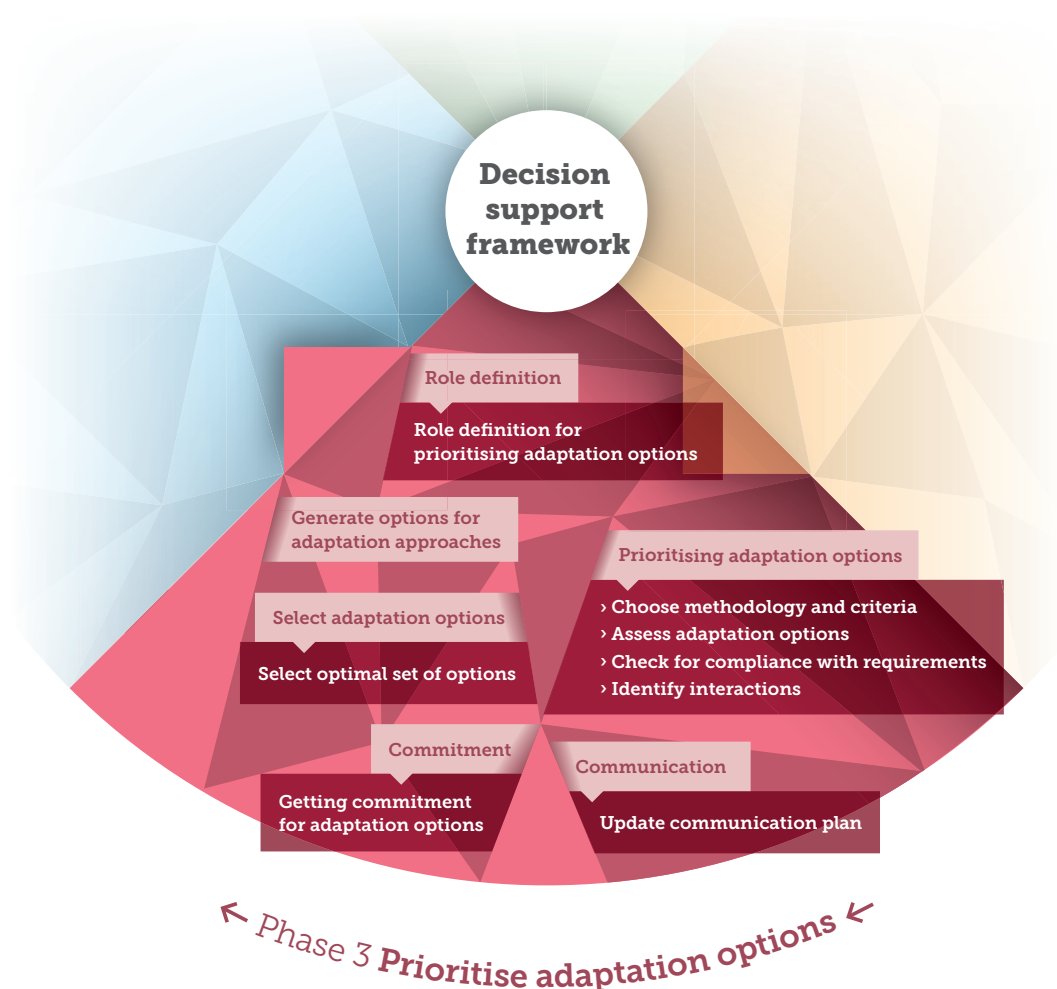


Figure 6: e-Guide phases and groups of steps

⁷ This information is valid at the time of writing, and does not necessarily reflect future changes to the CoM reporting framework and related documents.

4. EUROPEAN CLIMATE RISK TYPOLOGY



OVERVIEW

The European Climate Risk Typology offers an innovative way to enhance your understanding of climate risk. Available through an interactive online portal, the typology can visualise, describe, compare and analyse climate risk in European cities and regions. You can access a wide range of indicator data, covering different aspects of climate risk, to support climate change risk assessment and the development of adaptation and resilience strategies. The Typology also helps you to identify other regions with similar risk profiles, as a basis for sharing information on policies and practices, and for developing networks. As such, the Typology is a strategic decision-aid that supports more efficient and effective approaches to assessing and adapting to climate risks in European cities and regions.

