Toolkit on Spatial Planning: sustainable practices in adapting to climate change and energy efficiency

DELIVERABLE

PROJECT ACRONYM: 2ISECAP

PROJECT START DATE: 01.09.2021

DURATION: 36 months

DATE OF ISSUE OF THIS REPORT: June 2024 **VERSION No:** 2

"THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME EURATOM RESEARCH AND TRAINING PROGRAMME H2020-LC-SC3-2018-2019-2020 UNDER GRANT AGREEMENT NO 101033752 - 2ISECAP."

Document Control Sheet	
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Subject / Title of Document:	Toolkit on Spatial Planning
Related Task('s):	T 3.1
Deliverable No.	D 3.3
Date of Issue	June 2024
Version Number:	2
Ref./File Name	D3.1_Toolkit_v2
Number of Pages	45
Distribution Category: (PU/CO)*	PU
Nature of the Deliverable**	Deliverable (D)
Target Date	

*Type: **PU**: Public, **CO**: Confidential

**Nature: Type of deliverable could be a F: Flyer, B: Brochure, WP: working paper, P: Paper, D: Deliverable, MD: Management Document, S: Slides, PR: Press Release, CD: Cd-rom, C: conference, W: workshop, TR: training, ME: Media Event, WW: website/webtool

Content

As a Preamble. Energy and Spatial Planning.

I.

To establish a relationship between SECAP, as an effective urban planning tool, and the improvement of cities, would be necessary to detect in some way its mutual influence with spatial planning.

We are looking for a place oriented (space oriented) SECAP… But, With what references? Car we are not aware of any relevant reflection connecting -deeply- energy and spatial planning.

It is true that, in the origins of urban sustainability discussion, we have "Sustainability and Cities: Overcoming Automobile Dependence" of Peter Newman & Jeffrey Kenworthy (1999, Island Press), relating the city model with the automobile dependence, in terms or urban expansion and oil consumption, where land use is deeper conditioned by how cities manage transportation. The conclusion was that urban sustainability needs a new agenda related with urban mobility model… However, in the wide subsequent development of ideas about urban sustainability, energy has hardly been a factor considered in the design of urban space.

SECAP uses to work different sectors (fields affected by energy generation and consumption) as residential and public buildings, industry, mobility, logistics, supply of water or food, etc… The problem is both doing it in a coordinated manner and verifying how it affects land use, affecting the shape of the city and its functions and activities.

Perhaps we are standing from a prejudice: for changing cities we need to overcome the sectoral vision… and also action models. How to go beyond the purely accumulation of sectoral interventions?

Already The Leipzig Charter on Sustainable European Cities (EU, 2007) recommended a "greater use of integrated urban development policy approaches", while insisting in energy efficiency and on paying more attention to deprived neighbourhoods. In 2020, The New Leipzig Charter, with the subtitle of "the transformative power of cities for the common good", insisted on the relevance of spatial planning in its target "to establish integrated and sustainable urban development strategies and ensure their implementation for the city as a whole, from its functional areas to its neighbourhoods". However, the integrated approach seems far away in urban practice.

Why?

Space is a very abstract concept, it means land, territory, place and region, but also landscape and built environment, ecosystem, open spaces or countryside… Who plans the space? Actually, it is social life (in a broad sense) who shapes the urban space... and does it historically.

Where is it our confidence to move forward? Usually we work in two ways:

- By learning, in the replication of other experiences understood as good practices,
- By design, with singular solutions, more or less talented, for singular situations,

Doing and thinking at the same time, for an integrated approach we need foundations in knowledge, collaboration and social + economic support.

We cannot be always living in the beginnings, in “pilot projects”, we need to move from research to action

II.

Before any hasty judgment, we need calm, ongoing and open reflection (or debate). However, this debate largely began some time ago.

The Austrian thinker Ivan Illich wrote in 1974 “Energy and Equity” (Harper & Row) in the context of petrol crisis, when it was published “The Limits to Growth” report (1972, Meadows, D H; Meadows, DL; Randers, J; Behrens III, W, 1972. “The Limits to Growth; A Report for the Club of Rome's Project on the Predicament of Mankind” New York: Universe Books). Illich asserted that more energy gives negative returns for people and urban life. Pioneer of the idea of circular economy, in those years Barry Commoner proposed the motto “enough is best” (1971, “The Closing Circle. Nature, Man, and Technology”), at the same time that Ernst F. Schumacher coined his "small Is beautiful" (“Small Is Beautiful: A Study of Economics As If People Mattered”, 1973). Alongside the complaint of the abuse of natural resources, a more humane model of society is proposed, attentive to people and their quality of life. Man's habitat -shape and energy models in cities and countryside- will soon emerge as a determining factor. Little by little the idea of degrowth emerges. Now, radical environmentalism promotes that idea, referred to Climate Change and, with a boost of the official ideology of decarbonization, trying to convince people of the need for a radical change in lifestyles and in the consumption logics.

Vaclav Smil, in “Energy and Civilization: A History” (2017, The MIT Press) explained how energy has shaped society throughout history. Despite recent energy policies, today, the effective demand for fossil fuels does not decrease: “…the global share of energy produced from fossil fuels since 2000 has increased”, in fact, “…coal, oil, and natural gas still represent the 90% of primary energy (in 2016)”, even when the renewable energy, with its diverse technologies, has had a great improvement over time. Smil insists in the irreplaceable use of fossil energies in the basic industrial production (ammonia, cement, iron, and plastics), with around the 15% of total consumption. It would be important, according to Smil, to reflect the real costs in energy prices, including their emissions. Today, the context is not always stable, depending on the different perspectives that occur in disparate geopolitical frameworks.

It is worth remembering that cities were not at the centre of the Brundtland report. In the 300 pages of this 1987 document, the idea of Climate Change only appeared 10 times. But its drafting had been influenced by very relevant scientists. We highlight the economist Hermann E. Daly, promoter of the idea of “Steady State"; the mathematician Nicholas Georgescu-Roegen, who had introduced the idea of entropy into the reflection on economic development; or the chemist Ilya Prigogine who highlighted disorder and instability as key factors of the dynamic systems of biology, its condition of uncertainty… All of them emphasized the energy factor as a determinant of productive development models.

III.

The goal must be an evolution toward a "regenerative planning" for transforming the existing cities, not only experimental or sectoral retrofitting.

In a pioneering text on urban and territorial ecology, Ian McHarg (1969, "Design with Nature") asked the main question of man role in spatial planning action, responding with another question related with energy (entropy): How can men be negentropic agents? The idea of negentropy had been proposed in Schrödinger's "What Is Life?", a short essay on the physical foundations of the biological world (1944). The possibility of negative entropy transcends the paradox of science, and for McHarg it means a transference toward the capacity of human beings to manage their environment responsibly, toward their collective intelligence that creates order or balance, against the service of simple exploitation.

Much progress has been made in science and technology (see Ewing, Brad, et al., 2008, "Ecological Footprint Atlas", Oakland: Global Footprint Network), but governance is still needed, a governance capable of addressing interactions, moving from a sustainability focused on what and why, to an ecological imagination capable of focusing on where and on how: it is not enough to do one thing well, everything must be done.

Since the sustainable city began to be thought of as an ecosystem, it was thought of as follows: "The urban environment and spatial resources must be designed from an integrated treatment framework, to serve according to their capacities, as producers of food and energy, climate moderators, conservators of water resources, plants and animals, environment and leisure" (Gianni Vernetti, 1990, "La città come ecosistema territoriale").

In the way for building resilience, the answer could be a toolkit of experiences, issues and approaches…

Introduction

This toolkit aims to **guide local governments and urban planners** in developing plans that address both climate adaptation and energy efficiency. It provides methods to incorporate sustainable practices into urban growth, focusing on areas like energy use, transportation, and green infrastructure. By **aligning urban planning with climate goals**, cities can reduce emissions, improve air quality, and **build resilience** against climate impacts.

Climate change is one of the most important issues of our time. Rising global temperatures, largely the result of human activity, are likely to have severe - and potentially catastrophic - effects on both the Earth's natural systems and human society (IPCC, 2021). Rising sea levels and dramatic changes in weather patterns, which are expected as a result of sustained global warming, could accelerate the disruption of economic systems, the dislocation of coastal communities and port facilities, shortages of food and water supplies, increased disease, additional health and safety risks from natural hazards, and large-scale population migration. Secondary effects may include the possibility of civil unrest and war.

In the coming decades, unprecedented human intervention will be needed to reduce the extent of climate change and avoid its worst potential consequences (known as mitigation), or to make changes to accommodate those effects that are unavoidable (adaptation). To date, much of the

policy debate on mitigation has focused on reducing greenhouse gas (GHG) emissions through fuel substitution and energy efficiency in buildings and industry.

There are many ways to break down the municipal energy sector planning exercise into individual steps. Good examples can be found in the Covenant of Mayors' guide 'How to Develop a Sustainable Energy Action Plan' (EC 2010); the Energy System transformation Playbook developed for the Carbon Neutral Cities Alliance by Integral Group (CNCA 2016); or the JRC guide 'How to develop a Sustainable Energy and Climate Action Plan (SECAP)' (Bertoldi et al. 2018).

Urban and energy planning can contribute to the identification of solutions when dealing with complex decisions involving competing objectives (e.g. investment, location, management, strategy, etc.), which is the typical context of urban planning activities. (UN-Habitat, 2020) Multi-criteria decision analysis methods allow for a better understanding of the intrinsic characteristics of the problem, encourage direct participation in the decision-making process and facilitate engagement and collective decision-making, thus contributing to improve the quality of final decisions by making them more transparent, rational, acceptable and complete.

This includes the available local potential for energy production from wind, solar, geothermal, biomass and hydropower, as well as the energy infrastructure, the possibilities for importing natural gas or other fossil fuels, the potential of municipal and industrial waste as a resource, and the potential for energy efficiency in various municipal sectors. There is a lot of publicly available information on local resources: for example, solar irradiation and wind speed are often known. The availability of geothermal energy and sustainable biomass is more difficult to assess. In the case of biomass, some public sources can be used, such as the CORINE land cover database of the European Environment Agency, or other public land use cadastres.

Data availability and data quality are essential for energy modelling. Data requirements often depend on the modelling tool (IEA,2019). In general, data on energy demand projections, available resources, demographic and economic trends, current and future energy policies and measures, and learning curves are needed.

Irrespective of the chosen approach, the initial phase in urban energy planning should entail assessing the present energy consumption levels, evaluating the existing infrastructure, and appraising the energy provision, effectively establishing an energy equilibrium. This equilibrium functions as a structured accounting framework for the gathering and harmonization of data regarding all energy products coming in, going out, and being utilized within the jurisdiction of a specific local authority over a defined reference span. It is imperative that this balance sheet accurately reflects all energy forms using a standardized accounting measure and illustrates the correlation between the inputs and outputs of energy conversion processes (UN 2016). Information on energy consumption and emissions of greenhouse gases should be organized by sector and energy origin. Primary sectors necessitating energy consumption computations comprise residential and commercial domains, industry, transportation, and the public sector, encompassing potential inclusions such as public edifices, street lighting, public transportation fleets, and waste management systems, including wastewater.

Adhering to best practices involves gathering data on energy consumption over a span of at least one year, allowing for the identification of consumption trends across various sectors and consumer types. On the production front, it is advised to amass information pertaining to local electricity, heating, and cooling generation, as well as data on energy pricing and imports, each

with their unique supply patterns. Present figures for energy demand serve as the foundation for modelling future energy needs, marking the initial stride towards comprehending the pivotal parameters of forthcoming energy systems. Potential sources of data encompass national and regional statistical bureaus, energy providers, regulatory bodies, industry analyses, energy research, and reports from renewable energy agencies or associations, alongside municipal waste management and public transportation records, energy audit evaluations, biomass producers, surveys, and other outlets. Certain data may already be integrated into the model, such as technical specifications, costs, and emission metrics for various energy technologies.

