Politecnico di Torino

School of Planning and Design

Master of Science Territorial, Urban, Environmental, and Landscape Planning

Planning for the global urban agenda curriculum

Mapping dashboards for urban sustainability: tools for citizen engagement or technocratic governance?

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Academic year of 2024/2025

Abstract

Mapping dashboards are transformative tools in urban governance, offering real-time data visualization to support sustainable development, enhance decision-making, and foster citizen engagement. In this context, while some critics warn that mapping dashboard can embody an extremely technocratic form of city governance, others praise their potential for deeper forms of citizen engagement and participation in planning. As these tools are increasingly used by cities to achieve and monitor the transition to more sustainable futures, it is important to understand the extent to which urban dashboards are true to their participatory potential.

This dissertation analyses the role of mapping dashboards in supporting sustainable urban development in Turin by drawing comparative insights from Helsinki and Copenhagen. In doing so, this work seeks to understand how mapping dashboards can balance technocratic governance with citizen engagement in Turin to better achieve the SDGs. While mapping dashboards have proven effective in advancing sustainable urban development in cities like Helsinki and Copenhagen, Turin has yet to fully capitalize on these tools. The city's existing dashboards are fragmented and lack comprehensive integration across sectors, limiting their effectiveness in supporting sustainability initiatives. This gap raises critical questions about how Turin can enhance its use of digital platforms to address environmental, social, and economic challenges. There is a pressing need to explore how mapping dashboards can transition from being purely technocratic tools to inclusive platforms that foster citizen participation and collaborative governance.

Anchored in the theory of communicative planning, which emphasizes dialogue, inclusivity, and shared decision-making, this dissertation analyses how digital platforms are embedded in the urban governance cultures of these three cities. Through an in-depth case study of Turin—including tools developed by CSI Piemonte—and a comparative analysis of Helsinki's participatory data platforms and Copenhagen's real-time operational dashboards, the thesis of this work is that mapping dashboards can bridge technocratic governance and citizen engagement, offering a pathway to more inclusive, resilient, and sustainable urban environments. By aligning its strategies with leading cities, Turin can position itself as a model of sustainable urban development, contributing meaningfully to global sustainability goals.

Key words: Mapping Dashboards; Sustainable Development Goals (SDGs); Citizen Engagement; Technocratic Urban Governance, Helsinki, Copenhagen, Turin

Contents

Introduction

In the era of rapid urbanization and climate change, sustainable urban development has emerged as a critical focus for policymakers, urban planners, and researchers. Cities are at the forefront of addressing global challenges, including carbon neutrality, resource scarcity, and social inequality. In response, cities worldwide are adopting innovative tools and strategies to achieve the United Nations Sustainable Development Goals (SDGs). Among these tools, mapping dashboards have gained prominence for their ability to visualize complex data, monitor sustainability indicators, and facilitate evidence-based decision-making.

Mapping dashboards—interactive tools that visualize and analyse urban data—are increasingly integral to supporting green initiatives and strategic planning. These dashboards serve as dynamic platforms that not only enhance urban governance but also supposedly engage citizens in shaping resilient and inclusive cities.They allow policymakers and citizens alike to access real-time information on environmental conditions, mobility patterns, and resource consumption. This accessibility is meant to foster data-driven decision-making and enables more responsive and adaptive urban management. By integrating diverse datasets, mapping dashboards can track sustainability progress, identify problem areas, and guide targeted interventions for urban resilience.

However, the use of mapping dashboards has been met with both praise and critique. Proponents argue that these tools enhance transparency and foster citizen engagement by providing accessible data that encourages public participation in urban governance. Conversely, critics contend that dashboards can reinforce technocratic governance, prioritizing data-driven decision-making by experts while marginalizing community voices. This dual perspective raises important questions about how mapping dashboards can balance the need for efficient governance with the imperative for inclusive and participatory urban planning.

This type of interactive and inclusive planning has been described as “communicative planning.” Proposed by theorists Patsy Healey and Judith Innes, communicative planning calls for planning processes rooted in mutual learning, shared power, and ongoing dialogue among diverse stakeholders (1997). Rather than relying solely on top-down expertise or technical optimization, communicative planning seeks to bring different forms of knowledge—expert, experiential, local—into the policymaking arena. In this view, dashboards are not just management tools but potential platforms for deliberative engagement, where citizens are not passive consumers of data but co-producers of urban futures.

To explore this debate, this dissertation focuses on the deployment of mapping dashboard in the city of Turin, in Northern Italy. Turin has made significant strides toward its "green future" by adopting comprehensive strategies aimed at environmental sustainability, urban regeneration, and technological innovation. As part of the Covenant of Mayors for Climate and Energy, Turin is committed to reducing greenhouse gas emissions by 40% by 2030 and achieving carbon neutrality by 2050. These ambitious goals underscore the city's dedication to mitigating climate change impacts while promoting sustainable urban living. Mapping dashboards have played a crucial role in these efforts, supporting initiatives such as air quality monitoring, green mobility, and energy efficiency projects. In this context, dashboards are said

to contribute to Turin's broader sustainability goals, including achieving carbon neutrality by 2050.

However, while mapping dashboards have proven effective in advancing sustainable urban development in cities like Helsinki and Copenhagen, Turin has yet to fully capitalize on these tools. The city's existing dashboards are fragmented and lack comprehensive integration across sectors, limiting their effectiveness in supporting sustainability initiatives. This gap raises critical questions about how Turin can enhance its use of digital platforms to address environmental, social, and economic challenges. There is a pressing need to explore how mapping dashboards can transition from being purely technocratic tools to inclusive platforms that foster citizen participation and collaborative governance. To make this case and frame this investigation, two contrasting European cases are explored: Helsinki and Copenhagen—cities often praised for their progressive urban governance, environmental leadership, and inclusive use of digital tools.

In doing so, the dissertation contributes to two intersecting debates: first, the growing academic and policy interest in how digital technologies reshape urban governance; and second, the enduring question of how planning processes can be made more inclusive, just, and effective. Grounded in the communicative planning tradition, the research positions dashboards as boundary objects—tools that can mediate between institutions and the public, provided they are designed to support dialogue rather than control.

Ultimately, this thesis argues that the true potential of dashboards lies not in their technical sophistication, but in their capacity to facilitate civic participation, support shared understanding, and democratize urban knowledge through its integration across different communities of practice. In this way, dashboards can move beyond being mere instruments of oversight, becoming instead integral components of communicative, responsive, and sustainable urban governance.

0.1 Defining Urban Dashboards

Figure 1 organization and operational dashboards (The Smallman, 2024.)

Kitchin (2014) describes urban dashboards as tools that enable governments and the public to interact with city-related data, enhancing understanding of urban forms, functions, and dynamics. The "control room" is considered a predecessor to urban dashboards, allowing officials to observe and manage urban systems in real time (Mattern, 2015). Mattern (2015) links urban dashboards to definitions from business intelligence (BI), referencing Few's (2006) description of a dashboard as a "visual display of the most important information needed to achieve information that can be monitored immediately. Urban dashboards, therefore, are platforms that utilize visual analytics, dynamic and interactive graphics, maps, 3D models, and augmented landscapes to display information on the performance, structure, patterns, and trends of cities (Kitchin and McArdle, 2016). Analytical dashboards, also known as "dashboards of dashboards" (Dubriwny & Rivard, 2004) are more comprehensive, hierarchically organized systems that allow users to navigate interconnected data and explore from summaries to detailed information.

These dashboards do not merely consolidate information but also integrate tools such as Planning and Spatial Decision Support Systems (PSS & SDSS). Their primary purpose is to support visual analytics, which Thomas and Cook (2006) describe as a multidisciplinary science enabling analytical reasoning through interactive graphic interfaces. Pettit and Leao (2017) further define urban dashboards as "graphic user interfaces which comprise a combination of information and geographical visualization methods for creating metrics, benchmarks, and indicators to assist in monitoring and decision-making". However, they emphasize that their applications in decision-making and citizen participation require further investigation.

Examples of public-facing urban dashboards include the Dublin Dashboard (McArdle & Kitchin, 2016), the City of Sydney Dashboard (Pettit et al., 2017), the Michigan MIFuture Dashboard (State of Michigan, 2018), and the Edmonton Citizen Dashboard (City of Edmonton, 2017). In the private sector, platforms like Tableau and Power BI have democratized

dashboard creation, enabling non-specialists to create and share dashboards with ease (Lachev & Price, 2018). These dashboards also increasingly integrate AI capabilities, such as using deep learning to automate urban planning tasks (Feng & Bednarz, 2018). The development of immersive technologies, such as Oculus Rift, HTC Vive, and Microsoft HoloLens, further extends the functionality of urban dashboards. These head-mounted displays provide three-dimensional spatial contexts, enhancing immersion and interactivity for urban data analysis (Chen et al., 2017; Elvezio et al., 2018). All these technical devices are now part of the broader city analytics and visualization field.

0.2 The Importance of Mapping Dashboards in Urban planning for sustainable transitions

The integration of technology into the decision-making processes of city development is inevitable. Mapping dashboards have emerged as transformative tools in urban planning, providing valuable insights into the complex dynamics of cities and the broader environment. These tools allow stakeholders, from policymakers to local communities, to make informed decisions about urban growth, infrastructure, and sustainability. By presenting spatial data in intuitive formats, mapping dashboards make it easier to visualize and interpret information that would otherwise be overwhelming. Their impact spans across multiple sectors, from disaster response to environmental conservation, contributing to more effective, data-driven urban design.

One of the most significant advantages of mapping dashboards is their ability to facilitate real-time decision-making. In urban management, this becomes crucial, especially in contexts where timely responses are necessary. For example, during severe weather events, meteorologists rely on dashboards to predict conditions using satellite imagery and GIS data, as seen in the National Oceanic and Atmospheric Administration reports (NOAA, 2023). This approach aids in disaster preparedness, ensuring that cities are resilient to natural disasters by providing real-time insights on weather patterns and other critical conditions. Such real-time data also prove invaluable in urban planning, where changes must be swiftly implemented to accommodate growing populations and shifting demands.

Another key feature of mapping dashboards is their ability to simplify complex spatial data, turning intricate datasets into comprehensible visualizations. Urban planners, for example, deal with vast amounts of data related to traffic patterns, population growth, land use, and environmental conditions. Without the use of visual tools, these data points can appear as isolated figures, making it difficult to discern meaningful trends. Dashboards, however, provide an accessible and understandable format by transforming these relationships into visual representations. This shift from raw data to clear, graphical displays helps planners identify patterns, such as areas of rapid urbanization or regions in need of transportation infrastructure.

Mapping dashboards also play a crucial role across various sectors, highlighting their versatility and importance in decision-making processes. For instance, in public health, these tools were indispensable during the COVID-19 pandemic. Real-time mapping, which combined infection rates with geographical data, allowed policymakers to monitor and control the spread of the virus effectively. Similarly, in the realm of environmental conservation, mapping dashboards

have been used to monitor deforestation, wildlife migration, and biodiversity loss. A prime example is Oxford University's (2023) research on using mapping tools to mitigate the effects of biodiversity loss, demonstrating their global applicability and relevance in addressing critical ecological challenges.

Moreover, these tools support collaboration and accessibility, breaking down barriers to spatial data usage. Cloud-based technologies and open-source tools make mapping dashboards accessible to a broad range of users, from large institutions to smaller entities, ensuring that even local communities can access vital information. This democratization of spatial data fosters collaboration across various stakeholders. For example, researchers, policymakers, and citizens can now collectively analyse data, sharing insights and contributing to decision-making. In the context of urban planning, this collaborative framework can promote inclusive decision-making, allowing for the development of cities that reflect the needs of diverse populations.

Finally, mapping dashboards go beyond real-time data to provide historical and predictive insights, which are essential for proactive planning. By integrating past data with advanced predictive analytics, these tools offer foresight into potential challenges. For instance, NOAA's predictive models, which leverage satellite data to simulate the impacts of climate change, help urban planners anticipate future scenarios and develop strategies to address potential risks (NOAA, 2023). This capability extends the utility of mapping dashboards far beyond mere data visualization, providing actionable insights for long-term urban development and sustainability.

In this context, mapping dashboards have been praised for their potential to enhance citizen engagement in what it known as communicative planning.

0.3 Research questions

This dissertation addresses three empirical questions and explores a conceptual debate concerning the use of digital technologies in the governing of cities.

How have mapping dashboards been utilized in leading EU green cities such as Copenhagen and Helsinki? What successes and challenges have emerged in their application?

How have mapping dashboards in Turin been used to support sustainable urban development?

Given these examples, are mapping dashboards just tools for technocratic urban governance, or can they serve as platforms for citizen engagement in the green transition?

In answering these questions, this dissertation provides an in-depth analysis of the role mapping dashboards play in driving progress towards Turin's current green initiatives.

Through a comparative analysis of Copenhagen and Helsinki—renowned European green cities—this work examines best practices and transferable insights to enhance Turin's sustainability efforts. According to Sustainable Development Goals (SDGs) report published on 2019 ,Turin (35th, 56.4): Far behind its Northern European peers, Turin struggles with air quality and economic inequality.

In doing so, the following pages also evaluate the dual role of mapping dashboards, exploring their capacity to balance technocratic, data-driven decision-making with inclusive participatory governance. While mapping dashboards are highly effective tools for real-time monitoring and strategic planning, their success depends on their integration into broader participatory frameworks that foster transparency and citizen engagement.

Ultimately, this study demonstrates how mapping dashboards can bridge gaps between current practices and future targets, enabling more impactful, inclusive, and transparent urban development. By learning from successful practices in other cities, Turin can refine its approach to sustainability and strengthen its path toward meeting ambitious climate goals.

0.4 Overview of methods

This dissertation focuses on the use of mapping dashboards in supporting sustainable urban development in Turin, with comparative analyses of similar tools in Helsinki and Copenhagen. The research is limited to evaluating dashboards related to environmental sustainability, urban mobility and citizen engagement. It does not cover other digital governance tools unrelated to sustainability objectives. The study period aligns with the most recent data and initiatives up to 2024. Data were collected through document analysis and a review of academic and policy literature.

0.5 Thesis and contributions

As cities continue to expand and integrate new technologies, many are adopting digital platforms and mapping dashboards to guide and communicate urban planning efforts. These tools help make sense of complex spatial and numerical data, offering a clearer picture of how urban systems function. They're often praised for improving transparency, supporting real-time monitoring, and creating new ways for different groups to get involved in planning. But this digital shift also brings up an important concern: are these platforms genuinely encouraging public participation, or are they simply reinforcing systems where decisions are still made by a selected group of experts?

This dissertation explores how digital mapping dashboards are reshaping urban governance, questioning whether these tools genuinely foster citizen participation or primarily reinforce technocratic, top-down approaches to decision-making. Cantered on the case of Turin—and informed by comparative insights from Helsinki and Copenhagen—the study examines how these platforms are used to manage sustainability goals, guide planning strategies, and engage the public. Rather than labelling dashboards as inherently democratic or authoritarian, the research argues that their impact depends on how they are designed, governed, and embedded within participatory frameworks. By critically analysing the potentials and limitations of tools like those developed by CSI Piemonte, this thesis reveals how mapping dashboards can either consolidate centralized control or open new pathways toward more inclusive, transparent, and citizen-driven urban development.

This thesis looks at that tension by exploring the two sides of digital dashboards and platforms. On one side, they're seen as useful tools for promoting more open and communicative planning, helping people access and understand city changes.

On the flip side, some critics argue that they often end up serving the interests of city officials and technocrats, who use them to push decisions based on data and algorithms, with little room for broader public input (Kitchin et al., 2015; Cardullo & Kitchin, 2019).

In many cases, local governments use dashboards to support what's called "smart governance," relying on data analysis, algorithms, and visual reports to keep cities running efficiently (Batty, 2013). These tools can track trends, forecast future developments, and measure how policies might play out. Technocratic governance, in this context, means decisions are largely made by specialists and institutions rather than by the people affected by them (Swyngedouw, 2005). Dashboards, when not transparent, can act like black boxes—presenting polished visuals without showing the underlying data assumptions or methods used. This can make it difficult for citizens to question or engage with the information being presented. Even though these platforms are efficient and help streamline decision-making, they can also limit who gets to be part of the conversation. By focusing so heavily on metrics, charts, and optimization, they often overlook personal stories, community experiences, and broader questions of fairness and justice (Shelton et al., 2015). Increasingly, planning authorities rely on dashboards that pull together data from transport, energy, land use, emissions, and more summarizing it all in one place to guide major decisions (Cavalcante et al., 2021).

This research asks: are dashboards mainly tools for top-down management, or can they also be used to foster real participation and public input? As cities embrace data-led planning, dashboards are playing a bigger role in how urban policy is shaped. They offer insights and help guide strategy, but they also raise valid concerns about who controls the data and how it's used. Some argue they strengthen expert-driven decision-making; others believe they can open new paths for collaboration and dialogue.

Here, dashboards are treated as more than just tools—they are part of larger systems shaped by politics, institutions, and social dynamics. By looking at how they're designed, who uses them, and how they're applied in real-world settings, this study explores whether dashboards enable more democratic planning or simply reinforce existing power structures. Take energy dashboards, for example. These are being used by local governments to model renewable energy scenarios, track emissions, and prioritize investments based on how well different strategies perform (Kanellopoulos et al., 2021). By combining maps, data visualizations, and policy simulations in one platform, planners can justify their decisions more convincingly.

But with that also comes a growing reliance on numbers and measurable outcomes. This can create a false sense of neutrality—where decisions seem objective but are actually based on hidden assumptions. Without public oversight, these dashboards might unintentionally reinforce the status quo and deepen existing inequalities (McFarlane & Söderström, 2017).

Indeed, this research holds significance for two key reasons. Firstly, it adds to the expanding body of literature concerning the role of digital platforms—particularly city dashboards—in promoting sustainable urban governance and enhancing citizen engagement. By examining the case of Turin in comparison with leading cities in sustainability, such as Helsinki and Copenhagen, recognized as green leaders, the study offers meaningful insights into how digital innovation can be leveraged to address urban challenges and foster more inclusive civic participation and also by monitoring real time data via online digital platforms support decision makers for suitable decisions and citizens to take part in city decision making system and development.

Secondly, the research critically explores the inherent contradictions within data-driven decision-making processes through the notion of communicative planning, highlighting the risk of such approaches slipping into technocratic governance models that may overlook the importance of participatory and democratic urban futures.

Chapter 1. Background

1.1 A short history of mapping dashboards

Dashboards have emerged as indispensable tools in modern data analysis and decision-making processes, offering real-time visualization and enabling swift, informed actions. Their development reflects the interplay between technological advancements and the growing demand for accessible, actionable insights. To fully appreciate the transformative power of dashboards, it is essential to trace their historical roots, evolution, and current applications, which highlight their central role in a data-driven world.

Figure 2 Mission Control at Nasa (Johnson Space Centre)

1.2 The Origin of the Term "Dashboard"

The term 'dashboard' originated as a reference to a physical barrier on horse-drawn carriages, designed to shield drivers from mud and debris kicked up by horses. This concept transitioned into the automobile industry in the early 20th century, where dashboards provided critical information, such as speed, fuel levels, and engine temperature. These early iterations laid the foundation for modern digital dashboards. By the mid-20th century, automotive dashboards

had evolved into structured interfaces with gauges and dials, mirroring the organized and accessible data systems seen today (Saturday Evening Post, 2022).

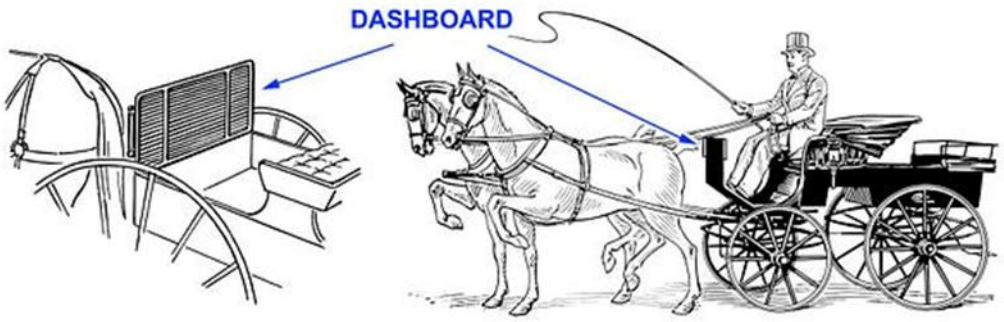


Figure 3 Primary dashboard (The Smallman, 2024.)

Figure 4 Modern car dashboard

1.3 Early Digital Dashboards: The 1970s and Project Cybersyn

Figure 5 Cybersyn operations room (Mattern, 2015)

The evolution of dashboards into digital formats began in the 1970s with pioneering initiatives like Chile's Project Cybersyn. This cybernetics-based decision-support system, implemented under Salvador Allende's government, sought to manage the nation’s economy through innovative technologies. The centrepiece of this effort was the hexagonal "Opsroom," which acted as a control hub where leaders accessed and analyzed economic data. Dashboards featured prominently, with data feed screens displaying production metrics, economic charts, and factory visuals. Operators could manipulate data displays via console controls, demonstrating an early instance of interactive data visualization (Mattern, 2015).

1.4 The GUI Revolution of the 1980s

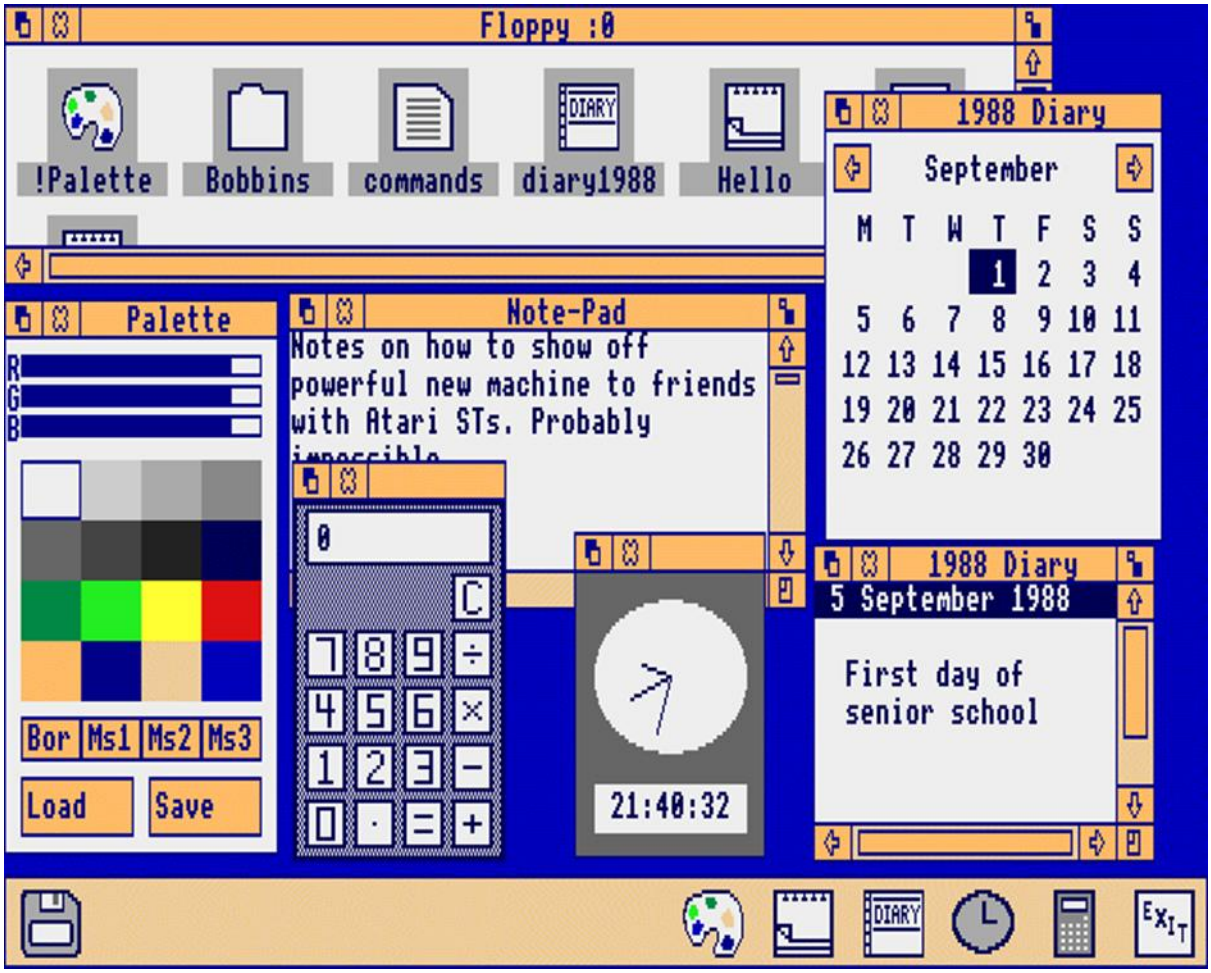


Figure 6 Arthur operating system .RISC OS (Reduced Instruction Set Computing Operating System,1987)

The introduction of graphical user interfaces (GUIs) in the 1980s revolutionized the presentation of information. Early computer dashboards, which had been limited to text-based data displays, were transformed by GUIs into visually engaging and user-friendly tools. Incorporating charts, graphs, and other visual elements, dashboards became more intuitive and accessible, as well as a more common feature of human-computer interaction. This era marked a transition from static data presentation to dynamic and interactive systems, paving the way for the versatile dashboards of today.