USES

- **Description and communication of climate risk:** visualise climate risk types and related indicator data.
- **Risk assessment:** indicator data can inform a climate change risk assessment.
- **Strategy and planning:** create a sound basis for an adaptation/resilience strategy, e.g. by identifying key drivers of climate risk to focus on.
- **Collaboration:** develop city/region networks based on shared climate risk profile.

Access the Typology at

www.resin-cities.eu/resources/risk-typology

13

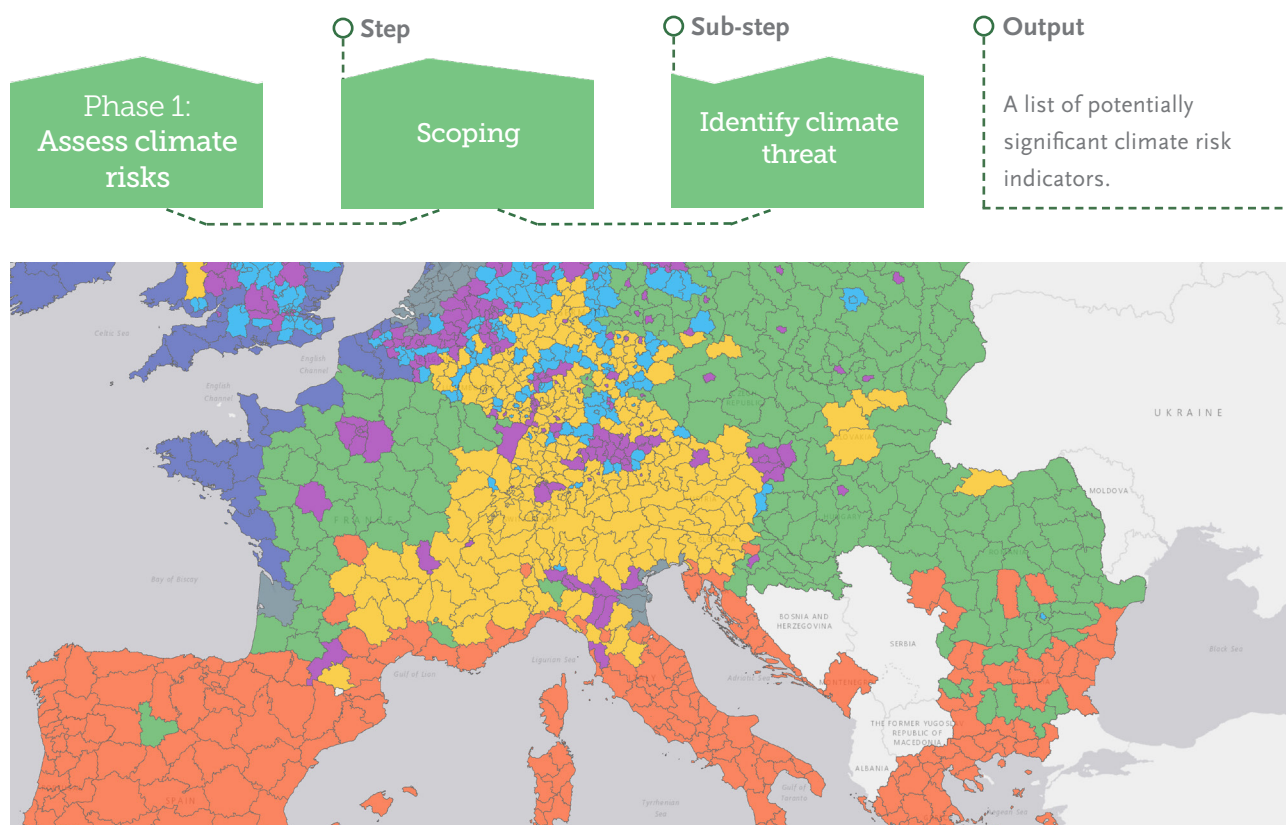


Figure 7: The European Climate Risk Typology is a map-based platform to visualise climate risk, based on a range of indicators.

5. IVAVIA (IMPACT AND VULNERABILITY ANALYSIS)



OVERVIEW

The IVAVIA methodology is designed to guide a risk-based vulnerability assessment as part of phase 1; helping you to map, analyse and communicate the impact of climate trends and weather events on key elements of your city's physical, social and economic fabric. IVAVIA provides guidance on how to prepare, gather, and structure data for your risk-based vulnerability assessment; to quantify and combine vulnerability indicators; to assess risk; and to present outcomes.

