

## 2. Climate Change: Adaptation

### 2A. Present Situation

The Mediterranean climate of Lisbon and decades of soil sealing processes due to urbanization demands a timely green strategy to face climate events supported by appropriate urban planning and management tools. The Municipal Administration has put in place its Master Plan(1) based on the green infrastructure as an ecologically vital spatial system, which itself responds and adapts to climate changes.

Biodiversity a Strategy for 2020(2) includes governance and ecosystem services approaches (e.g. Lisbon is a case study of the Mapping and Assessment of Ecosystem Services(3)). A Local Biodiversity Action Plan(4) is now in place with a set of indicators, targets and adaptation measures.

Reinforcing adaptation policies the municipality concluded the **EMAAC (Lisbon Strategy for Adaptation to Climate Changes)(5)**, approved in 2017. EMAAC results from ClimAdaPT-Local (2015-16)(6), a national project guided by a consortium formed by university institutions and 26 municipalities as beneficiaries (figure 2).

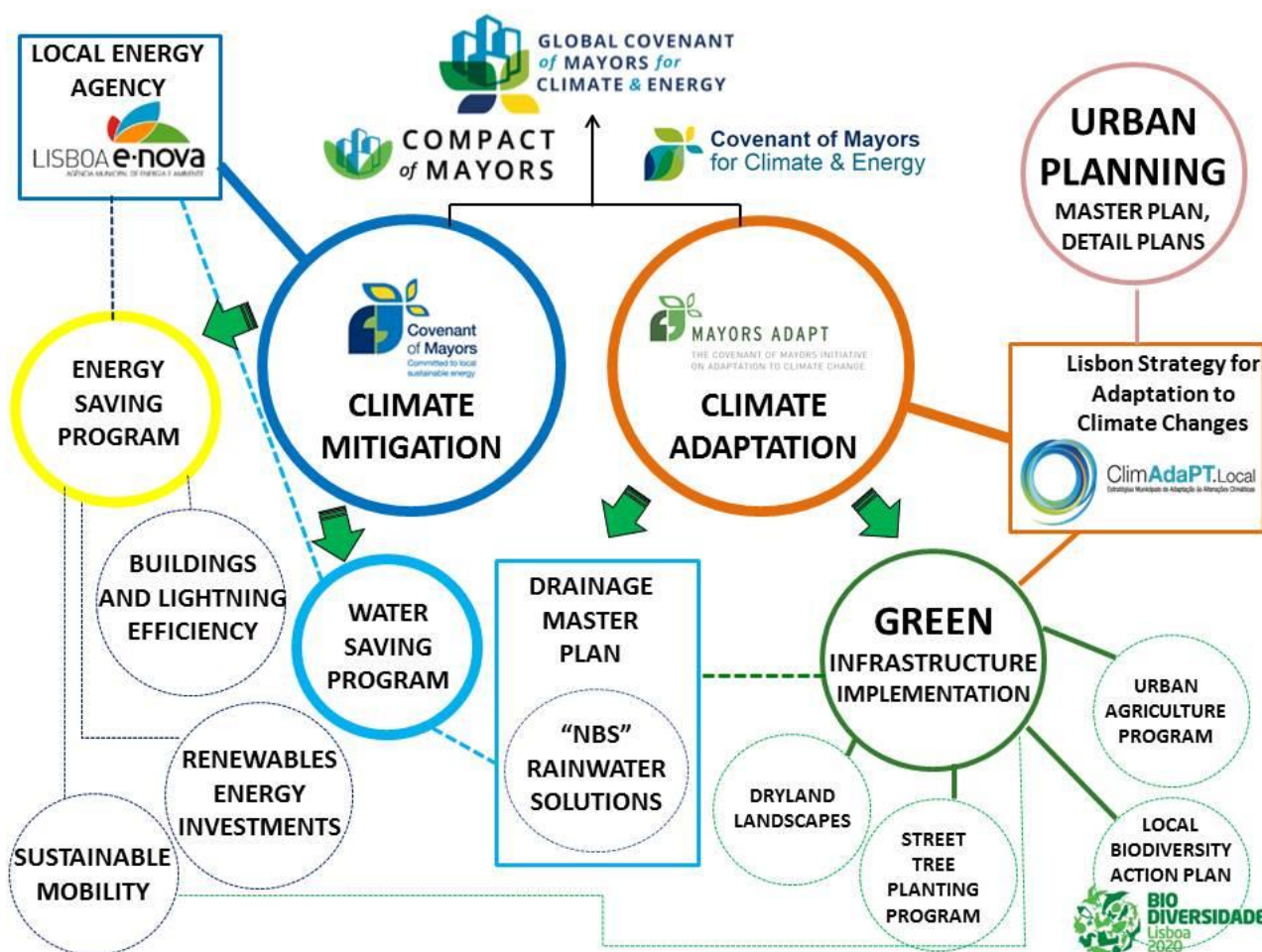
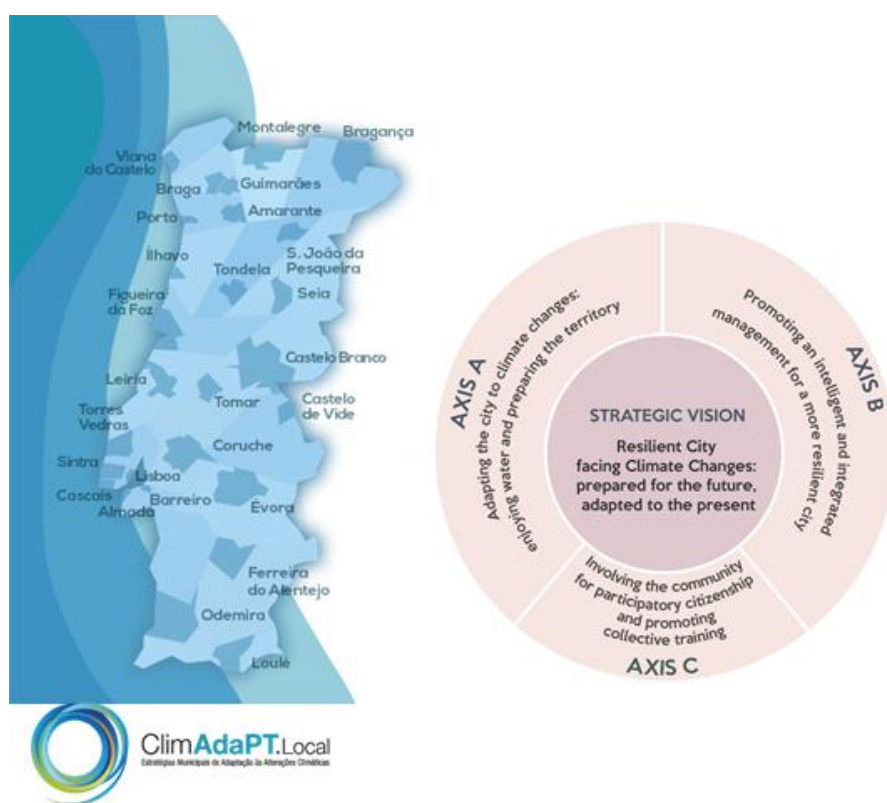


