

Transformative innovation for better Climate Change Adaptation – Case study: Leuven, Belgium

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Abstract

The aim of this report is to investigate the potential for harnessing key features of Transformative Innovation to improve the design and the implementation of Climate Change Adaptation (CCA) strategies, based on empirical analyses. The study draws on the conceptual framework on this question previously defined for the JRC (European Commission, 2024), and the methodology for case studies articulated in the same report. The case study research comprises overall 14 case study reports covering 16 different territories from across the EU and beyond, casing various institutional contexts, a variety of biogeographical regions within different climate risks, different ranges of population sizes, and representing a diversity of approaches to CCA and transformative innovation¹.

The framework takes the form of an analytical grid, structured into seven sections, each of them representing a key feature of the 'transformative innovation' approach where the features are understood as essential conditions for the design and implementation of CCA strategies with this high level of ambition. Each section sets out the main question(s) to be addressed in relation to its respective transformative innovation feature.

This report provides the findings for the city of Leuven, Belgium, as at October 2023, and is the result of a collaboration between the Joint Research Centre (JRC), DG CLIMA and DG RTD.

¹ A full list of the case studies is provided in Annex 2

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Executive summary

Policy context

Adapting to climate change has become an increasingly urgent priority for the EU and its territories. Given this urgency, and the systemic nature of climate resilience, new ways to accelerate adaptation are considered. Transformative innovation (TI) is at the focus of this report, particularly how it can help support and accelerate adaptation to climate change. The analysis in this report draws lessons for Leuven (Belgium) on how a TI approach is already helping the territory in increasing climate resilience, and what can be done in addition, to further accelerate adaptation. The analysis is based on a theoretical framework along 7 dimensions designed to compare TI and Climate Change Adaptation. It is one out of a series of 14 different case studies in European territories.

Main findings

As a signatory of the EU Mission on Climate Change Adaptation, the city of Leuven has committed to building climate resilience in an inclusive way, engaging with local stakeholders, civil society, the business community, industry, research organizations, and citizens. While the city has high ambitions regarding addressing climate impacts, it can benefit from introducing more elements of transformative innovation into its climate adaptation strategy. Features from the transformative innovation approach can support the city in its efforts towards systemic change.

The state-of-play for the city of Leuven on each of the seven key transformative innovation features can be summarized as follows.

- **Directionality:** Leuven has set tangible goals for climate adaptation in its strategic planning, considering also unequal distribution of climate risks. Local innovation hubs focus however more on solutions for climate mitigation.
- **Instrument portfolios and funding synergies:** A broad funding mix is applied for climate adaptation measures, and adaptation aspects are mandatory in many projects. A mix of regulations and subsidies is used at local level, in combination with living labs and pilots, including in cross-border setting.
- **Ensuring cross-domain synergies:** The Climate Adaption Plan for Leuven favors whole-of-government approaches by breaking silos and supports acceptance in society.
- **Stakeholder involvement in Leuven** focuses on social acceptance and public trust from citizens, as well as on KU Leuven University. Strong business involvement is not a priority yet.
- **Multi-level governance:** The city of Leuven is planning and executing its CCA strategy in line with the regional, national, and European strategic and legal frameworks, and issues of local authorities are communicated to the next governance level(s) if necessary.
- **Experimentation:** There is limited experimentation on innovative solutions, partially due to limited capacities and the perception that failure is as a waste of public money.

- Policy intelligence, learning and strategic capacity: Leuven is building a strong evidence base for climate adaptation. Capacity to use the knowledge base at local level, and interdisciplinary research to better manage transitions, are flagged as gaps.

Key conclusions

For each of the seven key transformative innovation features, possible ways towards a transformative climate adaptation approach for Leuven include:

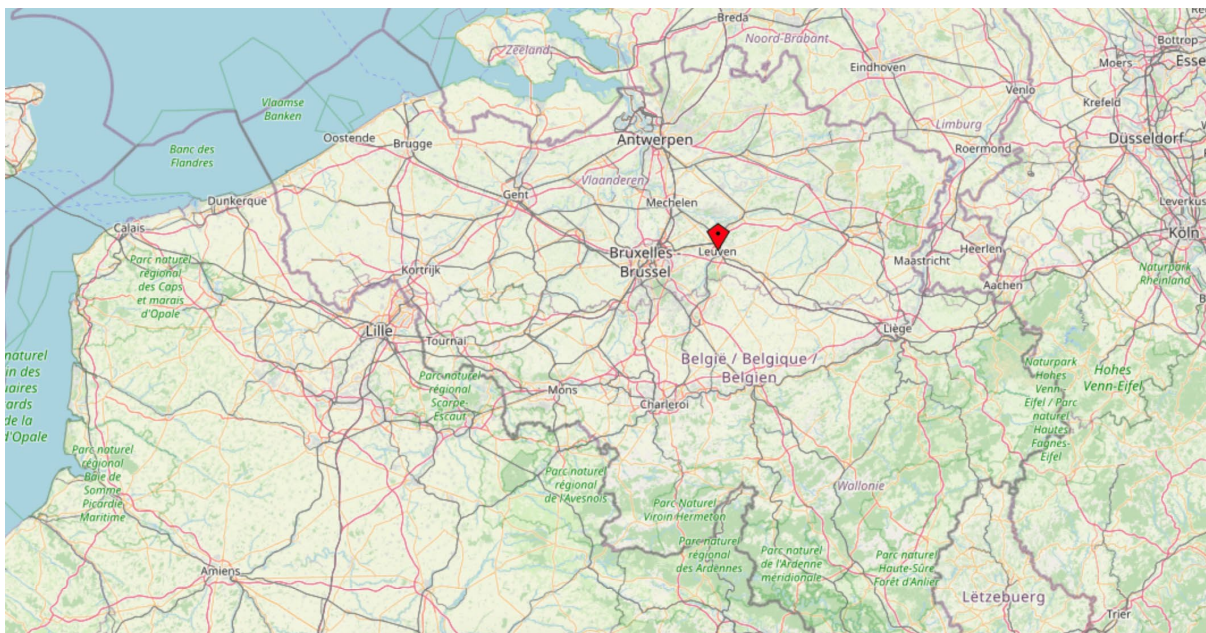
- Directionality: track the achievement of goals, involve local innovation hubs and develop business involvement, maintain the sense of urgency and apply more systemic and innovative climate adaptation strategies and solutions, e.g. involving land use and other territorial policies.
- Instrument portfolios and funding synergies: draw more on European funds for innovation, investigate synergies more systematically, foster private sector engagement in innovative climate adaptation.
- Ensuring cross-domain synergies: Foster interdisciplinarity research for cross-domain synergies, support a 'climate adaptation economy' and address any remaining silos at the strategic level.
- Stakeholder involvement: provide room for stakeholder exchange, (e.g. citizens, businesses, and research) to work on local solutions for climate adaptation
- Multi-level governance: Seek opportunities for regional synergies in CCA initiatives
- Experimentation: Enhance the tolerance for failure (e.g., by providing failure-tolerant funding), reinforce regulatory sandbox initiatives, and enhance local capacities for experimentation.
- Policy intelligence, learning and strategic capacity: Support the strategic capacities of local authorities by providing tailored information on funding opportunities. Foster interdisciplinary research to build up transition skills.