IVAVIA consists of seven modules (see Figure 8 below). Modules 0-2 allow a qualitative assessment, Modules 3-5 a more comprehensive, quantitative one, and Module 6 describes how to best present the outcomes of IVAVIA to your stakeholders.

USES

- ▶ To understand and visualise the cause-and-effect relationships of climate change
- ▶ To identify geographical risk and vulnerability hotspots
- ▶ To assess the demographic, economic and local impacts of climate change now and in the future.
- ▶ To identify entry-points for adaptation measures and areas where priority action is needed.

14

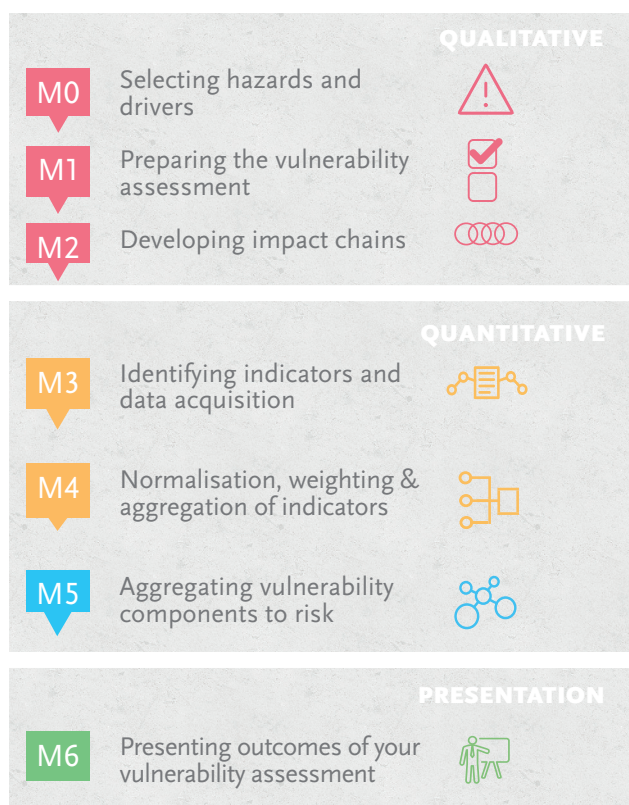


Figure 8: IVAVIA modules

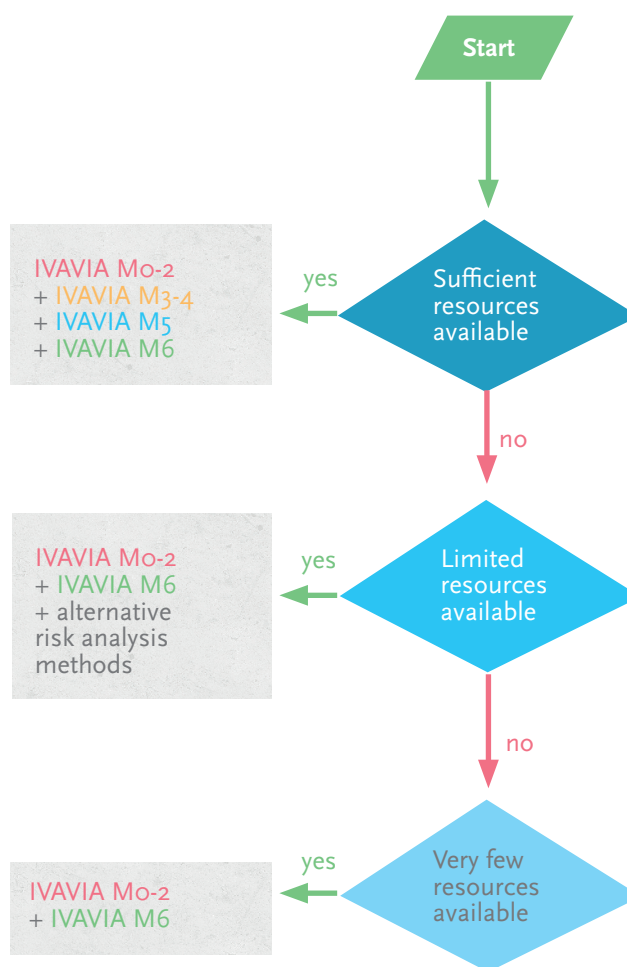
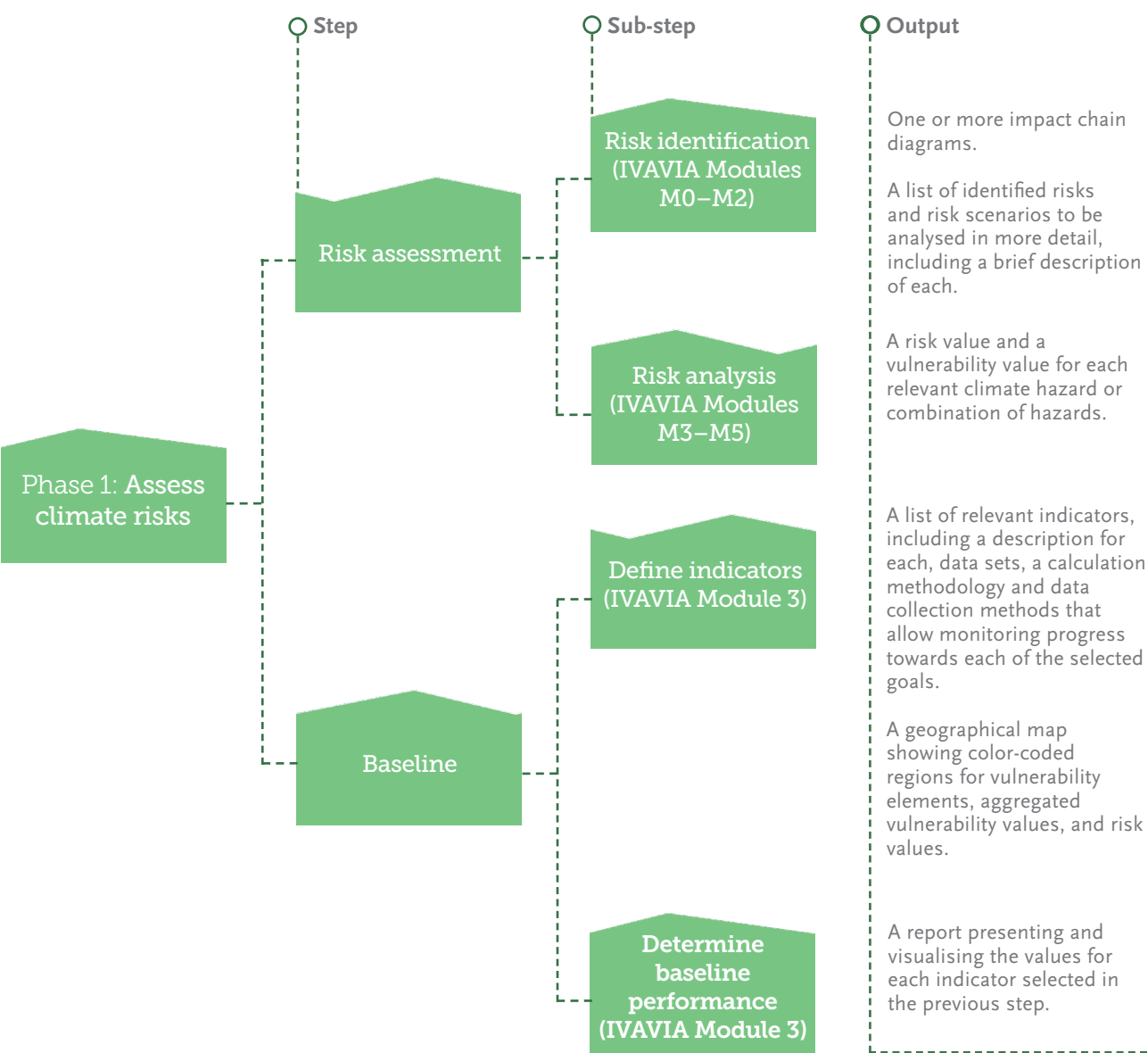


Figure 9: Options to use IVAVIA

IVAVIA can be used in a range of ways, depending on the intended outcome and resources available (see decision aid at Figure 9 on the previous page). For example, where the purpose is to raise awareness across departments of the consequences of particular risks and connections between them, Modules 0-2 can support a qualitative assessment, using Module 6 to present the outcomes. Where the outcomes are intended to inform operational decisions, a more comprehensive use of IVAVIA is recommended. See

the [IVAVIA Guideline](#) to help assess the level of resources needed for your situation and the corresponding modules to use – and for practical guidance on taking full advantage of all seven IVAVIA modules. The guideline provides an overview of relevant key concepts and climate scenarios, a detailed description of the modules and a step-wise approach to using them.