This document provides a set of tools to improve the performance of cities in adapting to climate change and improving energy efficiency in five areas: planning, mobility, built environment, land use, networks and structures, and governance (UN-Habitat, 2020). This represents critical aspects of urban systems that directly impact a city's resilience to climate change and energy efficiency. Each area offers strategic leverage points:

- Planning is essential for embedding climate adaptation and mitigation goals across all city functions and ensuring coherent policy alignment (EC, 2020).
- Mobility addresses the need to reduce emissions from transportation, one of the largest urban sources of greenhouse gases, by promoting sustainable and low-carbon alternatives (Rode & others 2018).
- Built environment targets buildings, which are significant energy consumers, and focuses on improving energy efficiency, retrofitting, and resilience to extreme weather events (OECD, 2021).
- Land use is crucial in managing urban density, green spaces, and water management, which are essential for heat reduction, stormwater management, and carbon sequestration (Angel & others 2020).
- Networks and structures include energy, water, and communication networks that are fundamental to maintaining city services during climate events and ensuring efficient energy use (IRENA, 2021)
- Governance ensures that adaptation and efficiency initiatives are coordinated effectively, engaging stakeholders and aligning policies across sectors to maximize impact. Together, these areas allow cities to address climate challenges comprehensively, creating robust, integrated systems that promote sustainable urban living (ICLEI, 2022).

This toolkit is designed to guide urban planners and policymakers in implementing energy-efficient and climate-resilient strategies across planning, mobility, land use, built environment, networks, and governance. Each section provides targeted tools and case studies to support cities in their climate action plans, aligned with SECAP objectives.

The toolkit also emphasizes the importance of the relationship between national and local levels of governance in addressing climate change and energy efficiency. By aligning local strategies with national policies and frameworks, cities can leverage resources, share best practices, and enhance their adaptive capacity. This integration facilitates a more cohesive approach to climate action, ensuring that local initiatives are supported by national objectives, ultimately leading to greater resilience and sustainability in urban areas.

In summary, this toolkit serves as a vital resource for city planners, policymakers, and stakeholders, providing strategic leverage points across critical urban areas. By focusing on both national and local dynamics, it empowers cities to navigate the challenges of climate change while improving energy efficiency, thereby fostering sustainable urban development for the future.

Methodological Introduction

This toolkit was developed with the purpose of serving as a comprehensive guide to support local governments in sustainable urban planning and management, focusing on energy efficiency and climate adaptation. The development methodology is based on international frameworks and guidelines, which set out the principles and criteria for effective and sustainable urban intervention in a climate change context. The main sources include the Covenant of Mayors for Climate & Energy guidance, the methodological framework of the Joint Research Centre (JRC) of the European Commission, and the International Energy Agency (IEA) guidelines, which recommend approaches based on resilience, efficiency and emission reductions.

Selection of Topics

The topics selected for this toolkit - mobility, infrastructure, environment and governance - reflect the priority intervention areas in most of the globally recommended climate and energy action plans. The selection is based on a comparative analysis of the sectors identified as high impact in the European Green Deal and the Sustainable Development Goals (SDGs), in particular goals 11 (sustainable cities and communities) and 13 (climate action).

The most critical issues for urban sustainability were incorporated, based on reports such as the Global Status Report for Buildings and Construction of the United Nations Environment Programme (UNEP) and European case studies provided by the European Environment Agency (EEA). These reports highlight mobility and urban infrastructure as key elements for reducing energy consumption and greenhouse gas emissions in cities. Smart grid infrastructure, for example, represents an opportunity for the modernisation of energy supply, while improved urban mobility and the creation of low-emission zones respond to the need to reduce pollution and promote sustainable modes of transport.

Selection of Good Practice Examples

The selection of good practice examples in this toolkit aims to present successful and replicable models from different cities that have implemented sustainable interventions with verifiable results. For this selection, cases documented in databases such as the Covenant of Mayors Library of Practices, the Urban Nature Atlas platform and publications of organisations such as ICLEI - Local Governments for Sustainability were reviewed, as well as based on the 2ISECAP database of good practices.

The examples were chosen on the basis of specific criteria such as: documented impact, innovation in strategies or scalability and adaptability.

Taken together, this selection methodology provides users of the toolkit with a solid, evidence-based basis for applying sustainable strategies in their own urban contexts. Each section of the document provides references to these examples of good practice, ensuring that the recommendations are both theoretical and practical and adaptable, aligning with the sustainability goals of the 2030 Agenda and the emission reduction targets of the Paris Agreement.

2.1 Planning

Urban planning is a fundamental process that lays the groundwork for sustainable and balanced city development. This comprehensive approach seeks to manage urban growth in a way that maximizes social, economic, and environmental benefits, ensuring the quality of life for citizens. Planning addresses not only the physical layout of urban spaces but also considers the social, economic, and cultural dynamics that influence daily life. (Kunzmann, 2018). By involving diverse stakeholders in decision-making, urban planning becomes a key tool for fostering citizen participation and promoting inclusive and equitable development.

Tool	Alignment with SECAP	Spatial planning relationship	Estimated impact
Strategic plans that includes existing tools	Aligns with SECAP by integrating climate adaptation and mitigation actions across different urban sectors.	Integrates sectoral plans into a unified spatial framework, coordinating infrastructure, natural spaces, and urban development under sustainable criteria.	Long-term emissions reductions, increased climate resilience, and improved coordination across sectors.
Circular economy plans	Supports SECAP by reducing waste and promoting efficient resource use, thus lowering the city's carbon footprint.	Involves zoning and urban planning adjustments to incorporate recycling and waste reduction practices, focusing on sectors like construction and food to close material loops.	Reduces waste generation by 25% and lowers emissions by supporting sustainable production and consumption.
Comprehensive plans at district level	Allows specific neighborhoods to address climate resilience through localized adaptation and mitigation, directly supporting SECAP's goals.	Enables spatial planning at a micro level to improve climate adaptation for specific districts, allowing zoning changes and infrastructure adjustments to enhance resilience.	Increased adaptability of districts, with reductions in localized climate vulnerabilities
Holistic trend scenarios	Helps municipalities model the effects of different strategies, optimizing SECAP measures by comparing potential outcomes for emissions reductions and climate adaptation.	Supports urban planning by visualizing possible impacts of climate actions on infrastructure, transport, and land use, aiding the development of resilient, anticipatory urban designs.	Provides a basis for 10-20% more effective climate actions through scenario-based decision-making.
Impact of different measures on emissions	Allows cities to track and optimize SECAP measures by analyzing the emissions impact of various actions, choosing the most effective strategies for carbon reduction.	Informs spatial planning by identifying high-emission zones and prioritizing areas for emissions-reducing measures such as low-emission zones, green areas, and energy-efficient infrastructure.	Supports 15-30% emissions reductions based on selection of high-impact climate strategies.
Sectoral plans that converge into a common plan	Converges individual sectoral plans (e.g., energy, transportation) to create a unified approach that aligns with SECAP goals, maximizing the effectiveness of climate and energy strategies.	Enhances spatial planning by integrating separate plans into a cohesive urban framework, ensuring consistent resource distribution and sustainability criteria across sectors	Facilitates coordinated climate action with approximately 20% improvement in sectoral energy efficiency.

Strategic plans that includes existing tools.

For a city to be resilient to climate change, it must integrate adaptation principles into the scope of the comprehensive plan, as it ensures that all policies stemming from this plan will promote adaptation. It will ensure that there are no contradictions between different urban policies and that they feed back into each other. This plan can become the main tool to achieve in the medium/long term the objectives set by the climate transition. This strategy should integrate and dialogue with all the general and sectoral planning tools of the municipality, under the coordination of a team responsible for the energy transition.

Example 1: Un filo naturale. Strategia di transizione climatica del Comune di Brescia

The Strategy has been approved by the Municipal Council in June 2021. It has been developed in the framework of the project "Un Filo Naturale - una comunità che partecipa per trasformare la sfida del cambiamento climatico in opportunità", with the financial and technical contribution of the Fondazione Cariplo.

The Strategy has a strong and close relationship with the SECAP, just approved in May 2021: most of the climate change mitigation actions are contained in the SECAP, while most of the adaptation ones are contained in the Strategy. Moreover, the overall accounting and assessment of the effects of mitigation and adaptation actions are under the responsibility of the Climate Transition Strategy.

The project partners are: the City Council, its Urban Centre, the Museum of Natural Sciences, AmbienteParco, the Euro-Mediterranean Centre for Climate Change (CMCC) and the Park of the hills surrounding the city. Several areas of the municipality are involved in the project, allowing integration between sectors: Urban planning, buildings and mobility, Environmental protection and sustainability, Culture, creativity and innovation, Technical services and occupational safety, Financial resources. The actions included in the Strategy will be carried out over the next 5 years, together with a long-term vision for the City.

The strategy includes: The description of the competition: territorial, energy, climate and climate risks; vision and objectives; governance of the strategy; network and SH engagement; actions; review of existing urban planning tools; adaptation actions; mitigation actions; funding request; climate monitoring systems and networks; capacity building; citizen engagement and communication; economic plan; and monitoring system.

The Strategy includes numerous pilot interventions such as green roofs, tactical urban planning projects, the implementation of resilient permeable pavements and the afforestation of green spaces. A key factor of the strategy is the systemic and widespread involvement of citizens and stakeholders.

More information: https://museoscienzebrescia.it/un-filo-naturale/

Circular economy plans

The European Commission Thematic Strategy on the sustainable use of natural resources (2005) was one of the first policies to introduce waste and resource efficiency into the European debate. However, the circular economy concept was introduced with the Roadmap to a Resource Efficient Europe (2011), six years later.

More and more countries are adopting circular economy strategies. In general, the most recent strategies include more inclusive partnerships and value chain approaches. Construction and food are recurrent sectors in many of the strategies due to their high resource consumption. While waste treatment is the second most common sector at national and local level, energy and water management appear on the list of priority sectors. In addition, there are horizontal priorities common to many of these strategies. For example, urban development and knowledge sharing.

The circular economy influences urban planning in three value chain processes: removing waste and pollution from urban products and systems, maintaining the use of materials and their value, and regenerating natural systems in and around cities. These three value chain processes above are included in public services that offer a systemic view of urban planning involving all major resources: water and energy; urban development and the growth of huge amounts of waste in the public and private sectors; and human capital as a resource whose social inclusion in the just transition is crucial.

In addition, cities have important energy flows that intervene in the life cycle of an urban area. These flows are known as urban metabolism and are a prerequisite for implementing synergies between public and private actors. Although this will have to be developed locally, a national regulation setting standards can force cities to take a further step towards a just transition.

standardise sustainability practices, urban planning can incorporate circular economy models, promoting recycling and waste reduction in the building and food sectors.

Example 2: Transition to a circular economy model for sustainable production and consumption patterns (Greece)

The transition to a low-carbon and resource-efficient circular economy is of vital importance for Greece to ensure environmental protection, but also to boost green growth, create new jobs, fight unemployment and support innovation in production, consumption, the materials value chain, shared-use methods and waste reduction, reuse and recycling, in order to extend the circle of life of products and optimise resources, water and energy. The Greek government has set the implementation of circular economy objectives in practice, through a Greek Circular Transition Business Plan, as one of its key cross-sectoral priorities, accelerating action at three levels:

- *o Establishing criteria for green and circular public procurement, including incentives to improve secondary raw material markets and industry, as well as product design, repair and re-use, with the aim of "closing the loop" of product life cycles and promoting the secondary use of by-products and waste in new production processes as primary raw materials, also applying in practice the "hierarchical approach" in waste management and with specific measures and targets for plastics (single-use plastics, fishing gear, etc.) and food waste.) and food waste;*
- *o Promoting industrial symbiosis and clustering to support circular entrepreneurship, environmental industry and digital transformation;*
- *o Stimulating employment through measures to strengthen the sharing or collaborative economy, the collaborative economy and small-scale entrepreneurship.*

Its implementation is expected to be further accelerated, along with a strong education and awareness raising component (SDG 17) by supporting circular consumption patterns through awareness raising and education; enhancing partnerships, synergies and communication between the various actors involved; and emphasising the monitoring of progress and results through concrete performance indicators.