1.5 The 1990s: Business Intelligence and Public Sector Innovations

The 1990s witnessed the expansion of dashboards into business intelligence (BI) and public sector governance, reflecting their growing versatility and utility.

One landmark innovation was CompStat, a statistical system introduced by the New York City Police Department. CompStat aggregated weekly crime data, which precinct personnel analysed to identify trends and guide enforcement strategies. The success of this approach led to widespread adoption by law enforcement agencies worldwide.

CompStat was a groundbreaking innovation in data-driven policing introduced in the 1990s (Bratton & Knobler, 1998). Developed to systematically track crime trends via weekly data aggregation, it revolutionized accountability within the New York City Police Department and later inspired broader applications of business intelligence in public sector governance.

However, the implementation of CompStat also attracted significant controversy. Critics have noted that the system's heavy reliance on numerical targets sometimes created a "numbers game," pressuring officers to prioritize statistical improvements over community relations. This focus is argued to have led to aggressive policing tactics that disproportionately impacted minority neighbourhoods—particularly Black communities—resulting in increased stops, searches, and arrests (Epp, 2011).

Moreover, the emphasis on quantifiable performance sometimes incentivized practices such as reclassifying or underreporting crimes to meet targets. Such measures not only called into question the integrity of the data but also contributed to systemic biases, raising ethical concerns about fairness and accountability in law enforcement (Bratton & Knobler, 1998; Epp, 2011).

In fact, while CompStat marked an important shift toward data-driven decision making in policing, its legacy is complex. Its innovative approach to managing crime statistics and holding personnel accountable must be weighed against the critical concerns regarding over policing and racial bias.

Simultaneously, dashboards began influencing governance. Baltimore Mayor Martin O'Malley introduced CitiStat in 1999 to address crime and economic challenges through internal accountability metrics. By 2003, CitiStat expanded into an online platform for public transparency. This initiative inspired similar systems, including DC Stat (2005), Maryland's State Stat (2007), and NYC Stat (2008). These innovations aligned with the "new managerialist" ethos of urban governance, emphasizing benchmarking and sustainability (Mattern, 2015). In the private sector, business intelligence tools transformed data management and decision-making. Companies like SAP, Oracle, and Microsoft developed sophisticated BI platforms capable of aggregating and visualizing complex datasets. Dashboards within these platforms enabled businesses to track performance metrics, identify trends, and make data-driven decisions. These advancements underscored the growing reliance on dashboards as analytical and strategic tools.

1.6 Bloomberg Terminals and the Financial Dashboard Evolution

In the realm of urban planning and design, the integration of advanced data visualization tools has become increasingly essential. Just as financial professionals have leveraged sophisticated dashboards to enhance decision-making, urban planners are adopting similar technologies to navigate the complexities of city development. The evolution of financial dashboards, particularly the advent of Bloomberg Terminals in 1982, offers valuable insights into how data visualization can transform professional practices.

In 1982, Michael Bloomberg introduced the Bloomberg Terminal, a groundbreaking system that revolutionized the financial industry. This multi-screen platform provided real-time and historical financial data, enabling users to analyse equities, fixed-income securities,

derivatives, and news events with unprecedented speed and accuracy. The Terminal's customizable views allowed traders to contextualize data effectively, setting a new standard for data accessibility and interactivity in financial decision-making (Mattern, 2015). Its comprehensive suite of analytical tools facilitated complex financial modelling and forecasting, empowering professionals to evaluate potential risks and returns of various investment opportunities (Leland, 2023). Moreover, the Terminal's integration of news and research features kept users informed about market trends and breaking news, further enhancing its utility in the fast-paced financial environment.

The principles established by the Bloomberg Terminal have influenced various industries, including urban planning. The evolution of Business Intelligence (BI) dashboards, from static reports to dynamic, interactive platforms, mirrors the transformation in urban planning tools. Modern BI dashboards allow users to collect and analyze data from diverse sources, facilitating informed decision-making (Yellowfin BI, 2021). Similarly, urban planners now utilize advanced mapping dashboards to visualize complex spatial data, monitor land use patterns, and design sustainable transportation networks. The integration of real-time data and predictive analytics in urban planning dashboards enables planners to anticipate challenges and develop proactive solutions. By leveraging historical GIS data and advanced modeling techniques, these tools provide actionable insights into potential risks and mitigation strategies, extending their utility far beyond static data representation (NOAA, 2023).

The evolution of financial dashboards, exemplified by the Bloomberg Terminal, has set a precedent for data visualization and interactive decision-making across various sectors. In urban planning and design, the adoption of similar technologies enhances the ability to analyze complex data, anticipate challenges, and develop sustainable solutions. As the field continues to embrace these advancements, the integration of sophisticated data visualization tools will be crucial in shaping the cities of the future.

1.7 The 21st Century: Real-Time Dashboards and Sector-Specific Applications

Advancements in internet technology and computing power in the 21st century have elevated dashboards to new levels of interactivity and functionality. Tools like Tableau, Power BI, and QlikView offer users the ability to customize interfaces, drill into specific data points, and integrate diverse data sources, such as cloud services and APIs. These features enable real-time updates and comprehensive insights, making dashboards indispensable across various fields.

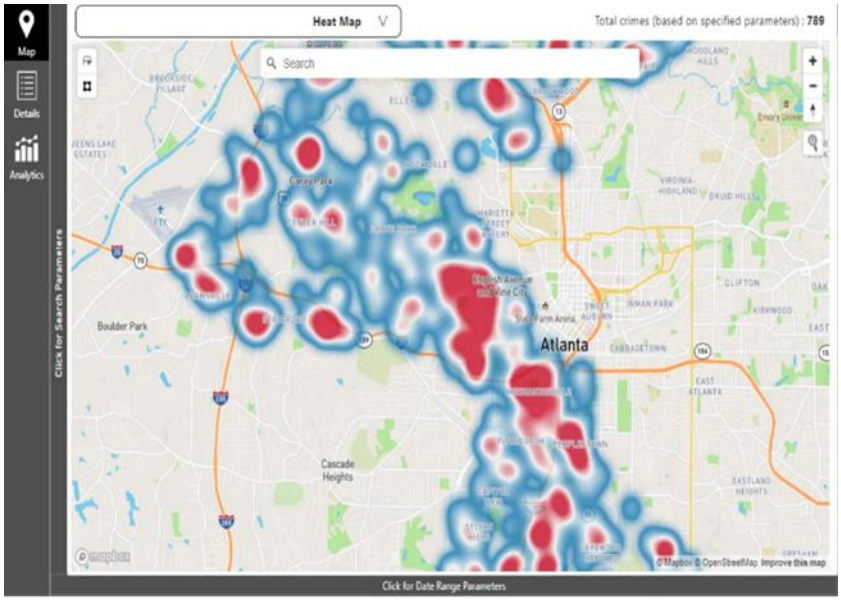


Figure 7 New York police department Crime types heat map in a specific region (zone).

Figure 8 New York police department Crime types in a specific zone and time frame

Public-sector dashboards exemplify these advancements. Michigan's "Mi Dashboard," for instance, provides visualized metrics on education, health, infrastructure, and other domains. Accompanying graphs and progress indicators facilitate user understanding, though transparency regarding data derivation remains a challenge (Mattern, 2015).

Figure 9 Data analysis dashboard

1.8 Dashboards and Communicative Planning: Enhancing Citizen Engagement

The increasing use of mapping dashboards in city management has prompted critical commentators to speak about "platform urbanism" or "dashboard urbanism" (Barns, 2016). In this sense, dashboards have been promoted as tools that can enhance complex decision making in the planning process, especially as far as they could facilitate more transparent and interactive forms of planning. These are usually described as the principles of "communicative planning" (Barns, 2016).

1.9 Definition of Communicative Planning

Communicative Planning is an urban planning approach that emphasizes stakeholder engagement and collaborative decision-making, aiming to respect and integrate diverse perspectives within the planning process. This paradigm shift, emerging prominently in the 1990s, moved away from traditional top-down planning methods, advocating for inclusive dialogue among community members, planners, and policymakers to achieve consensus-driven outcomes (Innes, 1995; Healey, 1992). It also focused on the cross-pollination of alternative forms of urban knowledge situated in diverse epistemic communities.

Dashboards, as visual data representation tools, play a significant role in facilitating Communicative Planning. They provide accessible platforms for stakeholders to interact with complex data, enhancing transparency and informed decision-making. By presenting real-time information through intuitive visualizations, dashboards enable community members to engage more effectively in the planning process, fostering a collaborative environment conducive to consensus-building (Research to Action, 2021).

The integration of dashboards into Communicative Planning processes has been explored in various academic studies. For instance, dashboards have been identified as mechanisms for community empowerment, allowing stakeholders to explore results, pose new questions, and disseminate findings based on data visualization capabilities (Innes, 1998; Research to Action, 2021). This accessibility to well-designed data visualizations contributes to genuine bidirectional communication, a cornerstone of Communicative Planning.

Furthermore, dashboards serve as conduits for collaborative planning by providing forums for detailed peer-reviewed research on planning that invites reflection by practitioners, academics, and students (Érudit, 2024). They facilitate the dissemination of complex data in a clear and actionable manner, supporting the collaborative efforts inherent in Communicative Planning.

Urban dashboards designed for communicative planning must cater to various stakeholders, including citizens, government agencies, planners, and policymakers. However, many dashboards fail to facilitate multi-directional information flows between these groups. This gap underscores the need for designs that support participatory outcomes, aligning with Arnstein's (1969) Ladder of Participation, which categorizes levels of public involvement into three tiers: nonparticipation, tokenism, and citizen control. Arnstein's framework remains a seminal guide for understanding power dynamics in decision-making processes.

Carver et al. (2001) argue that achieving two-way communication in participatory planning remains challenging, even with advances in internet communication. Initial steps, such as online data sharing, are straightforward, but deeper levels of participation require overcoming significant barriers in data analysis and engagement. Cardullo and Kitchin (2019) expand on Arnstein's framework with the Scaffold of Smart Citizen Participation, which categorizes urban data platforms by the degrees of citizen power they enable, ranging from "leader" to "data point." Urban dashboards often fall under tokenism, where information is simply shared with users. However, the framework highlights opportunities for dashboards to evolve into more participatory tools.

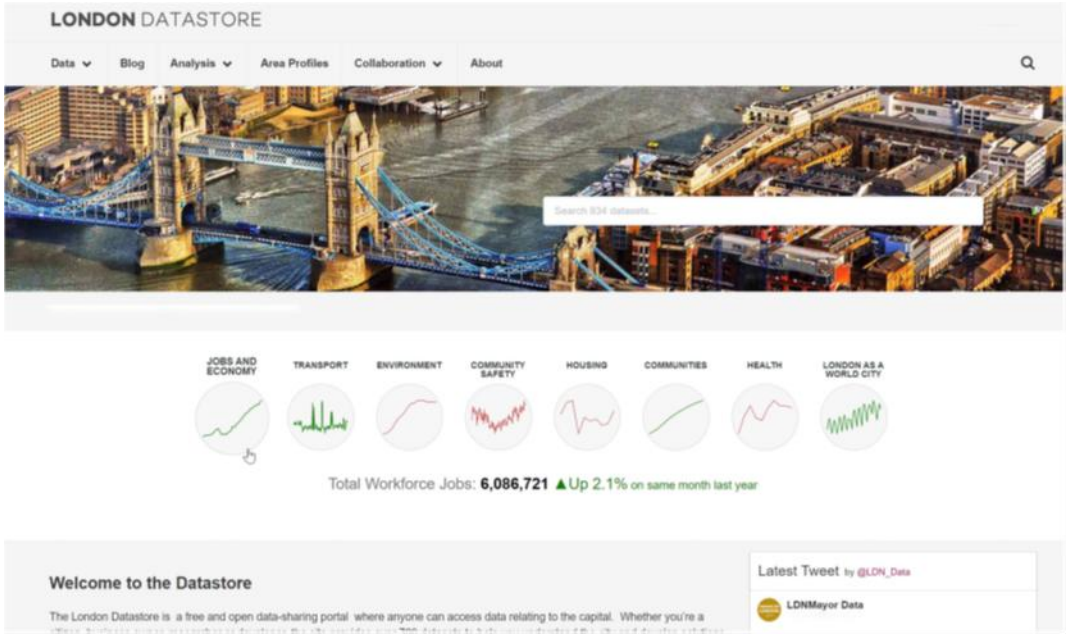


Figure 10 (London data store ,2024)

1.10 Technocratic urban governance: Expertise, Technology, and Inclusivity

Technocratic urban governance is characterized by its reliance on expertise, technology, and data-driven approaches to address urban challenges and optimize city functions. A key feature of this approach is data-driven decision-making, where policies are informed by real-time data, research, and analytics derived from sources such as sensors, urban informatics, and big data (Kitchin, 2014). Governance processes are typically led by professionals in fields such as urban planning, engineering, economics, and environmental science, ensuring a focus on scientifically sound solutions (Fainstein, 2005). The integration of advanced technologies, including the Internet of Things (IoT), Artificial Intelligence (AI), and Geographic Information Systems (GIS), further enhances efficiency in areas like traffic management, waste collection, and public safety (Batty et al., 2012).

Another significant aspect of technocratic governance is its emphasis on depoliticization, which seeks to reduce the influence of political agendas by prioritizing objective, technical solutions over partisan interests (Swyngedouw, 2011). Furthermore, this governance model often prioritizes long-term sustainability, balancing environmental concerns with economic growth and social equity (Campbell, 1996). For instance, urban resilience programs benefit from technocratic approaches through predictive modeling and real-time monitoring systems, improving disaster preparedness and response (Birkmann et al., 2016).

The advantages of technocratic governance include increased efficiency in service delivery, improved resource allocation based on empirical evidence, and enhanced transparency achieved through data sharing and monitoring (Meijer & Bolívar, 2016). However, this approach is not without its criticisms. Critics argue that it can marginalize citizen voices, as decision-making power is concentrated among unelected experts, leading to a lack of democratic participation (Swyngedouw, 2011). Additionally, an overreliance on technology may overlook the social and cultural dimensions of governance, while a focus on efficiency

can sometimes exacerbate inequalities by prioritizing technical solutions over social equity (Shelton et al., 2015)

1.11 The Impact of Mapping Dashboards on Inclusive Urban Planning and Technocratic Governance

Mapping dashboards are powerful tools that aggregate and visualize data, often presenting urban realities in neat, quantifiable formats. However, this process inherently lends itself to technocratic decision-making rather than inclusive participation and communicative planning for several reasons:

Expert-DrivenDesign:
Mapping dashboards are typically designed by technical experts who decide which data to collect, how to classify it, and which metrics to emphasize. This design process, while efficient, can inadvertently exclude local knowledge and the nuanced realities of diverse communities. As a result, the data reflects a specific, often narrow, perspective that privileges technical rationality over community insights (Kitchin, 2014).

Oversimplification of Complex Urban Dynamics:
By reducing multifaceted urban issues to numerical indicators and spatial representations, dashboards can obscure the social, cultural, and historical contexts that are crucial for understanding urban challenges. The emphasis on quantifiable data may lead decision-makers to favor solutions that address what is measurable, sidelining qualitative aspects like resident experiences or local priorities that are not easily captured by data alone (Vanolo, 2014).

Marginalization of Public Deliberation:
The reliance on data visualizations can create a dynamic where decisions are made based on the apparent objectivity of the dashboard outputs. This approach tends to sideline traditional democratic deliberation and communicative planning, where stakeholders—including marginalized groups—participate in a dialogue about urban issues. The technical nature of these tools may exclude non-experts from the conversation, reinforcing a top-down approach to urban governance (Kitchin, 2014; Vanolo, 2014).

Incentivization of Efficiency over Inclusivity:
Mapping dashboards are often used to drive efficiency in urban management, addressing issues like traffic congestion or energy consumption with clear, measurable goals. While this focus can lead to rapid improvements, it may also prioritize short-term efficiency gains over long-term community well-being and equity. This shift toward technical optimization can weaken the mechanisms for inclusive participation, as decisions become more about meeting data targets than engaging with the public (Caragliu et al., 2011).

In summary, while mapping dashboards contribute significantly to modern urban management by offering clear, actionable insights, their design and use tend to promote a technocratic approach to decision-making. This approach risks sidelining the rich, qualitative aspects of urban life and reducing the role of communicative planning, which is essential for ensuring that governance processes remain inclusive and responsive to all citizens.

Technocratic urban governance aims to create more livable, efficient, and sustainable cities by leveraging expertise and technology. However, to achieve its full potential, it must carefully balance the benefits of relying on expertise with the need for inclusivity and fairness in urban decision-making. By prioritizing technical expertise, data, and technology rather than traditional political processes, technocratic governance emphasizes evidence-based policies and the role of experts in shaping urban strategies, often sidelining traditional democratic deliberation (Kitchin, 2014) and, therefore, forms of communicative planning. Such a model is increasingly prevalent in the context of smart cities, which leverage advanced technologies like the Internet of Things (IoT), big data analytics, and artificial intelligence (AI) to enhance urban efficiency and sustainability. By using these technologies, cities aim to address challenges such as traffic congestion, energy consumption, and public safety, creating an interconnected urban ecosystem (Caragliu et al., 2011). However, critics argue that technocratic governance can exacerbate social inequalities and undermine citizen participation, as it often prioritizes efficiency over inclusivity (Vanolo, 2014). As cities continue to adopt these models, striking a balance between technical optimization and democratic accountability remains a critical challenge. Even the governance of existing dashboards, as detailed in Box 1, is often relegated to apolitical, technocratic forms of regulation.

Box 1

Urban dashboards operate under a mix of international, national and local data governance frameworks, which emphasize:

Data Privacy: Regulations like the EU's General Data Protection Regulation (GDPR) and similar frameworks in other regions protect citizens' personal data. They mandate secure data handling and transparency regarding usage (Johnson et al., 2020).

Open Data Principles: Many cities adhere to open data policies, ensuring that urban data is publicly accessible. Examples include New York City's Open Data Law (2012) and Barcelona's Open Government policy.

Cybersecurity Standards: Urban dashboards must comply with security standards to prevent data breaches, using frameworks like the NIST Cybersecurity Framework.

Inclusivity and Accessibility: Guidelines such as the Web Content Accessibility Guidelines (WCAG) ensure dashboards are usable by diverse populations, including people with disabilities.

1.12 Typologies of digital dashboards in urban management

To understand whether urban dashboards are tools of participation and communicative planning or technocracy, it is important to take a step back and understand the different uses for which they have been developed. This section provides an overview of such diverse applications. First, it is important to recognize that data dashboards exist across different sectors, beyond the realm of urban planning and environmental management. These sectors include healthcare (Dashboards track patient data, monitor hospital resources, and analyze public health trends to improve patient care and operational efficiency), finance (financial dashboards provide insights into market trends, investment performance, and risk management, enabling real-time monitoring of financial health and strategic planning), education (educational dashboards track student performance, attendance, and administrative metrics, identifying areas for improvement and optimizing educational outcomes), and marketing (marketing dashboards analyse campaign performance, customer engagement, and social media metrics, refining strategies and measuring returns on investment rates).

Urban marketing uses communication strategies and data analytics to promote a city's assets, attract investors and skilled workers, and foster civic identity (Kavaratzis & Ashworth, 2005). Dashboards that track marketing metrics—like citizen satisfaction, tourism trends, event engagement, or social media activity—can support city managers in adjusting communication and outreach strategies accordingly.

Meanwhile, mapping dashboards can be categorized based on their functionality and target applications. Each type serves distinct purposes and is tailored to meet specific user needs. Below, the primary types of mapping dashboards are explored, highlighting their unique characteristics and applications.

Real-Time Monitoring Dashboards

Real-time monitoring dashboards integrate live data feeds with spatial maps to provide up-to-the-minute insights. These dashboards are particularly valuable in contexts that require immediate responses, such as disaster management. For instance, during hurricanes, wildfires, or floods, these tools enable emergency response teams to monitor evolving situations and allocate resources efficiently (NOAA, 2023). In traffic management, real-time dashboards display current conditions, helping transportation departments address congestion and accidents. Additionally, public health agencies have used such dashboards to track disease outbreaks, including the widespread deployment of COVID-19 case maps (Oxford University, 2023).

Analytical Dashboards

Analytical dashboards focus on interpreting historical and spatial data through the integration of statistical tools and GIS layers. These dashboards are instrumental in urban planning, where they help analyze population growth and land use changes to ensure sustainable city development (USGS, 2023). Environmental studies also benefit from analytical dashboards, which are used to assess trends in deforestation, biodiversity, and water resource management. Furthermore, economic development initiatives rely on these tools to evaluate the impact of

infrastructure projects on regional economies, offering data-driven insights for strategic planning.

Predictive Dashboards

Predictive dashboards leverage advanced analytics and modeling techniques to forecast future scenarios based on spatial data. For instance, these dashboards are used to simulate the effects of sea-level rise on coastal areas, aiding in climate change adaptation strategies (NOAA, 2023). In agriculture, predictive dashboards forecast crop yields and model the spread of pests by analyzing environmental and weather data. Similarly, they play a crucial role in risk management, modeling flood risks and earthquake impacts to guide insurance policies and mitigation efforts.

Interactive Storytelling Dashboards

Interactive storytelling dashboards combine narrative elements with GIS to communicate complex information effectively to diverse audiences. These dashboards are often used in educational settings, providing students and researchers with visual tools to understand geographic concepts. They are also instrumental in raising public awareness about policy decisions or conservation efforts. For example, visualizations that highlight the impacts of changes in public transit routes or conservation campaigns make these initiatives more accessible and engaging (Oxford University, 2023). Journalistic storytelling similarly benefits from these dashboards, which present geographic contexts in compelling ways to inform and captivate audiences.

Decision-Support Dashboards

Decision-support dashboards integrate spatial analysis with key performance indicators (KPIs), aiding decision-makers across various domains. In the business sector, these dashboards optimize retail site selection by analyzing demographic and economic data. Resource management applications use them to track and allocate critical resources such as electricity and water efficiently. Additionally, military planners utilize decision-support dashboards to monitor battlefield conditions and develop strategic missions using spatial intelligence.

While these dashboards have often multiple functions and overlap in their goals, to summarize their diverse functionalities the table below provides a concise overview of their types, descriptions, key uses, and illustrative examples:

Type of Dashboard	Description	Key Uses	Examples
Real-Time Monitoring	Displays live data on a map interface.	Disaster response, traffic management, public health	COVID-19 case trackers, NOAA weather tools
Analytical	Combines spatial data with statistical tools.	Urban planning, environmental studies, economic development	Land use studies, biodiversity monitoring
Predictive	Uses models to forecast future scenarios.	Climate change impacts, agriculture, risk management	Flood risk assessments, pest spread models
Interactive Storytelling	Blends narratives with GIS to educate and inform.	Public awareness, education, journalistic storytelling	Conservation outreach tools, case studies
Decision-Support	Integrates spatial analysis with KPIs.	Business optimization, resource management, military planning	Retail site selection, resource platforms

Table 1 Different types of dashboards table. (Esri Team, 2018; Esri, 2025)

Mapping dashboards exemplify the convergence of GIS and cartographic innovations, showcasing their transformative role in turning spatial data into actionable knowledge. By catering to various needs through specialized types, these dashboards have redefined how industries harness geographic information for strategic insights and impactful decision-making.

The choice of mapping dashboard type depends on the goals of the user. For instance, emergency managers prioritize real-time dashboards, while urban planners benefit from analytical tools. The versatility of mapping dashboards lies in their ability to adapt to diverse needs, supported by GIS technology. As explained in the methodological section, this dissertation focuses specifically on mapping dashboards that have been used to achieve and track sustainability goals.

1.13 The Future of Urban Dashboards

Looking ahead, the future of urban dashboards is likely to be shaped by advancements in artificial intelligence (AI), particularly machine learning (ML). These technologies can enhance dashboards by providing predictive analytics, automated insights, and natural language processing (NLP) capabilities. AI-driven dashboards will be able to anticipate user needs, offer recommendations, and present data in even more intuitive ways. Additionally, the integration of virtual reality (VR) and augmented reality (AR) could lead to immersive data visualization experiences, making it easier to interact with complex datasets.