Access IVAVIA at www.resin-cities.eu/resources/ivavia



6. ADAPTATION OPTIONS LIBRARY



OVERVIEW

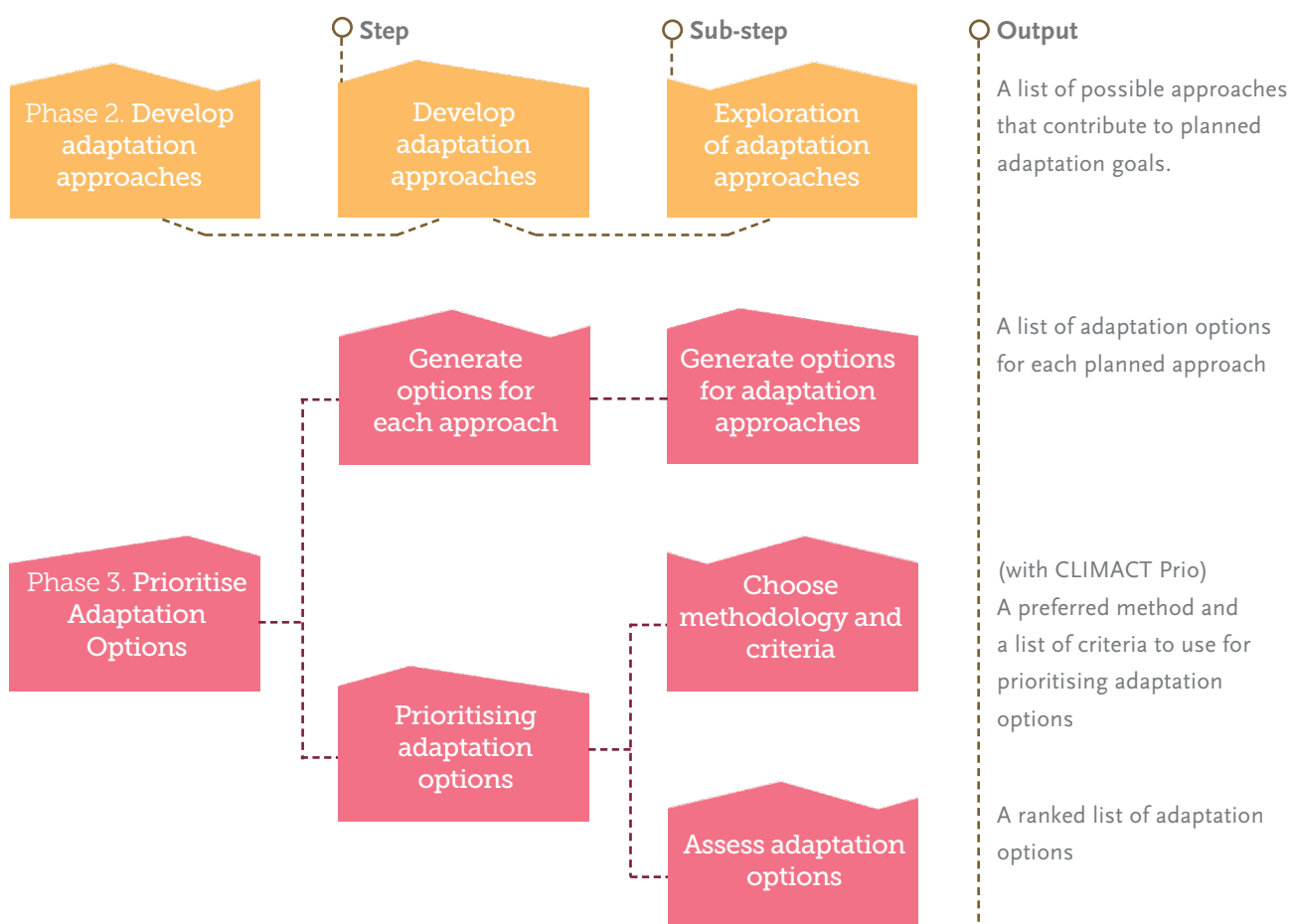
The Adaptation Options Library is a searchable database of all kinds of adaptation measures, addressing climate risks including heat; pluvial, fluvial and coastal floods; and drought. The performance of these measures has been evaluated through an extensive review of scientific literature, with references corresponding to each measure indicated as relevant. There are two entry points to the Library: a 'quick access' entry point for a basic review of available measures, and another for a more detailed investigation. Search filters allow you to find and compare measures depending on your main interests, with effectiveness and cost efficiency among the criteria available for comparison.