Figure 1 - Lisbon's Municipality organization to respond to climate change

Guided by the **strategic vision**:

**“Resilient City facing Climate Changes: prepared for the future, adapted to the present”**

EMAAC opens a new chapter in city adaptation and defines adaptation options organized in 3 axes: urban planning, urban management and governance (figure 2). Its contents are aligned with the core objectives of the National Strategy for Adapting to Climate Change, which advances EU climate change policies. EMAAC is a comprehensive local adaptation strategy facing the main challenges in climate changes in the 21<sup>st</sup> century.



**Figure 2** - Climadapt-Local municipalities' project beneficiaries. Vision and strategic axes of EMAAC

From its inception in 2008, **green infrastructure** is principally supported by **green corridors**(7). The **green infrastructure program** based on the idea of multifunctional systems and uses are the umbrella tool for climate adaptation responses, improving the water cycle, urban climate regulation (e.g. heat Island effects) and the avoidance of soil sealing.

**The Green infrastructure program** comprises:

- Implementation of **9 green corridors**, work in progress for 5-10 years, an 80 M€ investment (figure 3), including a Urban Allotment Garden program (figure 4);
- Reinforcement of the tree plantation – more than 30 000 in the last 4 years - mostly street alignment trees;

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- Development of **nature based solutions (NBS)** such as rainwater retention basins and water-free biodiversity rainfed meadows (figure 5). The first five NBS retention basins to reduce flash floods will be completed in 2018, representing an investment of 3 M€.