Dashboards also influence epistemological and methodological practices. By defining key variables and operationalizing data collection methods, they shape what is considered important and exclude the immeasurable. Their streamlined displays may lower barriers to user engagement but obscure data origins and the politics of information visualization. These tools construct urban subjects and influence how users conceive of and interact with their cities (Mattern, 2015).

Citizen engagement through mapping dashboards and digital platforms represents a transformative approach to participatory urban governance by integrating technology with community involvement (Goodchild, 2007). Similarly, digital platforms, such as mobile apps and online forums, offer accessible channels for citizens to voice concerns, report issues, and collaborate on community initiatives (Sieber, 2006). For instance, participatory GIS (PGIS) systems and open-data portals empower marginalized communities by amplifying their perspectives in decision-making and fostering transparency. These tools create a bottom-up governance model, complementing traditional top-down approaches. However, challenges such as the digital divide and data privacy concerns persist, potentially excluding individuals without adequate access to technology or digital literacy (Elwood, 2008). Despite these limitations, the integration of mapping dashboards and urban governance holds potential for new forms and models of communicative planning practice.

Chapter 2. Methodology

This dissertation employed a comparative method to investigate how mapping dashboards are utilized in Copenhagen and Helsinki to achieve their sustainability goals. The comparative method, a qualitative research approach widely applied in social sciences and urban studies, is instrumental in identifying patterns, similarities, and differences between cases (Ragin, 2014). By systematically contrasting these two leading EU green cities, the researched charted the different uses and successes of dashboard application.

The study is grounded in the theory of communicative planning, which emphasizes the importance of dialogue, inclusivity, and mutual understanding in the planning process. This theoretical lens shifts the focus from viewing dashboards merely as technical tools to considering them as platforms that can either facilitate or hinder participatory governance.

Communicative planning theory suggests that effective planning arises from the interplay of diverse stakeholders engaging in meaningful dialogue. Therefore, the research investigates whether the dashboards in question serve as instruments for such engagement or reinforce top-down decision-making structures. The method follows a structured process, beginning with the selection of relevant cases based on criteria such as representativeness and exceptional performance. It involves establishing a consistent framework for analysis, ensuring that the evaluation of each case adheres to the same thematic focus. Patterns, shared practices, and distinctive strategies are then examined to derive transferable lessons (Collier, 1993; George & Bennett, 2005). This approach is particularly relevant to urban studies, where cities often serve as laboratories for testing policy outcomes and innovative practices.

The comparative method forms the backbone of this research, providing a lens through which to examine the role of mapping dashboards in advancing sustainability goals. In this context, Copenhagen and Helsinki were selected as case studies due to their recognized leadership in sustainability and their innovative use of dashboard technologies. The analysis focuses on three core areas: the role of dashboards in urban planning, their function in environmental monitoring, and their impact on citizen engagement.

The study relies on secondary data drawn from city reports, academic literature, and publications by organizations such as the World Economic Forum. This data informs the evaluation framework, which examines practices, strategies, and outcomes in both cities.

To understand the case of Turin, this research employs a desk-based policy analysis approach to critically analyse the role of mapping dashboards and digital platforms in sustainable urban development, focusing on their dual function as tools for technocratic governance and citizen engagement. The study is anchored in a case study analysis of Turin, a city grappling with complex environmental, economic, and social challenges, complemented by a comparative evaluation of Helsinki and Copenhagen, internationally recognized as leaders in sustainable urban development. This methodological framework provides a nuanced understanding of how digital tools, particularly mapping dashboards, contribute to urban governance and sustainability goals.

A combination of qualitative methods was used to explore the integration of digital tools into urban planning strategies. This included the analysis of key strategic documents, such as Vision Turin 2050 and the Turin 2030 Action Plan, to contextualize Turin's progress in meeting the Sustainable Development Goals (SDGs). These plans were evaluated alongside the 2019 SDG Report, which provided a benchmark for Turin's performance in sustainable urban development. The comparative dimension involved studying the development strategies and digital platforms of Helsinki and Copenhagen to identify innovative practices that could inform Turin's approach.

Moreover, variety of Turin city dashboards have been analysed in terms of function and services.

The in-depth analysis of Turin's mapping dashboards—Urban Atlas, Cruscotto Urbano, and Turin City Lab—served as a central component of the research. These platforms were assessed for their capacity to enhance transparency, facilitate evidence-based policymaking, and encourage public participation. Additionally, the study examined the initiatives of CSI Piemonte, a technological agency that exemplifies the integration of geospatial data and participatory frameworks in urban governance. Tools like the Dalia app and open data platforms were analyzed to understand how they contribute to inclusivity and equity in urban planning.

The comparative analysis was guided by thematic coding, identifying recurring patterns across case studies related to technocratic governance, citizen participation, and SDG alignment. Local social and environmental factors, such as air pollution, urban sprawl, were considered to ensure the findings were grounded in the specific context of Turin.

Through this methodological approach, the dissertation seeks to illuminate how mapping dashboards and digital platforms can balance technological precision with participatory practices. The findings aim to provide actionable recommendations for enhancing Turin's sustainable urban development strategies and improving its SDG performance, while offering broader insights into the transformative potential of digital tools in urban governance.

This study, while offering meaningful insights, is subject to certain limitations that should be acknowledged. First, its scope is intentionally narrowed to dashboards that focus on sustainability and urban planning, which means it does not account for the full range of dashboard applications present in each city. Additionally, limited access to internal decision-making processes has posed challenges in fully uncovering the institutional dynamics that shape these tools. The findings also reflect a specific temporal context—the period in which the research was conducted—and it is important to recognize that both dashboard technologies and planning practices are continually evolving. Nonetheless, these constraints do not diminish the study's contribution; it sheds light on the relationship between digital platforms and participatory planning, offering a foundation for further exploration.

Chapter 3. Lessons from Copenhagen and Helsinki

This chapter focuses on analysing how Copenhagen and Helsinki have utilized mapping dashboards to advance their sustainability goals, aiming to derive transferable insights for Turin. The discussion begins with an overview of Copenhagen and Helsinki's key sustainability achievements and objectives, highlighting their status as leading green cities in the European Union.

Subsequently, the chapter delves into the specific applications of mapping dashboards in these cities. This includes their use in urban planning to optimize land use, environmental monitoring to track progress on climate goals, and fostering citizen engagement by making data accessible to the public. These dashboards serve as vital tools for visualizing data, enabling informed decision-making, and facilitating collaboration between stakeholders.

A comparative analysis is then conducted, examining the practices, strategies, and outcomes achieved by Copenhagen and Helsinki through their mapping dashboards. By identifying shared patterns of success and innovative approaches, the chapter seeks to highlight actionable insights and lessons that Turin can adapt to its own urban sustainability initiatives.

Through this examination, the chapter underscores the potential of mapping dashboards as transformative tools in driving sustainable urban development while fostering international knowledge exchange and collaboration.

3.1 Helsinki's Progress Toward the SDGs: Insights from the 2019 European Cities Report and the Role of Mapping Dashboards

The 2019 SDG Index and Dashboards Report for European Cities evaluates the progress of European cities toward achieving the United Nations Sustainable Development Goals (SDGs), emphasizing the critical role cities play in addressing global challenges. This report, part of a broader initiative to localize and monitor SDG progress at the subnational level, provides insights into urban sustainability efforts across Europe.

A notable feature of the report is its city-level focus, offering a detailed analysis of urban contributions to sustainability rather than a national overview. The methodology employs a dashboard approach, presenting data on various SDG targets using a color-coded system—green, yellow, orange, and red—to indicate each city's proximity to achieving specific goals. Cities are ranked based on their performance across multiple indicators, with the assessment spanning SDGs related to poverty (SDG 1), health (SDG 3), education (SDG 4), sustainable cities (SDG 11), and climate action (SDG 13). This localized analysis highlights strengths and areas for improvement, illustrating disparities between cities. For example, cities in Northern and Western Europe generally perform better on environmental and social metrics compared to others.

Helsinki stands out in the report, ranking third among 45 European cities with a score of 71.3, following Oslo and Stockholm. This ranking underscore Helsinki's success in advancing sustainability goals, although challenges remain in areas such as climate action (SDG 13) and

responsible consumption (SDG 12). A significant factor in Helsinki's achievements is its effective use of mapping dashboards, which have played a crucial role in monitoring progress, identifying priorities, and facilitating data-driven decision-making. These dashboards integrate various datasets, offering real-time insights into urban metrics and enabling targeted interventions.

By utilizing mapping dashboards, Helsinki has not only enhanced transparency but also fostered collaboration among stakeholders, including citizens, policymakers, and researchers. This approach has contributed significantly to the city's ability to address urban challenges and sustain its progress toward the SDGs, serving as a model for other cities aiming to improve their sustainability outcomes.

3.2 Helsinki's Strategic Measures for Advancing Sustainable Development Goals: A Focus on Climate Neutrality, Clean Transportation, and Inclusive Urban Planning

Helsinki has implemented several key strategies to enhance its performance in achieving the Sustainable Development Goals (SDGs). One of the primary objectives of the city is to achieve carbon neutrality by 2035, a goal that is being pursued through a combination of energy efficiency improvements, the adoption of renewable energy sources, and sustainable urban planning practices. These efforts are integral to Helsinki's approach to mitigating climate change and contribute to the achievement of SDG 13 (Climate Action).

In addition to climate initiatives, the city has made significant progress in decarbonizing transportation. By expanding cycling infrastructure and promoting the use of public transportation, Helsinki aims to reduce emissions and enhance the overall sustainability of its urban mobility system. These transportation policies are critical in advancing SDG 11 (Sustainable Cities and Communities), as they foster a more sustainable and accessible urban environment.

Moreover, Helsinki has prioritized inclusive urban planning by investing in affordable housing and implementing initiatives designed to reduce inequality. These investments not only support the achievement of SDG 11 but also contribute to creating more equitable and resilient urban communities.

Finally, Helsinki has embraced data-driven governance, utilizing the integration of various data sources to improve policy outcomes. This approach emphasizes inclusivity, sustainability, and innovation, enabling the city to make informed decisions that align with its long-term sustainability goals. Through these strategic measures, Helsinki has positioned itself as a leader in sustainable urban development, demonstrating a commitment to both environmental and social goals.

3.2.1 contribution of mapping dashboards

Mapping dashboards and city dashboards play a critical role in The 2019 SDG Index and Dashboards Report for European Cities. Their contribution lies in visually organizing, analysing, and communicating complex data to enhance understanding and decision-making about sustainable development. The 2019 report and its associated dashboards were developed by the Sustainable Development Solutions Network (SDSN) and the Brabant Centre for

Sustainable Development (Telos). They build on prior initiatives, such as TELOS' sustainability monitoring efforts, emphasizing the role of cities in achieving sustainable development goals.

Here's a breakdown of their role

Title	Key Points
1. Visualization of Complex Data	- Simplifies large datasets into easy-to-understand visuals (e.g., maps, graphs, color-coded indicators). - Allows users to compare city performance using clear visual cues like color gradients or thresholds (e.g., green for high achievement, red for urgent improvement). - Helps identify disparities and patterns related to SDG progress.
2. Geographic Context	- Enables spatial analysis to identify regional trends in sustainability. - Reveals geographic distribution of challenges and successes. - Guides targeted interventions, e.g., Northern Europe excelling in SDG 13 (climate action) while Southern Europe lags in SDG 11 (sustainable cities and communities).
3. Monitoring and Accountability	- Allows cities to track progress over time by monitoring changes in key indicators. - Promotes transparency by publicly displaying performance data. - Enables stakeholders to hold cities accountable for their SDG commitments.
4. Policy and Decision Support	- Helps decision-makers prioritize resources by identifying areas with the greatest needs (e.g., areas with "red" indicators). - Assists in tailoring policies to local contexts, ensuring more effective and equitable interventions for sustainable development.
5. Stakeholder Engagement	- Makes data accessible and visually appealing to engage citizens, researchers, and organizations. - Raises awareness about sustainability challenges and encourages community involvement in local solutions.
6. Standardization and Comparisons	- Standardizes data presentation, making it easier to compare cities across diverse contexts. - Facilitates benchmarking progress and sharing best practices between cities.
7. Examples in the Report	- The 2019 SDG Index and Dashboards Report for European Cities uses dashboards to showcase city performances across various SDGs.

	- The mapping component emphasizes disparities in areas like environmental quality, economic inclusion, and urban infrastructure.
8. Contribution to the SDG Report's Goals	- Provides actionable insights for urban policymakers. - Facilitates collaboration by highlighting successful strategies between cities. - Enhances the accessibility and impact of the report through intuitive design.

Table 2 Role of mapping dashboards. (Adapted from SDSN & Telos, 2019)

Dashboards are not merely tools for reporting; they are transformative enablers for tracking, planning, and achieving sustainable urban development while enhancing urban governance. By aggregating data from various sources, dashboards provide an accessible platform for users to explore city-level indicators, fostering informed decision-making and encouraging civic engagement. They also offer comparative insights, enabling cities to benchmark their performance against peers and identify best practices and lessons for improving progress toward the Sustainable Development Goals (SDGs). Furthermore, dashboards emphasize local action, addressing the critical need for localized implementation of SDGs by highlighting areas such as transportation, housing, and inequality that require targeted interventions. Interactive features enhance engagement, allowing stakeholders to dynamically analyze trends, focus on specific SDG goals or targets, and adapt strategies in real time. These capabilities make dashboards indispensable tools for aligning urban governance with the goals of sustainable and inclusive development.

3.3 Leveraging Mapping Dashboards for Sustainability: Copenhagen's Progress and Challenges in Achieving SDGs

Mapping dashboards have played a significant role in helping cities like Copenhagen and Helsinki achieve their sustainability goals, particularly in areas such as carbon neutrality, green mobility, and citizen engagement. These dashboards provide real-time data visualization, which aids in effective decision-making and promotes transparent governance. For Copenhagen, the use of such dashboards has been integral in tracking progress toward its sustainability objectives.

In the 2019 SDG Index for European cities, Copenhagen ranked fourth, with a score of 68.7, positioning it as one of the leading cities in Europe for progress toward the Sustainable Development Goals (SDGs), just behind Oslo, Stockholm, and Helsinki. This high ranking reflects Copenhagen's strong policies and initiatives in sustainable urban planning, clean energy, and green infrastructure. Notably, the city has implemented several innovative strategies to address SDG challenges. These include extensive investment in sustainable urban mobility, such as the development of cycling infrastructure and efficient public transportation

networks, as well as a clear commitment to carbon neutrality by 2025. Copenhagen's focus on renewable energy use and energy-efficient buildings further underscores its efforts to reduce its carbon footprint. Additionally, the city has made significant strides in increasing green spaces and promoting urban biodiversity, aligning with SDG 15 (Life on Land) to enhance the quality of life for its citizens.

However, despite these achievements, Copenhagen still faces challenges, particularly with SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action). The city is working to address waste management issues and further reduce carbon emissions in its ongoing effort to meet its ambitious sustainability targets.

3.3.1 Copenhagen's Approach: Real-Time Data for Carbon Neutrality and Mobility

Copenhagen aims to become the world's first carbon-neutral capital by 2025, and its use of digital dashboards is integral to this goal. The city utilizes platforms like Copenhagen Solutions Lab to collect and analyze real-time data from sensors and IoT devices across urban areas. These data streams monitor air quality, energy consumption, and traffic patterns, enabling targeted interventions to reduce carbon emissions (World Economic Forum, 2023).

In Copenhagen, integrated dashboards play a crucial role in supporting the city's sustainability and mobility goals through a range of practical applications. One key area is smart traffic management, where dashboards process real-time traffic data to improve circulation, reduce vehicle emissions, and promote alternative modes of transportation such as cycling and public transit. This not only enhances mobility but also contributes to the city's broader environmental objectives. Another significant use is in monitoring energy efficiency. These dashboards offer dynamic insights into energy consumption across public buildings and urban infrastructure, allowing for timely adjustments that align with Copenhagen's ambitious energy-saving targets (SPUR, 2021). Through these applications, dashboards are embedded in the everyday functioning of the city, enabling data-informed decisions that directly support climate action and sustainable urban living.

3.3.2 Helsinki's Approach: Open Data and Participatory Governance

Helsinki leverages mapping dashboards to promote transparency and citizen participation in its quest for carbon neutrality by 2030. The city's Helsinki Region Infoshare (HRI) platform provides open access to municipal data, including environmental indicators, mobility statistics, and energy consumption patterns. This open-data initiative empowers residents, businesses, and researchers to co-create solutions for urban challenges (Helsinki-Uusimaa Regional Council, 2023).

Copenhagen's experience with digital dashboards highlights several key successes that reflect the city's commitment to participatory governance and sustainable mobility. One notable achievement is the integration of participatory budgeting tools, which allow residents to use mapping dashboards to follow the progress of municipal projects and share feedback. This fosters transparency and ensures that urban planning decisions are responsive to public needs and aligned with broader sustainability goals. Another success lies in supporting green mobility initiatives. Dashboards are employed to monitor the performance of bike-sharing systems and electric bus routes, providing data that helps refine these programs and promote low-emission

transport options. By encouraging active citizen engagement and environmentally conscious mobility, these dashboards have become vital instruments in advancing Copenhagen's climate and urban planning strategies (Eurocities, 2023).

3.3.3 Current City Dashboards in Helsinki and Copenhagen

Helsinki Current Dashboards

Helsinki leads European cities in terms of SDG performance, and it uses several dashboards to monitor and guide its progress toward sustainability:

Helsinki City Dashboard: This tool aggregates real-time data from various sectors, including environmental quality, urban mobility, and economic performance. It helps city planners track progress on climate actions, waste management, and green infrastructure initiatives. The city also employs the Helsinki Smart City Framework, which integrates data from sensors, public services, and city systems to create an interconnected urban environment.

Helsinki Sustainability Dashboard: Part of Helsinki's ambition to become carbon-neutral by 2035, this dashboard tracks energy use, emissions, and resource efficiency. It provides actionable data to improve energy management, foster circular economy practices, and measure progress on SDG 7 (Affordable and Clean Energy)

These tools help Helsinki not only monitor its SDG progress but also enable efficient governance by integrating smart technologies to boost sustainability. The dashboards provide comprehensive insights into environmental impact, including waste production, air quality, and carbon emissions.

3.3.4 The Dashboard Builder

The Dashboard Builder is a browser-based environment that enables the construction of both general-purpose and city-specific dashboards. These interfaces remain accessible to decision-makers around the clock and adapt seamlessly to displays that range from handheld devices to ultra-high-definition public screens (Snap4City, 2025).

Because each dashboard is compiled as an HTML5 page enriched with JavaScript, no client-side installation is required. Dashboards can be edited, shared, cloned, delegated, or protected, and they may be embedded within third-party websites to facilitate direct communication with citizens. A streamlined interface also expedites the creation of city dashboards for Internet-of-Things (IoT) applications (Snap4City,2025).

City dashboards are assembled by combining widgets drawn from an extensive library, and developers can extend this catalogue with bespoke components. The system supports multiple data modalities: historical records retrieved from storage, streaming information from sensors and IoT devices, live feeds delivered through WebSockets, and outputs from full-scale IoT applications. All connections employ secure protocols such as HTTPS, WSS, and TLS (Snap4City,2025).

The widget library spans charts, tables, time-series plots, histograms, maps, lists, selectors, heatmaps, weather forecasts, and actuator controls. Mapping widgets interface with services such as ServiceMap, ServiceMap 3D, OpenStreetMap, and Google Maps, offering drill-down

to historical databases and exploration of inter-entity relationships within the city (Snap4City, 2025.; Open StreetMap Foundation, 2025.; Google, 2025.).

In addition, the platform integrates external services—including traffic-flow reconstruction, bus tracking, social-media monitoring, and Wi-Fi status—and supports micro-applications for point-of-interest search, route planning, public-transport queries, parking forecasting, pollution and pollen monitoring, and first-aid location.Widgets operate as first-class user-interface elements: one widget may filter map data, another may function as an IoT actuator, and a third may display real-time sensor readings via WebSockets. Collectively, these components interrelate, connect directly to IoT brokers, and leverage the underlying knowledge base, thereby providing a cohesive real-time decision-support environment (Snap4City, 2024.).

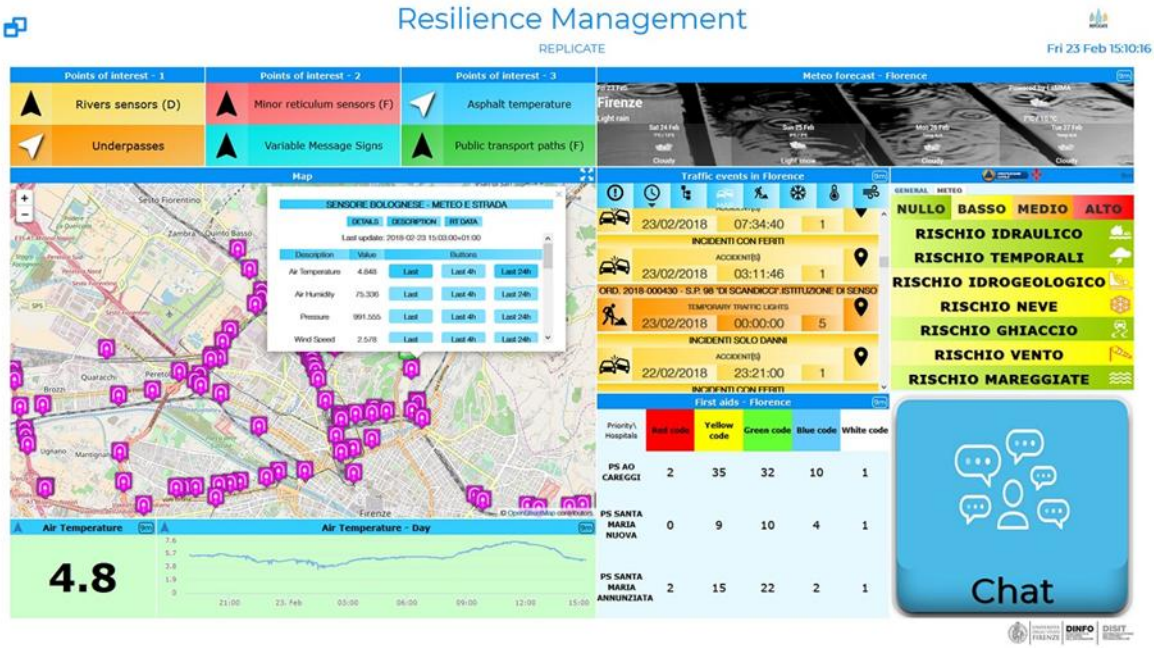


Figure 11 Resilience management dashboard. (Snap4City, 2024)

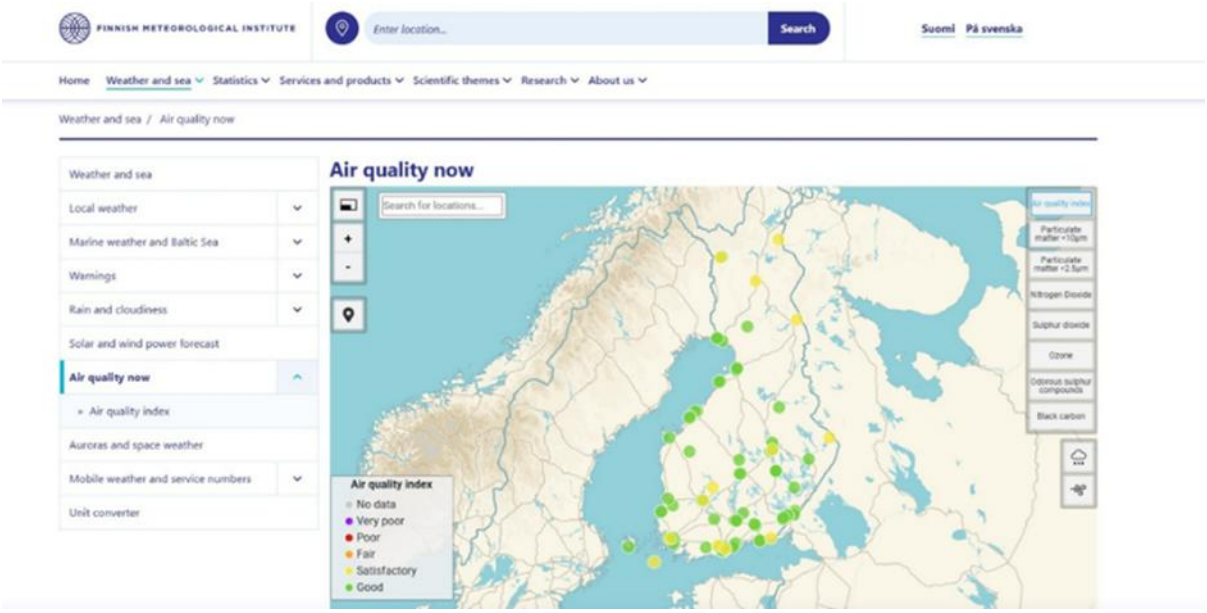


Figure 12 Finland weather and air quality monitoring dashboard of air quality index.(Finnish Meteorological Institute,2025)