1 Introducing Leuven

Profile of the territory

The city of Leuven has about 102.000 inhabitants and is the capital and largest city of the province of Flemish Brabant in the Flemish region of Belgium. Leuven covers an area of 56,63 square kilometers and is located about 20 km east of Brussels at the river Dyle. Figure 1 shows Leuven's geographical location in Belgium.

Figure 1. Geographical location of Leuven in Belgium (Open Street Map, 2023).



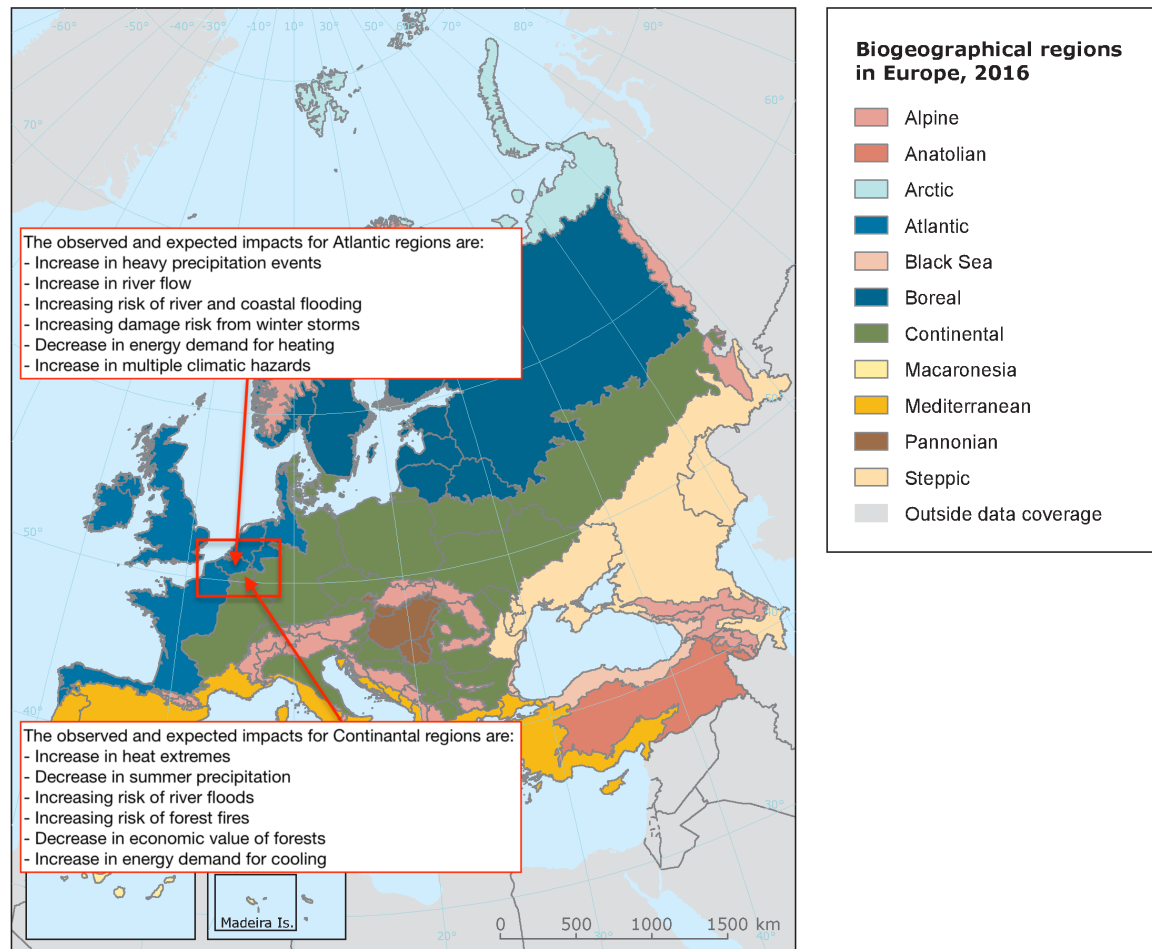
Main climate change risks and vulnerabilities

The European Environmental Agency has classified key climate impacts into biogeographical regions. The territory of Belgium is divided into two regions. While the north is an 'Atlantic' biogeographical region, the South is a 'Continental' biogeographical region (EEA, 2017). Figure 2 shows the biogeographical regions and the observed and expected impacts of climate change for 'Atlantic' and 'Continental' regions.

Leuven is located in the center of Belgium and needs to consider the impacts on the 'Atlantic' biogeographical region in the North and 'Continental' biogeographical region in the South. Leuven has identified the following major risks of climate change for the city (Climate Action Plan, p. 97):

- (1) Drought and depletion of water reserves: diagnosis elaborated in drought study
- (2) Flooding and erosion due to rainwater runoff: potential nuisance and measures discussed in the rainwater plan and erosion control plan
- (3) Flood risk from the waterways and rivers: potential nuisance and measures discussed in the rainwater plan and erosion control plan
- (4) Heat stress in neighborhoods with a lot of paving where risk groups live
- (5) Loss of ecosystem space and biodiversity

Figure 2. Biogeographical regions and impacts of climate change for the 'Atlantic' and 'Continental' region (modified from EEA, 2017).



Climate change adaption and innovation strategies

The city of Leuven has signed the EU Mission “Adaptation to Climate Change”. As part of this mission the EU supports (a) regions and local authorities towards climate resilience by 2030, (b) building a community of practice on adaptation to climate change, and (c) delivering the European Green Deal and the [Climate Adaptation Strategy](#). Additionally, the city of Leuven has signed the [Covenant of Mayors](#). Thereby, the city of Leuven has committed to achieving its share of emissions reductions and to developing a comprehensive adaptation plan. Furthermore, Leuven has been chosen by the European Commission for the mission ‘[100 Climate-Neutral and Smart Cities by 2030](#)’. With this mission, Europe supports the selected ‘Mission City’ with expertise and (financial) resources in their journey towards climate neutrality by 2030. As a Mission City, Leuven has committed to delivering a Climate City Contract with its partners: Leuven 2030 (Non-profit), Stad Leuven (Local government), KU Leuven (Non-profit), Imec (Non-profit), Leuven MindGate (Civil society organization), Leuven Europa Club (Civil society organization).

There are several strategic documents on climate change adaptation (CCA) that are relevant to the city of Leuven. The key strategic document for CCA is the ‘Climate Action Plan – City of Leuven 2020-

2025' (2020). The document includes a chapter on CCA. In this chapter, the city presents its climate adaptation strategy and translates it into measures and actions.

Together with Leuven 2030, a non-profit organization that is in charge of citywide collaboration in a quadruple helix model, the 'Leuven 2030 Roadmap' was published. This document mainly serves as a guide for achieving climate neutrality by 2050. However, it also includes the program "green and resilient spaces", which focuses on climate adaptation.