**There is a growing investment in the environment**, as shown by the doubling of the municipal Budget in green infrastructure from 2015 to 2018. This represents in 2015: 15 349086€, 2016: 21 775262€, 2017: 28 841734€ and 2018: 33 621705€.



**Figure 3 - Green corridors planning, 2017**



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Figure 4 - Urban Allotment Garden program, 2016

The **Lisbon Drainage Master Plan, 2016-2030**(10) is being implemented in a 170M € global investment, 100M € of which is expected to be allocated in the first five years. Designed to deal with rainfall over a period of 100 years, it takes into account climate change, sea level increase and high intensity rainfall events.

The combination of drainage plan solutions with local **NBS** is the answer to the increasingly frequent problem of floods in the city in relation to the unique geography of the capital.



**Figure 5 - NBS measures (Up: Biodiversity Rainfed Meadows; Down: Rainwater basins)**

In terms of water resources the city has targeted the wastage of potable water for irrigation, namely the irrigation systems in “Eduardo VII” Park and “Campo Grande” garden. Nowadays, streets are already being cleaned with recycled water using vehicles, which is going to be extended through a dedicated infrastructure in the future.

## 2B. Past Performance

The **Green Plan Preventative Measures** (2008) incorporated in the **2012 Master Plan** defined the most sensitive ecological areas for preservation and promotes ecological sustainability, biodiversity and quality of green public spaces across the green corridors, soft drainage systems, pedestrian and cycle paths and an increase in permeable areas. The green infrastructure is a cross-platform in order to promote diversity and functionality and also taking into consideration the interconexion within the green infrastructure of Lisbon Metropolitan Area.



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**Lisbon Master Plan** - based on the assessment of natural and man-made threats - set the guidelines and objectives for targeted individual planning and local development founded on ecological principles, water cycle improvements and sustainable mobility, through the enhancement of the green infrastructure (figure 6). The International Society of City and Regional Planners honoured Lisbon with its Award of Excellence (2013) for innovative approaches to implementation that set the priorities for the municipal budget.



**Figure 6** - Enhancement of green Infrastructure (2008-2017), (new and renovated areas represented in red)

The **Water Matrix 2014** (Lisboa E-Nova - Lisbon's Energy and Environmental Agency)(11) identifies and quantifies the main water flows in the Lisbon region, encompassing water supply, wastewater collection and treatment systems.

The Water Matrix enables key actors in the water sector and policy makers – lead by the “AdP-Águas de Portugal” Group - to define indicators, actions, targets and measures for more efficient water management.

Lisbon Municipality and Lisboa E-Nova implemented the **Remote Manager project** aimed at increasing the efficient use of water through leak detection and repair, automatic control of reservoir levels and automatic irrigation controllers, among other initiatives.