To this end, the Government is re-launching an inter-ministerial Committee composed of representatives of all key ministries involved, coordinated by the Hellenic Ministry of Environment and Energy, and has updated its National Strategy and Action Plan for the Circular Economy, originally approved in April 2018, to now extend to 2025 (activity linked to the implementation of SDGs 16 and 17).

More information: https://www.circular-economy.gr/%20;%20http://www.ypeka.gr/

Comprehensive plans at district level.

Comprehensive, or strategic, planning refers to the long-term vision or goal that guides local policy on a range of issues such as urban development, transport, housing, economic development, social inclusion and the environment. The comprehensive plan ensures that the policies designed in these different areas support the overall goals that the city aspires to achieve. It also ensures that all urban policy areas work together so that contradictions do not arise.

For a city to be resilient to climate change, it must integrate adaptation principles into the scope of the comprehensive plan, as this ensures that all policies derived from the plan will promote adaptation. This requires identifying the climate change-related hazards to which the city is vulnerable and ensuring that each area of local policy takes these into account.

Translating this same vision to a larger scale would allow not only detailed development and analysis but also implementation of the urban strategy at the district scale. At this scale the government can test more innovative adaptation requirements that can be extended to the rest of the city. In addition to finding concrete actions that are more precisely tailored to the needs of the area.

Example 3: Urban units. Valladolid

The actual General Urban Plan of Valladolid was approved in June 2020, being a review of the previous one of 2004. This new plan pretends to take advantage of the potential of urban units as an instrument for the regeneration of the existing city with a detailed analysis of them.

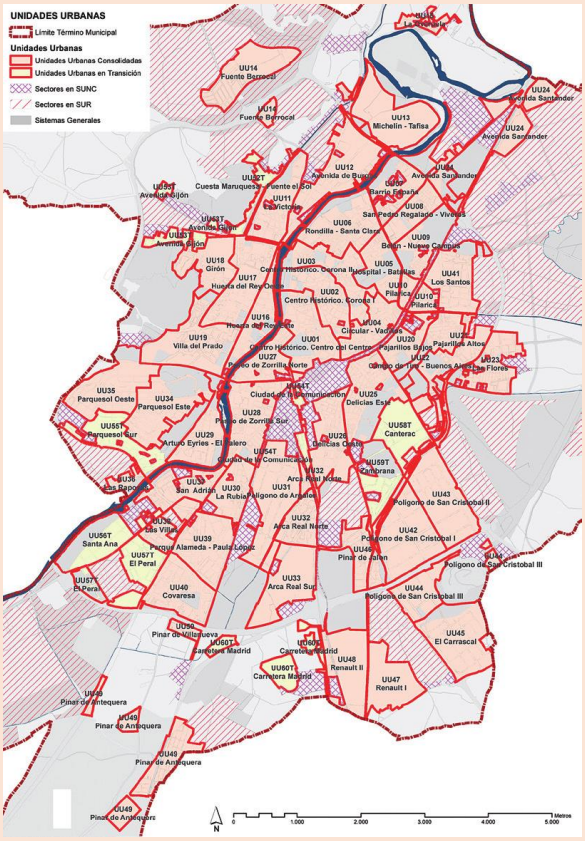
Throughout the document, the consolidated urban land is organized into urban units that serve as an instrument of the existing city to recompose the urban fabric, not corresponding to complete neighbourhoods due to the limitation of extension, allowing a detailed quantitative and qualitative study of the areas. As an annex, a binding report on urban units is provided, where the urban function of these is defined and the urban units are identified and analysed exhaustively through a summary of the starting situation, the planning proposed in the review and the result after the proposed arrangement.

Sixty urban units have been delimited based on a previous study of the city's neighbourhoods, an exhaustive analysis of their current situation is incorporated and they are linked to a series of interventions in spaces of opportunity. It strives to use the potential of urban units as a tool for analysis and control, defining with them a comparative framework between areas of the city useful for discovering and correcting dysfunctions and promoting concrete improvements. Likewise, within each urban unit, a division into micro-districts can be proposed that articulates the specific actions of the integrated urban regeneration program.

Although the urban units are diluted within the planning, the truth is that they are part of the general planning of the city and retain all the potential to spatially articulate multiple policies such as urban mobility, the network of facilities and public provisions and of course the network

of energy. The roads between these districts would articulate intra-urban mobility, forming a hierarchical network that connects with the neighborhood centers and with the large endowments on an urban scale. The division into micro districts can become the areas of reference for the programming of energy rehabilitation actions that transcend.

More information:
https://cloud.valladolid.es/index.php/s/vkII7KzVWVkSdhn?path=%2F00_PGOU%202020



Holistic trend scenarios for each of the strategic objectives of the plans.

Scenario planning is a strategic planning tool used to provide a more structured framework for thinking about the future. It involves developing multiple scenarios and exploring their implications, to ensure that potential problems can be addressed and tackled at the outset. Identifying future scenarios helps to make more informed decisions. A thorough understanding of the future environment helps to ensure that the action plan is the most appropriate for the particular context.

While it is true that the results provided are often inaccurate, as they are based on assumptions made today that can easily become outdated as conditions change. These scenarios will need to evolve in response to changing trends and the environment. Another potential limitation is that it may be difficult to detect correlations between variables. It may currently be predicted that a certain event will lead to a certain outcome, but there may be other factors that have not yet been taken into account that influence the outcome.

The scenarios, according to the latest IPCC AR5 report, describe various time periods (2011-2040, 2041-2070 and 2071-2100) and have been conducted under two scenarios or Representative Concentration Pathways (RCP): RCP 4.5 (medium scenario) and RCP 8.5 (most extreme scenario).

Compare the impact of different measures on emissions and build multiple scenarios, helping municipalities to determine the most effective strategies to achieve their SECAP targets.

Local governments that have signed the Covenant of Mayors have put a lot of work and effort into developing their Sustainable Energy and Climate Action Plans (SECAPs). But this is only the beginning of the road. To achieve the goals set out in their SECAP, they must ensure that they are taking the most effective and impactful measures every step of the way.

For most municipalities, this can be a daunting task. The complexity of SECAPs, the lack of resources, the uncertainty about the effectiveness of different measures and the challenge of collecting the relevant data? These are just some of the challenges that local governments face in identifying the right measures for their SECAP.

Example 4: EUCityCalc

The EUCityCalc project, funded by the Horizon 2020 programme of the European Commission (EC), has developed a tool to assist municipalities with Sustainable Energy and Climate Action Plans (SECAPs).

This calculator allows local authorities and stakeholders to compare the emissions impact of different measures and build multiple scenarios, helping municipalities to determine the most effective strategies to achieve their SECAP targets. There are, at the moment, 24 measures available, each with various levels of implementation, giving a total of 70 possible study combinations.

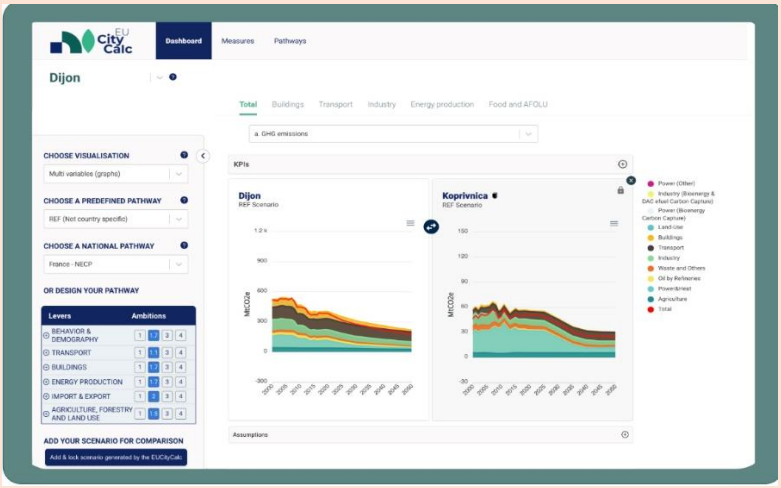
The calculator is currently being used by ten Covenant of Mayors pilot cities in six different member states. The aim is to facilitate the transfer of data between this tool and the SEAP/SECAP template in order to take advantage of the pathways and scenarios developed in the latter.

One of the key objectives of the European Cities Calculator is to provide emission calculation processes that can be used to meet the SEAP criteria, in particular for the Baseline Emission Inventory.

The guidelines will be available in 2024 to take advantage of the pathways and scenarios developed with the tool in the SEAP/SECAPs and will comply with the Covenant of Mayors' SEAP/SECAP guidelines. The team behind the Calculator is currently working to facilitate the transfer of data between the tool and the SE(C)AP template.

It is expected that by the end of 2023 more cities will be able to use the web-based tool through a dedicated training programme.

More information: https://europeancitycalculator.eu/the-eu-city-calculator/



Sectoral plans that converge into a common plan.

Sectoral plans have the advantage over comprehensive plans of developing in depth the issues they deal with. Sectoral planning deals with economic infrastructure (supply, telecommunications, transport, territory), economic activity (industry, commerce, tourism, etc.); the built environment (housing, facilities, etc.); and the environment (greenways, hydrography, natural spaces, heritage, etc.). Until now, the development of these plans covered the specific needs at a given time, so they may not have been homogeneous in terms of objectives, methodology and periodicity, as they did not respond to a common requirement.

The plans are the central axis of operations, but the success of the discipline does not depend on the use of instruments, but rather on the suitability of the instruments to the associated scales and functions, which is why we find ourselves at a time when many of the strategic plans are only halfway to achieving the objectives they set out to achieve, with a difficult development on many occasions due to a highly complex approach.

For this reason, the convergence of the details of the sectoral plans in a common framework with similar objectives by merging them into a single strategic plan can, with a greater initial coordination effort, facilitate the implementation of the plans and thus the fulfilment of the objectives.

Ejemplo 5: PACES Vitoria. PAACC+PATEI

The municipality has recently renewed its commitments to the Covenant of Mayors initiative, which involve the development of this Sustainable Climate and Energy Action Plan (SECAP). This plan aims to accelerate the energy and climate transition in Vitoria-Gasteiz; that is, to contribute to the decarbonization of the territory, ensure that citizens have access to secure, sustainable, and affordable energy, and strengthen their capacity to adapt to the inevitable impacts of climate change.

Furthermore, this entire plan is aligned with the 2030 Agenda and the Sustainable Development Goals (SDGs). It represents a systemic transformation process led by the City Council of Vitoria-Gasteiz, which will, among other things, align all of its policies, not only those related to energy and decarbonization, with the SDGs of the United Nations' 2030 Agenda.

The SECAP 2030 of Vitoria-Gasteiz constitutes the municipal action for emissions reduction and local adaptation to climate change. Both areas have been developed through a participatory process involving all relevant stakeholders in the creation of two action plans: the Integrated Energy Transition Action Plan (PATEI 2030) and the Climate Change Adaptation Action Plan 2030 (PAACC 2030).