The city of Leuven places its adaptation strategy within the regional and national CCA strategy. At the regional level, Flanders has published the 'Flemish Climate Adaptation Plan' (2023). At the national level, the strategic document 'Federal Adaptation Measures 2023-2026' (2023) set strategic guidelines. The following list shows an overview of the strategic documents.

- 2020: Climate Action Plan – City of Leuven 2020-2025, City of Leuven.
- 2019: Leuven 2030 Roadmap, Leuven 2030.
- 2023: Flemish Climate Adaptation Plan, Flemish government.
- 2023: Federal Adaptation Measures 2023-2026, Federal Working Group on Adaptation.

In 2020 Leuven was selected as the European Capital of Innovation. The city of Leuven has forged an exceptional alliance characterized by empathetic leadership and structural collaboration between citizens, knowledge institutions and local organizations. Through this approach, the city has consistently remained committed to its vision of building a better future, not only for itself but also for a broader community. The city has been selected for a number of groundbreaking collaborations.

Through the non-profit organization Leuven 2030, over 600 partners, including governments, knowledge institutions, companies, organizations and citizens, collaborate structurally and intensely on the city's climate transition strategy and its implementation. Part of this strategy is CCA, which can be found in the Leuven Roadmap 2030. Although the Leuven 2030 Roadmap focuses on innovation for climate mitigation, innovation topics are less present in CCA.

2 Application of the conceptual framework: Transformative Innovation for Climate Change Adaptation

In a separate analytical framework report for territories (European Commission, 2024), seven key features of Transformative Innovation have been identified as essential conditions for the design and implementation of CCA strategies. These features can be summarised as follows:

1. **Directionality:** defining goals and scope of strategic action, as well as articulating impacts, in a way which reflects societal challenges with wide appeal, formalised through endorsement at the highest political level to secure engagement of all relevant authorities and stakeholders.
2. **Articulating instrument portfolios and defining synergies between funding sources:** establishing all-encompassing instrument portfolios addressing the whole innovation cycle and the various aspects of CCA, paired with adequate funding resources.
3. **Ensuring cross-domain synergies:** favouring whole-of-government approaches to ensure greater horizontal coherence between various thematic policy areas (R&I, agriculture, environment, mobility, health etc.), resulting in coordinated mixes of instruments of different types.
4. **Increasing breadth and depth of stakeholder involvement:** working towards social acceptance of new solutions and shaping innovative developments, as well as improving public trust, opening up public debates, and managing diverse and sometimes conflicting views over alternative pathways.
5. **Setting up effective multi-level governance models:** maximising potential of vertical synergies, recognising complementary roles for various governance levels – local, regional, national and EU.
6. **Making room for experimentation:** providing adequate spaces for risk-taking and creativity – ensuring a risk-tolerant environment to facilitate the development of new and/or radical solutions.
7. **Securing high levels of policy intelligence, learning and strategic capacity:** building strong evidence-based policy learning capacities, based on a solid knowledge base and special skills to manage transitions, as necessary companions to the transformative innovation approach.

The following analysis is based on the framework stated above. The analysis investigates to what extent the seven characteristics of transformative innovation are at place in Leuven's Climate Change Adaptation strategy. The report is structured into the seven sub-chapters following transformative innovation characteristics. In the final section of the report, recommendations towards stronger transformative innovation in Climate Change Adaptation are developed.

2.1 Directionality: defining goals and expected impacts for society

Box 1. Directionality in Leuven

Leuven has set tangible goals for CCA and communicated these in its Climate Adaptation Plan and in the roadmap Leuven 2030. Thereby societal challenges, such as the unequal distribution of climate risks, are considered and addressed. The strategic actions are supported by the local authorities and receive the highest political support at the city level. However, the strategic actions for CCA are not in the focus of local innovation hubs, such as Imec (an organization that strengthens the international position of the Leuven Innovation Region) and MindGate (a research center that supports companies and governments in sustainable innovation). These innovation hubs focus on solutions for climate mitigation.

Leuven has a high-quality blue-green structure with large green 'fingers' that divide the urban area into recognizable parts and surround the residential areas. The carriers of this structure are the river Dyle and its tributaries and the witness hills, supplemented by a number of contiguous agricultural zones and larger forest complexes. Smaller-scale neighborhood and district greenery in the residential areas complement these large structures.

To increase the resilience of the city against the impacts of climate change, Leuven wants to strengthen its blue-green structure in the city and to integrate it deep into the residential areas. Leuven's overall strategy for climate resilience is the application of nature-based solutions for flood and water management, where rainwater is absorbed and captured and by this, the city's resilience to heavy rainfall and droughts is strengthened. Additionally, the heat-island effect can be reduced and the ecological environment and biodiversity improved.

Leuven has set tangible goals for creating green and permeable surfaces. In 2019, Leuven measured 315 hectares of green public spaces (Omgevingsanalyse Leuven in Cijfers, 2018). The city has committed to adding 30 hectares of green spaces by 2025. By 2030 350 hectares of green spaces will cover Leuven's surface (Climate Action Plan – City of Leuven 2020-2025, p. 103). Until 2050, there should be no additional paving in Leuven. The city's initiative to reduce paved areas and increase green spaces is in line with Flanders's goal to reduce paved areas by 20% until 2050 (Climate Action Plan – City of Leuven 2020-2025, p. 108). Starting in 2025 (15 years ahead of Flanders), Leuven will put a stop to the development of vacant spaces (i.e., undeveloped areas in urbanized areas) unless such development is offset by vacating spaces elsewhere (Leuven 2030).

Creating green spaces, the city of Leuven pays special attention to the uneven distribution of climate risks as they touch the most vulnerable groups of society. Extreme heat is dangerous for elderly people. Heat-island effects and floods are more likely in heavily paved areas, which can be often found in socially weak neighborhoods. Creating green spaces for these vulnerable groups provides cool spaces with good air quality and, hence, increases livability. At the same time, these nature-based solutions absorb rainwater and reduce the risks of floods.

"Leuven will expand green spaces and enhance biodiversity in the built environment. Starting from 2025, Leuven will put a stop to the development of vacant spaces." – Leuven 2030

Box 2. Good practices for directionality

Good practices for directionality

- Setting tangible long-term goals for creating green and permeable surfaces (e.g., adding 30 hectares of green spaces by 2025; reduce paved areas by 20% by 2050).
- Placing emphasis on social justice in goal definition in response to uneven distribution of climate risks (e.g., focus on elderly people and socially weak neighborhoods). Embedding stronger emphasis on just transformation through Transformative Innovation will help to secure high-level political endorsement.

2.2 Articulating instrument portfolios and defining synergies between funding sources

Box 3. Instrument portfolios and funding synergies in Leuven

Leuven is using municipal, regional, and European funding to finance CCA projects. Part of the funding provided by the local government is not exclusively dedicated to CCA (e.g., funding for reconstruction). However, running and future projects that can integrate CCA aspects are required to do so (e.g., road construction projects need to consider the goal of permeable surfaces). European funding is mainly used to develop and implement nature-based solutions. The city established regulation and soft support in synergy with the funded projects. Installed nature-based solutions act as a ‘living library’. Citizens who want to install solutions from the ‘living library’ on their private land are supported with subsidies.