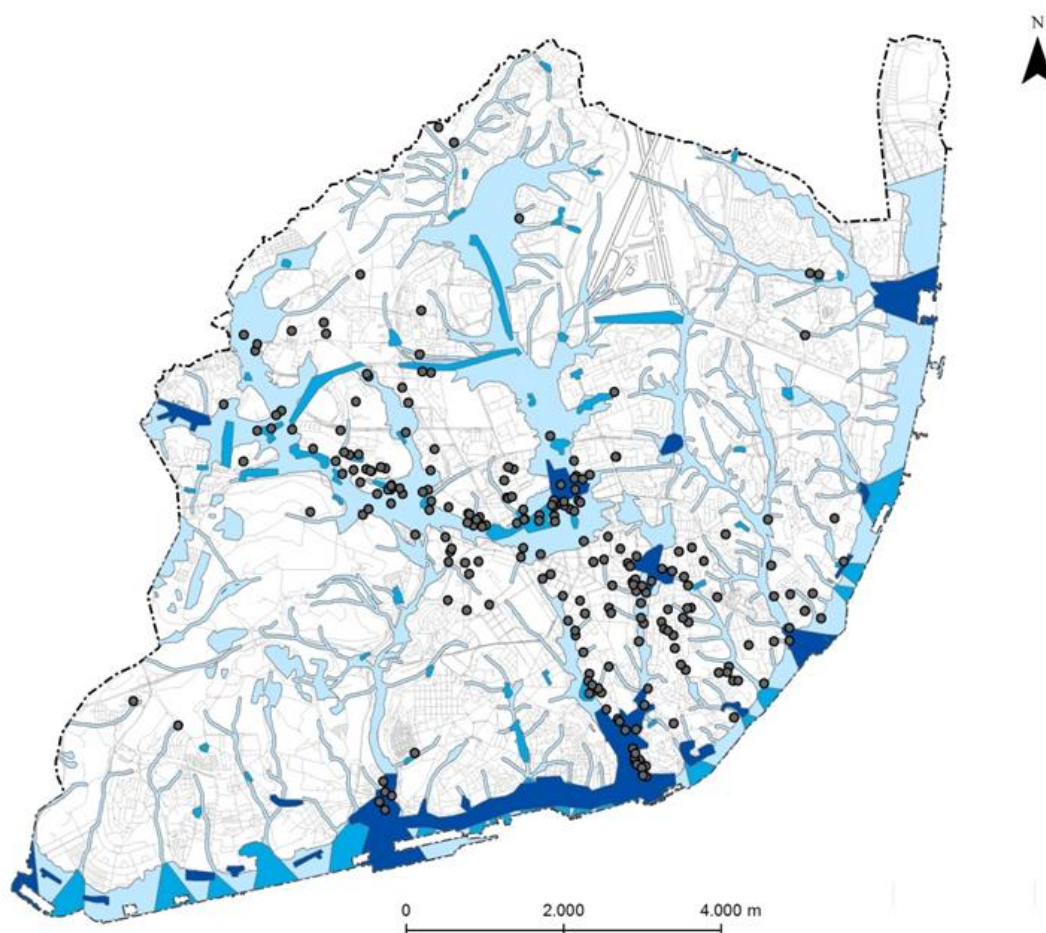
**Biodiversity Local Action Plan** provides a framework and a set of measures that reflect the role of urban biodiversity and ecosystem services in the municipality's sustainability policies. For example, since 2008 6.3ha of new biodiversity rain fed meadows have been created to cope with rising temperature and water scarcity. This solution provided by a project awarded by the EU Commission in 2016 creates green spaces adapted to low-cost maintenance requiring less water and less nitrogen fertilizers (figure 7).



**Figure 7** - Lisbon campaign for the use of biodiverse rainfed meadows.



The **Lisbon Fire Brigade Database** provides the registration of all calls due to the impacts caused by adverse meteorological events in the city. The assessment of vulnerabilities, carried out for the EMAAC elaboration, was based on this data from 2010 to 2014. Days with extreme weather events were chosen from this database to be mapped in the GIS environment (eg occurrences due to flashfloods map (figure 8)).

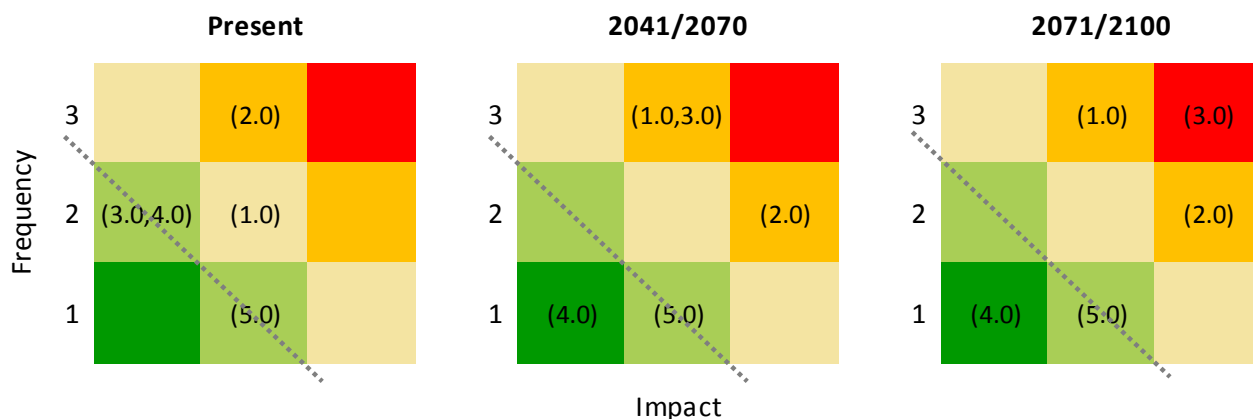


**Figure 8** - Mapping of occurrences recorded on a day of intense precipitation

Climate change projections for Lisbon up to the end of century (Faculty of Sciences, University of Lisbon for the ClimAdaPT.Local) defining a **matrix of current and future risks**, 2041/2070 and 2071/2100 (figure 9).