USES

- To select adaptation measures
- To benchmark adaptation measures depending on their cost-efficiency and effectiveness
- To better understand different types of measures
- To support Covenant of Mayors reporting
- To extract relevant information to support the design and implementation of selected measures
- To find literature for further investigation
- To help prioritise measures and design adaptation pathways (see page 17)

Access the Library at
www.resin-cities.eu/resources/library

16



PRIORITISING OPTIONS

The Library provides information that can help you prioritise adaptation options as part of a long term planning process (see diagram on page 16). The RESIN project has developed an approach for prioritising options⁸ based on the following key elements:

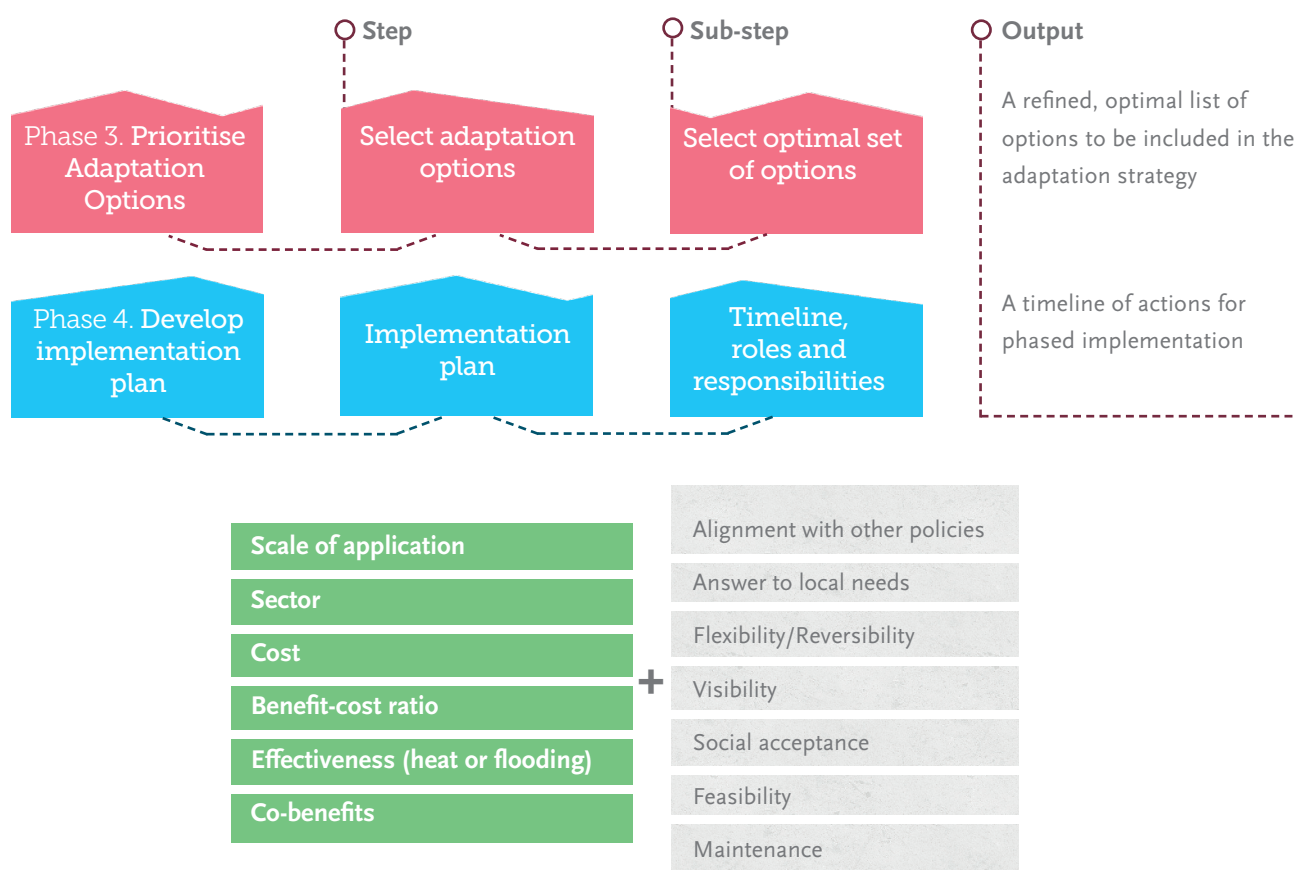
- Access to the Adaptation Options Library
- 2-stage multi-criteria decision analysis (MCDA)⁹
- Box-ticking
- CLIMACT-Prio tool for MCDA
- Stakeholder workshops