The policy portfolio shows elements of transformative innovation, such as pilots and living labs. It incorporates collaborative and cross-border initiatives, such as the LIFE Participation Hub where practices and experiences with nature-based solutions are shared and related to those in Madrid.

Leuven aims at creating as much green and permeable surface as possible. For that, paved spaces (e.g., squares, parking lots, playgrounds) are greened and unsealed to expand green spaces in and outside of the city, on public and private land (Leuven 2030). Green roofs on buildings also contribute to green spaces. These efforts create horizontal green spaces to fight drought and depletion of water (1), flooding and erosion due to rainwater runoff (2), fight heat stress (4) and loss of ecosystem space and biodiversity (5) (numbers in parentheses refer to Leuven’s major climate changes risks). Leuven also commits to planting trees and outfitting buildings with green facades. These vertical green spaces further reduce heat stress (4) and fight the loss of ecosystem space and biodiversity (5). To reduce the risk of river floods, Leuven stopped new building around the river area to give space to the valley system.

Leuven aims at creating as much green and permeable surface as possible. The efforts of the city can be structured into (1) adding green spaces, (2) protecting and maintaining existing green spaces, (3) connecting green spaces and (4) softening the ground (e.g., replacing pavement with permeable materials).

The city pursues these efforts on public land. However, 80% of Leuven's sealed surfaces are on private property. Hence, the city needs to motivate citizens to install green spaces and unseal paved areas on private land to achieve its goals. The following efforts are being made to motivate citizens to include more greenery on private land.

Pilots and good examples finding their way from public to private land

Green and softened public spaces, including green roofs and facades and urban agriculture, act as examples. Citizens experience the positive effects of green spaces, such as lower temperatures, better air quality, and positive effects on mental health. Through the experience, citizens will understand the importance of green spaces. Further, citizens might consider implementing some solutions on private land to contribute to a greener neighborhood.

Green facades in public spaces together with information panels, not only let citizens experience the positive effects of green facades but also explain how green facades can be installed (e.g., which plants are suitable, how to attach the plants, etc.). Acting as examples in public spaces, green facades are more likely to be installed in private spaces.

Urban agricultural projects, such as [Geogarden KU Leuven](#) and [Gardening in the City](#), expose citizens to urban agriculture. This can motivate citizens to participate in such projects or to produce food on their private land. Like in the case of green facades, citizens can learn from these projects how to implement agricultural projects on their private land. Urban agriculture needs green space and hence, can help to keep green spaces or to remove pavement from private land.

In the past, citizens have shown reluctance to public places being greened and softened, as this sometimes includes removing parking spaces. Positive experience with green areas will make people less reluctant to future projects. The city has even experienced the opposite; citizens asking for more greenery in their neighborhood after visiting neighborhoods with a lot of green spaces.

Installing green and softening public spaces act as pilots and good examples on public land which can be transformed to private land and reduces citizens' reluctance towards such projects in the public space. Leuven refers to such completed projects as a 'living library'.

Regulation and soft support for greening private land

To support citizens in greening and softening their private land the city of Leuven has installed some regulation and support mechanisms. Spatial planning allows citizens to have a maximum of one parking lot in their front yard. Removed pavement from private land is picked up and disposed for free. Furthermore, the city provides subsidies for greening and softening private land. Regulation, soft support and subsidies work in synergy with the city's efforts in greening and softening the city.

Domestic funding

As greening the city is a major goal, the reconstruction of streets and squares or the management of parks and green areas causes high expenditure. Over the entire legislature, the city of Leuven will invest more than 25 million Euro in reconstruction, with a great deal of emphasis on climate adaptation. More than 6 million Euro will be allocated to the management of the existing green areas. The city provides 4 million Euro specifically for small green development projects in the city and for the softening and greening of the public domain or for the implementation of projects from the

rainwater plan (Climate Action Plan – City of Leuven 2020-2025, p. 25). A separate funding of 400.000 Euro per year is provided for Leuven 2030.

Implementing green areas in some cases leads to the reduction of parking spaces. Hence, it is necessary to provide funding for mobility projects to provide citizens with alternatives to cars. Therefore, mobility policy is also a major cost item, with support for public transport, the redesign of streets for safe and smooth traffic, but also with more than 3,5 million Euro for cycling infrastructure, bicycle parking or encouraging bicycle mobility (Climate Action Plan – City of Leuven 2020-2025, p. 25).

A separate budget is also reserved for the development of the food strategy. More than 400.000 Euro will be spent on food and urban agriculture projects (Climate Action Plan – City of Leuven 2020-2025, p. 25).

Besides city investment, there are regional investments in climate adaptation. The Flemish investment plan of the Flemish Climate Adaptation Plan was adopted in February 2023 providing 150 million Euro for 2023-2024.

European funding

The LIFE program is the EU's funding instrument for the environment and climate action with a total budget of 5,45 billion Euro (2021-2027). For CCA the LIFE program co-finances projects in the areas of urban adaptation and land-use planning, resilience of infrastructure, sustainable management of water in drought-prone areas, flood and coastal management, resilience of the agricultural, forestry and tourism sectors. The program supports the EU's outermost regions to prepare for extreme weather events, notably in coastal areas. The funding is also provided for action grants for best practice, pilot and demonstration projects that contribute to increasing resilience to climate change.

The city of Leuven has four running LIFE projects, where it applies nature-based solutions. Thereby, three housing projects for vulnerable groups (i.e., elderly people and children) are made climate-adaptive by greening and softening the space to increase biodiversity, decrease temperature and increase quality of life. For example, the city works with Zorg Leuven, a welfare association, to make the outdoor space of Ter Putkapelle (elderly care facility) climate adaptive by increasing biodiversity and thus also the quality of life of its residents. The city's approach is to involve residents and managers, work out nature-based solutions tailored specifically to older residents, and to provide expert support.

In another LIFE project, the neighborhood 'Spaanse Kroon' is targeted. According to the city's rainwater plan, the district's water management can be improved through softening and greening the surface. The aim of the project is to soften and green the streets and pedestrian walks through an external contractor. Together with the citizens the driveways and gardens are also in the focus of greening and applying nature-based solutions for climate adaptation.

Part of the LIFE program is the LIFE Participation Hub which supports strategic learning and capability building in the LIFE program. The LIFE Participation Hub has two levels. Locally, it supports neighborhood-scale projects - for example assisting with participatory design activities in pilot sites. Globally, the LIFE Participation Hub connects people, places and processes. The aim is to foster cross-border, interdisciplinary collaboration and innovation in democratic practice, in service of project cities and their communities. With the LIFE program and the LIFE Participation Hub, Leuven has published a document with Practices for nature-based solutions.