The PATEI 2030, developed under a new governance and participation model, follows the Cities4ZERO methodology for urban decarbonization (Urrutia-Azcona et al., 2020), which advocates for an integrated approach to urban and energy planning. This model specifically translates into:

- *Horizontal integration, at the sectoral level, of strategies and projects promoted by various municipal departments, organizations, and companies for better coordination among initiatives throughout the AVG.*
- *Integration through intensive participation with local agents, involving contributions from various groups within the city (public sector, private sector, research, citizens).*
- *Vertical, multi-level integration, which includes the participation of representatives from regional institutions (Basque Government, Provincial Council of Álava, EVE, Ihobe, VISESA).*

On the other hand, the PAACC 2030 adopts the following approaches and methodological frameworks:

- *An approach focused on reducing risks associated with climate change, using a methodological framework for the development of climate risk assessment aligned with the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) - known as AR5 - published in 2014.*
- *An approach aligned with existing international, national, and regional policies, plans, and strategies regarding climate change adaptation, as well as local ones.*
- *A sectoral approach tailored to the main activities characterizing the municipality, adapting climate planning to the local reality.*

- *A "multi-actor" approach, involving personnel from various municipal departments, as well as the general public.*

More information: https://www.vitoria-gasteiz.org/wb021/was/contenidoAction.do?idioma=es&uid=u_39f815d1_127fa8ec204__7fb5

2.2 Mobility

Urban mobility is a crucial element for the efficient functioning of modern cities. This concept encompasses not only the transportation of people and goods but also access to services and opportunities that contribute to the population's well-being. Planning sustainable mobility systems that prioritize public transportation, bike paths, and pedestrian spaces is essential for reducing congestion and emissions of pollutants. Promoting active and sustainable mobility not only improves air quality and public health but also fosters greater social cohesion by facilitating access to different areas of the city. (UN-Habitat, 2020)

Tool	Alignment with SECAP	Spatial planning relationship	Estimated impact
Mobility plan aligned with SECAP approach	Supports SECAP by focusing on sustainable mobility, reducing urban transport emissions through public transit, cycling, and walking infrastructure.	Guides the spatial organization of transport hubs and low-emission zones, integrating them with residential and commercial areas to reduce car dependency.	Reduction in transport emissions by up to 30%, improved air quality, and increased public transit use.
Model implementation that reduce the impact of transportation	Encourages energy-efficient transport options and reduced dependency on fossil fuels, directly contributing to SECAP's climate goals.	Integrates transit-oriented development with urban planning to promote public transport hubs, reduce vehicle usage, and establish low-emission areas.	Reduces traffic congestion and emissions by approximately 25% in high-density areas.

Observing mobility action plans (low-emission zones) and adjusting the mobility approach of the PACES for this purpose.

European policies have set ambitious sustainability targets for all levels of governance in the coming decades, anticipating significant reductions in Greenhouse Gas (GHG) emissions, a substantial increase in energy efficiency, a rise in renewable energy production, and at the same time, a major decrease in Europe's dependence on oil imports. The development of strategic local plans for energy, transportation, and mobility is crucial to achieving these objectives. However, individual sectoral plans related to energy, transportation, and mobility separately have often proven to be ineffective in providing long-term solutions.

Focusing on isolated and individual sectoral policies does not appear to be cost-effective: the solution must be sought in a holistic approach to urban development planning. Furthermore, a harmonized process of strategic planning for energy, mobility, transportation, and land use policies provides policymakers, technical departments, and stakeholders, both public and private, with a better, integrated, and synergistic understanding of the actions necessary to build the European cities of tomorrow.

Harmonization means working in complementary areas so that plans work together to achieve an overarching strategic goal. Harmonization helps different departments within local authorities share the same vision, work together, and optimize resource use.

Potential areas of cooperation to focus on during the harmonization process include:

- Strategic Vision: Both PMUS and PACES (especially considering the new elements added by PACES) aim to improve citizens' quality of life and minimize environmental impacts.
- Baseline: All plans are based on a comprehensive definition of the baseline against which progress towards plan objectives must be measured. Defining common databases leads to greater coherence and more efficient resource use.
- Stakeholder Participation: The successful development of a PACES and a PMUS depends on the active participation of stakeholders. Coordinated management of the participatory process helps define a unified vision and better resource management.
- Common Actions: Low-carbon mobility actions contribute to achieving the goals of both plans, by achieving energy efficiency and in mobility or renewable energies. Therefore, the need for coordinated actions is crucial.
- Monitoring and Control: Monitoring progress towards objectives is common for both PACES and PMUS, as is identifying new challenges. Therefore, both plans must be monitored and controlled in a harmonized manner.

Local authorities initiating their harmonization process can start from different scenarios: they may already have a PACES and a PMUS that need harmonization; they may already have one of the plans (PACES or PMUS) and need to develop the other in a way that is harmonized with the existing plan; or they may need to develop both plans.

Model implementation that reduce the impact of transportation.

Establish a long-term vision for the city focused on public transit-oriented development, and conduct municipal-scale consultation processes to ensure it functions at the local level.

To promote transit-oriented development, it is crucial to establish a long-term vision for the city and conduct municipal-level consultation processes to ensure effectiveness at the local level. It

is also important to assess current access to public transportation and consider the implementation of specific objectives in this area.

It is essential to identify areas where transit-oriented development should be applied, determining the appropriate density and mix of constructions. Additionally, a significant portion of new constructions should be allocated for affordable housing to promote greater inclusivity and accessibility.

To support these initiatives, it is recommended to update regulations to align land use and planning regulations with transit strategies. This involves enhancing areas near transportation hubs, investing in transportation infrastructure, and shifting regulations from "minimum" to "maximum" parking requirements to discourage car usage.

Furthermore, it is worth noting that the promotion of dense, mixed-use neighborhoods not only drives transit-oriented development but also contributes to a balanced energy demand throughout the day, benefiting both local clean energy initiatives and district heating and cooling networks.

2.3 Built environment

The built environment plays a central role in the transition to more sustainable and climate-resilient cities From energy efficiency in buildings to urban planning, tools targeting the built environment are key to reducing emissions, improving resource use and adapting to current and future climate conditions. This section presents a set of strategies and tools that support the retrofitting, regulation, monitoring and continuous improvement of urban built environments.

These tools not only respond to the decarbonisation and efficiency goals set out in the Climate and Energy Action Plan (SECAP), but also integrate with spatial planning at multiple levels: from retrofitting individual buildings to optimising entire districts with approaches such as positive energy districts. The tools presented here are essential to transform cities into interconnected and sustainable urban ecosystems, where built infrastructure can adapt, mitigate its environmental impacts and actively contribute to balanced and efficient urban development.

By addressing the challenges and opportunities of the built environment, these tools provide a coordinated framework for action that facilitates the integration of renewable energy, material efficiency, and resource planning in a low carbon context.

Tool	Alignment with SECAP	Spatial planning relationship	Estimated impact
Climate adaptation and life cycle of buildings inclusion	Supports SECAP by coordinating building retrofits across regions, enhancing energy efficiency and reducing emissions in the building sector.	Adapts national building retrofit strategies to local needs, integrating energy-efficient designs into regional and urban spatial plans, ensuring sustainable land use and infrastructure development.	Achieves up to 30-40% reduction in building energy consumption, fostering resilience and lowering emissions.
Climate adaptation and life cycle of buildings inclusion	Includes life cycle assessments to reduce emissions from building materials and ensure energy-efficient performance, supporting SECAP's adaptation and sustainability goals.	Informs building code regulations, ensuring sustainable materials and energy efficiency are prioritized across new developments	Up to 40% reduction in building life cycle emissions and improved climate resilience in construction standards
Prototype buildings and scenario models to measure the carbon footprint	Models project building emissions and energy use to identify opportunities for improvement, aligning with SECAP's emissions reduction and efficiency goals.	Aids in the spatial planning of energy-efficient building clusters, optimizing land use for reduced emissions and resilience	Provides a measurable basis for up to 25% emissions reduction through optimized building design and retrofitting
Incentives for improvements in energy efficiency	Promotes higher-than-mandated energy efficiency levels, supporting SECAP's targets for building sustainability and reducing overall energy demand.	Encourages sustainable building practices through zoning incentives and tax breaks, fostering eco-friendly urban development.	Up to 20% reduction in energy consumption for buildings with incentives applied.
Digital Twins to support building construction linked to city wide-services	Allows cities to simulate SECAP-aligned scenarios for energy, emissions, and resource management, providing data-driven support for decision-making.	Helps plan resource-efficient city infrastructure by linking buildings and utilities, optimizing spatial and energy use.	Improves efficiency of urban energy and resources management, reducing waste by 15-30%

National building rehabilitation plan and adapting it to regional and local plans.

National rehabilitation plans represent a significant step forward in the strategic planning for regenerating the building stock. This improvement is reflected in the need to organize and prioritize interventions over time through municipalities, as well as to facilitate the financial measures to make them possible, and to enhance coordination with national planning for energy transition and combating climate change (integration with the National Integrated Energy and Climate Plan. The national rehabilitation plan is the key strategic instrument for coordinating all necessary actions for decarbonizing the building sector in each member country.

Example 6: Long-term strategy for energy rehabilitation in the Spanish building sector (Spain)

The current "Long-term strategy for energy rehabilitation in the Spanish building sector" (ERESEE), evaluated by the European Commission as the most comprehensive of all member states' strategies, has become a key instrument in Spain for coordinating policies, plans, and measures to promote rehabilitation. It serves as a reference for the entire country and allows for the guidance and harmonization of policies that each autonomous community establishes within the framework of its competencies. The working groups organized for its drafting, revision, and implementation involve all stakeholders in the sector, including the three tiers of public administrations. The evolution from ERESEE to the National Plan is a natural step that allows for the continuation of the work being done thus far and facilitates the implementation of new instruments proposed by the Energy Performance Building Directive (EPBD), with the direct participation of all involved parties.

More information:
https://www.transportes.gob.es/recursos_mfom/paginabasica/recursos/eresee_2020.pdf

Climate adaptation and life cycle of buildings inclusion

Regulatory strategic frameworks have been oriented towards reducing energy consumption and associated emissions during the building's use. It is estimated that 41% of cumulative emissions from residential buildings are attributed to embodied carbon. This is due to the increase in performance demands on buildings, and as emissions are optimized during their use, the emissions from manufacturing and end-of-life phases begin to carry more weight in the overall emissions balance.

Successive energy efficiency standards have led to a reduction in life cycle carbon due to improved energy performance during the use phase. However, an analysis of embodied carbon reveals an increase in relative and absolute contributions. Therefore, decarbonizing the building sector cannot be achieved without considering the role of embodied carbon.

To do this, consumption should be reported in different phases: production/construction (raw material supply, transportation, manufacturing, construction...); use (heating, hot water production, electrical consumption...); maintenance or repair; and end of life (demolition, transportation, waste management, disposal...).

In this regard, life cycle assessment allows different stakeholders to select alternatives with lower environmental impact within the range of solutions, thereby aligning with defined decarbonization objectives. This assessment is standardized according to UNE-EN 15978, which presents the general structure and definition of building life cycle stages, applicable to both new construction and rehabilitation. Some software programs like SimaPro, GaBi, or OpenLCA are based on it.