Involving the right stakeholders is key to successfully determining priorities. This is true for the whole process, but especially when identifying (and weighting) criteria. Criteria should be as simple, measurable, available and relevant as possible to achieve the desired aims. The RESIN team, based on available information and feedback from partner cities, proposes the backbone criteria pictured at Figure 10.

DESIGNING PATHWAYS

Also supported by the Library, an adaptation (or climate resilient) pathway is an iterative, ongoing process of decision-making, informed by a strategic vision and with a focus on experimentation and learning, so that decisions can be altered and outcomes improved over time¹⁰. The process of designing an adaptation pathway can be divided into four key steps, outlined below. Steps 3 and 4 are assisted by the prioritisation approach.

- Step 1: Analyse context, define objectives and set acceptable risk threshold
- Step 2: Identify adaptation options and assess their effectiveness
- Step 3: Develop potential adaptation pathways by aggregating different options, and sequencing them over time according to the relevant turning points¹¹, objectives and scenarios
- Step 4: Recommend an adaptation pathway using MCDA



17

Figure 10: RESIN backbone criteria for use in prioritising adaptation options. The first column lists the criteria used to evaluate all measures in the Adaptation Options Library. The second column lists complementary criteria identified by the RESIN cities.

⁸ For more on this approach, see the report *D3.2 Standardising methods for prioritising adaptation options: Toolbox* available on the RESIN website.

⁹ Multi-criteria decision analysis involves evaluating a problem according to multiple (potentially conflicting) criteria in order to arrive at a preferred solution.

¹⁰ See Wise, et al., 2014. Reconceptualising adaptation to climate change as part of pathways of change and response. *Global Environmental Change*, Volume 28, Pages 325-336.

¹¹ Turning points (or tipping points), identify at what point in time a system may become particularly sensitive (given the selected climate scenarios).

7. NEED MORE?

The e-Guide and all RESIN tools and methods are available online.

- The **RESIN urban adaptation e-Guide**
- **IVAVIA: A risk-based impact and vulnerability analysis methodology**
- The **Adaptation Options Library** (and related prioritisation and adaptation pathway design approaches)
- The **European Climate Risk Typology**

In addition, a range of other tools and methods exist to support your local adaptation work, and can be accessed through the RESIN e-Guide. You'll find [here](#) an overview, including a brief description of each and information about ease of use.



OUR PARTNERS

TNO (Netherlands Organisation for Applied Scientific Research)

www.tno.nl

Arcadis (The Netherlands)

www.arcadis.nl

BC3 (Basque Centre for Climate Change)

www.bc3research.org

City of Bilbao

www.bilbao.net

City of Bratislava

www.bratislava.sk

Comenius University of Bratislava

www.uniba.sk

EIVP (Paris School of Urban Engineering)

www.eivp-paris.fr

Fraunhofer IAIS

www.iais.fraunhofer.de

Greater Manchester Combined Authority

www.greatermanchester-ca.gov.uk/

ICLEI – Local Governments for Sustainability (European Secretariat)

www.iclei-europe.org

ITTI Sp. z o.o.

www.itti.com.pl

NEN (Standardisation Institute of the Netherlands)

www.nen.nl

Siemens Germany and Siemens Austria

www.siemens.com

Tecnia

www.tecnalia.com

The University of Manchester

www.manchester.ac.uk/

Uniresearch

www.uniresearch.com

INTERESTED IN THE RESIN PROJECT?

RESIN project coordinator:

TNO

PO Box 80015

3508 TA Utrecht

Peter Bosch

peter.bosch@tno.nl

resin@tno.nl

www.resin-cities.eu