Under the European Union's Horizon 2020 Research and Innovation Programme, JUSTNature has received funding. JUSTNature supports the city of Leuven among six other cities with a socially just approach to climate adaptation in the dense city center. In the focus are the sites Constantin Meunierstreet, a residential street and Leuven Central, a detention facility with a surface of about 4 ha. Both sites are dominated by concrete and asphalt and are located within the densely built city center. With the support of JUSTNature, the grey and paved areas will be transformed into climate-adaptive areas. Thereby, the urban heat island effect through the science-based implementation of greenery and capture of rainwater. The project follows a multi-stakeholder design process, including citizens' engagement of vulnerable social groups. Greening the street 'Constantin Meunierstreet' additionally serves the goal of improving the green-blue infrastructure, as the street continues the green link to nearby Ruelens park.

Box 4. Good practices for instrument portfolios and funding synergies

Good practices for articulating instrument portfolios and defining synergies between funding sources

- Incorporating instruments of different natures acting in synergy and maximizing co-benefits (e.g., set goals are supported by regulation; the regulation is supported by subsidies).
- Supporting the move from small, localized pilot experiments in CCA solutions towards mainstreaming CCA in many programs and instruments and supporting large-scale deployment of systemic solutions (e.g., installing green and softening public spaces act as pilots and good examples on public land which can be transformed to private land and reduces citizens' reluctance towards such projects in the public space).

2.3 Ensuring cross-domain synergies

Box 5. Cross-domain synergies in Leuven

The Climate Adaption Plan for Leuven (Climate Action Plan – City of Leuven 2020-2025) favours whole-of-government approaches by breaking silos. Several departments work together on strategic Climate Change Adaption goals, ensuring important topics are integrated into various projects and act in synergy (e.g., the green management department installing more greenery coordinated with the mobility department to ensure that lost parking spaces are compensated by alternative mobility solutions). To ensure acceptance in society, the communication department informs citizens about the necessity of projects and their positive impacts on the citizens.

Leuven's strategy towards climate resilience receives support from the major and impacts the work of several departments. All departments are asked to follow the strategy in their planning and execution of projects. However, that does not mean that there is no allocation of responsibility to achieve the set goals. In Leuven 2030, each project on CCA is owned by a department. Additionally, several departments support the efforts of the owner.

For example, the goal of softening the city is owned by Katleen Remeysen from the Road and Water Management Study Service and is supported by the Department of Spatial Planning and Immovable Heritage, the Sustainability Department, and the Green Management Department. Greening the city is owned by Wim Verheyden from the Green Management Department and is supported by the Department of Spatial Planning and Immovable Heritage and the Sustainability Department among

others (Climate Action Plan – City of Leuven 2020-2025). The examples show that Leuven established a project-based cross-department cooperation to unbreak silos.

The Green Management Department works closely with the Mobility Department. In some cases, parking places need to be removed to create new green spaces. The reduction of parking spaces is closely coordinated with public transportation services. When citizens can no longer park their vehicles in the city center, there need to be other ways to get into the city (e.g., park-and-ride services). By coordinating the reduction of parking space in favor of green spaces and public transportation, the reluctance towards the reduction of parking spaces can be lowered. Communicating and explaining these developments can further increase the acceptance in the public.

Box 6. Good practices in cross-domain synergies

Good practices for ensuring cross-domain synergies

- Establishing a project-based cross-department cooperation to unbreak silos at strategic level (e.g., all city departments are asked to follow the CCA strategy in their planning and execution of projects).
- Using good communication of implementation of CCA strategies to increase acceptance.

2.4 Increasing breadth and depth of stakeholder involvement

Box 7. Stakeholder involvement in Leuven

Stakeholder involvement is in place to achieve social acceptance and improve public trust. Vulnerable groups are involved in the planning stage of projects to ensure socially just CCA that fits their needs. Citizens are part of the implementation of the strategy (e.g., installing solutions for CCA from the 'living library' on private land). Furthermore, citizens are engaged in the preparation of strategic decisions by collecting and providing data relevant for CCA (e.g., data on green spaces and groundwater levels), which results in stronger justifications of CCA and should help overcome resistance towards future interventions. Aside from citizens, the University KU Leuven is involved in finding solutions for CCA. Transformative CCA will require larger funding sources including private funding. Strong business involvement is not in the focus of CCA actions yet.

To achieve climate resilience the city of Leuven puts a strong emphasis on stakeholder involvement. The city follows the LIFE PACT approach, while PACT stands for People-driven Adapting Cities for Tomorrow. The following objectives are at the core of the LIFE PACT projects.

Citizen engagement

Nature-based solutions (greening and softening the city) for climate resilience can conflict with other needs (e.g., parking spaces). The city uses co-creation and crowdsourcing for nature-based solutions to increase acceptance among and value for the citizens. To find suitable spaces to be greened, Leuven has launched a crowdsourcing campaign. Citizens could send in ideas for spaces to install green and what to do. About 140 ideas were sent in, of which 8 were put in place.

Besides providing good examples and pilots ('living library') of nature-based solutions for climate resilience in public spaces, the city of Leuven provides a selection of solutions that can be used on private land. Additionally, the city provides information on subsidies for these solutions. Furthermore, Leuven informs its citizens about the benefits of installing nature-based solutions for the city's climate resilience and for the citizens' quality of life.

Combined these efforts increase acceptance towards climate adaptation solutions in public space, although these might contradict with other needs, and increase citizen engagement on their private land.

Multi-stakeholder collaboration

Beyond citizens, the city of Leuven recognizes the importance of non-city stakeholders (i.e., hospitals, care centers, schools, universities, and companies). Activating non-city stakeholders is crucial since the majority of the city's sealed surfaces are on private property. For example, together with Zorg Leuven, a welfare association, the city of Leuven is working closely with the residents of an elderly home to develop an outdoor space that is climate-adaptive, provides space for biodiversity and serves the residents as a recreational space, even during hot summer days.

Furthermore, the city is working with the university KU Leuven to find nature-based solutions for climate adaptation. The city calls for theses on tangible climate adaptation solutions tailored to the city. Thereby, the city works closely together with the students and provides information and support where needed.

Data collection and monitoring

Like many cities, Leuven lacks a clear picture of its green spaces. This is particularly due to a lack of data on private land. Without such data, it is difficult to design or plan for effective interventions and to monitor the progress of implementing more green spaces.

The city of Leuven is working on developing a tool to track the city's green spaces, particularly on private land. The tool will make it possible for citizens and other stakeholders to enter implemented nature-based solutions on their private lands and track the progress. The use of data in designing and implementing nature-based solutions will be mainstreamed in city processes.

Beyond data collection on green spaces, non-city stakeholders can participate in Flanders' Internet of Water. The [Internet of Water Flanders](#) is a research and innovation project to digitally monitor water quality indicators across Flanders. Citizens can help to measure groundwater levels, by installing low-cost, smart, connected sensors on their private property and sharing that data with Flemish authorities.

The data collection provides a holistic picture of the green spaces in Leuven and water quality indicators across Flanders. This allows for stronger, evidence-based justification for necessary and bold CCA interventions (including regulation).