These tools rely on information from environmental product declarations that manufacturers of construction products increasingly make publicly available. In this sense, in addition to the common methodology, one of the main limitations is the availability of comparable information. At the EU level, the most likely policy initiatives to integrate this are green public procurement criteria and the EU taxonomy for sustainable finance

Prototype buildings and scenario models to measure the carbon footprint

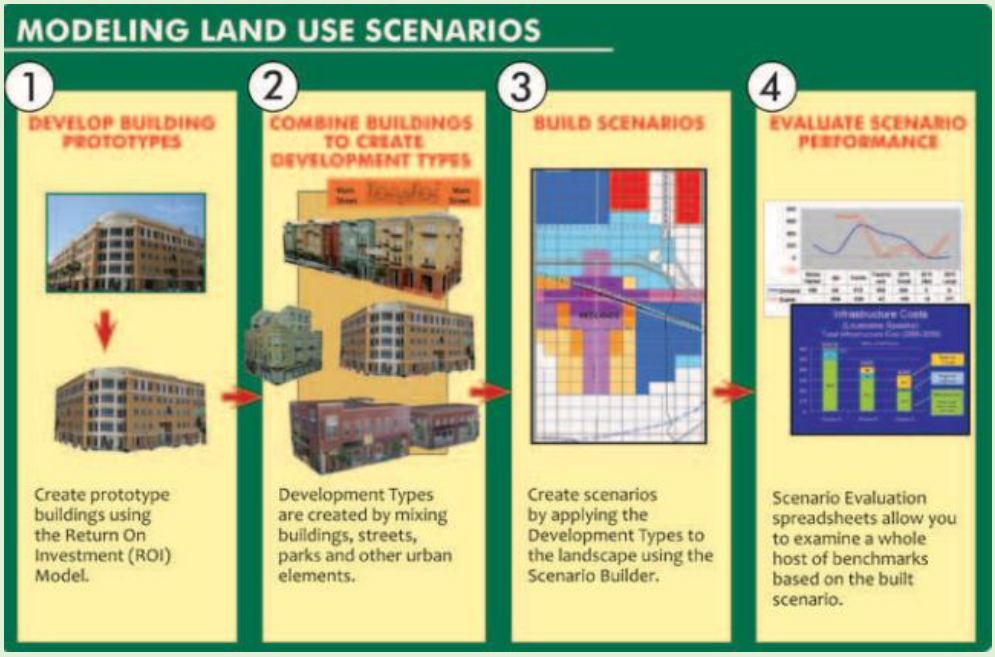
New and renovated non-residential buildings often fail to achieve the expected performance. Deficiencies manifest in excessive energy consumption, high carbon dioxide emissions, and other quantitative and qualitative shortcomings. The components of performance deficit can be described based on data from building performance evaluations. Introduce a way to visualize the consequences of decisions and actions known to compromise performance results through a proven methodology, which traces performance and the root causes of low performance, from the project's outset to initial implementation and beyond. Additionally, ongoing projects should be addressed so that they can monitor emerging energy and operational emissions compared to a high-energy and emissions trajectory created from empirical data. This way, professionals identify the main risk factors that could compromise building performance and mitigate these risks in various design and implementation phases.

Example 7: Envision tomorrow

It is a set of freely accessible urban and regional planning tools developed by Fregonese Associates, used to model land use decisions at various scales. It allows for the generation of between 2 and 5 possible scenarios to analyse city growth patterns and make decisions regarding their impact on public health, fiscal resilience, and sustainability. It not only enables the generation of scenarios but also their analysis and comparison for land use, housing, demographics, economic growth, development feasibility, fiscal implications, transportation, environmental factors, and quality of life.

At the site scale, this tool can be used to identify financially viable development opportunities and suggest ways to adjust existing land use regulations to encourage new developments. At the neighbourhood scale, various combinations of buildings and other attributes (such as streets, green areas) can be compiled to assess the implications of different development styles. These buildings and types of development can be used to create land use scenarios at the district, city, county, and regional scales. The Envision Tomorrow tool also allows for modelling energy and water consumption and the carbon footprint of potential development at the building, district, and regional scenario levels.

More information: https://envisiontomorrow.org/et-online



Incentives for improvements in energy efficiency or the use of renewable energy sources beyond what is mandated by regulations.

The high costs of energy and the climate and supply issues stemming from the use of fossil fuels have become one of the major challenges facing states in recent times and looking ahead to the

future. Therefore, significant efforts are being made to reduce the consumption of these fuels and replace them with clean and renewable energy sources.

Cities choose to develop incentive programs to promote desirable practices that may be costly or uncommon. In doing so, incentives can be proposed as long as the improvement surpasses the requirement set by regulations, such as increasing building capacity or reducing fees, both in construction and subsequent taxes like property taxes or personal income taxes.

Example 8: Terrassa

The municipality of Terrassa, in order to promote the use of renewable energies, grants bonuses for non-mandatory installations with a capacity of 1800WP or 400WP for collective self-consumption. These bonuses apply to property taxes, construction, facilities, and works tax; or economic activities tax. In addition, there are exemptions regarding the Fee for Legalization Services of Activities and Installations and Environmental Services for energy communities, activities that improve the energy rating of the premises by two grades or achieve an 'A' rating, or activities that have renewable energy production systems with a nominal power of more than 15 kW.

As for the Fee for Urban Services, there are exemptions for urban licenses and communications for aerothermal or geothermal installations with SCOP > 2.5 for the air conditioning of the installations, and for renewable energy production installations that have not been carried out in compliance with the CTE or other regulations, for actions to improve the energy rating of the building by at least two grades, or achieve an 'A' certificate, provided that the actions are not carried out in compliance with the CTE or other regulations for the installation of electric vehicle charging systems.

More information: https://www.terrassa.cat/es/empresa-bonificacioons-foment-energies-renovables

Supporting real estate developers in converting vacant lots or empty buildings into affordable housing

In the current context of the climate crisis, rehabilitation and regeneration actions have often replaced growth on the outskirts of cities. This interest in existing cities allows for the identification of vacant plots or abandoned buildings that have the potential to be transformed into housing

It is important to prioritize locations that allow for complementary construction within the existing urban structure, especially in areas with access to public transportation connections/infrastructure. Additionally, vacant lots within the urban structure can offer unique opportunities for redevelopment. Regional aspects should also be taken into account; cross-municipal planning (regional structure planning) enables efficient use of regions

Design Digital Twins to support building construction, and link them to city-wide services, enabling urban environment analysis.

Digital twins are currently being leveraged to explore the effects of different policies, strategies and plans related to the optimal network structure (e.g. location, size, end users and infrastructures) of the energy system. Drawing on inputs and data from multiple sectors (e.g. water, electricity, heat and gas), digital twins are helping to expose gaps and relationships between plans, actions, and possible outcomes, supporting multi-criteria decision-making and enabling users to test and model options and important trade-offs. In the years ahead, it will be essential to develop and connect this type of digital twin with high resolution, multi-carrier, cross-sector energy system models. Doing so will support the delivery of national innovation goals and provide key decision-makers with up-to-date capability projections.

At a local level, digital twins can be leveraged to understand energy demand associated with microgrids – 'small-scale, low-voltage power systems with distributed energy sources, storage devices and controllable loads'. Incorporating a digital twin at this level can allow microgrid designers and operators to simulate the impacts of cost-cutting measures (e.g. by evaluating the trade-offs of various CapEx strategies) and enable the servicing of multiple customers. While financial analysis of a conventional (single-customer) microgrid is relatively simple, analysing the financial rewards of multi-customer community microgrids is considerably more complex. In this regard, digital twins can be used to make sense of complexity, to provide vital information to decision-makers and to help define the potential benefits involved in community microgrid projects, helping to attract sustainable buy-in and investment.

2.4 Land use

Land use is a determining factor in shaping cities and their functioning. Effective land use management involves planning and regulating the various activities that take place in a given area, ensuring a balance between urban expansion, the preservation of natural spaces, and the protection of cultural heritage. Proper land use planning aims to optimize the location of services, infrastructure, and housing, promoting accessibility and sustainability (Angel et al.,2020). Additionally, well-planned land use contributes to urban resilience, allowing cities to adapt to demographic and climate changes.

Tool	Alignment with SECAP	Spatial planning relationship	Estimated impact
Impact of land use decisions on greenhouse gas emissions measurement	Provides emissions metrics for various land use decisions, helping to optimize land use under SECAP's emission reduction goals.	Allows spatial planning to prioritize high-density zones, green spaces, and transport hubs that minimize emissions.	Allows targeted actions to reduce GHG emissions by up to 15% based on land use planning.
Climate vulnerabilities mapping	Identifies high-risk areas for targeted adaptation actions, directly supporting SECAP's resilience objectives.	Informs spatial planning by designating zones for climate-resilient infrastructure, protecting vulnerable areas.	Reduces climate-related risk in vulnerable areas by up to 20%.
Urban Planning Plans adaptation to the current energy crisis context	Updates urban plans to prioritize energy efficiency and resilience, aligning with SECAP's goals for low-energy use and sustainable infrastructure.	Increases integration of low-energy zones, efficient transport links, and sustainable energy sources in urban planning.	Reduces urban energy demand by 15-25%, enhancing resilience to energy fluctuations.

Impact of land use decisions on greenhouse gas emissions measurement.

Measuring the impact of land use decisions on greenhouse gas emissions allows for the assessment of how choices related to land planning and development influence the release of gases contributing to climate change. This entails considering factors such as building density, the type of structures, associated transportation, and economic activities present in a specific area. A comprehensive approach may also encompass the amount of vegetation and green spaces available, as well as the preservation of natural areas. This type of analysis is essential for informing policies and strategies that promote sustainable urban development and the reduction of greenhouse gas emissions.

This process can encompass several crucial aspects:

- Building Density: It assesses how compact or dispersed the construction is in a given area. Higher density can promote efficiency and reduce the need for long-distance travel.
- Type of Structures: The design and energy efficiency of existing buildings are considered. Well-insulated and energy-efficient buildings can significantly reduce emissions associated with heating and cooling.
- Associated Transportation: The access and availability of sustainable transportation options, such as public transport, cycling routes, and pedestrian facilities, are analyzed.
- Economic Activities: The industries and businesses present in the area are examined, and how they contribute to greenhouse gas emissions. For example, the presence of factories or high-emission companies.
- Vegetation and Green Spaces: The quantity of green areas and vegetation in the area is quantified. These elements can act as carbon sinks and contribute to air quality.
- Preservation of Natural Areas: The conservation of natural habitats, such as forests and wetlands, which play a crucial role in carbon capture, is evaluated.

A comprehensive analysis considers all these factors to understand how land use decisions affect greenhouse gas emissions. This assessment provides vital information for the formulation of policies and strategies that promote sustainable urban development and contribute to the reduction of greenhouse gas emissions.

Mapping climate vulnerabilities allows for the precise identification of climate impacts and the implementation of actions in specific locations.

A more detailed analysis will enable prioritizing the most vulnerable areas. To do this, future climate projections are developed at the local scale, populations, assets, and vulnerable infrastructure are mapped, and the city's adaptation capacity is assessed. An analysis of interdependencies between the city's infrastructure systems can strengthen the Climate Change Risk Assessment. This involves identifying not only spatial but also operational interconnections, where the effects of an extreme weather event trigger a chain of impacts across multiple sectors. For example, extreme heat may necessitate a reduction in vehicle speed, or temporary road flooding due to heavy rainfall could disrupt the distribution of goods, maintenance, water and fuel supply services, waste collection services, and more. This could lead to a transportation sector issue that cascades into other sectors (energy, water, waste, food) and impacts the city's economy.

This will allow for prioritizing the most critical infrastructures and reinforcing procedures to mitigate these cascading impacts. It should be included in the proposed strategies the potential to mitigate climate risks in multiple interconnected systems. On the contrary, these connections can also create trade-offs, synergies, and opportunities to support sectoral investments in both climate mitigation and adaptation efforts.

Urban Planning Plans adaptation to the current energy crisis context.

It implies conducting a thorough evaluation of existing urban planning schemes to ensure they align with the needs and challenges arising from the current energy crisis situation. This involves considering measures that promote energy efficiency, emission reduction, and the transition to more sustainable energy sources.