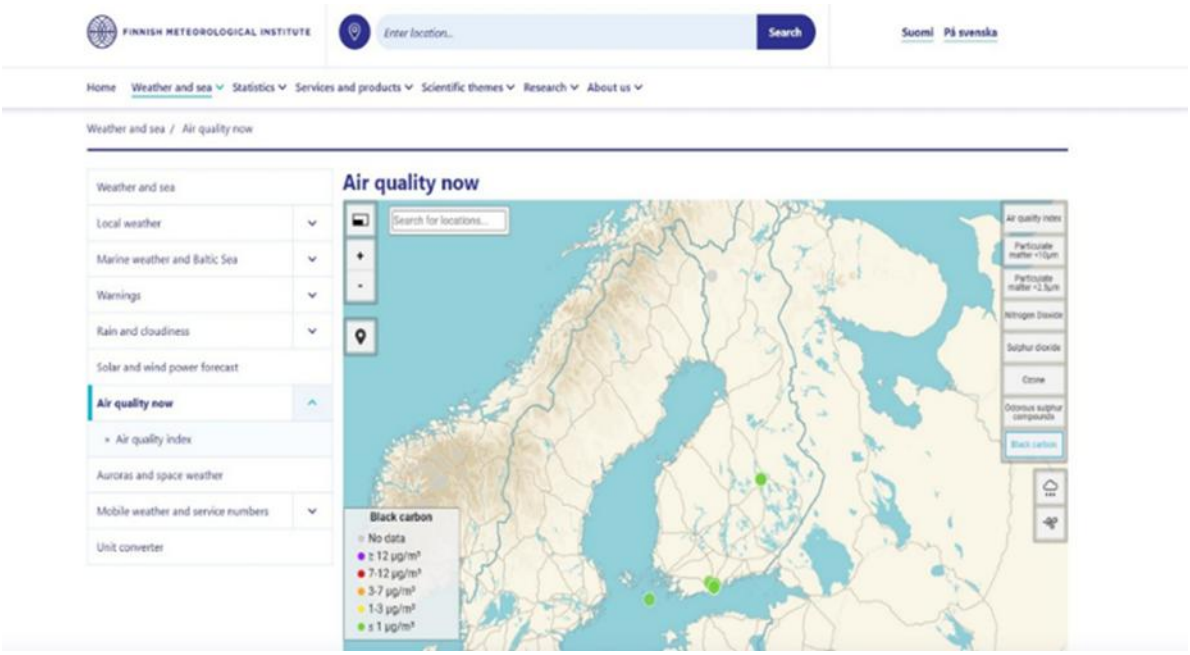


Figure 13 Finland weather and air quality monitoring dashboard of black carbon index.(Finnish Meteorological Institute,2025)

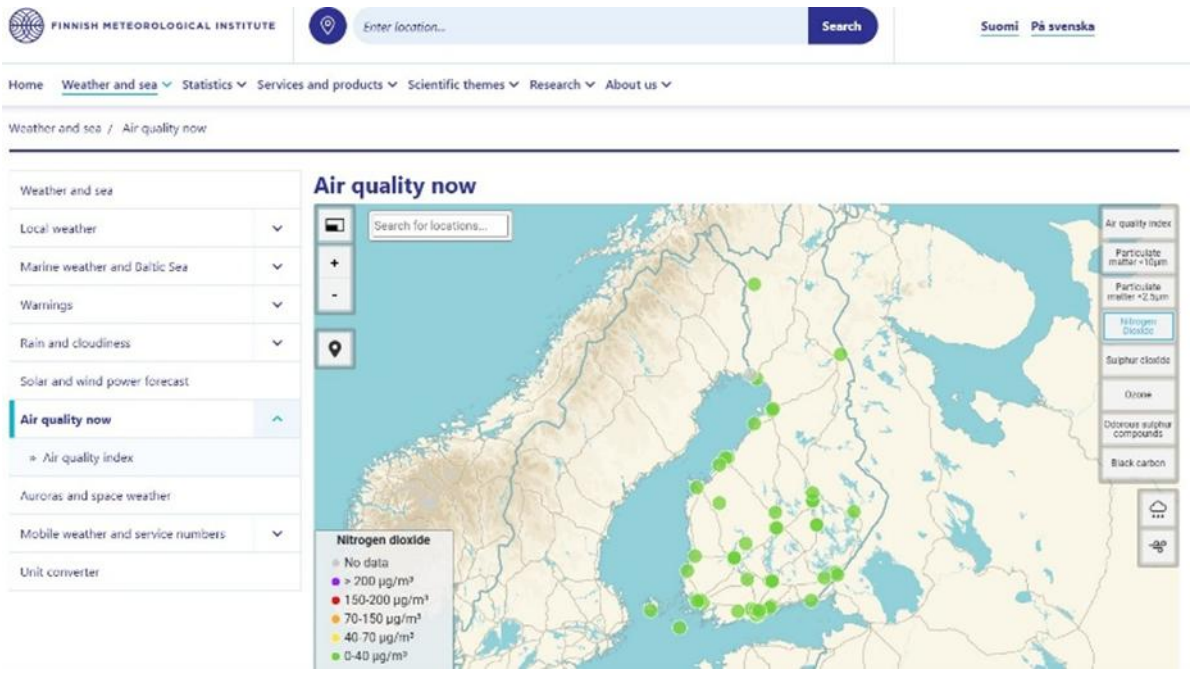


Figure 14 Finland weather and air quality monitoring dashboard of Nitrogen dioxide index.(Finnish Meteorological Institute,2025)

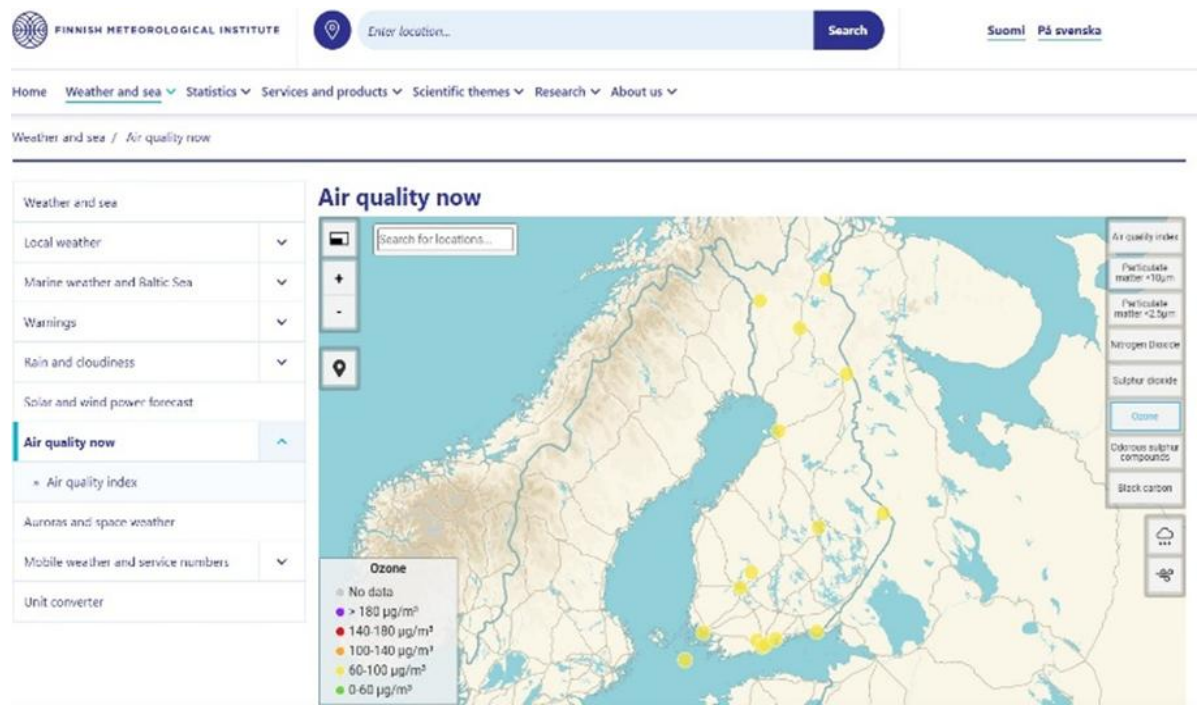


Figure 15 Finland weather and air quality monitoring dashboard of Ozone index.(Finnish Meteorological Institute,2025)

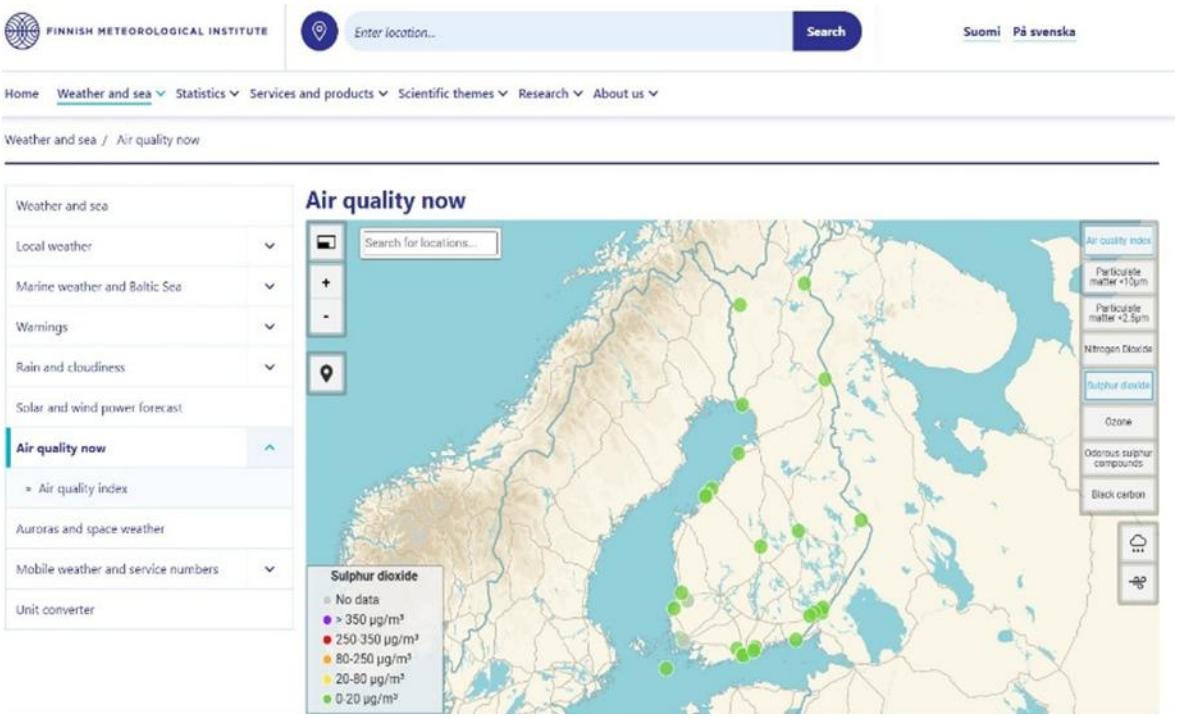


Figure 16 Finland weather and air quality monitoring dashboard of sulphur dioxide index.(Finnish Meteorological Institute,2025)

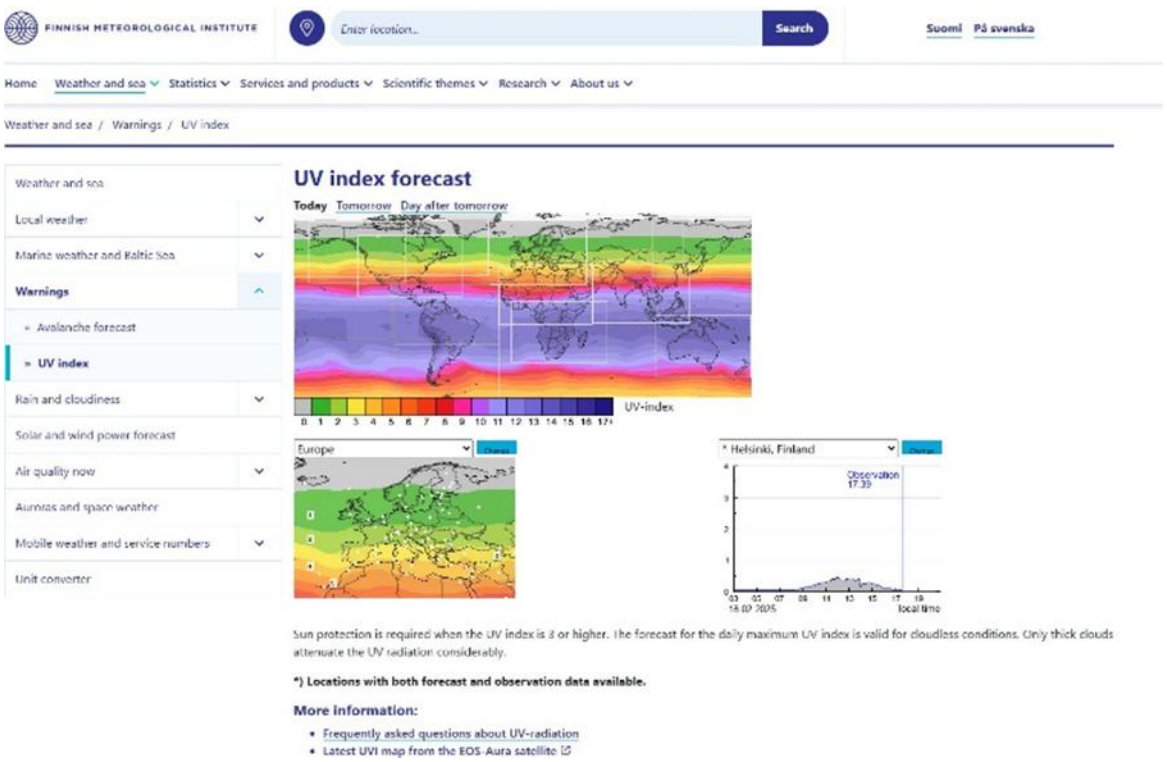


Figure 17 Finland weather and air quality monitoring dashboard of UV index.(Finnish Meteorological Institute,2025)

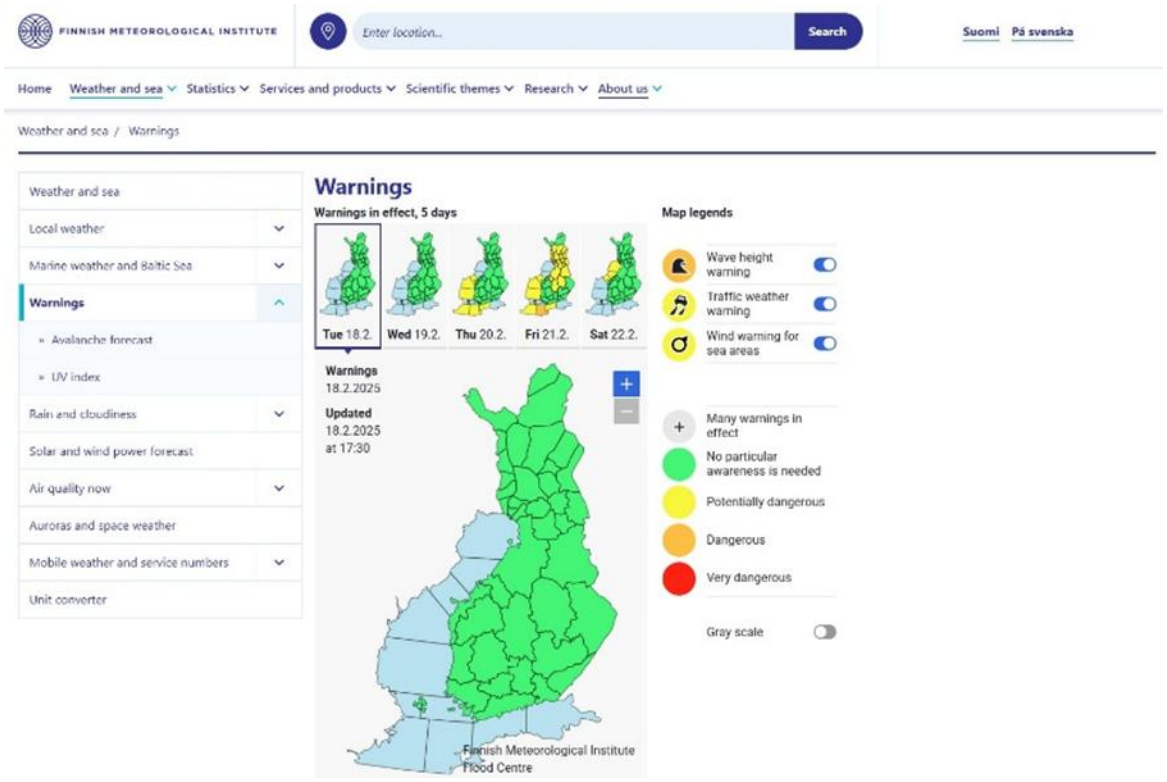


Figure 18 Finland weather and air quality monitoring warning dashboard.(Finnish Meteorological Institute,2025)

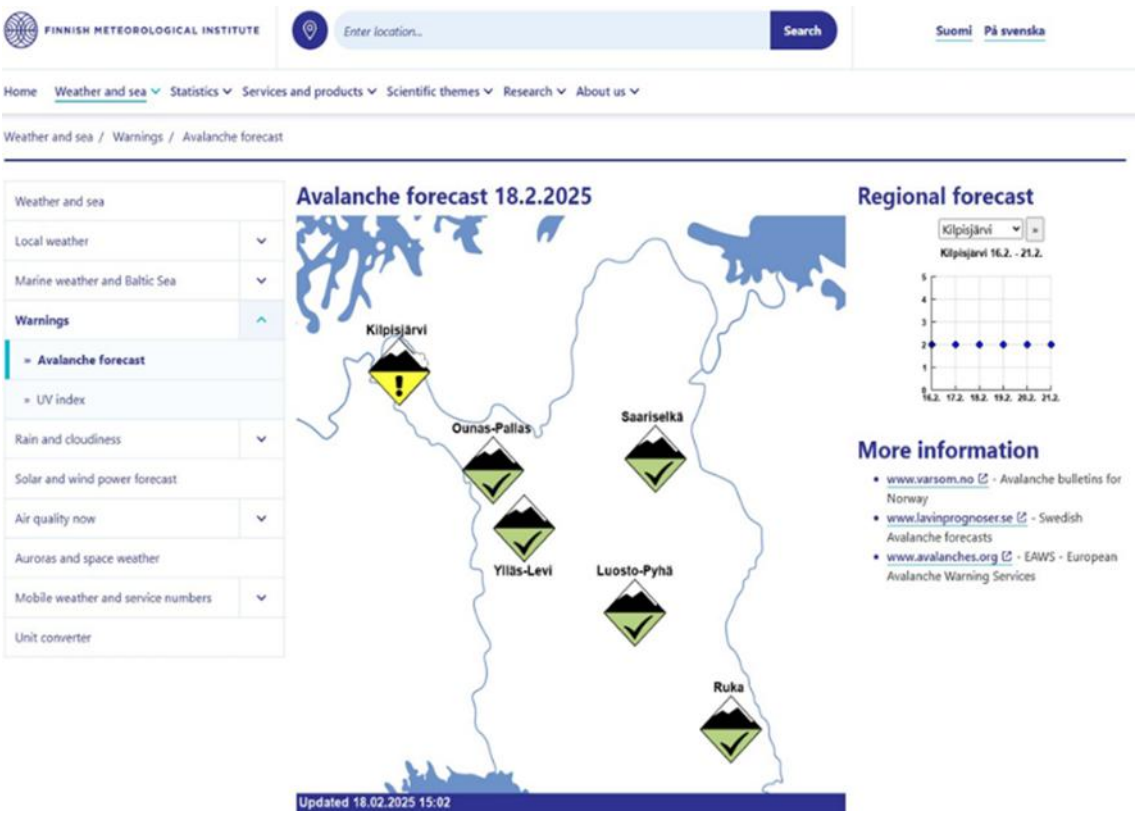


Figure 19 Finland weather and air quality of Avalanche forecast.(Finnish Meteorological Institute,2025)

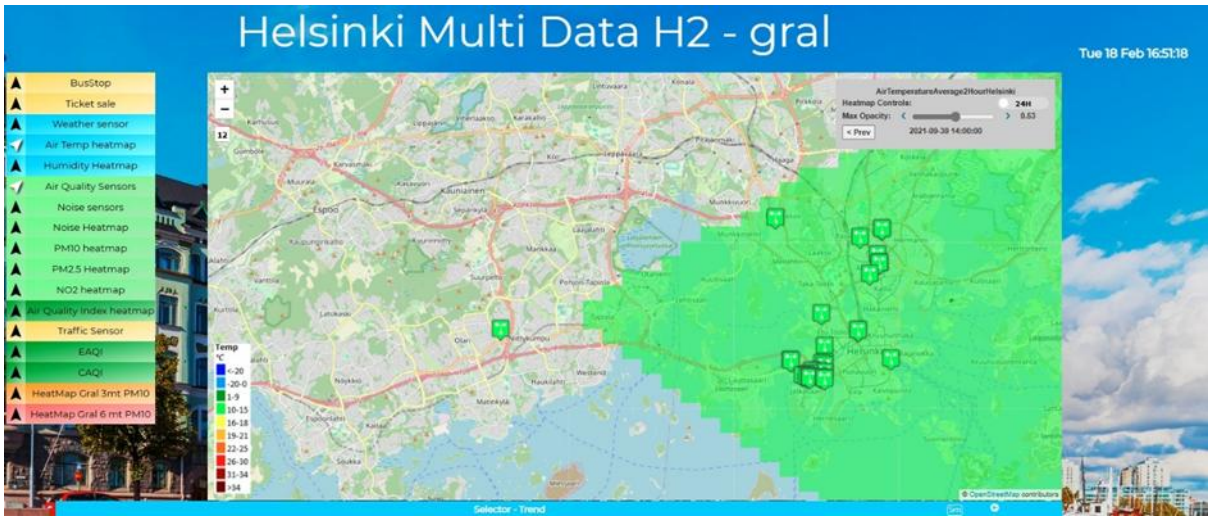


Figure 20 Helsinki air temperature dashboard. (Snap4City, 2024)

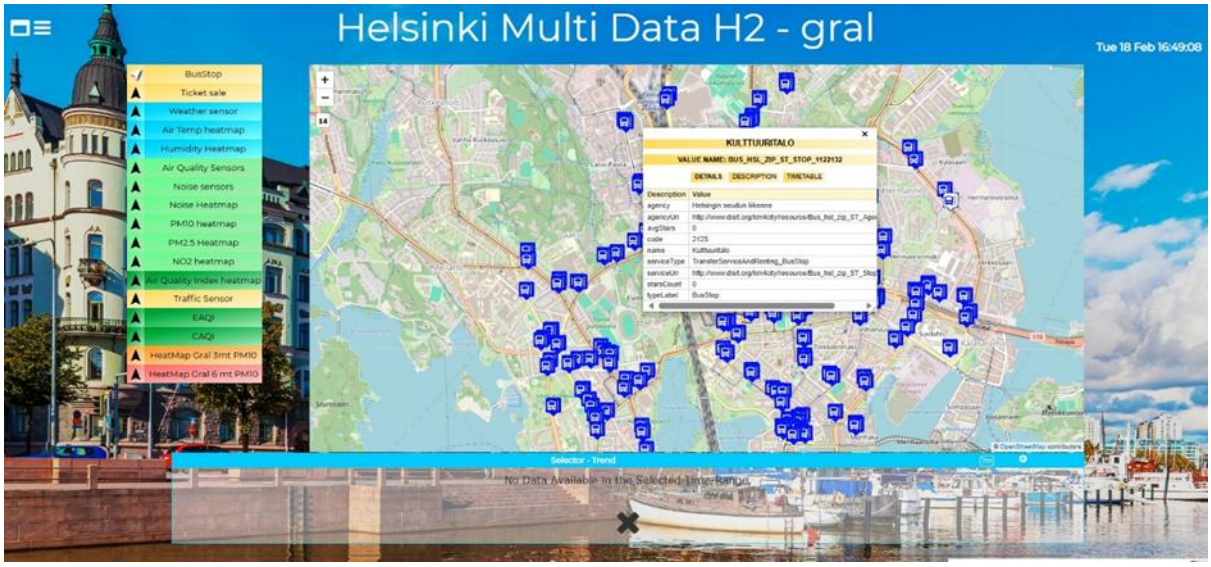


Figure 21 Helsinki bus stop dashboard. (Snap4City, 2024)