Box 8. Good practices in stakeholder involvement

Good practices for increasing breadth and depth of stakeholder involvement

- Using co-creation and crowdsourcing for nature-based solutions in public spaces to increase acceptance among and value for the citizens.
- Motivating citizen to install nature-based solutions on private land (e.g., through pilots on public land, information on benefits and subsidies).
- Seeking wider and inclusive societal transformation through involvement of vulnerable groups (e.g., involving residents of an elderly home to develop an outdoor space that is climate-adaptive, provides space for biodiversity and serves the residents as a recreational space).
- Collecting data to provide a holistic picture of the green spaces in Leuven and water quality indicators across Flanders. This allows for stronger, evidence-based justification for necessary and bold CCA interventions (including regulation).

2.5 Setting up effective multi-level governance models

Box 9. Multi-level governance in Leuven

The city of Leuven is planning and executing its CCA strategy in line with the regional, national, and European strategic and legal frameworks. In practice, CCA actions are implemented by local authorities, who propose projects directly to the regional, national, and European governance level. There are effective mechanisms in place for local authorities to exchange on climate adaptation topics with other local governments and with the regional government. Issues of local authorities (e.g., legal limitations, funding issues, etc.) are collected at the regional level and carried to the next governance level if necessary.

The city of Leuven is planning and executing its CCA strategy in line with the regional, national, and European strategic and legal frameworks. To align the city's strategy with European efforts, the city has signed the EU Mission to 'Adaption to Climate Change' and the Covenant of Mayors (see section Goals and Scope Definition). Additionally, the city has been chosen as one of the 100 Climate-Neutral and Smart Cities by 2030.

The Flemish government committed to support local authorities in their attempts toward climate resilience. Therefore, the Flemish government has signed the '[Local Energy and Climate Pact](#)', which translates European climate ambitions into tangible targets. With the signatory the Flemish government promises to provide financial support, and knowledge transfer via the VVSG² and to facilitate the local realization of the climate ambition.

² The VVSG is the umbrella organization of local governments in Flanders.

The limited range of responsibilities and corresponding powers of local city authorities are in some cases barriers to ambitious local CCA strategies. For these cases, the Flemish government together with local authorities have installed mechanisms. The Flemish government and local authorities, among them representatives of the city of Leuven, have regular meetings on climate change topics, including climate change mitigation and adaptations. In these meetings, local governments give feedback to the Flemish government. Such feedback can include, that regulation at the regional level needs to be adjusted in order to empower local authorities to achieve the goals set by the European authorities (e.g., when regional regulation is not strong enough to enforce actions for CCA). These meetings are also used by local authorities to exchange good practices and how to overcome barriers.

As a local authority, the city of Leuven sees itself in the role of applying for funds to finance projects for CCA. The city has no structured process for the screening of funds at the national, regional, or European level. Hence, it is rather by chance that local authorities discover funds that fit with their CCA strategy. The regional government could support local government in funding opportunities for CCA.

Box 10. Good practices in multi-level governance

Good practices for setting up effective multi-level governance models

- The city of Leuven is planning and executing its CCA strategy in line with the regional, national, and European strategic and legal frameworks.
- Installing mechanisms to address barriers of local authorities that result from the limited range of responsibilities and corresponding powers of those local authorities (e.g., regular meetings of local authorities and the Flemish government).

2.6 Making room for experimentation

Box 11. Experimentation in Leuven

There is limited experimentation on innovative CCA solutions in Leuven. There are some A-B-tests at the local level where different solutions are compared against each other. The city names limited capacities as a reason for limited experimentation. Furthermore, public funds want to be spent well and not be 'wasted'. As the public might judge experiments ending in a failure as a waste of public money.

Experimentation does not play a big role in the climate adaptation strategy of Leuven. The acceptance of failure by public authorities is low in society and is considered a waste of public money. Furthermore, authorities disposing of funds are known not to appreciate risks in project drafts submitted as applications for funding money. Hence, the funded projects usually do not leave room for experimentation or failure.

„I do not see any examples from the past where we could not approve the project.“ – Representative of the Flemish government

On a small scale, the city of Leuven is allowing some experimentation as the following examples show. On a cemetery, different plants are tested to identify those resilient to the effects of climate change and low in maintenance. The city has screened the market for water-permeable surfaces (i.e., permeable asphalt, concrete, and pavement). To test those different solutions, the city has equipped its own parking spaces with the available permeable surfaces.

Box 12. Good practices in experimentation

Good practices for making room for experimentation

- Testing different plants and greenery to identify those that are resilient to the effects of climate change and low in maintenance.
- Testing different water-permeable surfaces (i.e., permeable asphalt, concrete, and pavement) on the city's parking spaces.

2.7 Securing high levels of policy intelligence, learning and strategic capacity

Box 13. Policy intelligence, learning and strategic capacity in Leuven

Leuven has a strong understanding and commitment towards CCA. In order to develop an evidence based CCA strategy and build a policy portfolio a strong knowledge base has been established. The knowledge base is further developed with the goal of creating a digital twin encompassing relevant data for CCA. By updating the knowledge base the impacts of CCA can be measured, which will enhance policy learning capabilities in the future. However, due to limited strategic capacities, the use of the knowledge base is limited. Local authorities do not have the capacity to use the knowledge base for daily and strategic decisions.

Interdisciplinary research is not the focus of CCA actions in Leuven. To manage transitions, as necessary companions to the transformative innovation approach, more interdisciplinary research is needed.

Establishing a knowledge base

The city of Leuven is translating global data on climate hazards and impacts into locally relevant knowledge. Therefore, the city has developed a geographical overview of risk-relevant measures for CCA. Climate actions are facilitated today by the Rainwater Plan, the Drought Plan, the Erosion Control Plan and in the near future also by the Green Plan. The Green Plan will form a link between the Leuven Spatial Structure Plan and the concrete projects and measures that should contribute to a greener city (Climate Action Plan – City of Leuven 2020-2025, p. 97). Within the project Leuven Cool the city of Leuven together with the university KU Leuven installed thermometers across the city to measure the temperature. The measures allow to establish of a Heat Plan and to identify areas with strong heat island effects. The overall aim is to create a digital twin of the CCA relevant measures.

The digital twin will help the city to prioritize its activities (e.g., identify areas with high potential for improvement, areas with highly vulnerable groups and systems, high-risk areas). Furthermore, the digital twin allows monitoring the progress of climate adaptation actions and their effectiveness towards the strategic goals. By evaluating the effectiveness, the city of Leuven can learn which activities work well and which need improvement. Additionally, the digital twin can be used to forecast climate hazards and in turn to prevent those.

Strategic capacity

The established knowledge base has been used by the city of Leuven to develop the Climate Adaptation Plan (Climate Action Plan – City of Leuven 2020-2025). The development of the Climate Adaptation Plan required strategic capacity. The city of Leuven shows learning capacities by constantly enlarging its knowledge base, i.e., working on a Heat Plan and a Green Plan.