Some key steps in this process could include:

- Analysis of the Current Energy Situation: Understanding the current energy consumption in the city, the energy sources used, and the associated emissions.
- Identification of Areas for Improvement: Identifying areas in urban planning schemes that can be enhanced to promote more efficient and sustainable energy use. This could include promoting low-energy buildings, areas with better access to public transportation, among other measures.
- Integration of Sustainable Technologies: Considering the integration of sustainable technologies and practices in urban planning, such as the implementation of renewable energy infrastructures, efficient energy management systems, and the promotion of buildings with high energy efficiency standards.
- Promotion of Sustainable Transportation: Assessing and encouraging the creation of infrastructure for sustainable transportation, such as bike lanes, pedestrian routes, and efficient public transportation systems.
- Incentives for Energy Efficiency: Considering the implementation of incentives for energy efficiency in the construction and renovation of buildings, such as granting tax benefits or streamlining procedures.
- Promotion of Green Areas and Public Spaces: Promoting the creation and conservation of green areas and public spaces, which not only contribute to quality of life but can also have a positive impact on energy efficiency in the city.
- Citizen Participation: Involving the community in the process of reviewing and adapting the plans, ensuring that local needs and concerns are taken into account.
- Continuous Monitoring and Evaluation: Establishing mechanisms to assess the impact of the modifications made to urban planning plans and making adjustments as necessary.

This process aims to transform urban planning plans into effective tools to address the challenges of the energy crisis and promote a more sustainable and resilient urban development.

2.4 Networks and structures

Urban networks and structures are the framework that supports life in cities. These include transportation infrastructure, public services, drainage systems, and green spaces, all essential for community functioning and well-being. The planning of these networks should be comprehensive and consider their interconnection, ensuring that they complement and optimize resources (IRENA, 2021). A well-designed urban network not only enhances service delivery efficiency but also promotes equity and access to essential resources for all citizens, thereby strengthening social cohesion.

Tool	Alignment with SECAP	Spatial planning relationship	Estimated impact
Blue-Green Infraestructure benefits evaluation and monetization	Aligns with SECAP by offering co-benefits like stormwater management, temperature regulation, and improved air quality, reducing urban climate impact.	Allows spatial planning to incorporate BGI, ensuring green and water systems are strategically placed for climate resilience.	Increases flood resilience and reduces urban heat, improving quality of life and air quality.
GI indicator	Monitors environmental benefits, helping meet SECAP's adaptation targets by providing measurable ecosystem services data.	Enhances spatial planning with data on green space effectiveness, supporting evidence-based decisions for future GI projects.	Improves environmental quality indicators by 20-30%, based on GI use and effectiveness data.
Positive energy districts promoted by local government	Supports SECAP's energy self-sufficiency and carbon reduction goals by generating surplus energy in urban districts.	Promotes integrated land use planning by combining renewable energy, efficient buildings, and green spaces to create self-sufficient districts.	Achieves up to 50% reduction in district-level emissions and energy independence.

To evaluate and monetize the social and environmental benefits of green-blue infrastructures (BGI) to support investment decisions and identify stakeholders for potential funding avenues.

Green-blue infrastructures (BGI), including Sustainable Drainage Systems (SuDS) and Natural Flood Management (NFM) systems, consistently provide essential benefits ranging from public health to flood risk reduction. However, some systems can deliver even greater benefits. NFM and SuDS-based systems yield the anticipated benefits of a conventional, engineered approach, along with many additional advantages. This is possible because SuDS and NFM systems invariably enhance urbanized areas and contribute to economic development and environmental quality.

Stakeholders are increasingly collaborating to design and build improved urban or rural drainage systems. They are considering the benefits that solutions can provide, their scale, and their value. Understanding these benefits can help identify stakeholders and promote collaboration in funding.

Example 9: Benefits Estimation Tool (BEST)

B£ST is a free tool that provides a structured approach to assess a wide range of benefits from green-blue infrastructures (particularly SuDS and natural flood management), often based on the overall performance of the chosen intervention. It follows a simple structure, starting with screening and qualitative assessment to identify benefits that should be evaluated further. When feasible, it provides support to help quantify and monetize potential benefits and can assist in underpinning collaborative work.

Once the assessment is complete, the tool provides a series of graphs and charts to present benefits based on Ecosystem Services (ESS) criteria and the Triple Bottom Line (TBL).

The tool creates summary tables presented under the framework of Ecosystem Services (ESS) and in terms of natural, social, and other capitals. It automatically generates a series of charts for use in reports. An option allows for copying data from more than one B£ST "simulation" and comparing them with the current cost, benefit, and overall net present value. The tool also includes a "rough assessment" sheet to quickly obtain a high-level indication of the potential range of benefits of a system with a limited set of data. This can help focus attention on the most significant benefits in an analysis and minimize the need to collect and input data on benefits that are likely to be less significant.

More information: https://ecosystemsknowledge.net/resources/tool-assessor/best-benefits-estimation-tool/

Understanding the benefits derived from green infrastructure for climate change mitigation and adaptation, in monetary, quantitative, and qualitative terms.

Green infrastructure—the network of trees, parks, green spaces, canals, and rivers that extends within and between our towns and cities—is our life support system. It also contributes to underpinning and driving our economy. Like other infrastructures, it serves as a backdrop for leisure, tourism, and investment, and supports physical and mental health and well-being. When it is lacking or disappears, places do not thrive. Conversely, well-designed, planned, and managed green infrastructure can provide a wide range of benefits to communities and localities, from reducing flood risk and combating air pollution to attracting investments and promoting tourism.

We need a common understanding among governments, businesses, and civil society about the importance of our shared green infrastructure. This means recognizing it as a common good that provides tangible physical and emotional benefits to people; that protects, enhances, and energizes the economy of our towns and cities; and that is an essential part of the natural ecosystem on which we all depend. To do this, we have to clearly demonstrate that the multiple and essential functions of green infrastructure confer significant monetary value upon it.

The role of green infrastructure is now better understood. However, project managers, funders, and client teams often need to provide solid evidence that environmental and economic development projects that include new green infrastructure deliver economic benefits.

Existing green infrastructure may also be at risk if its conservation is not economically justified. While the intrinsic value of a rare species, a cultural landscape, or a peaceful area in the heart of a city may be considered "priceless," there is a danger that being unpriced could lead them to be perceived as "worthless" in terms of economic evaluation.

Example 10: Mersey Forest

Numerous efforts have been made to assess the benefits of the natural environment using a wide range of techniques. Many of these are academic and are not readily accessible to project managers who need solid data from easily accessible sources to provide a robust valuation that they can use as justification to funders and/or promoters.

To conduct such an assessment, The Mersey Forest has developed GI-Val. This tool calculates the monetary values of the social, economic, and environmental benefits provided by green infrastructure.

The toolkit was originally developed as part of a Natural Economy Northwest project, in collaboration with other regions of England and national bodies like Defra. Several organizations pooled their knowledge to contribute to the design of a user-friendly toolkit for valuing green infrastructure.

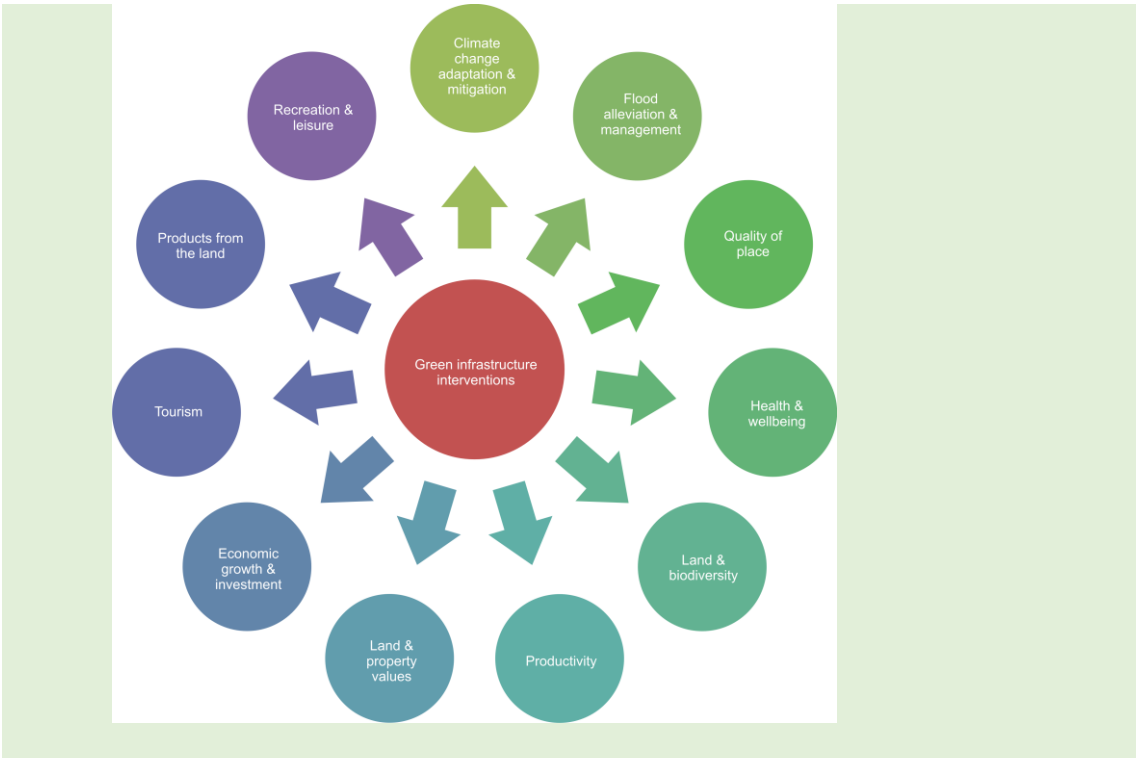
The kit provides a set of calculation tools to help evaluate an existing green asset or a proposed green investment. They are organized around eleven key benefits of green infrastructure. The toolkit examines how the range of green infrastructure benefits derived from an asset or investment can be demonstrated:

- *In monetary terms, using economic valuation techniques whenever possible.*
- *Quantitatively, for example, in terms of jobs, hectares of land, or visitors.*
- *Qualitatively, referring to case studies or significant research where there seems to be a connection between green infrastructure and economic, social, or environmental benefits, but where the scientific basis for quantification and/or monetization is not yet solid enough.*

Standard valuation techniques are used to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are evaluated in terms of the functions that green infrastructure can play, support, or promote, depending on the type of project.

Once the data is input into the tool, it generates financial values for many of the green infrastructure benefits. The toolkit identifies the marginal benefit, the added value of green infrastructure, and also seeks to ensure that there is no double counting of value.

More information: https://www.merseyforest.org.uk/services/gi-val//



Positive energy districts promoted by local government.

Positive Energy Districts (PEDs) are urban areas where a series of buildings, both public and private, residential or tertiary, produce and share energy with the aim of generating an overall energy surplus that can be exchanged with other urban and peri-urban areas of the city. PEDs have recently emerged as a driving tool for the energy transition of cities, primarily promoted by the SET-Plan [01] with the goal of combating climate change. Following the Paris Agreement within the COP21 framework, cities worldwide are taking steps to promote the use of renewable energies and electric vehicles, as well as implementing measures to increase the energy efficiency of their urban districts.

Since common practice in urban planning has often considered the energy performance of buildings individually, without taking into account the surrounding buildings, the PED breaks this habit by applying integrated strategies for building renovation, energy efficiency, and local energy production from renewable energy sources (RES) in an interconnected and holistic way at the local level.