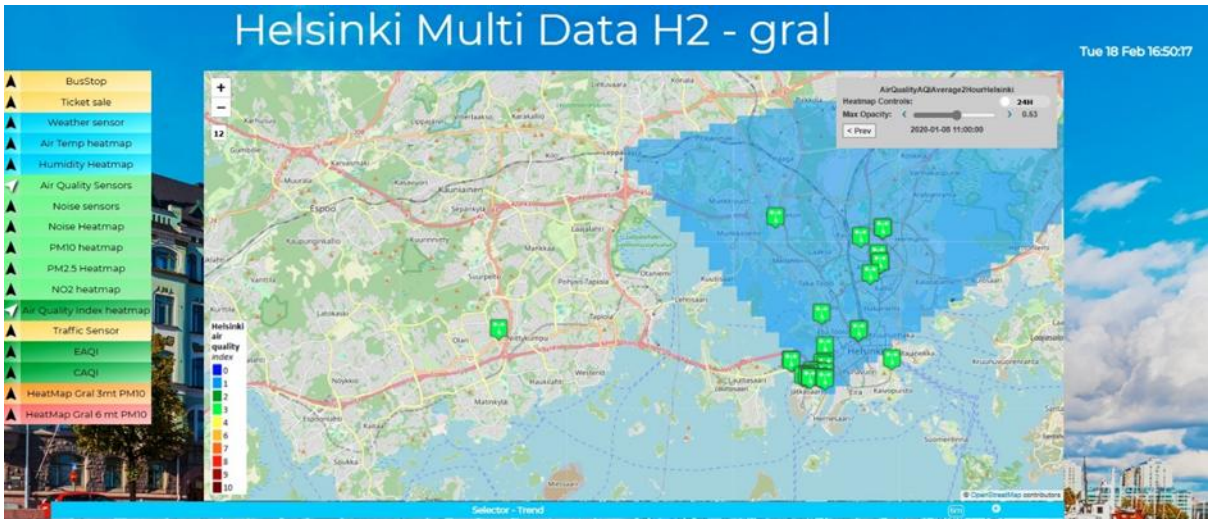


Figure 22 Helsinki air quality dashboard. (Snap4City, 2024)

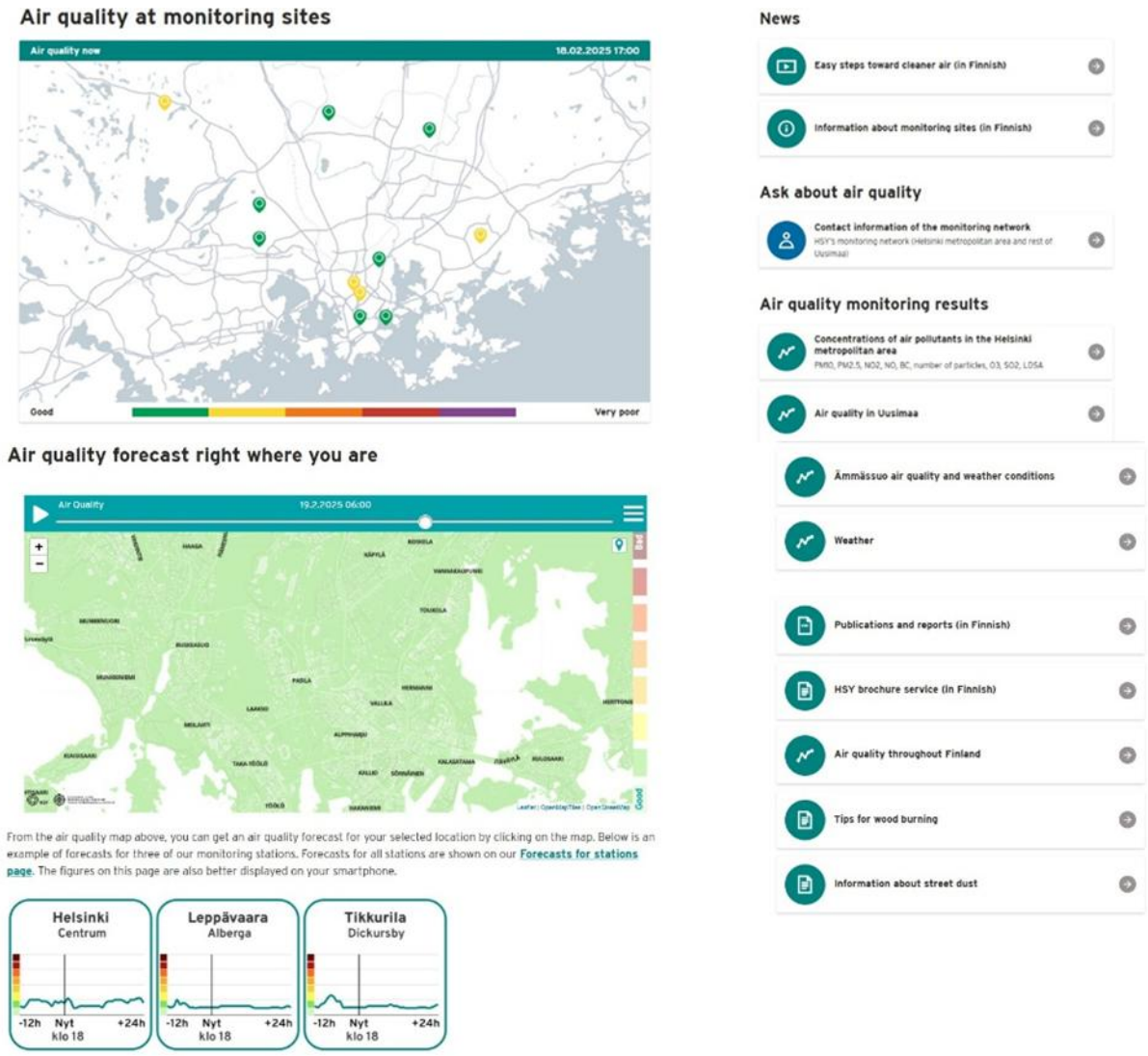


Figure 23 Helsinki air quality monitoring dashboard. (Snap4City, 2024)

3.3.5 Copenhagen: Current Dashboards

Copenhagen, aiming for carbon neutrality by 2025, utilizes several cutting-edge dashboards to monitor its sustainability efforts:

Copenhagen's Climate Action Dashboard: This dashboard tracks real-time carbon emissions, energy consumption, and renewable energy integration. It has been pivotal in tracking the city's climate impact, guiding policies in transport, energy, and waste. It includes data on SDG 13

(Climate Action) and provides transparency regarding the city's targets for reducing emissions

Copenhagen City Data Hub: This tool integrates data from multiple sectors, including waste management, public transportation, and public health. It allows policymakers to track performance across a wide range of SDGs, providing insights into areas such as SDG 11 (Sustainable Cities and Communities) and SDG 12 (Responsible Consumption and Production). The platform also supports Copenhagen's transition toward becoming a "smart city" by leveraging IoT and data analytics for urban planning

The dashboards in Copenhagen enable detailed monitoring and are an essential part of the city's ambitious climate neutrality goals, helping the government make data-driven decisions and prioritize initiatives for sustainability.

3.3.6 THOR - an Integrated Air Pollution Forecasting and Scenario Management System

Since 1996, the National Environmental Research Institute (NERI), Denmark, has developed a comprehensive and unique integrated air pollution model system, THOR. The model system includes several meteorological and air pollution models capable of operating for different applications and different scales. The system is capable of accurate and high resolution three-days forecasting of weather and air pollution from regional scale over urban background scale and down to individual street canyons in cities - on both sides of the streets. Coupling models over different scales makes it possible to account for contributions from local, near-local as well as remote emission sources to describe the air quality at a specific location - e.g. in a street canyon or in a park. The system is used in connection with the urban and background monitoring programs in Denmark. Furthermore, the system can be used to forecast air pollution from accidental releases as e.g. power plants, industrial sites and natural or human made fires.

The main purposes of the THOR system are forecasting, nowcasting, emission reduction scenarios, retrospective analyses and air pollution assessments and management. The system can be used for information and warning of the public in cases of high air pollution levels and for policy management (e.g. by emission reduction or traffic scenarios) of many different chemical compounds. The system can be applied operationally for any location all over the world. The system consists of several different air pollution models - all developed at NERI during the last decades. A schematic diagram of the different modules and the data flow chart of the THOR system is shown in the figure below. The model system consists of a coupling of several models, briefly described in the following.

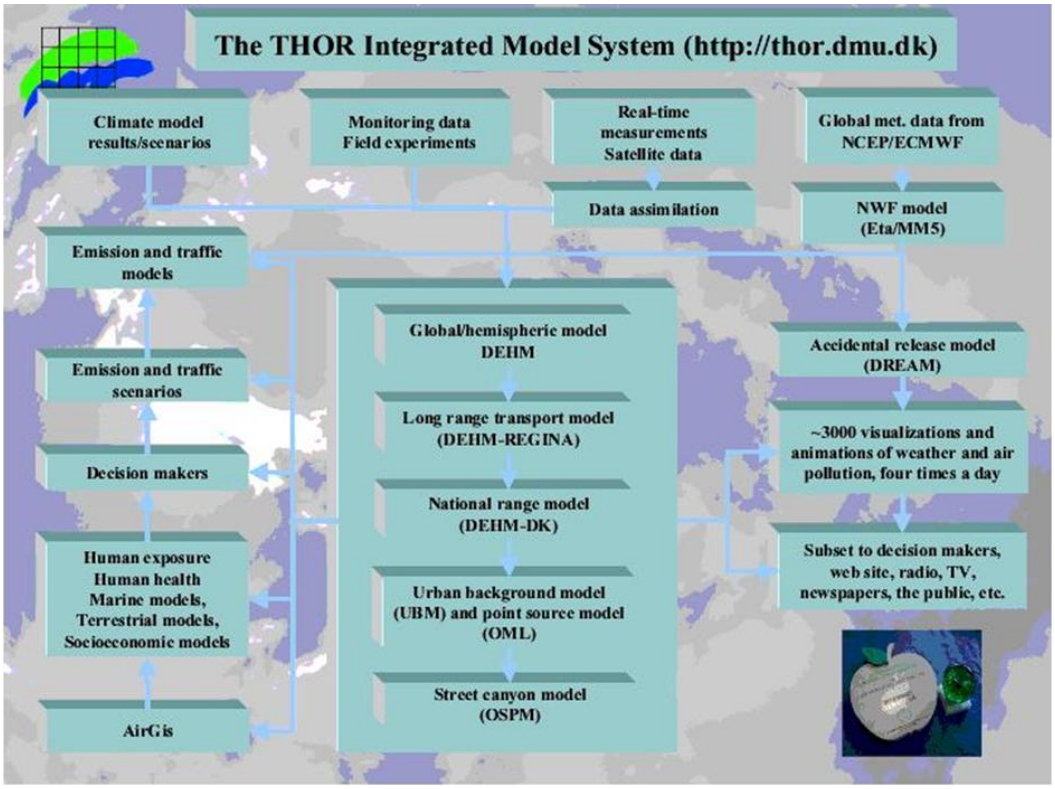


Figure 24 The THOR model structure.(National Environmental Research Institute, 2025)

Applications

Present capabilities of the THOR system include all aspects within forecasting, nowcasting, supplement to monitoring programs, scenarios, retrospective analyses, assessment and management of air pollution.

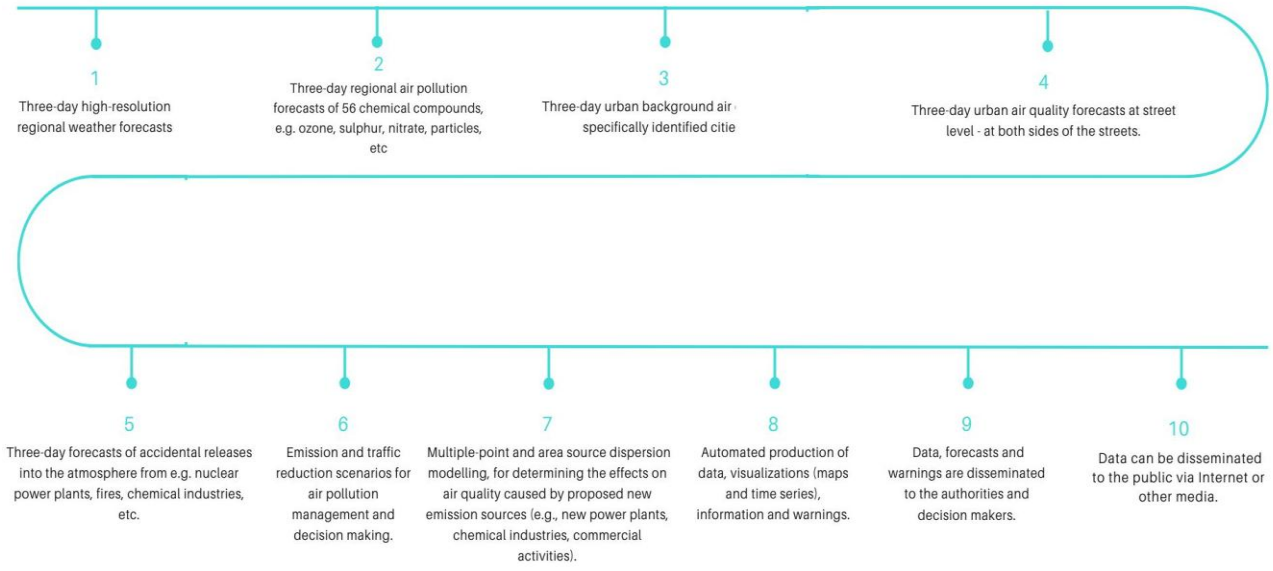


Figure 25 The THOR model structure.(National Environmental Research Institute, 2025)

Air pollution in street canyons

The output from the urban background model is used as input to the Operational Street Pollution Model, OSPM, producing the air pollution concentrations at street level at both sides of the streets in cities. The model calculates air concentrations of NO, NO_2, NO_x, O_3, CO and benzene in the street canyon at both sides of the street. Particles will be included in the model in the near future. The OSPM has been successfully tested under specific European field campaigns in a variety of different climatic and air quality conditions in, e.g., Copenhagen, Gothenburg, Helsinki, Oslo, Brussels, Berlin, Hanover, and Milano. It has also been tested and applied in Beijing, China, under a cooperation agreement with Tsinghua University.

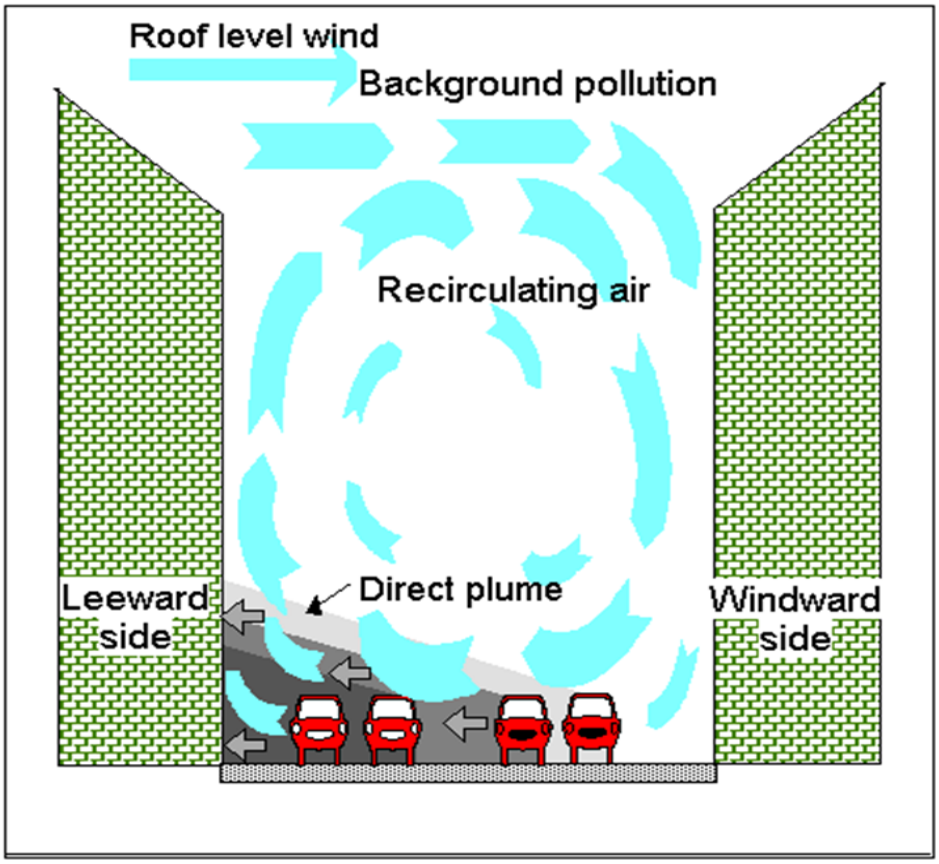


Figure 26 Operational Street Pollution Model (OSPM) .(National Environmental Research Institute, 2025)

Due to the circulation of air in street canyons (see the figure above), the air pollution concentrations can be very different at the two sides of a street. This is illustrated in the two sets of figures below. The upper set of figures show a three-day forecast of air pollution concentrations at the eastern and western side of a street in Copenhagen for different chemical compounds. Depending on the meteorological situation, the concentration levels are very different. In the lower set of figure, the maximum value of the two sides of the street is visualized as coloured levels. Blue indicates concentrations below mean, green indicates mean concentrations, and red indicates air pollution concentrations above mean.

Future Dashboards for Helsinki and Copenhagen

To further enhance its sustainability performance, Helsinki could benefit from the development of additional dashboards that address critical aspects of environmental and social sustainability. A Biodiversity and Ecosystem Services Dashboard would enable the city to monitor the health of its urban ecosystems and assess their contribution to climate resilience and sustainability, aligning with Sustainable Development Goal (SDG) 15. This tool would support Helsinki's objective of integrating natural elements into urban environments, fostering a balance between urban development and ecological preservation. Additionally, an Inclusive Growth and Social Mobility Dashboard could strengthen the city's social inclusion strategies by tracking key indicators such as social inequality, employment rates, and poverty levels, directly supporting SDG 10 on reducing inequalities. Implementing these dashboards would allow Helsinki to adopt a more comprehensive approach to sustainability, ensuring that social inclusion and environmental objectives are pursued in tandem.

Copenhagen: Needed Dashboards

While Copenhagen’s current dashboards are comprehensive, the city could benefit from:

Green Infrastructure and Biodiversity Dashboard: With urbanization affecting biodiversity, a specific dashboard to track green infrastructure and urban biodiversity would support SDG 15. This would help monitor areas such as the expansion of urban forests and green roofs.

Sustainable Agriculture and Food Security Dashboard: Given the city's strong focus on sustainability, expanding into monitoring sustainable food production, consumption patterns, and food security (SDG 2: Zero Hunger) would support Copenhagen’s goals of becoming a resilient and sustainable urban area.

These additional dashboards would align Copenhagen's efforts more closely with the SDGs related to environmental preservation and food security.

Both Helsinki and Copenhagen leverage advanced dashboards to support their SDG-driven agendas. These tools allow for continuous monitoring of sustainability goals and guide policy decisions. However, as both cities move forward, adding dashboards that focus on biodiversity, social inclusion, and sustainable agriculture would help them address gaps and enhance their contributions toward achieving the SDGs.

3.4 Helsinki City Dashboards and Copenhagen City Dashboards comparison

Helsinki employs a variety of tools as part of its "Smart City" initiative, integrating data from sensors and public services to support urban management. One of the key platforms is the Helsinki Sustainability Dashboard, which monitors metrics such as energy consumption and carbon emissions. Both the Helsinki Smart City Framework and the Sustainability Dashboard, available on the city's official website, serve as examples of these digital platforms. The City of Helsinki's Open Data Portal: Helsinki also offers a City Data Hub where citizens and businesses can access urban data related to traffic, environment, and more. The portal includes data relevant to SDGs such as waste management, air quality, and mobility.

Copenhagen Climate Action Dashboard. This platform allows citizens and decision-makers to track Copenhagen's progress towards climate neutrality and carbon emissions reduction targets.

Copenhagen City Data Hub:
The City Data Hub integrates data from various sectors, enabling the city to monitor sustainability progress, such as public transportation usage, waste management, and urban health metrics.

3.5 From Leaders to Learners

This section presents a comparative analysis of the urban sustainability efforts of Helsinki, Copenhagen, and Turin, examining their respective performances across key indicators such as governance, climate action, urban mobility, green spaces, waste management, and economic inclusion. By contrasting these cities, this chapter aims to identify the policies and practices contributing to the high rankings of Helsinki and Copenhagen, as well as the barriers that hinder Turin's progress. This approach highlights the significant variations in urban sustainability strategies within Europe and provides insights into how cities at different stages of development address the challenges of sustainable urbanization.

Helsinki's proactive approach to sustainability is underpinned by its ambitious carbon neutrality target for 2035 and extensive green infrastructure, setting it apart as a leader in climate-conscious urban planning (Rossi & van Vliet, 2020). Similarly, Copenhagen's long-standing commitment to becoming carbon neutral by 2025 and its world-renowned cycling infrastructure reflect its dedication to clean energy and urban mobility (Gehl, 2013). In contrast, Turin struggles with persistent air pollution, socio-economic inequalities, and limited public investment in green spaces, illustrating the complex interplay of governance, policy, and economic challenges in achieving urban sustainability (Boccardo et al., 2021). These cases offer a rich comparative framework for understanding both the potential and the obstacles in implementing Sustainable Development Goals (SDGs) at the municipal level.

3.5.1 The Role of Mapping Dashboards and Digital Platforms in Urban Sustainability Analysis

To facilitate this analysis, mapping dashboards and digital platforms play a critical role by providing real-time data visualization and evidence-based insights. These tools enable cities to monitor progress on sustainability metrics, assess the effectiveness of policy interventions, and engage stakeholders through transparent reporting mechanisms (Batty et al., 2012). For example, Helsinki utilizes advanced digital platforms to integrate data from multiple sectors, driving informed decision-making in urban governance. Copenhagen leverages mapping tools to optimize its cycling networks and track carbon emissions reductions. Conversely, Turin's limited adoption of such technologies reflects a missed opportunity to streamline urban planning and improve policy coordination. By incorporating digital innovations, this study underscores the transformative potential of technology in advancing urban sustainability goals.

3.5.2 Ranking Overview:

Helsinki (3rd, 71.3): Known for its strong focus on sustainability, carbon neutrality, and social equity, Helsinki is a global leader in sustainable urban development.

Copenhagen (4th, 68.7): Close behind Helsinki, Copenhagen excels in clean energy, urban mobility, and green spaces but shares similar challenges in waste management and climate action.

Turin (35th, 56.4): Far behind its Northern European peers, Turin struggles with air quality, economic inequality.

2. Key Factors Behind Rankings:

Factors	Helsinki	Copenhagen	Turin
Governance and Policy	Proactive, data-driven governance	Carbon-neutral policies	Limited integration of SDGs in governance
Climate Action (SDG 13)	Strong climate-neutral plans (2035)	Carbon neutrality by 2025	Weak emission reduction targets
Urban Mobility	Public transport, cycling initiatives	Extensive cycling network	Over-reliance on private transport
Green Spaces (SDG 15)	Abundant urban green spaces	Green space integration	green spaces
Waste Management (SDG 12)	Effective policies and high recycling rates	Progressing but challenges remain	recycling rates
Economic Inclusion (SDG 10)	High inclusion levels	Moderate success	Persistent inequalities

Table 3 Key factors of Copenhagen and Helsinki on 2019 SDG ranking

3.6 A Tale of Three Cities in Urban Development

Mapping dashboards have become indispensable instruments for visualising complex urban data, guiding sustainability policy, and fostering citizen participation. Turin, Helsinki, and Copenhagen exemplify this trend through integrated dashboard suites that address four inter-related domains. First, each city maintains an environmental dashboard: Turin streams real-time air-quality readings to support pollution-mitigation measures, Helsinki employs the Environmental Insights Explorer to estimate carbon emissions and energy consumption, and Copenhagen couples live environmental indicators with resilience metrics to inform climate-adaptation planning (Hexagon, 2024). Second, mobility dashboards reveal transport dynamics, enabling Turin to analyse daily traffic flows, Helsinki to optimise public-transit operations through granular ridership maps, and Copenhagen to refine accessibility scenarios for active and public transport (Hexagon, 2024). Third, waste-management dashboards underpin resource efficiency by allowing Turin to monitor recycling rates and collection performance, Helsinki to correlate household waste generation with participation campaigns, and Copenhagen to track collection and processing in real time in pursuit of circular-economy targets (HaulerWaste Management, 2025). Finally, dedicated citizen-engagement platforms invite residents to co-design neighbourhood interventions: Turin hosts participatory planning workshops online, Helsinki integrates dynamic visualisation tools to broaden public input channels, and Copenhagen embeds community feedback loops into its environmental decision-making processes (Konstantinidou & Salanova Grau, 2025; NetZeroCities, 2025). Collectively, these initiatives illustrate how technology-mediated dashboards can translate heterogeneous urban datasets into actionable knowledge, promote transparency, and align municipal governance with the principles of sustainable and inclusive development.