Although, the development of a strong knowledge base and the Climate Adaptation Plan signals strong strategic capacities, operative local authorities report a lack of capacities to fully use the knowledge base to work towards the developed strategic goals. Local authorities are busy with operative tasks, like working on running climate adaptation projects. Although the team is highly motivated and wants to do more projects (e.g., visiting workshops on CCA) there are not enough capacities to do so. There are no capacities to systematically screen for funding opportunities, to apply for funding money and in case of successful application to work on the project and do all the reports that come with funded projects.

At the local level, the decisions for which projects to pursue are usually not strategically thought through and do not always consider the knowledge base in detail. Local authorities report to “jump on opportunities” and make decisions “based on feelings”.

Box 14. Good practices in policy intelligence, learning and strategic capacity

Good practices for securing high levels of policy intelligence, learning and strategic capacity

- Creating a digital twin of the CCA relevant measures to create a robust knowledge base to understand the baseline situation, and for anticipatory and orchestration capacities to co-create future pathways.
- Using established knowledge base to develop Climate Action Plan.

3 Possible ways forward

By becoming a signatory of the EU Mission on Climate Change Adaptation, Leuven has committed to building climate resilience in an inclusive way, engaging with local stakeholders, civil society, the business community, industry, research organizations, and citizens. Features from the transformative innovation approach can support the city in its efforts towards systemic changes that are needed for effective CCA. To achieve transformative CCA, there is a powerful role to be played by innovation for developing 'out-of-the box' transformative CCA solutions, tailored to territories' needs and opportunities.

As a signatory, Leuven can benefit from research and innovation funding opportunities to join large innovation actions, pilot projects and demonstrations (budget from Horizon Europe for 2023-2024: 138 million Euro). Leuven is making use of this funding (see section 2). However, the developed nature-based solutions are rather incremental and leave room for transformative approaches.

Below, the state-of-play for each of the seven key transformative innovation features of the analytical framework are linked to possible ways towards a transformative CCA approach for Leuven.

3.1 Directionality

Leuven has set tangible goals for CCA and communicated these in its Climate Adaptation Plan and in the roadmap Leuven 2030. Thereby societal challenges, such as the unequal distribution of climate risks, are considered and addressed. The strategic actions are supported by the local authorities and receive the highest political support at the city level. However, the strategic actions for CCA are not in the focus of local innovation hubs, such as Imec (an organization that strengthens the international position of the Leuven Innovation Region) and MindGate (a research center that supports companies and governments in sustainable innovation). These innovation hubs focus on solutions for climate mitigation.

Possible ways forward:

- Track the achievement of goals.
- Emphasize the need for innovative CCA approaches and coordinate with innovation hubs (e.g., Imec and MindGate).
- Maintain the sense of urgency for CCA. To overcome the long-term and uncertain perspective on CCA simulation and prediction instruments can help (e.g., calculate and communicate the deficit of green and permeable surfaces to absorb territorial rainfalls for different scenarios).
- Develop effective CCA strategies phase out unsustainable models and replace them by more resilient ones. For example, target competition of land use in the city (e.g., competition of green spaces and parking spaces) by replacing unsustainable models (e.g., use private cars for transportation and use of public space for parking) and replace them with more resilient ones (e.g., accessible public transport, strong limitation of public parking space).

- Integrate transformative and society-focused objectives for CCA into relevant strategic documents under preparation and emphasise the need for more systemic and innovative CCA solutions.

3.2 Articulating instrument portfolios and defining synergies between funding sources

Leuven is using municipal, regional, and European funding to finance CCA projects. Part of the funding provided by the local government is not exclusively dedicated to CCA (e.g., funding for reconstruction). However, running and future projects that can integrate CCA aspects are required to do so (e.g., road construction projects need to consider the goal of permeable surfaces). European funding is mainly used to develop and implement nature-based solutions. The city established regulation and soft support in synergy with the funded projects. Installed nature-based solutions act as a 'living library'. Citizens who want to install solutions from the 'living library' on their private land are supported with subsidies.

The policy portfolio shows elements of transformative innovation, such as pilots and living labs. It incorporates collaborative and cross-border initiatives, such as the LIFE Participation Hub where practices and experiences with nature-based solutions are shared and related to those in Madrid.

Possible ways forward:

- Expand the policy portfolio for CCA by European funds for innovation.
- Establish structures to systematically investigate synergies of existing and potential portfolio instruments.
- Ensure private sector presence to allow new market creation, through the use of public procurement.

3.3 Ensuring cross domain synergies

The Climate Adaption Plan for Leuven (Climate Action Plan – City of Leuven 2020-2025) favors whole-of-government approaches by breaking silos. Several departments work together on strategic Climate Change Adaption goals, ensuring important topics are integrated into various projects and act in synergy (e.g., the green management department installing more greenery coordinated with the mobility department to ensure that lost parking spaces are compensated by alternative mobility solutions). To ensure acceptance in society, the communication department informs citizens about the necessity of projects and their positive impacts on the citizens.

Possible ways forward:

- Foster interdisciplinarity research and integrate the results into CCA projects to contribute further to cross-domain synergies.
- Exploit the potential of 'climate adaptation economy' to bring in business-oriented innovation instruments in the portfolio.
- Investigate if there are any silos at the strategic level.

3.4 Increasing breadth and depth of stakeholder involvement

Stakeholder involvement is in place to achieve social acceptance and improve public trust. Vulnerable groups are involved in the planning stage of projects to ensure socially just CCA that fits their needs. Citizens are part of the implementation of the strategy (e.g., installing solutions for CCA from the 'living library' on private land). Furthermore, citizens are engaged in the preparation of strategic decisions by collecting and providing data relevant for CCA (e.g., data on green spaces and groundwater levels), which results in stronger justifications of CCA and should help overcome resistance towards future interventions. Aside from citizens, the University KU Leuven is involved in finding solutions for CCA. Transformative CCA will require larger funding sources including private funding. Strong business involvement is not in the focus of CCA actions yet.

Possible ways forward:

- Establish mechanisms (awareness, incentives) to ensure strong business involvement and foster a 'climate adaptation economy'.
- Include citizens at the strategic level, e.g., through workshops where different resilience levels are discussed under different goals that are set.
- Provide room for stakeholder exchange, e.g., bring citizens, businesses, and research together to work on solutions for CCA to mobilize local environmental knowledge and understand socio-cultural factors.

3.5 Setting up effective multi-level governance models

The city of Leuven is planning and executing its CCA strategy in line with the regional, national, and European strategic and legal frameworks. In practice, CCA actions are implemented by local authorities, who propose projects directly to the regional, national, and European governance level. There are effective mechanisms in place for local authorities to exchange on climate adaptation topics

with other local governments and with the regional government. Issues of local authorities (e.g., legal limitations, funding issues, etc.) are collected at the regional level and carried to the next governance level if necessary.

Possible ways forward:

- Recognize the limited range of responsibilities and corresponding powers of local authorities as a barrier to transformative CCA strategies. Support and empower local authorities to overcome these barriers.
- Seek opportunities for regional synergies in CCA initiatives.
- Consider trade-offs between the institutionalization of multi-level governance systems and their flexibility in the context of 'system change' implicit in transformative innovation approaches.