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**Figure 9** - Climate change risk matrix (1.intense precipitation; 2.strong wind; 3.heat wave; 4.cold wave; 5.hail)

A vulnerabilities assessment concluded that the major risks in the present and medium term will result from intense precipitation and winter storms, with rain and gale force winds. In the long term, although a decrease in the frequency of these events is forecast, they are expected to increase in magnitude. Climate projections have pointed out high temperatures as the major threat at the end of the 21<sup>th</sup> century.



**Figure 10** - Up: Floods in Praça do Comércio; Down: damage due to gale force winds

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EMAAC was carried out by a multidisciplinary team from the municipality (environment, planning and civil protection) in close collaboration with the ClimAdaPT-Local team. Throughout this process, 2 stakeholder engagement workshops were held with about 100 participants, including: “AdP-Águas de Portugal” Group, Subway Company “Metropolitano de Lisboa EPE”, “APL”-Lisbon Harbour Authority, “IPMA”- Portuguese Institute of the Sea and the Atmosphere - among many others. This process gave rise to an open set of adaptation options, which were further strengthened through a public consultation period.

Subsequently, adaptation actions are already being implemented or reinforced in several areas, such as in depth studies to fill gaps in knowledge and the enhancement of green infrastructure adopting adaptation solutions. Among the initiatives undertaken to broaden knowledge of the cities characteristics and vulnerabilities and the production of management tools some projects stand out:

- **Stormsurge effect study** (“Institute D.Luiz”, “Faculty of Sciences of the University of Lisbon”) Results identify the most vulnerable areas on the riverfront, as well as the security levels and endangered infrastructure that must be adapted throughout the 21st century, following climatic projections.
- **BildAdaPT project** developed in parallel with the ClimAdaPT-Local project correlates socio-economic factors of the population and vulnerabilities of buildings (EMAAC-anex III) to extreme temperatures.

An example of integrated urban rehabilitation, the “**Eco-Bairro da Boavista**” (2011-2013) - a priority neighborhood classified by the **BIP-ZIP** strategy(12) – introduced adaptation solutions for building refurbishment and urban environment within the scope of environmental sustainability involving the population with an investment of 4.4M€ (2.5M€ co-financed by ERDF) .

According to the goals of the 2012 Master Plan, Lisbon provides a **System of Management Planning and Assistance** (SGPI) which sets coordinates and monitors the actions planned by each municipal service integrating it within the multiannual investment plan(13).

Master Plan monitoring utilizes detailed data on global benchmarks and environmental adaptation targets collected through the 2014 **REOT** (Land Management Situation Report)(14).

**The set of biodiversity indicators** also incorporated in REOT contributes to a stronger assessment of adaptation to climate change, namely: permeable areas, connectivity measures, permeable sites, CO<sub>2</sub> sequestration, budget allocations to the department in charge of implementing the green structure, etc.

**Environmental policies have been strengthened by the participation in international networks and projects**, often providing significant frameworks for the improvement of monitoring systems **such as Mayor's ADAPT** (Lisbon was Mentor City in the Twinning Project in 2016)(15) and the **new integrated Covenant of Mayors for Climate and Energy**, CDP-Carbon Disclosure Project, ICLEI-Local Governments for Sustainability, EnRoute-Enhancing Resilience of urban ecosystems through green infrastructure, OECD-Sustainable urban development policies in ageing societies, as core examples.



With the aim of contributing to the planning and prevention of situations of expected meteorological risk of disaster, the Municipal Civil Protection Service (SMPC) has developed several emergency planning instruments, in particular the Municipal Emergency Civil Protection Plan and Occurrences Coordination Plans.

The Municipal Civil Defense Service (SMPC) activates a **Contingency Plan for Homeless People** (Municipal Homeless Program 2016-2018) whenever alert levels are recorded and subsequently implemented by the social sector of the municipality to support the most vulnerable population(16).

Following the United Nations appeal, SMPC joined the UNISDR-Making Cities Resilient: *My City is getting ready!* (17) in 2010 with the aim of raising awareness of the local level role in disaster risk reduction including meteorological hazards.

A children's animation "Crescer em Segurança" has been developed by SMPC since 1992. In a space known as "Tinoni House" each child learns to identify the risks that are run in their daily lives and the rules that best fit each situation (18).

Since 2006, "Lisboa E-Nova" Energy Agency has organized regular thematic meetings -The Meeting Point- (19) to promote dialogue on sustainable development, focusing climate change mitigation and adaptation.