3.6.1 Comparative Analysis of Sustainability Policies in Helsinki and Copenhagen

Both Helsinki and Copenhagen utilize digital platforms and mapping dashboards to support sustainable urban development. Helsinki's approach emphasizes technological integration with tools like the "Helsinki 3D+" project and the Whim app, focusing on advanced urban planning and seamless mobility solutions. Copenhagen combines technological initiatives with strong policy commitments, aiming for carbon neutrality by 2025 and promoting cycling as a primary mode of transport. While both cities engage citizens in urban planning, Helsinki places a notable emphasis on participatory processes through digital tools, whereas Copenhagen integrates citizen engagement within its broader sustainability policies.

In summary, both cities demonstrate a commitment to sustainable urban development through the use of digital platforms and mapping dashboards, each with unique strategies tailored to their specific urban contexts.

Criteria	Helsinki	Copenhagen
Carbon Emission Reduction (%)	Reduced CO_2 emissions by 75% since 2005; aiming for 80% reduction by 2025.	Reduced CO_2 emissions by 75% since 2005; aiming for 80% reduction by 2025.
	Le Monde.fr	Le Monde.fr
Bike Lane Length (km)	Approximately 1,200 km of bike lanes.	Approximately 397 km of cycle paths.
	Kestävä Helsinki	Le Monde.fr
Public Transport Reliability (%)	Public transport punctuality rate of 99.4%.	Public transport punctuality rate of 98%.
	Kestävä Helsinki	Le Monde.fr
CO_2 Reduction Goal Year	Aiming for carbon neutrality by 2035.	Aiming for carbon neutrality by 2025.
	Kestävä Helsinki	Le Monde.fr
Citizen Engagement Tools	Participatory budgeting, open data platforms.	Public consultations, climate action plans.
	Kestävä Helsinki	Le Monde.fr
Smart Waste Management	Smart bins with sensors to optimize collection.	Waste-to-energy plant (Amager Bakke).
	Kestävä Helsinki	Le Monde.fr

Table 4 Comparative Analysis of Sustainability Policies in Helsinki and Copenhagen

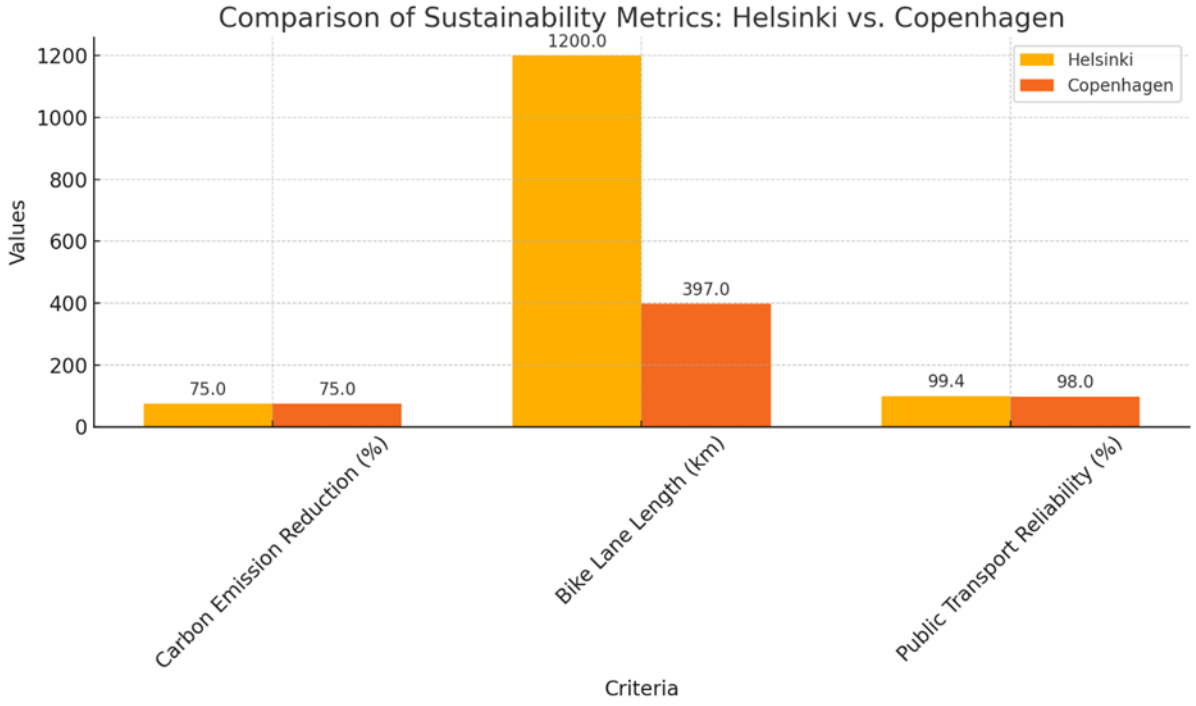


Figure 27 Sustainability comparison between Helsinki and Copenhagen

The bar graph provides a comparative analysis of the sustainability metrics between Helsinki and Copenhagen, focusing on carbon emission reduction, bike lane length, and public transport reliability. Both cities have achieved a 75% reduction in carbon emissions since 2005, reflected by equal bar heights, although their target years for carbon neutrality differ—Copenhagen aims for 2025, while Helsinki targets 2035. In terms of cycling infrastructure, Helsinki significantly surpasses Copenhagen, offering 1,200 kilometers of bike lanes compared to Copenhagen's 390 kilometers. This substantial difference is visually represented by a much taller bar for Helsinki, highlighting its stronger commitment to promoting cycling as a sustainable mode of transport. Public transport reliability is high in both cities, with Helsinki slightly leading at 99.4% punctuality compared to Copenhagen's 98.0%. The bars in this category are nearly identical, indicating that both cities maintain efficient and dependable public transport systems. Overall, the graph illustrates Helsinki's strength in sustainable mobility infrastructure and technological integration, while Copenhagen emphasizes ambitious carbon neutrality goals and policy-driven sustainability initiatives.

Sustainable urban development has become a critical priority for cities worldwide, driven by the urgent need to combat climate change and promote environmental resilience. Among leading examples, Helsinki and Copenhagen stand out for their innovative and ambitious sustainability strategies. While both cities leverage digital platforms and mapping dashboards to advance urban sustainability, their approaches differ significantly. Helsinki focuses on integrating cutting-edge technology and participatory tools to engage citizens in urban planning, exemplified by projects like the Helsinki 3D+ and the Whim app. In contrast, Copenhagen emphasizes robust policy frameworks and infrastructural investments, aiming for carbon neutrality by 2025 and heavily promoting cycling as a primary mode of transport.

This comparative analysis explores the successful sustainability policies of both cities, highlighting how technological innovation and policy-driven approaches contribute to their environmental goals. Through examining initiatives in mobility, energy transition, urban planning, and citizen engagement, this study provides insight into how Helsinki and Copenhagen tailor their sustainability strategies to their unique urban contexts.

City	Policy/Initiative	Description	Reference
Copenhagen	Copenhagen Climate Plan (2009)	Aims for carbon neutrality by 2025 with actions in energy efficiency, renewables, and green mobility.	City of Copenhagen, 2009
	Green Mobility Plan	Investments in cycling infrastructure and promotion of cycling as the main transport mode.	City of Copenhagen, 2013
	Cycle Superhighways	Long-distance bike commuting routes to encourage cycling.	European Cyclists' Federation, 2020
	Energy Transition Policies	Shift to biomass, wind, and solar energy in district heating.	International Energy Agency, 2019
	Offshore Wind Farms	Expansion of offshore wind to supply over 40% of electricity demand.	City of Copenhagen, 2020
	Nordhavn Urban Development	Sustainable district with green buildings, mixed land use, and smart energy solutions.	Gehl Architects, 2017
	Green Roof Policy (2010)	Mandates green roofs on new buildings for insulation and stormwater management.	City of Copenhagen, 2010
Helsinki	Carbon-neutral Helsinki 2035 Action Plan	Roadmap with 147 actions to achieve carbon neutrality by 2035.	City of Helsinki, 2018
	Helsinki 3D+ Project	3D models for urban planning, energy simulations, and environmental impact assessments.	Kangasoja et al., 2019
	Mobility as a Service (MaaS) - Whim App	Integrates various transport modes into a single mobility platform.	Jittrapirom et al., 2017
	Smart & Clean Foundation (2016–2021)	Public-private partnership for scalable climate solutions and circular economy.	Smart & Clean Foundation, 2016
	Cycling Promotion Plan	Investment in 1,200 km of bike lanes, aiming for 15% of all trips by bike by 2025.	City of Helsinki, 2019
	Winter Maintenance of Bike Lanes	Year-round cycling supported through prioritized winter maintenance.	European Cyclists' Federation, 2020
	Energy Efficiency in Buildings	Incentives for energy retrofitting and smart grids integration.	Helsinki Energy Challenge, 2020

Table 5 Comparative Analysis of Sustainability Policies in Helsinki and Copenhagen

Copenhagen focuses on policy-driven climate action, combining ambitious carbon targets with infrastructural investments in renewable energy and cycling (City of Copenhagen, 2009).

Helsinki emphasizes technological innovation and digital tools to enhance citizen participation and optimize urban services (City of Helsinki, 2018).

Both cities' policies are tailored to their unique urban contexts but share a common goal: achieving a sustainable and climate-resilient future.

Chapter 4. Case Study Analysis of Turin

Turin, the capital of the Piedmont region in northwest Italy, is a city deeply influenced by its industrial legacy and geographical location. Situated in the Po Valley at the foothills of the Alps, its strategic position facilitated rapid industrialization, but the region's topography—characterized by low wind flow and temperature inversions—has amplified environmental challenges, particularly air pollution. This makes Turin one of Europe's most polluted cities, with emissions from industry, traffic, and residential heating as key contributors. In addition to environmental issues, the city faces economic and social challenges, including the need to transition from a manufacturing-dependent economy, address urban sprawl, and ensure equitable access to housing and green spaces. Effective governance is crucial in tackling these interconnected problems, especially in aligning local strategies with broader sustainability goals. Moreover, digital tools such as geospatial mapping, real-time dashboards, and data platforms have become essential for identifying pollution sources, optimizing urban planning, and fostering citizen engagement. These technologies play a pivotal role in shaping Turin's path toward resilience and sustainable urban development.

This chapter addresses the following questions: How have mapping dashboards in Turin been used to support sustainable urban development? What successes have been obtained? Key elements of this study include an overview of Turin's green initiatives and urban planning strategies, an analysis of the role of mapping dashboards and an assessment of the successes and challenges of using mapping dashboards in Turin's sustainability efforts.

4.1.1 Performance and Challenges in Achieving SDG Goals in Turin

Turin's performance in meeting the Sustainable Development Goals (SDGs) highlights both its potential and its challenges. Ranking 35th out of 45 cities, with a score of 56.4, Turin has significant room for improvement. While it outperformed cities like Bucharest and Athens, it continues to lag behind many of its Northern European counterparts. This disparity reflects broader regional differences, where Southern European cities often contend with pronounced economic disparities and environmental pressures.

4.1.2 Key Measures and Initiatives

In its pursuit of sustainable development, Turin has concentrated on specific areas that align with its unique urban and social context. One of its key focuses is social inclusion, an effort guided by SDG 10 (Reduced Inequalities) and SDG 11 (Sustainable Cities and Communities). Local economic programs and affordable housing initiatives aim to address inequality,

fostering a more equitable urban environment. These efforts are critical in promoting a sense of community and ensuring that all residents benefit from the city's development strategies.

Another major focus area is cultural heritage preservation and urban renewal. Turin has embraced the revitalization of its historical neighbourhoods as a strategy for sustainable urban development. This approach not only preserves the city's rich cultural assets but also reduces urban sprawl by maximizing the potential of existing urban spaces. By integrating sustainability principles into its cultural and architectural restoration projects, Turin is enhancing its identity while contributing to the broader goals of sustainability.

4.1.3 Ongoing Challenges

Despite these efforts, Turin faces several significant challenges in achieving its SDG targets. One pressing issue is air quality, which directly impacts SDG 13 (Climate Action). The city's air pollution levels remain a persistent problem, exacerbated by its geographic location and industrial legacy.

Finally, inefficiencies in waste management contribute to the city's struggle with SDG 12 (Responsible Consumption and Production). Addressing this issue requires coordinated efforts across the public and private sectors to improve recycling rates, reduce waste generation, and implement circular economy principles.

These challenges underscore the complexity of urban sustainability, particularly in cities like Turin that must balance economic growth, environmental conservation, and social equity. Moving forward, addressing these issues will require bold, innovative strategies that leverage data-driven tools, community engagement, and regional collaboration to ensure progress toward the SDGs.

4.2.1 Contribution of Mapping Dashboards to Sustainable Urban Development in Turin

Mapping dashboards have emerged as critical tools in urban planning, offering unprecedented insights into areas such as pollution, inequality, and resource management. By visualizing complex data, these tools facilitate targeted interventions that enhance urban sustainability. They also foster collaboration between local authorities and citizens, ensuring transparency and accountability in meeting Sustainable Development Goals (SDG). This chapter examines how Turin has increasingly integrated mapping dashboards and digital platforms to advance sustainable urban development.

Turin's approach centres on data-driven governance and enhanced citizen engagement. Through these platforms, urban planners and policymakers gain access to detailed analyses of land use, mobility patterns, environmental conditions, and public participation. These tools form the backbone of Turin's efforts to transform itself into a more sustainable, resilient, and inclusive city.

4.2.2 Mapping Dashboards in Action

One of Turin's flagship tools, the Urban Atlas, plays a pivotal role in sustainable urban development. This initiative, part of a broader European effort, provides high-resolution data on land use and urban changes, enabling decision-makers to monitor and evaluate critical issues such as green infrastructure integration, urban sprawl, and land use dynamics. The insights derived from this tool have significantly improved the city's capacity to make informed and sustainable planning decisions (European Commission, 2019).

Complementing the Urban Atlas is Turin's Cruscotto Urbano, literally Urban Dashboard, which integrates real-time data on various urban systems. This platform tracks metrics such as energy consumption, traffic patterns, and the performance of public services. By making this information accessible, the dashboard promotes transparency and encourages public involvement in the city's sustainability initiatives (OECD, 2022).

Additionally, the Turin City Lab serves as a strategic innovation hub, providing a testing ground for new solutions in areas such as smart mobility and energy efficiency. This initiative fosters public-private collaboration, creating a fertile environment for projects that contribute to the city's long-term sustainability and economic growth (OECD, 2022; Bloomberg Philanthropies, 2019).

4.2.3 Achievements in Sustainable Urban Development

Turin's adoption of mapping dashboards has yielded several notable successes. One example is the transformation of former industrial zones, such as the Lingotto district, into vibrant mixed-use areas. By balancing residential, commercial, and green spaces, these regeneration projects have enhanced urban liveability and promoted social inclusion (CERUS, 2023).

Citizen engagement has also seen a marked improvement, thanks to open-data platforms and participatory planning processes. These tools have empowered residents to take an active role in urban decision-making, fostering greater public support for sustainability initiatives (OECD, 2022). Meanwhile, smart mobility projects facilitated by the Turin City Lab have introduced innovative transportation solutions, such as smart traffic management systems and expanded electric vehicle infrastructure. These efforts have not only reduced congestion but also promoted low-carbon mobility (OECD, 2022).

4.2.4 Strategic Frameworks: Turin 2030 and Vision Turin 2050

Turin's planning initiatives are guided by two comprehensive frameworks: the "Turin 2030" Action Plan and the "Vision Turin 2050." These strategies outline the city's path toward a sustainable and resilient future, with an emphasis on environmental stewardship, social inclusivity, and economic innovation.

The Turin 2030 Action Plan prioritizes eco-friendly transportation, equitable development, and enhanced quality of life. It emphasizes community involvement in decision-making, with the ultimate goal of creating a city that is participatory, liveable, and dynamic. This plan integrates mapping dashboards to monitor progress in areas such as air quality, energy consumption, and carbon emissions, aligning with broader European climate objectives (TheMayor.EU, 2023).

Extending this vision, the Vision Turin 2050 framework envisions a post-carbon future. Supported by the European Union's POCACITO project, the initiative focuses on reducing emissions, expanding renewable energy, and enhancing green infrastructure. The framework highlights key areas such as energy efficiency, circular economies, and poverty reduction. By collaborating with local academic institutions, including Politecnico di Torino, and governmental organizations, the plan ensures that strategies are both comprehensive and evidence-based (POCACITO, 2014).

4.3 Areas of Focus in Turin's Mapping Dashboards

Turin's mapping dashboards address several critical areas. They play a significant role in sustainability and climate monitoring, supporting efforts to reduce emissions and promote renewable energy. By providing real-time data on air quality, energy use, and carbon emissions, these tools enable urban planners to track progress and make informed decisions aligned with the city's post-carbon goals.

Citizen-centric urban planning is another area of emphasis. Dashboards facilitate participatory processes by integrating real-time feedback channels, allowing residents to interact with city authorities and influence planning decisions. This approach has strengthened public trust and ensured that urban development aligns with community needs.

Moreover, the dashboards support economic and social development by tracking socio-economic indicators such as employment rates and public health metrics. Tools like the Turin Action Plan for Energy (TAPE) focus on reducing CO_2 emissions across sectors, using data to enhance energy efficiency and track city-wide progress.

In the realm of transportation, Turin has embraced multimodal systems and smart mobility solutions. Dashboards provide detailed analyses of public transit usage, congestion levels, and pedestrian traffic. These insights enable planners to optimize transit routes, reduce reliance on personal vehicles, and expand infrastructure for sustainable mobility solutions as part of the Vision Turin 2050 plan (POCACITO, 2014).

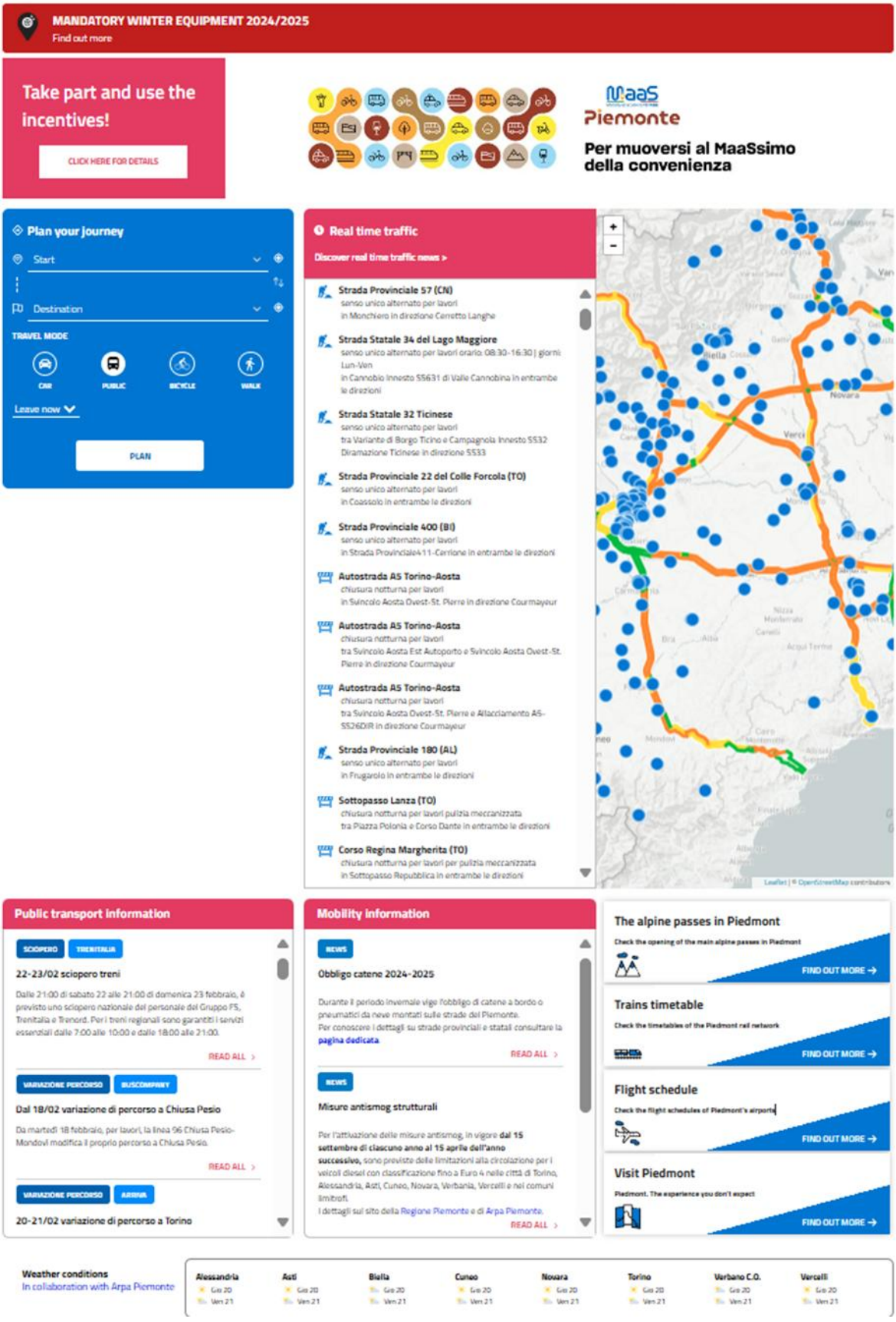
Turin's integration of mapping dashboards into its urban planning processes underscores the transformative potential of these tools in driving sustainable development. By leveraging advanced data analytics, the city has enhanced its capacity for informed decision-making, public engagement, and targeted interventions.

Through initiatives like the Urban Atlas, Cruscotto Urbano, and Turin City Lab, the city has successfully addressed critical challenges such as urban regeneration, citizen participation, and smart mobility. Furthermore, the strategic frameworks of Turin 2030 and Vision Turin 2050 provide a clear roadmap for achieving long-term sustainability goals. By focusing on reducing emissions, fostering economic innovation, and enhancing quality of life, Turin demonstrates how mapping dashboards can be harnessed to create a resilient and inclusive urban environment.

4.4 Turin city dashboards

4.4.1 Mobility and Transportation Dashboards

The 5T Mobility Dashboard provides real-time information about public transport services, traffic flow, parking availability, and electric vehicle charging stations.



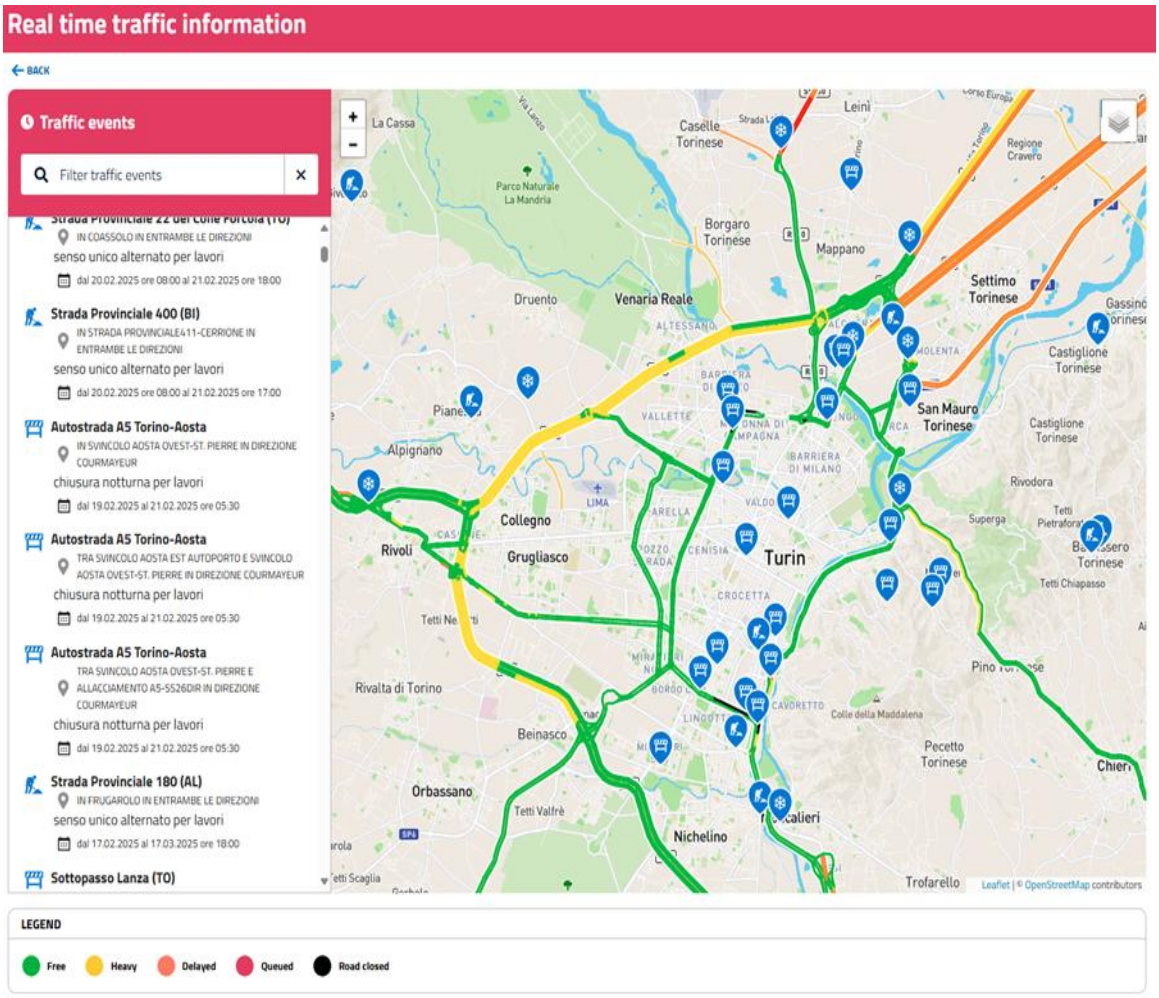


Figure 28 Public transportation and mobility dashboard of Piedmont region.(Muoversi in Piemonte, 2025)

4.4.2 Public Safety Dashboards

Torino Police Dashboard: This dashboard visualizes crime statistics and patterns throughout the city, helping citizens understand the safety of different neighbourhoods and also learn about last situation of stollen objects.