3.6 Making room for experimentation

There is limited experimentation on innovative CCA solutions in Leuven. There are some A-B-tests at the local level where different solutions are compared against each other. The city names limited capacities as a reason for limited experimentation. Furthermore, public funds want to be spent well and not be 'wasted'. As the public might judge experiments ending in a failure as a waste of public money.

Possible ways forward:

- Enhance the tolerance for failure (e.g., by providing failure-tolerant funding).
- Reinforce regulatory sandbox initiatives relevant to innovative CCA.
- Enhance local capacities for CCA, so that local authorities can create room for experimentation.

3.7 Securing high levels of policy intelligence, learning and strategic capacity

Leuven has a strong understanding and commitment towards CCA. In order to develop an evidence based CCA strategy and build a policy portfolio a strong knowledge base has been established. The knowledge base is further developed with the goal of creating a digital twin encompassing relevant data for CCA. By updating the knowledge base the impacts of CCA can be measured, which will enhance policy learning capabilities in the future. However, due to limited strategic capacities, the use of the knowledge base is limited. Local authorities do not have the capacity to use the knowledge base for daily and strategic decisions.

Interdisciplinary research is not the focus of CCA actions in Leuven. To manage transitions, as necessary companions to the transformative innovation approach, more interdisciplinary research is needed.

Possible ways forward:

- Foster interdisciplinary research to build up transition skills. Social and behavioural sciences would need to complement knowledge produced by climate scientists and the solutions developed by engineers.
- Support the strategic capacities of local authorities by providing tailored information on funding opportunities.
- Enhance strategic capacities by freeing capacities in other areas (e.g., funding application and reporting).
- Support local authorities' capacities for long-term planning under uncertainty as it is a key enabler for transformative innovation.

4 Conclusions

The city of Leuven has high ambitions regarding addressing climate impacts and has set tangible goals for climate adaptation in its strategic planning. This strong leadership on addressing climate adaptation is a good precondition to further advance towards a genuine transformative innovation approach towards climate resilience. Connecting better current innovation activities to climate adaptation, diversifying funds and policies supporting resilience, engaging business more actively, making more room for experimentation, and further supporting the strategic capacities of local authorities can be useful pathways to do so.

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List of abbreviations and definitions

CCA	Climate Change Adaptation
DG CLIMA	Directorate-General for Climate Action
DG RTD	Directorate-General for Research and Innovation
EIA	Environmental Impact Assessment
GHC	Green House Gas
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Center
KIA	Knowledge and Innovation Agendas
MMIP	Multi-year Mission-driven Innovation Programmes
NAP	National Adaptation Plan
NAS	National Climate Adaptation Strategy
NOVI	National Strategy on Spatial Planning and the Environment
NPLG	National Rural Area Programme
NRRP	National Recovery and Resilience Plan
PPS	Purchasing power standard
R&D	Research and development
R&I	Research and innovation
TCR	Transboundary climate risks
TI	Transformative Innovation
TTO	Technology Transfer Office
VVSG	Umbrella organization of local governments in Flanders

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Annexes

Annex 1. List of interviewees

Organisation	Name & surname	Function/responsibilities
City of Leuven, Public Works Department	Remeysen, Kathleen	Head of Public Works Department
Flanders, Department of Environment	Verstraten, Griet	Policy Advisor on Climate Change Adaptation
VLAIO	Van de Loock, Leo	Agency for Innovation & Entrepreneurship
City of Leuven, Department of Sustainability	Vanhorebroek, Geert	Sustainability Advisor
City of Leuven	Dessers, David	"Aldermen" (Member) in the board of mayor and member of the municipal council; Member of the council for social welfare; Member in permanent office; Effective member in General United Committees

Annex 2. List of case studies

Case studies have been carried out to analyse to what extent and how enabling factors towards 'Transformative Climate Change Adaptation' strategies, as identified in the conceptual report (European Commission, 2024), are at play in reality, and what can be done to overcome barriers in various territorial contexts. The methodological framework described in the conceptual report essentially acts as a practical guide for undertaking cases studies on CCA strategies in different territories, in a uniform way. These case studies are listed below:

“Transformative innovation for better climate change adaptation” – Case studies

Country	Territory	URL (*)	DOI	JRC number
Belgium	Leuven	https://publications.jrc.ec.europa.eu/repository/handle/JRC137313	10.2760/58125	JRC137313
Finland	Espoo	https://publications.jrc.ec.europa.eu/repository/handle/JRC137316	10.2760/177322	JRC137316
Finland	Turku - Southwest Finland	https://publications.jrc.ec.europa.eu/repository/handle/JRC137315	10.2760/211155	JRC137315
France	Provence-Alpes-Côte d'Azur	https://publications.jrc.ec.europa.eu/repository/handle/JRC137314	10.2760/46893	JRC137314
Greece	Attica and North Aegean regions	https://publications.jrc.ec.europa.eu/repository/handle/JRC137322	10.2760/493562	JRC137322
Iceland		https://publications.jrc.ec.europa.eu/repository/handle/JRC137291	10.2760/305796	JRC137291
Italia	Emilia-Romagna	https://publications.jrc.ec.europa.eu/repository/handle/JRC137319	10.2760/790200	JRC137319
Netherlands	Northern Netherlands	https://publications.jrc.ec.europa.eu/repository/handle/JRC137312	10.2760/10862	JRC137312
Poland	Mazovia - Stare Babice	https://publications.jrc.ec.europa.eu/repository/handle/JRC137323	10.2760/58125	JRC137323
Portugal	Norte	https://publications.jrc.ec.europa.eu/repository/handle/JRC137321	10.2760/399394	JRC137321
Romania	Nord Vest - Cluj	https://publications.jrc.ec.europa.eu/repository/handle/JRC137317	10.2760/923916	JRC137317
Slovenia	Gorenjska	https://publications.jrc.ec.europa.eu/repository/handle/JRC137320	10.2760/502482	JRC137320
Spain	Andalucia - Granada	https://publications.jrc.ec.europa.eu/repository/handle/JRC137324	10.2760/104672	JRC137324.
Sweden	Blekinge and Värmland	https://publications.jrc.ec.europa.eu/repository/handle/JRC137318	10.2760/249067	JRC137318

(*) Links may give error message for those studies still under publication

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All over the European Union there are hundreds of Europe Direct centres. You can find the address of the centre nearest you online (european-union.europa.eu/contact-eu/meet-us_en).

On the phone or in writing

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
- at the following standard number: +32 22999696,
- via the following form: european-union.europa.eu/contact-eu/write-us_en.

Finding information about the EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website (european-union.europa.eu).

EU publications

You can view or order EU publications at op.europa.eu/en/publications. Multiple copies of free publications can be obtained by contacting Europe Direct or your local documentation centre (european-union.europa.eu/contact-eu/meet-us_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex (eur-lex.europa.eu).

EU open data

The portal data.europa.eu provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for free, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets from European countries.

Science for policy

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