**Lisbon hosted events related to adaptation**, among others: the Urban Green Spaces Seminar (2015) and Ecosystem Services in Cities Conference, (2017) (20).

## 2C. Future Plans

The purpose of EMAAC is to conceive an integrated adaptation action program for the next **10** years carried out by a multidisciplinary team. **A Local Liaison Council (CLA)** is being organized to co-ordinate the adaptation process as a consultative structure, bringing together key public, private and civil society participants, in which the scientific communities will play an important role.

Lisbon has joined a **national network of municipalities - ClimAdapt Project(21)**, aiming to increase local capacity to incorporate adaptation into their policies and actions.

The EMAAC adaptation response has been programmed according to climate projections utilizing the major identified vulnerabilities and risks in Lisbon, evolving the most fragile sectors (socioeconomic, physical and territorial). It relies on an integrated and comprehensive framework structured through three main axes and programmatic lines (figure 11) fitting an open set of options.

**Axis A** priorities rely on the **transposition of adaptation options into urban planning tools** and the **deepening of knowledge** ensuring continuous updating through ongoing action:

- The updating of the **Natural and Entropic Risks Chart**;
- Refinement of **Urban Heat Island** study;

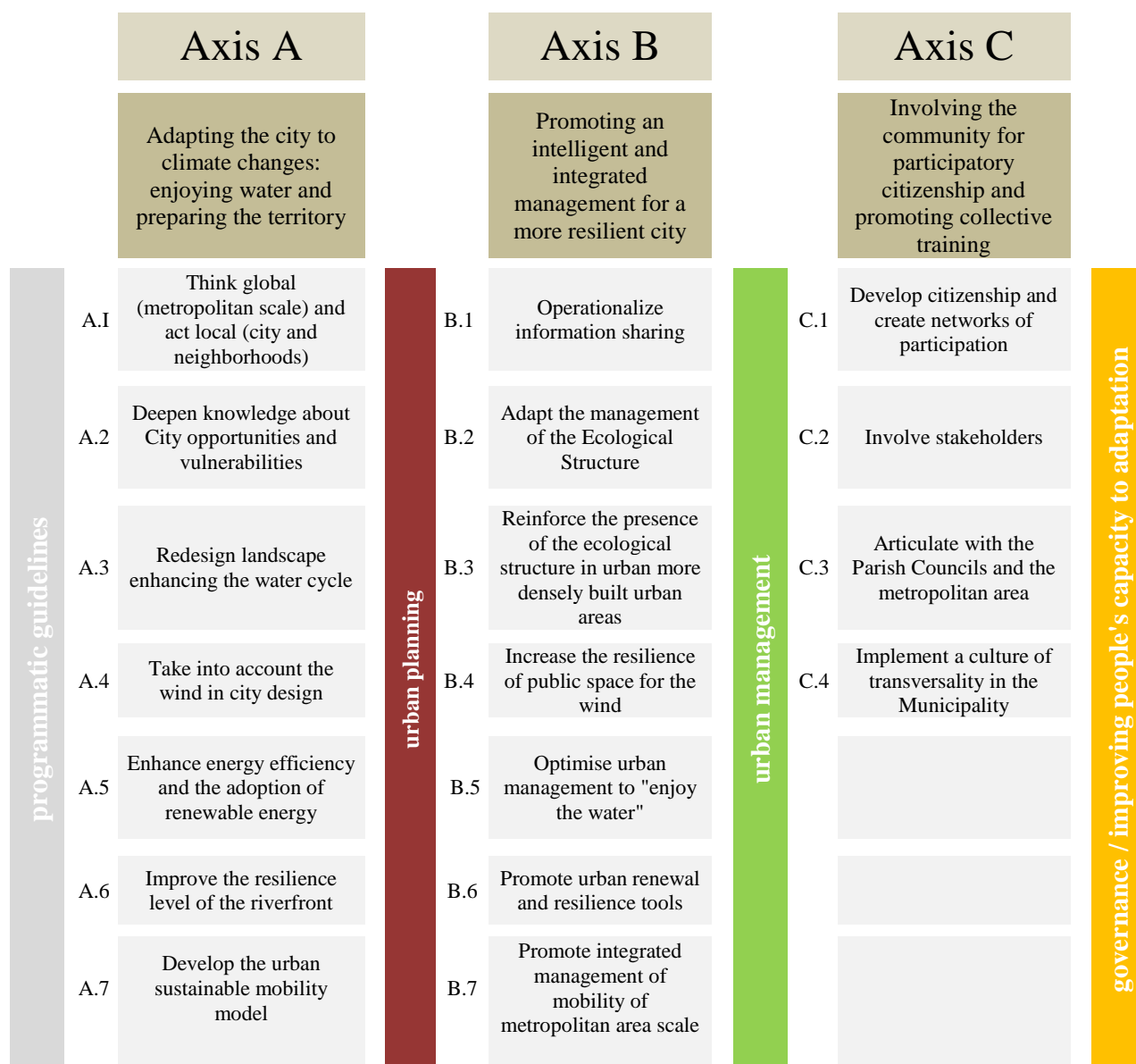
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- Transposition of the **Stormsurge Effect Study** to urban management tools.
- Multisectorial projects, aligned with **Lisbon 2020 Strategy** that rolls out the **Sustainable Cities Strategy 2020**, promoting fundraising and co-financing solutions, e.g.:

-**GeoSIG project** (22). Georeferenced database compiling geological, geotechnical and hydrogeological data (40% cofinanced by ERFD);

-**RESCCUE-RESilience to cope with Climate Change in Urban arEas** (23). Multisector approach for the construction and implementation of models and tools in the water sector; (figure 14)

-**RESILENS - Realising European RESilience for Critical INfraStructure** (24) Research and Innovation Program (EU H2020) for incorporating the concept of resilience into operational measures.



**Figure 11** - EMAAC Structure: axes, programmatic lines fitting adaptation options



**Axis B** action is focused on the following priorities:

- **Drainage Master Plan** (2016-2030);
- **Green Infrastructure** enhancement aiming to grow by 20% by 2020 through:
  - Conclusion of Green corridors, e.g. Alcântara Valley (25-video) (over 6 M€), regenerating a former brownfield which drains the city's largest drainage basin;
  - Dissemination of biodiverse rainfed meadows (26), a solution with a strong potential for replication in cities in southern Europe;
  - Continuation of the tree planting program (80.000 trees planted by 2021);
  - Water Re-use project is under way for the reuse of a treated wastewater network, originated from the Wastewater Treatment Plants (Chelas and Alcântara) for irrigation and street cleaning.



**Figure 12** - Tree planting will improve efficient response to increase in heat waves

**Axis C** is focused on the empowerment of political commitments and the involvement and participation of different stakeholders. It should also nurture the interconnections between the metropolitan region and local boroughs.



**Figure 13** - Adaptation awareness campaign taking place in urban parks, by means of information panels.

It is under study an adaptation monitoring process (**Lisbon Smart Management Platform**) for a collaborative management of happenings and events between Civil Defense, Fire Brigade, Municipal Police and operational services, also integrating city infrastructure operators.

**Moreover, Lisbon is involved in the establishment of agreements on the next steps of climate policy through active participation in the new Covenant of Mayors (27).**

**EUROCITIES and ICLEI have been selected by the European Commission DG Environment to develop a strategic plan for the Urban Water Agenda 2030 (28) in which Lisbon is integrated into its core group.**

**Lisbon will host the European Climate Change Conference (May 2019) (29),** providing the opportunity to reassert the theme, to promote solutions and the empowerment of all the agents involved in making Lisbon a more resilient city to climate change.



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## RESCCUE

## LISBOA – a city committed with Resilience

### 100 Resilient Cities RF (USA)



### OCDE – Cities & Governance



### UN HABITAT

#### Post 2015 Agenda



The "Post-2015 Agenda" is the development agenda that will replace the Millennium Development Goals (MDGs) upon their expiration in 2015. After 2015, efforts to achieve a world of prosperity, equity, freedom, dignity and peace will continue unabated.

The UN is working with governments, civil society, and other partners to build on the momentum generated by the MDGs and carry on with an ambitious post-2015 development agenda. The MDGs will be replaced with the Sustainable Development Goals (SDGs), which will shape the Post-2015 Development Agenda.

### JPI Urban Europe



### ClimAdapt Local



### ICLEI - Local Governments for Sustainability



### Covenant of Mayors



### UNISDR - The United Nations Office for Disaster Risk Reduction



Figure 14 – Lisbon's approach in to Research and Innovation Programs for incorporating the concept of resilience.

## 2D. References

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- (4) <http://www.cm-lisboa.pt/viver/ambiente/biodiversidade/plano-de-acao-local>
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