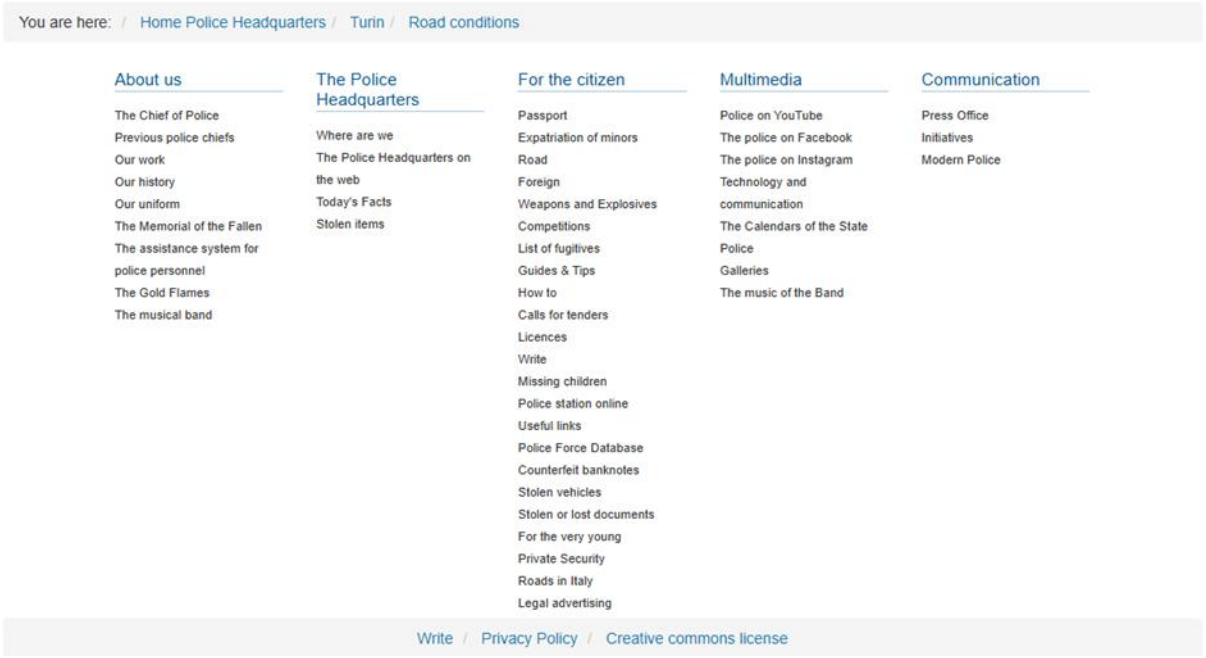


Figure 29 Torino Police Dashboard.(Polizia di Stato, 2024).

The Noticeboard of Stolen Items and Recovered Items

Has an item been stolen from you? Maybe we found it. Take a look at our Noticeboard of Recovered Items. It is divided into categories and you can select the city in which to search or extend it to all of Italy because stolen items are often found in a city other than the one in which you suffered the theft.

Do you want to help us find it instead? When reporting the theft, bring us a photo of the stolen item, we will insert it in the section of Reported but not Found Items and everyone will be able to contribute to finding it.

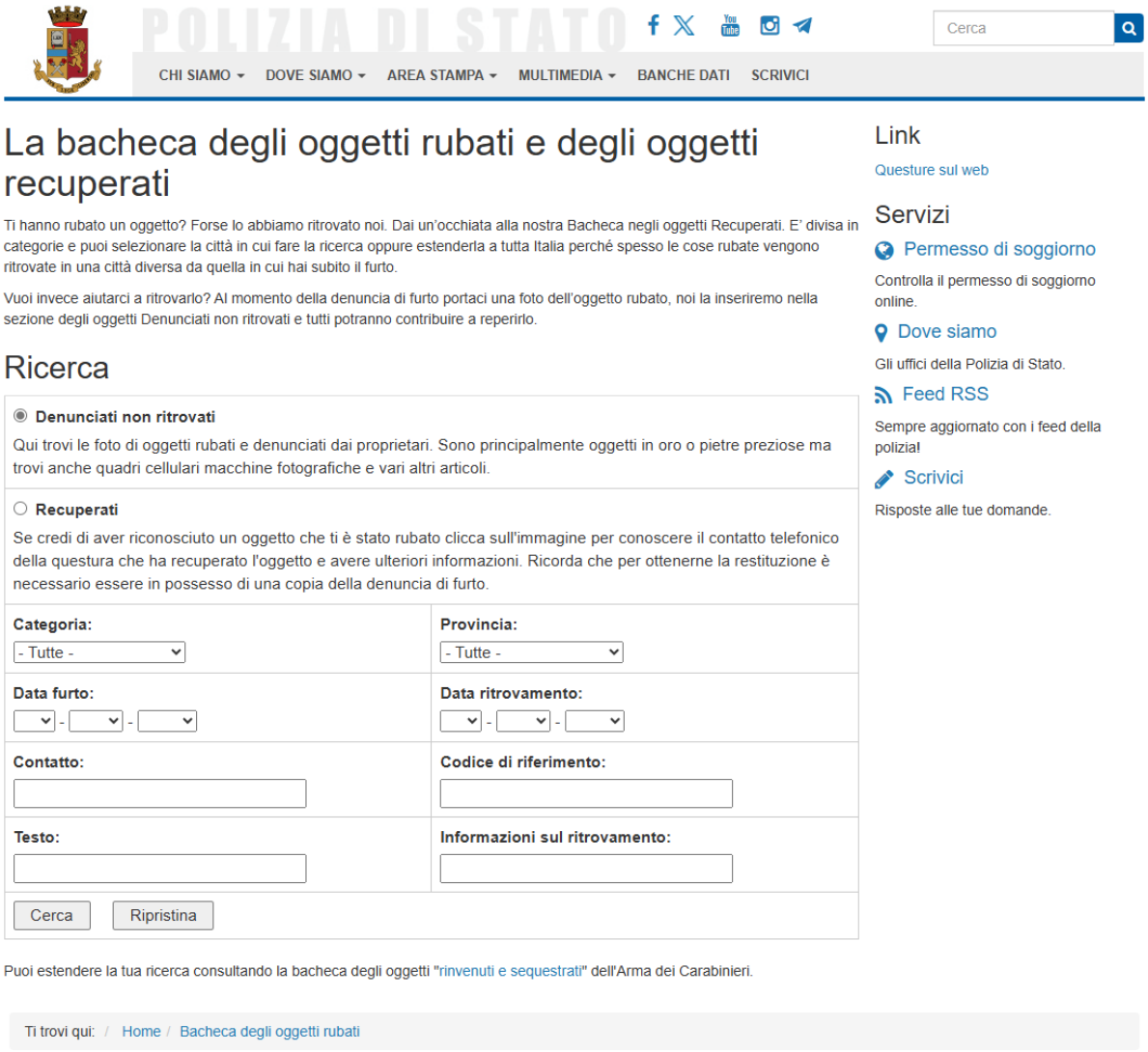


Figure 30 Torino Police Dashboard.(Polizia di Stato, 2024).

4.4.3 Environmental Quality Dashboards

Air Quality Monitoring Dashboard:Tracks air quality metrics across different neighborhoods, providing real-time data on pollutants like PM10, NO2, and ozone levels.

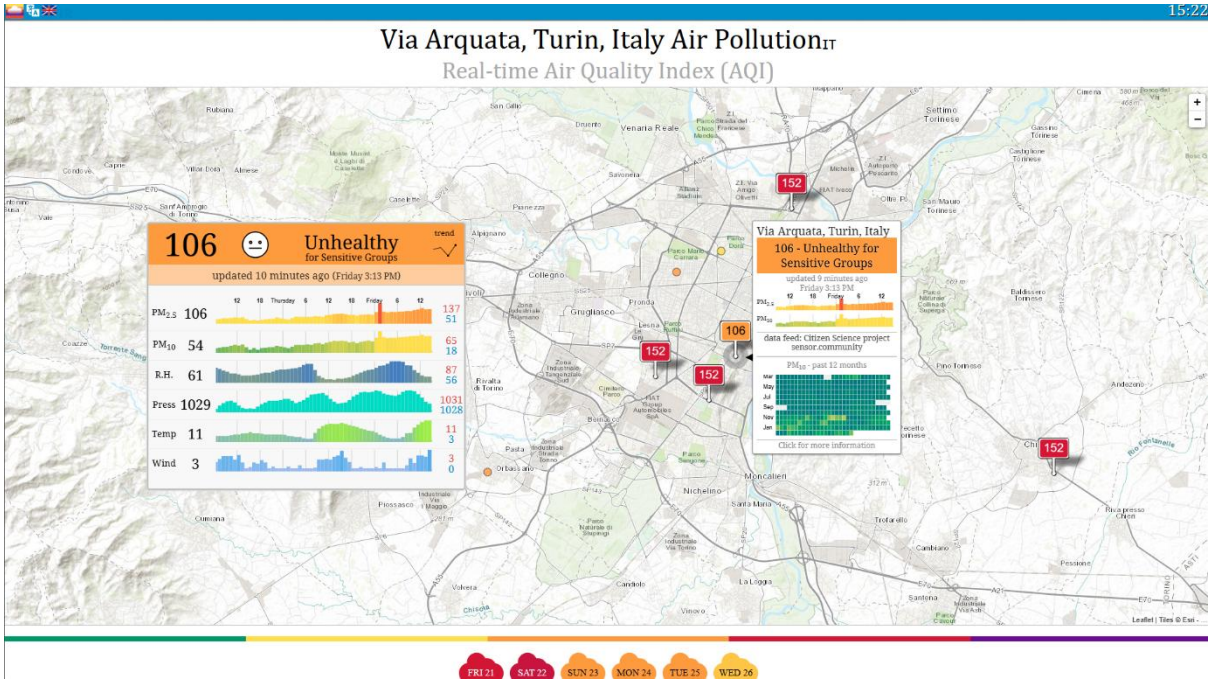


Figure 31 Turin air pollution dashboard(World Air Quality Index Project, 2025)

Air Quality Monitoring

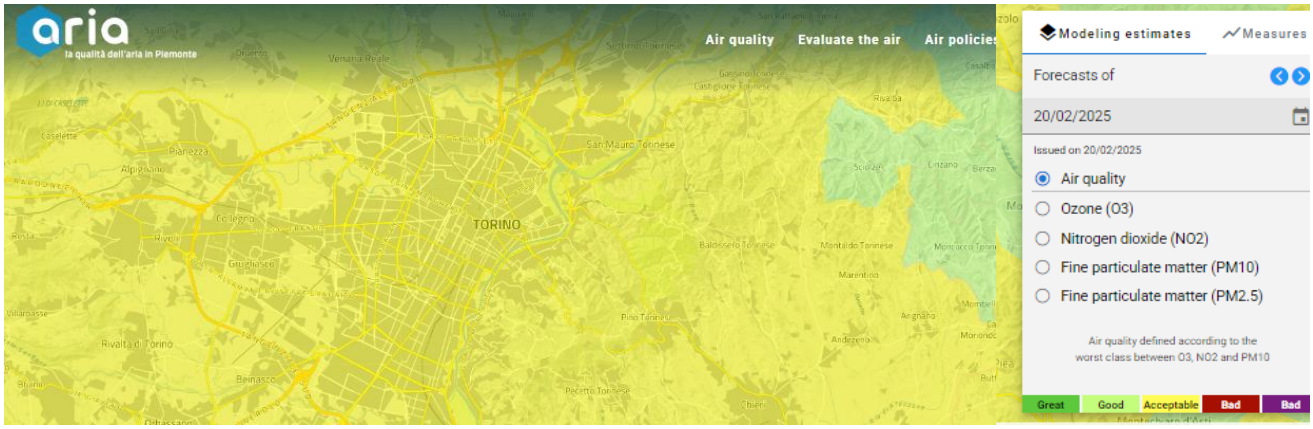


Figure 32 Turin air quality monitoring dashboard. (ARPA Piemonte, 2025)

Ozone levels

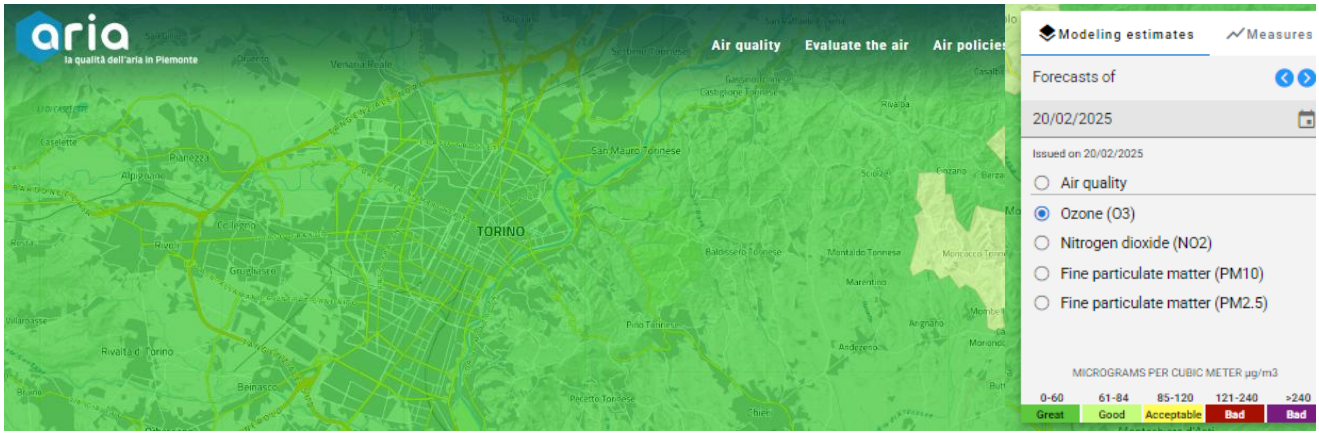


Figure 33 Ozone quality monitoring dashboard. (ARPA Piemonte, 2025)

NO2

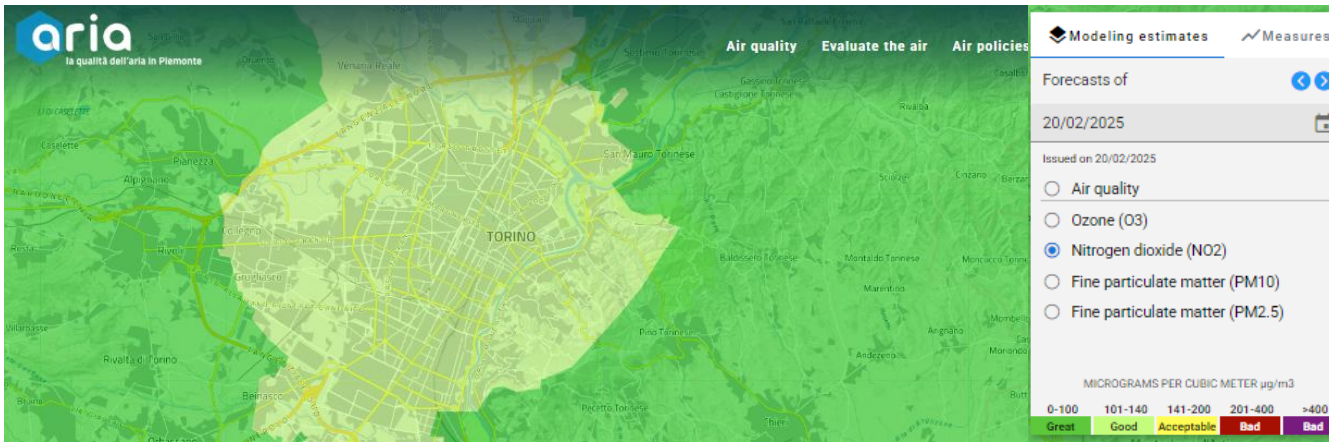


Figure 34 Turin Nitrogen dioxide quality monitoring dashboard. (ARPA Piemonte, 2025)

Emission sources in Piedmont region

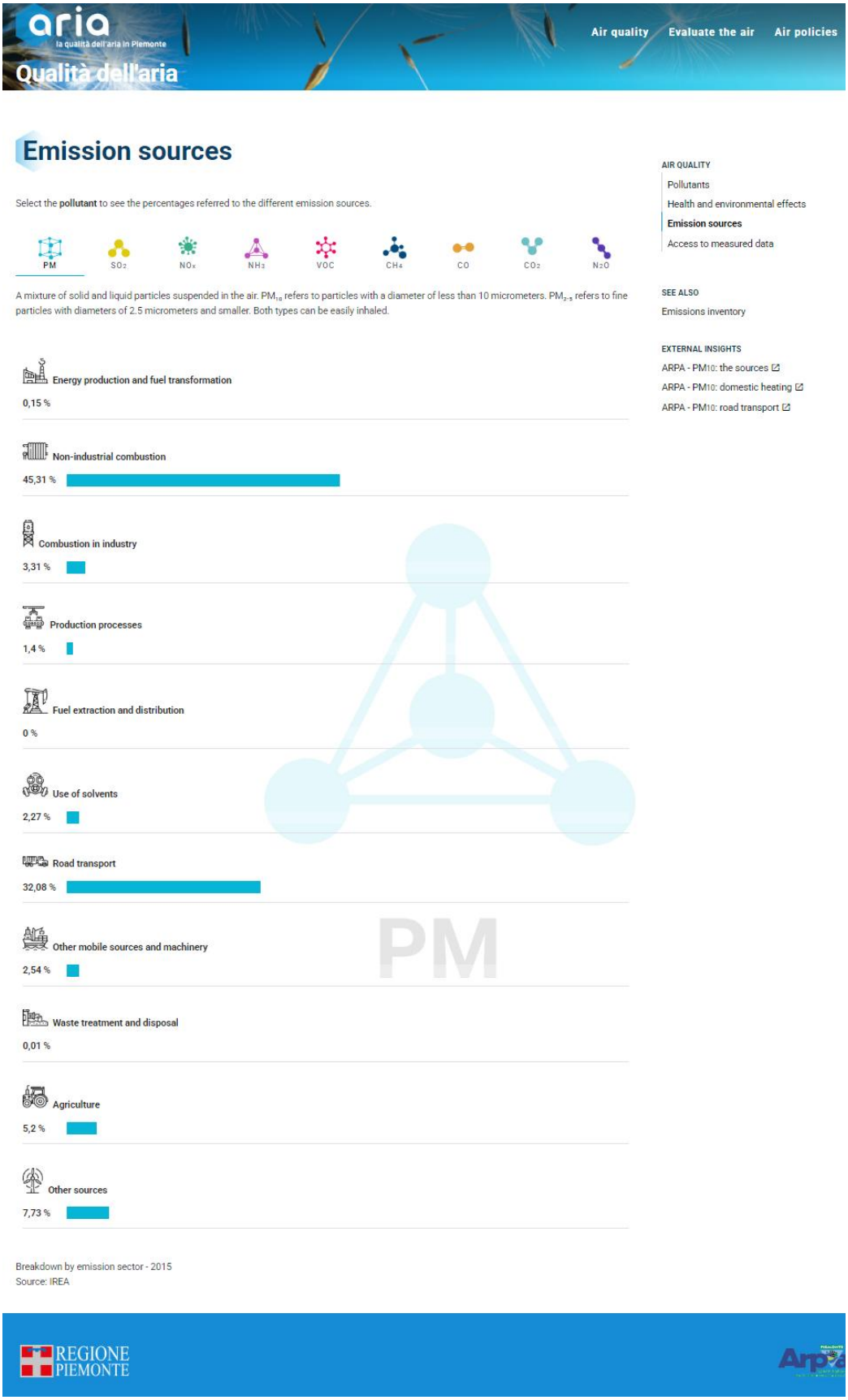


Figure 35 Turin Emission sources monitoring dashboard. (ARPA Piemonte, 2025)

4.4.4 Healthcare Dashboards

COVID-19 Dashboard:Provides essential data on COVID-19 infection rates, hospital capacities, and vaccination progress in the region.

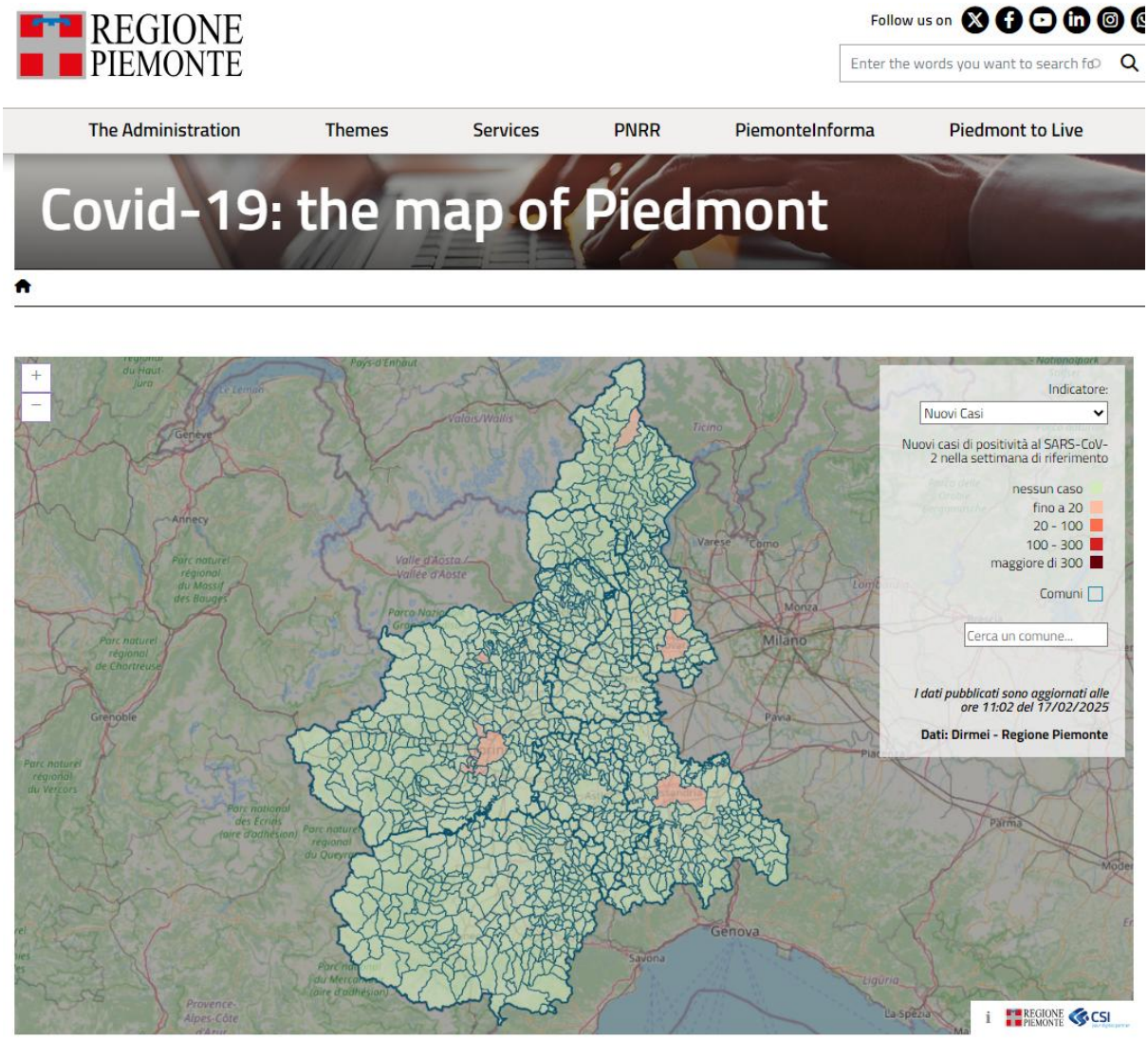


Figure 36 Turin Covid-19 monitoring dashboard. (Regione Piemonte, 2025)

4.4.5 Civic Engagement and Inclusivity Dashboards

Open Data Torino Dashboard Provides access to datasets related to city governance, public services, and urban planning, encouraging citizen participation.