The key concept of a PED is a district that produces more energy from RES than is needed to meet the district's demand, allowing for the export of this energy surplus to another part of the city. Existing definitions of PED, such as the Joint Programming Initiative (JPI) Urban Europe, include other characteristics in the definition of PED, addressing that the PED should be an "added value for the user" or achieve an "affordable and high-quality standard of living." The concept of PED can also be related to the "Citizen Energy Community" (CEC) defined by the EU Internal Electricity Market Directive (IEMD), or the "Renewable Energy Community" (REC) found in the EU Renewable Energy Directive (REDII). While RECs and CECs are more related to organizational structures and energy generation management, PEDs do not need to be a legal

entity and, in principle, can adopt any form of organization and management to achieve the goal of a positive energy balance.

Example 11: Groningen North and Groningen South

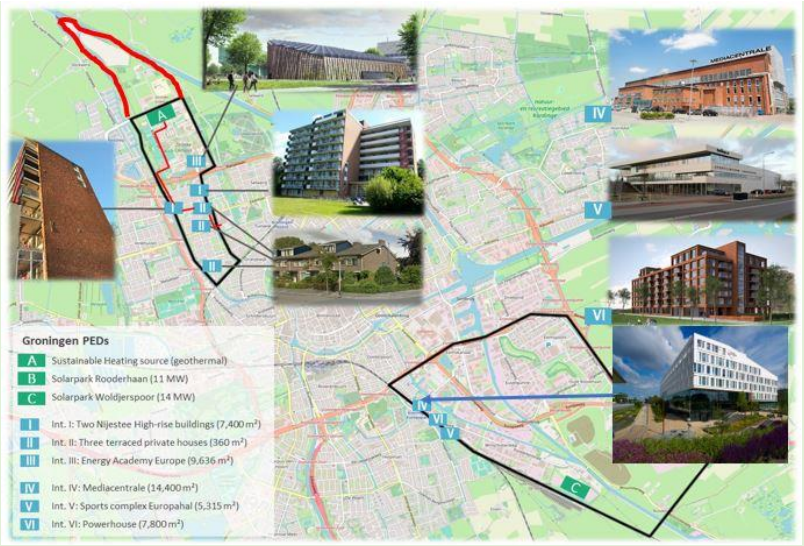
Groningen is known due to its current urban energy transformation strategy. In the Netherlands, natural gas remained for decades the main energy source to respond to the national energy demand. However, reiterated earthquakes caused by the gas exploitation activities seriously damaged houses and revealed a need for sustainable alternatives.

Several infrastructure typologies are represented in both urban areas: residential buildings bordering a university campus, industrial and tertiary blocks, public facilities, etc. Part of the residential area in Groningen North was built in the 1960's while the vast majority of Groningen South is relatively new, constructed around the 1980's.

Overall, the PED implementation in Groningen North and Groningen South involves the retrofitting of residential buildings (floors, roofs, fronts, windows, smart thermostats and sensors to real-time measuring of energy consumption…) in order to maximise infrastructure performance. Solar panels will be installed on the roofs of some buildings and car parks. In addition, solar thermal panels will support geothermal heat pumps which are directly connected to the geothermal district heating system. The surplus of thermal energy produced by some residential buildings will be stored and used during energy demand peaks. On the other hand, biogas technology will be used to collect and "digest" -under high pressure and thanks to bacteria-, waste and waste water produced by public sport and catering facilities.

To monitor the technical and the social adaptations, four sustainable demohouses were created where in which innovative retrofitting measures are being tested on terraced houses in a real life setting.

More information: https://makingcity.eu/groningen/


Groningen PEDs
A Sustainable Heating source (geothermal)
B Solarpark Rooderhaan (11 MW)
C Solarpark Woldjerspoor (14 MW)
I Int. I: Two Nijestee High-rise buildings (7,400 m²)
II Int. II: Three terraced private houses (360 m²)
III Int. III: Energy Academy Europe (9,636 m²)
IV Int. IV: Mediacentrale (14,400 m²)
V Int. V: Sports complex Europahal (5,315 m²)
VI Int. VI: Powerhouse (7,800 m²)

2.5 Governance

Urban governance is the framework that guides decision-making and policy implementation at the local level. This process involves collaboration among different levels of government, the private sector, and the community, ensuring that decisions are inclusive, transparent, and accountable. Effective governance is fundamental to addressing contemporary urban challenges, such as climate change, social inequality, and sustainable development. By fostering active citizen participation and promoting accountability, urban governance contributes to creating an environment conducive to the development of resilient and sustainable cities (ICLEI, 2019).

Tool	Alignment with SECAP	Spatial planning relationship	Estimated impact
Existing supply companies and citizen initiatives inclusion in the drafting and implementation of plans	Ensures SECAP plans reflect the technical capacities of companies and the needs of local communities, enhancing engagement and support.	Encourages collaboration within spatial planning, allowing resources and solutions to be tailored to local demands and infrastructure capacities.	Increases community buy-in and plan success rate, enhancing impact on emissions and resilience by up to 20%.
Actions priority when implementing	Focuses on actions with the highest climate impact, ensuring SECAP objectives are met efficiently.	Supports spatial planning by identifying priority areas for intervention, such as high-density or vulnerable zones.	Maximizes resource use, achieving up to 20% improvement in plan efficiency and emissions reductions.
Regional energy agency	Provides coordination across local and regional levels for energy efficiency and renewable energy projects, aligning with SECAP targets.	Enhances spatial planning by ensuring energy projects are evenly distributed and integrated into urban plans at different levels.	Ensures up to 15-30% improvement in energy project coordination and implementation success.
Internal energy capacity of the municipality	Strengthens SECAP objectives by enhancing the municipality's ability to develop and implement climate and energy strategies.	Enables spatial planning that integrates sustainable practices at an operational level, ensuring that energy projects are realistic and supported by the city's infrastructure.	Improves implementation rates of climate and energy initiatives, achieving 10-20% faster plan execution.
Analysis of (social) vulnerability to urban heat with socioeconomic indicators	Incorporates vulnerability to urban heat in decision-making, supporting SECAP's focus on climate adaptation and protection of at-risk communities.	Informs spatial planning to reduce exposure to extreme heat, identifying zones for cooling measures such as green roofs and shaded spaces.	Reduces urban heat risks by up to 25% in vulnerable areas.
Introducing Living Labs or social hubs for city decision-making	Involves communities in testing and improving SECAP-related policies, ensuring plans are responsive to local needs and effective on the ground.	Provides real-world testing grounds within spatial planning to adapt policies to various areas, fostering localized climate solutions.	Increases policy adoption rate and community support, ensuring up to 30% more effective climate initiatives.
Online platform with collaborative city maps	Supports SECAP transparency and community involvement by offering a digital space for public input, tracking, and information sharing.	Allows spatial planning data to be accessible and interactive, supporting informed decision-making across all urban sectors.	Improves community awareness and participation, increasing plan success by up to 15%.

Existing supply companies and citizen initiatives inclusion in the drafting and implementation of plans.

This process involves the active integration of supply companies and pre-existing citizen initiatives in the formulation and implementation of energy and climate plans. This translates into a collaborative approach that engages stakeholders from both the private sector and the local community in the planning and execution of strategies to address energy and climate change.

Supply companies, which may include energy companies, public utility providers, and other sector actors, bring their technical expertise, resources, and knowledge about the existing energy infrastructure. This may involve the implementation of more efficient technologies, the expansion of renewable energy sources, or the improvement of energy distribution and transmission. Their participation is essential to ensure an effective and sustainable energy transition.

On the other hand, pre-existing citizen initiatives represent the voice and action of the local community in relation to energy and climate change. These can include interest groups, non-governmental organizations, environmental collectives, and other entities already working on projects or campaigns related to energy and the environment. Their participation is crucial to ensure that the proposed solutions are responsive to the needs and concerns of the local community.

The inclusion of these stakeholders in the formulation and execution of energy and climate plans not only enriches the process with a variety of perspectives and knowledge but also fosters a higher level of acceptance and support from the community. This can lead to more effective and sustainable long-term solutions, as they are based on a more comprehensive understanding of local realities and technical capabilities.

In summary, including supply companies and pre-existing citizen initiatives in the drafting and execution of energy and climate plans implies an active collaboration between the private sector and the local community to effectively address energy and climate challenges.

Prioritizing the relevance of different actions when implementing action plans.

Prioritizing the implementation of climate and energy action plans involves assigning varying levels of importance to the various proposed actions based on their relevance and impact on achieving established objectives. This means identifying and classifying actions according to their potential to significantly contribute to climate change mitigation and the transition to more sustainable energy sources.

This prioritization is based on a detailed assessment of each action, taking into account factors such as its potential for reducing greenhouse gas emissions, its technical and economic feasibility, as well as its alignment with the goals and targets set in the plans. Other relevant criteria are also considered, such as the impact on climate resilience, job creation, social equity, and the improvement of community quality of life.

By prioritizing actions, the aim is to maximize the efficient use of available resources and ensure that areas with the greatest positive impact on combating climate change and promoting

cleaner, more sustainable energy are addressed first. This may involve, for example, focusing on transitioning to renewable energy sources, improving energy efficiency in buildings and transportation, and promoting sustainable mobility, among other measures.

It is important to note that prioritization does not necessarily imply the exclusion of certain actions, but rather establishes an implementation order that optimizes results and available resources. Furthermore, this prioritization should be dynamic and reviewed periodically as results are obtained and long-term objectives are adjusted.

Implementing a regional energy agency that is part of the teams drafting local, metropolitan, and regional plans in various areas.

The implementation of a regional energy agency involves establishing an organizational entity responsible for coordinating and promoting energy-related initiatives at the regional level. This agency actively integrates itself into teams tasked with drafting plans in various contexts, including local, metropolitan, and regional levels.

This agency plays a crucial role by providing specialized expertise and resources for the development of energy policies and strategies at the regional level. It works closely with decision-makers and planners at each level, contributing technical expertise and up-to-date knowledge on sustainable energy technologies and practices.

The regional energy agency is responsible for analyzing, proposing, and overseeing measures for energy efficiency, promoting renewable energy sources, reducing emissions, and other aspects relevant to energy sustainability. Additionally, it ensures that these initiatives are aligned with the objectives and goals set forth in plans at the local, metropolitan, and regional levels.

As an integral part of plan-drafting teams, the energy agency helps ensure that energy considerations are appropriately integrated into the planning process. This means that strategies and actions related to energy are consistent and complementary with other goals and objectives in areas such as land use, transportation, urban development, and the environment.

Example 12: Tartu action plan for developing Regional Public Transport and multimodal transport solutions

In Tartu, the transportation system has changed drastically in the last 10 years. About 60,000 new cars have hit the streets, of which approximately one-third (18,000) are registered in Tartu and two-thirds commute to the city daily. As a result, the car fleet has more than doubled, and private cars have become the primary mode of transportation, accounting for 46% of trips within the city. The intensive use of cars significantly impacts traffic regulation, road safety, the living environment, the cost of daily services, health, and urban planning both inside and outside the city. With the continued increase in private car usage, congestion rises, and the quality of other modes of transportation diminishes.

This mobility plan continues the process of sustainable planning, climate resilience, and sustainable mobility planning in the city of Tartu, as outlined in the urban development plan for 2018-2025 and the master plan for 2030+. The mobility plan specifies the transportation section of the Tartu Energy 2030+ sustainable energy

and climate action plan (currently in development), proposing actions and their coordination to increase transportation multimodality, improve regional public transport services, and the share of active transportation modes. The mobility plan also supports the implementation of the strategic bicycle action plan for 2019-2040. The Tartu Regional Energy Agency, in collaboration with the City Government of Tartu, was responsible for coordinating the working group for the preparation of a mobility plan and completing the plan. The document overlaps with other strategic documents of the City Government of Tartu, with the most significant being the energy and climate plan Tartu Energy 2030+. These overlaps are intentional, as the mobility plan specifies previous strategies of Tartu, is part of the action plan of the Tartu Energy 2030+ development plan, uses a similar methodology, and addresses some of the same themes and objectives. The development of the mobility plan is supported by the European Union within the framework of the OptiTrans, SUMBA, and Cities projects.

The key action of the mobility plan is to create multimodal mobility hubs in the heart of Tartu and its suburbs, and connect them through sustainable modes of transportation from within and outside the city. Mobility hubs will enhance the accessibility of urban services for public transport users, making it faster, smoother, and more convenient. Mobility hubs will improve the integration of public transport systems within and outside the city, providing better information and ticketing access. The implementation of shared transportation subscriptions and a common real-time information system, as well as new parking services, will support the operation of mobility hubs.

The implementation of the mobility plan will create an opportunity to mitigate the effects of private car usage in Tartu and help increase the share of sustainable transportation modes in urban transport. The mobility plan supports the implementation of the Tartu Energy 2030+ sustainable energy and climate action plan by helping to reduce energy consumption and environmental impact in the private transportation sector by 15%. By applying principles of sustainable urban development and enhancing the sustainability of the transportation system, the mobility plan supports the implementation of Tartu's general development plan.

During the preparation process, a group of experts suggested a more radical intervention, reducing car usage to 30% by 2030 and 13% by 2040. Political groups within the city government committed to the less ambitious levels of 35% by 2030 and 25% by 2040, leaving unanswered questions about the actual impact of private car usage and the safety of other modes of transportation, specifically walking and cycling. Nevertheless, as the first commitment using numerical indicators to address the uncontrolled increase in private car usage, the political acceptance of reducing this favored mode of transportation for a long time, supported by both municipal officials and transportation experts, remains noteworthy.

More information: https://sumba.eu/en/article/action-plan-developing-regional-public-transport-and-multimodal-transport-solutions-tartu

Developing the internal energy capacity of the municipality.

This approach requires a fairly comprehensive capacity development and the purchase or free download of an energy planning tool. The choice of the tool will determine the training needs, as different tools have very different learning curves, and experts in energy modeling are usually specialized in one tool or model.

This will allow the internal expertise in energy to be developed by understanding the local energy situation, facilitating communication with different local offices and stakeholders. It will promote an understanding of the needs and preferences of citizens and the economic and social situation in the municipality, which will also allow for the adjustment of the energy plan or model of the locality to the municipality's situation, without significant additional costs. If the municipality is able to develop this capacity, it can provide specialized services to other municipalities in the region.

On the other hand, this development requires a lengthy process of modeling and has a high cost to maintain internal expertise, especially if energy planning is not a regular exercise. Additionally, it requires ongoing training due to the rapid advancement in technologies and energy planning models. The smaller the municipality, the more difficulties there are in finding expert candidates who can dedicate themselves to this.

Including an analysis of (social) vulnerability to urban heat with socioeconomic indicators

It entails assessing how different population groups within an urban environment are exposed and may be affected by extreme heat conditions. This analysis relies on indicators that reflect socio-economic aspects of the community, enabling the identification of areas and groups with

higher vulnerability. This is done not only objectively but also by cross-referencing objective data with qualitative input from citizens.

To conduct this analysis, data related to socio-economic factors such as income, educational level, access to resources, housing, among others, are collected and analyzed. These indicators provide a detailed insight into the composition and situation of the population in different urban areas.

The analysis of social vulnerability to urban heat involves collecting socio-economic data, gathering information about the population in question, including income, educational level, occupation, age, among others. Aspects such as population density and demographic composition are also considered. The exposure of different urban areas to extreme heat is examined. This may include identifying areas with high temperatures and the duration of heat episodes.

Through the use of socio-economic indicators, groups of the population that may be more susceptible to the effects of extreme heat are identified. This could include low-income individuals, elderly people, children, or those with limited access to resources. Mapping techniques are employed to visualize areas of higher social vulnerability to urban heat. This aids in identifying zones where adaptation measures should be implemented.

Based on the results of the analysis, specific strategies can be developed to reduce social vulnerability to extreme heat. This may involve the implementation of cool spaces, awareness campaigns, assistance programs, among other measures.

Introducing Living Labs or social hubs for city decision-making

Establishing physical or virtual spaces where citizens, experts, organizations, and relevant entities come together to collaborate on decisions related to the city. These environments are designed to encourage active participation and co-creation of solutions to improve urban quality of life.

Living Labs, often located in urban areas, are spaces where experiments and tests of innovative solutions take place. They can address a wide range of topics, from mobility and sustainability to technology and urban infrastructure. Social hubs, on the other hand, can be both physical and online platforms, facilitating interaction and collaboration among different stakeholders involved in urban development and planning.

In these spaces, knowledge exchange and co-creation of ideas are encouraged among participants. Citizens can contribute their local expertise and knowledge, while experts and organizations bring technical expertise and resources. This collaboration can lead to the identification and development of innovative solutions tailored to the specific needs of the community.

Living Labs and social hubs promote transparency and citizen participation in city decision-making. This contributes to greater legitimacy and acceptance of implemented measures and policies, as they reflect the needs and aspirations of the community. Furthermore, these spaces

foster innovation and the adoption of more sustainable technologies and approaches in urban development.

Example 13: 2ISECAP Project Living Labs

One of the objectives of the project 2ISECAP will be occurred by the establishment, coordination and operation of Living Labs (ISECAP LL) focused on local energy transition. Within the ISECAP LLs environment, public officers, energy and spatial planners at local and regional levels, institutional actors, the business community and the civic will work together to co-create and co-implement a new way of planning and implementing the SECAPs of their local communities to a resilient future. Specifically, six ISECAP LLs will facilitate the experiential learning of stakeholders on the 2ISECAP approach at the six municipalities aiming at the development of their SECAPs.

It is also provided 12 learning modules about the concept of living lab and its establishment as well as different tools to use during LL activities: living lab approach and stakeholders ecosystem management, governance models, how to set up a Living lab, defining the roles within the living lab, business models, open innovation legal aspects, design thinking, empathise and define, ideation and co-design, prototyping and testing solutions, experimentation and scaling up and evaluating the performance.

More information: https://2isecap.eu/living-labs/

Create an online platform with collaborative city maps

On the one hand, the top-down urban planning approaches investigate urban form as a holistic matter which only can be calibrated by urban professionals. These approaches are not able to offer enough information to the end users to predict the urban form. On the other hand, the bottom-up urban design approaches cannot visualise predicted urban scenarios, and most often the design decisions stay as general assumptions.

Shifting from top-down modelling to more generative and bottom-up systems has influenced urban designers to address morphogenetic changes in urban design. Such design systems can perform as creative design assistants during the initial stages of concept development. The traditional urban design and planning approaches have limited ability to address multiple urban complex rules and are not able to provide necessary information to predict the urban forms. Bottom-up design approach encourages the process of local participation in every aspect of development. It involves local participants either through design consultation or by collaboration. Design discussion in bottom-up approach is time-consuming, and most often the design ideas stay in assumption.

Moreover, because of lack of visual information, the stakeholders aren't able to compare multiple urban scenarios. Traditional top-down urban design and planning approaches provide limited information for lay people to understand the process of idea generation. These methods have communicative established symbols which only can be calibrated by professionals. They have lack of communication channels for stakeholders to participate in the design discussion process. Also, the final rendered outputs are not flexible enough to visualise multiple design ideas at a time. There are always differences exist in thinking and communicating language between professionals and laypersons. A computational virtual platform can overcome such communicative gap between practitioners and laypersons.

Example 14: Urban Master Plan Tartu 2030+

Tartu is an increasingly international university town with a unique creative aura and a spatially dense culture and education network. Along with the neighbouring rural municipalities and urbanisation towards the Nõo and Elva direction, Tartu has become a unified and spatially cohesive urban region.

Tartu 2030 is a platform for cooperation and a set of guidelines primarily to the present and future members of the City Council and the City Government of Tartu, in addition to all the people interested in the welfare of Tartu. Tartu 2030 lays the perfect foundation for negotiations with public agencies, local self-governments, private investors, business people and non-governmental organisations. Together, the best ideas for supporting sustainable development and competitiveness of Tartu are generated. With this purpose, plans are made for the use of resources.

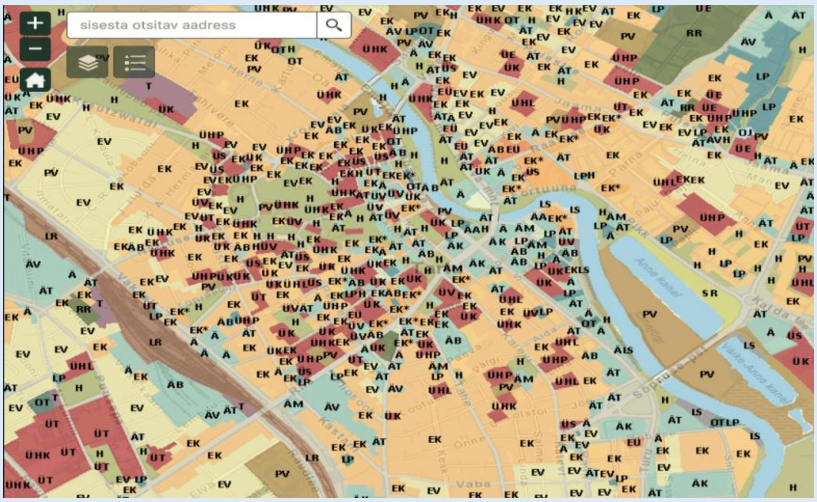
One of the important prerequisites for the creation and maintenance of a good living and economic environment in a local government is the existence of a high-quality and functioning master plan and purposeful co-operation with the plan for the implementation of what is planned. The master plan has a role in determining the conditions of major use and construction, the master plan is the basis for the preparation of the relevant investment and the detailed plan preparing the construction, and it concerns the development of the city as a whole.

The main topics covered in the city master plan: urban sprawl, architecture, environmental protection, areas of environmental value, definition of public space, energy and population mobility.

They have created an interactive online platform, where citizens and technicians/politicians can communicate directly from the city map. From the local government, the actions that are being carried out in the city and future proposals are reported geo-located. On the other hand, citizens can directly report complaints, suggestions or

assessments of the city's actions on the same platform. In this way, a direct relationship between government and citizens is established.

More information: https://cooperativecity.org/tartus-new-masterplan/



Conclusion

This toolkit serves as a comprehensive guide to enhance urban resilience and sustainability by providing tools for cities to address climate change adaptation and improve energy efficiency across five critical areas: planning, mobility, built environment, land use, networks and structures, and governance. By focusing on each of these domains, the toolkit enables cities to tackle the complex, interconnected challenges posed by climate change and energy transitions.

Through the integration of these areas, the toolkit highlights the importance of **strategic urban planning** that aligns local and national objectives under the SECAP framework. **Planning** and **land use** tools emphasize how spatial organization and resource allocation can be optimized to support energy efficiency and carbon reduction. Similarly, innovations in **mobility** promote sustainable, low-emission transportation options that are accessible and well-integrated with urban structures. The **built environment** strategies underscore the role of energy-efficient, climate-resilient building codes and retrofitting plans that work to reduce emissions throughout the building life cycle.

The sections on **networks and structures** and **governance** underscore the foundational role of urban infrastructure and collaborative policymaking in achieving sustainable goals. Green-blue infrastructure (BGI) and collaborative governance models, such as Living Labs, foster both social cohesion and resilience, ensuring that energy initiatives have broad stakeholder support and that local adaptation strategies are community-driven and context-specific.

By facilitating a **synergistic approach** that aligns local initiatives with national standards, the toolkit offers cities the tools to develop resilient urban systems capable of enduring climate impacts while progressing toward a sustainable, low-carbon future. This holistic model

promotes cities as leaders in climate action, able to harness both local insights and national resources to meet ambitious SECAP objectives and contribute to a just energy transition.

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