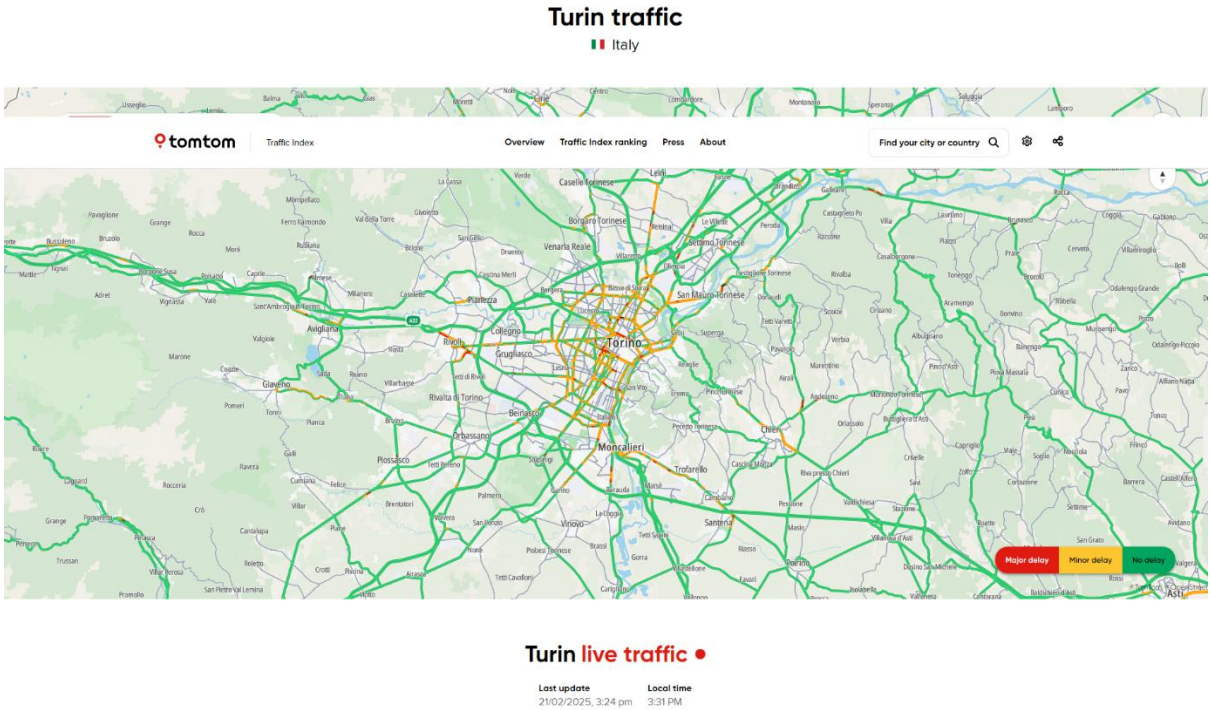


Figure 37 Turin Live trafic monitoring dashboard. (TomTom, 2025)

Figure 38 Turin Environment and greenery dashboard (Comune di Torino, 2025)

Figure 39 Turin Health and social (Comune di Torino, 2025)

4.4.6 Energy and Sustainability Dashboards

In the Piedmont region, particularly in the city of Turin, several initiatives have been developed to enhance energy transparency and citizen engagement through digital platforms and dashboards. One of the most notable is Enercloud, a web-based monitoring system managed by the Metropolitan City of Turin. This platform allows the public to explore energy consumption data from municipal buildings, including schools, administrative offices, and public infrastructure. Citizens can access real-time data on electricity and gas usage, analyze historical consumption trends, and evaluate efficiency improvements across districts (Città Metropolitana di Torino, 2025.). By making such data accessible, Enercloud empowers residents to monitor the sustainability performance of public assets and hold local institutions accountable. Complementing this, the Energy Observatory developed under the European Energee-Watch initiative provides a more macro-scale overview. It publishes biennial reports detailing energy consumption, production, and greenhouse gas emissions across 312 municipalities in the Turin metropolitan area (Energee-Watch,2025.). This tool supports participatory governance by enabling citizens, NGOs, and local organizations to track municipal compliance with Sustainable Energy Action Plans (SEAPs). Additionally, more localized models such as the energy communities in the Pinerolo area—coordinated by ACEA Pinerolese Industriale—demonstrate how shared renewable production (e.g., solar and hydro) is monitored through dedicated dashboards. These platforms offer insights into community-level self-consumption, overproduction, and economic savings, directly engaging residents as active stakeholders in the energy transition (ACEA Pinerolese Industriale, 2025.). For private users and SMEs, commercial tools like Canavisia provide real-time monitoring of household electricity, gas, and water consumption using IoT sensors, though access is typically restricted to paying customers. Collectively, these platforms illustrate how digital infrastructure can enhance transparency, foster sustainable behaviour, and support a more democratized approach to energy governance in urban and regional contexts.

Dashboard / Tool	Scope	Data Provided	User Type
Energy Observatory (Energee-Watch)	Metropolitan City of Turin	Building-level use, production, CO_2 emissions	Citizens, planners
Clean Energy Atlas (PoliTo)	Piedmont municipalities	Renewable potential, community aggregation tools	Citizens, communities
Pinerolo Energy Community	47 municipalities near Turin	Collective generation, % self-sufficiency	Participants
Canavisia Dashboard	Individual buildings/sites	Real-time consumption, vector breakdown, alerts	SMEs, public bodies

Table 6. Energy and Sustainability Dashboards

Tool	Public Access?	Tracks Public or Private Use?	Citizen Involvement
Enercloud	✅ Yes	Public buildings only	View consumption per building
Energy Observatory	✅ Yes	Municipality-wide	View reports and maps
Energy Communities (CERs)	⚠️ Partially	Shared/local renewables	Join or follow dashboard
Canavisia	❌ Paid	Private buildings	Install & monitor your own data

Table 7 . Citizen Involvement

4.5 The table of Turin city dashboards

Dashboard Type	Dashboard Name	Description
Mobility and Transportation	5T Mobility Dashboard	Provides real-time information about public transport services, traffic flow, parking availability, and electric vehicle charging stations.
Public Safety	Torino Police Dashboard	Visualizes crime statistics and patterns throughout the city, helping citizens understand the safety of different neighborhoods.
Environmental Quality	Air Quality Monitoring Dashboard	Tracks air quality metrics across different neighborhoods, providing real-time data on pollutants like PM10, NO2, and ozone levels.
Healthcare	COVID-19 Dashboard	Provides essential data on COVID-19 infection rates, hospital capacities, and vaccination progress in the region.
Civic Engagement and Inclusivity	Open Data Torino Dashboard	Provides access to datasets related to city governance, public services, and urban planning, encouraging citizen participation.
Energy and Sustainability	Smart Meter Dashboard	Allows users to monitor their energy consumption through smart meters, promoting energy-saving practices.

Traffic management	Operational Monitoring Dashboards	Provides real-time updates on assets, vehicles, or resources, such as traffic conditions, fleet locations, or utility outages.
Analyzing Performance and Market Reach	Location Analytics Dashboards	Combines spatial data with business metrics to analyze performance and market reach of specific locations.
Tracking Environmental Factors	Environmental Monitoring Dashboards	Tracks environmental factors like air quality, weather conditions, and soil moisture using IoT sensors or satellite imagery.
Disease Outbreaks and Healthcare Analytics	Public Health Dashboards	Visualizes data on disease outbreaks, vaccination rates, and healthcare facilities to aid decision-making and resource allocation.
Urban Development and City Planning	Urban Planning Dashboards	Shows information on urban development projects, zoning, and infrastructure conditions to assist in city planning and maintenance.
Assessing and Visualizing Risks	Risk Assessment Dashboards	Assesses and visualizes risks such as natural disasters, crime, or other hazards, including shelter locations and hazard zones.
Supply Chain Management and Logistics	Supply Chain Dashboards	Maps the supply chain, tracking shipments, inventory, and distribution points, often integrating IoT for sensitive goods monitoring.
Agriculture and Crop Health Monitoring	Agricultural Dashboards	Displays crop health, land utilization, and water resources using satellite data, IoT sensors, or drone imagery.
Recreational and Tourist Mapping	Tourism Dashboards	Highlights points of interest, routes, or services, showing trail conditions, park occupancy, or tourist recommendations.
Historical and Cultural Site Visualization	Historical Mapping Dashboards	Visualizes historical sites, cultural landmarks, and archaeological findings, often including time sliders for data changes over time.

Table 8 Turin different types of city dashboards

4.6 "Integrating Digital Tools in Turin's Green Future: The Role of Mapping Dashboards in Sustainable Development"

Understanding Turin's current strategies for environmental sustainability is essential to appreciate the significant role that mapping dashboards and digital platforms play in the city's sustainable development. These technological tools are integral to monitoring, planning, and implementing the city's green initiatives, providing real-time data and visualizations that inform decision-making and public engagement. Turin has been actively pursuing a "green future" with a comprehensive set of strategies aimed at environmental sustainability, urban regeneration, and technological innovation. As part of its smart city and sustainable development goals, the city is implementing a variety of green projects to address climate change, reduce carbon emissions, promote renewable energy, and improve the overall quality of life for its residents (City of Turin, 2023).

Mapping dashboards and digital platforms are pivotal in these efforts. For instance, the city's environmental dashboard enables authorities to observe land transformations, set environmental policies, and prioritize interventions to maintain or augment ecosystem functions against anthropogenic threats and unpredictable natural events due to climate change (ResearchGate, 2020). Additionally, Turin's Smart City strategy includes the development of digital dashboards for urban governance. These platforms support decision-making processes by providing graphical representations of data, enhancing the effectiveness of urban tourism management, and contributing to the implementation of the Sustainable Energy Action Plan (Politecnico di Torino, 2020).

By integrating these digital tools into its sustainability strategies, Turin enhances its capacity to monitor progress, engage with citizens, and adapt to emerging challenges, thereby reinforcing its commitment to a sustainable and resilient urban future (OECD, 2022).

4.7 Tracking Urban Sustainability: The Power of Dashboards in Achieving SDGs in European Cities

As the world increasingly turns its attention to achieving the United Nations Sustainable Development Goals (SDGs), cities play a significant role in driving progress toward a more sustainable future. Urban areas are both the source of many global challenges and the key to innovative solutions, as they house most of the world's population and are responsible for significant environmental and social impacts. In response, cities are adopting new technologies and tools to monitor, analyse, and address these challenges. Among the most powerful of these tools are mapping dashboards, which integrate data from multiple sources to provide real-time, visually intuitive insights into urban sustainability.

This section explores the transformative role of mapping dashboards in the context of urban development, focusing specifically on the 2019 SDG Index and Dashboards Report for European Cities. By leveraging advanced data visualization and geographic information systems (GIS), these dashboards enable cities to track their performance across various SDGs, such as poverty reduction, health, education, climate action, and sustainable cities. Through the use of color-coded indicators, geographic analysis, and interactive tools, dashboards not only enhance the accessibility and clarity of complex data but also foster accountability, policy

development, and citizen engagement. By examining the contributions of mapping dashboards, this chapter highlights how they are reshaping urban governance and accelerating progress toward sustainable development in European cities.

The 2019 SDG Index and Dashboards Report for European Cities evaluates the progress of cities across Europe toward achieving the United Nations Sustainable Development Goals (SDGs), with a particular focus on urban contributions to global sustainability challenges. Recognizing the crucial role that cities play in addressing these issues, the report emphasizes the importance of mapping dashboards and interactive tools as integral components in advancing sustainable development goals at the urban level. These dashboards serve as powerful tools for visualizing data, comparing cities' performance on each of the 17 SDGs, and identifying both successes and gaps. Through their interactive capabilities, they enable policymakers, researchers, and the public to better understand sustainability challenges and act accordingly (Sustainable Development Solutions Network [SDSN], 2019).

The report's coverage includes a selection of cities across Europe, focusing on their performance on SDG indicators. It shifts away from a national perspective, instead offering a city-level analysis that is critical for understanding urban contributions to sustainability. Methodologically, the report employs a dashboard approach to present data on various SDG targets, ranking cities based on their performance across multiple indicators, using a color-coded system to indicate progress—ranging from green for high achievement to red for areas requiring urgent attention. The assessment covers a wide range of SDGs, including poverty (SDG 1), health (SDG 3), education (SDG 4), sustainable cities (SDG 11), and climate action (SDG 13), highlighting both strengths and areas needing improvement. The findings reveal disparities between cities, with cities in Northern and Western Europe generally performing better on environmental and social metrics, while others face significant challenges (SDSN, 2019).

Mapping dashboards play a critical role in the 2019 SDG Index and Dashboards Report by organizing, analyzing, and presenting complex data in a visual format. These dashboards simplify large datasets through visual elements like maps, graphs, and color-coded indicators, enabling users to quickly compare city performance across different SDGs. By presenting data in this intuitive format, they make it easier to identify disparities between cities and detect patterns in SDG progress. Furthermore, mapping dashboards provide a geographic context for the data, allowing for spatial analysis that highlights regional trends in sustainability. For instance, these tools might reveal that cities in Northern Europe excel in climate action (SDG 13) while cities in Southern Europe may face greater challenges in achieving sustainable cities and communities (SDG 11). This geographic context helps policymakers to see where interventions are needed and supports targeted actions (SDSN, 2019).

Dashboards also foster monitoring and accountability by allowing cities to track their progress over time, offering transparency through publicly displayed performance data. This transparency helps to engage a broad range of stakeholders, including governments, businesses, and citizens, in holding cities accountable for their SDG commitments. Moreover, mapping dashboards serve as valuable tools for policy and decision support, helping decision-makers prioritize resources by identifying areas in need of intervention, such as those with "red" indicators. These tools enable tailored policies that are more locally relevant and equitable (SDSN, 2019).

The interactive and accessible nature of mapping dashboards enhances stakeholder engagement by making data both visually appealing and understandable. They raise awareness about sustainability challenges and encourage community involvement in developing local solutions. Standardizing the presentation of data, dashboards facilitate comparisons between cities across various contexts, making it easier to benchmark progress and share best practices. This standardization is essential for driving collaboration between cities, highlighting successful strategies, and promoting cross-city learning (SDSN, 2019).

The 2019 SDG Index and Dashboards Report demonstrates how mapping dashboards contribute to advancing sustainable urban development. By providing accessible and dynamic data visualizations, these tools offer actionable insights for urban policymakers, facilitate collaboration between cities, and enhance the overall impact of the report through intuitive design. They support decision-making by fostering a deeper understanding of urban sustainability issues, guiding more effective and localized interventions (SDSN, 2019).

The contributions of mapping dashboards in the SDG report extend beyond just data presentation. They aggregate data from various sources, fostering informed decision-making and encouraging civic engagement. Dashboards also enable cities to compare their performance against peers, facilitating the identification of best practices and lessons learned. Since many SDGs require localized action, dashboards focus on urban contexts and highlight critical areas needing attention, such as transportation, housing, and inequality. The interactive nature of these tools allows stakeholders to analyse trends dynamically and explore specific SDG goals in detail (SDSN, 2019).

Developed by the Sustainable Development Solutions Network (SDSN) and the Brabant Centre for Sustainable Development (Telos), the 2019 report and its associated dashboards build on previous sustainability monitoring initiatives, emphasizing the essential role cities play in achieving the SDGs. These dashboards are not just tools for reporting but also serve as powerful enablers for tracking, planning, and achieving sustainable urban development (SDSN, 2019).

Chapter 5. Mapping Dashboards: Tools for Technocratic Governance or Citizen Engagement?

This chapter explores the dual role that mapping dashboards play in contemporary urban governance, functioning both as technocratic instruments and as platforms for citizen engagement. By examining digital platforms—particularly those implemented in the Piemonte region, including initiatives by CSI Piemonte—the chapter aims to critically analyse how these tools operate at the intersection of centralized decision-making and participatory urban planning. At the core of this inquiry lies the question: are mapping dashboards primarily tools for expert-led, technocratic control, or do they genuinely foster civic involvement and public dialogue? To address this, the chapter investigates the mechanisms through which mapping dashboards facilitate citizen feedback, evaluates existing participatory features within these platforms, and considers how they might either reinforce or challenge traditional power dynamics in urban governance. Technocratic approaches typically emphasize liveability, efficiency, and sustainability through expert-driven solutions and data technologies, yet ensuring inclusivity remains a persistent challenge. For instance, data and algorithm-based systems—like automated traffic management—are often praised for optimizing services (Kitchin, 2014; Braun, 2014), but their reliance on automation can marginalize public input. Moreover, urban policy decisions are frequently shaped by "epistemic communities," or networks of professionals with specialized knowledge in planning, technology, and environmental science, whose influence can inadvertently limit democratic participation (Haas, 1992). The growing prevalence of public-private partnerships adds another layer of complexity, reflecting a shift from state-centred governance to a more market-driven model. While some argue this fosters innovation and improves service delivery, others caution that it may prioritize corporate goals over the public interest (Sadowski & Pasquale, 2015). Ultimately, this chapter seeks to understand whether digital dashboards can bridge the gap between top-down governance and bottom-up engagement, or whether they simply reproduce existing hierarchies under a digital guise.

5.1.1 Are mapping dashboards a tool for technocratic urban governance or platform for citizens engagements and participation?

Mapping dashboards are often embedded in broader technocratic strategies for urban management. They aggregate, visualise, and interpret large data streams—ranging from traffic flow and waste collection to emergency response—thus providing city officials with real-time insights that enhance operational efficiency and accountability. Centralising these data within a single interface affords policymakers greater top-down oversight. Critics, however, contend that such systems prioritise metrics and automation at the expense of community perspectives. When the focus tilts too strongly toward data, citizen voices and participatory processes risk being sidelined, entrenching an efficient yet exclusionary governance model.

Despite their technocratic pedigree, dashboards possess significant potential to empower communities—especially when inclusivity guides their design. Publicly accessible urban data can increase transparency, enabling residents to scrutinise governmental actions and hold officials accountable. By opening information channels, dashboards equip individuals and groups to propose policy changes, highlight neighbourhood issues, and initiate dialogue with decision-makers. Participatory features—such as citizen-reporting modules or opportunities to contribute local knowledge—can foster collaborative urban environments in which residents actively shape policies that affect their lives. Platforms like SeeClickFix allow users to report potholes or malfunctioning streetlights, while participatory GIS and crowd-sourced mapping projects enable communities to generate or verify spatial data. Yet the promise of these tools is tempered by digital inequality: if marginalised groups lack adequate technology or digital literacy, participation remains uneven. Achieving equitable engagement therefore demands not only technical solutions but also complementary social and educational support.

5.1.2 Balancing Data, Democracy, and Decision-Making

In practice, mapping dashboards can function either as technocratic control mechanisms or as participatory platforms, depending on their implementation. At their best, digital dashboards act as a bridge between citizens and city authorities. For policymakers, they offer visual monitoring and control systems that consolidate complex information, thereby supporting multicriteria, evidence-based decision-making (Arnstein, 1969; Shelton et al., 2015). For citizens, real-time data transform users into field observers who can verify municipal performance and advocate for community priorities. Nevertheless, technocratic uses of dashboards often marginalise lived experience by elevating performance metrics (Cardullo & Kitchin, 2018).

Conversely, dashboards can nurture inclusive governance by promoting transparency, empowering residents through open data, and supporting collaborative policymaking (Bibri & Krogstie, 2020). Applications such as participatory GIS allow citizens to report issues and share local knowledge (Haklay, 2010), yet digital divides continue to limit participation, particularly among vulnerable populations (Elwood, 2008). The enduring challenge, therefore, is to design and govern dashboards that balance the efficiency of data-driven management with the principles of democratic inclusion—ultimately producing systems that are not only smart but also just.

5.1.3.Which Perspective Dominates?

The role that mapping dashboards play in urban governance is deeply influenced by their design and the governance context in which they are deployed. When managed by centralized authorities with minimal avenues for public input, these platforms tend to embody a technocratic ethos—prioritizing efficiency, control, and data-centric decision-making. Conversely, when built on principles of openness, collaboration, and inclusivity, they can serve

as powerful platforms for citizen engagement. In reality, most dashboards fall somewhere along a spectrum between these two poles, reflecting ongoing tensions between centralized control and participatory governance. The ideal approach lies in developing hybrid models that balance the operational advantages of data-driven governance with mechanisms for meaningful citizen involvement. The case of CSI Piemonte offers a compelling example of this duality. As a regional initiative in Turin's ongoing digital transformation, it illustrates how dashboards can simultaneously function as tools for streamlined urban management and as interfaces that invite public participation. The impact of such platforms ultimately depends on their governance structures, the accessibility of their data, and the degree of interactivity they offer. For urban planners and policymakers, the challenge is to design dashboards that do more than deliver information—they must foster transparency, broaden access, and embed participatory features that bridge the gap between institutional expertise and everyday civic life. CSI Piemonte demonstrates how technology, when thoughtfully applied, can support resilient and inclusive urban futures.

5.1.4. Benefits and Criticisms:

Technocratic governance offers notable advantages in urban management, primarily through its reliance on evidence-based decision-making, which can significantly enhance service delivery and optimize the allocation of resources. By harnessing data and technology, cities are often able to operate more efficiently, addressing complex challenges with greater precision and speed. However, this approach is not without its criticisms. Scholars such as Graham and Marvin (2001) have pointed out that technocratic models, when not implemented with equity and transparency in mind, can marginalize public participation and deepen existing social inequalities. The emphasis on centralized control and expert-led decision-making may sideline democratic processes, limiting opportunities for citizens to influence urban development. In essence, while technocratic governance strives for a streamlined and data-driven model of city management, it simultaneously raises critical questions about inclusivity, openness, and the role of civic engagement in shaping the urban future.

5.2.1 Analysing the Role of Mapping Dashboards in Urban Governance: The Case of CSI Piemonte

The integration of digital tools—particularly mapping dashboards, which are interactive platforms that visualize complex spatial data—represents a significant evolution in contemporary urban governance. These technologies not only enable data-driven decision-making and enhance the efficiency of urban management, but also open new pathways for citizen engagement, aligning with broader objectives of sustainable and inclusive urban development. This chapter addresses the core research question: how are mapping dashboards utilized within urban governance, and to what extent do they support participatory decision-making models? Using CSI Piemonte as a central case study, the analysis explores the complex interplay between technology, governance, and urban planning, with a particular focus on inclusive design principles, accessibility, and the transformative potential of digital platforms in reshaping the way cities are governed and experienced. and experienced.

5.2.2 Why CSI Piemonte?

To explore how digital tools can bridge the gap between institutional decision-making and citizen engagement, the case of CSI Piemonte—a prominent technological agency in the Piedmont region of Italy—offers a compelling example. Operating in Turin and across the region, CSI Piemonte plays a central role in Piedmont's broader digital transformation, which has been marked by the adoption of cutting-edge technologies, the expansion of digital infrastructure, and the implementation of smart city initiatives aimed at improving both governance and civic participation (CSI Piemonte, 2024). The agency exemplifies how hybrid governance models can emerge when top-down institutional frameworks are combined with bottom-up participatory mechanisms. Its mapping dashboards, which address areas such as urban mobility and environmental monitoring, illustrate the dual capacity of digital tools to support data-informed policymaking while also enhancing transparency and public access (CSI Piemonte, 2024). A strong focus on inclusivity is evident in its commitment to accessibility, particularly through open data platforms and user-friendly applications designed to serve diverse populations. One such initiative, the Dalia app, supports vulnerable groups by offering customized services, aligning well with principles of equitable and responsive urban planning (CSI Piemonte, 2024). Moreover, CSI Piemonte's work has practical relevance for urban planning, as its tools facilitate collaboration across sectors and encourage stakeholder engagement through accessible data visualization and interactive planning features. Many of its projects also emphasize environmental sustainability, using dashboards to promote ecological resilience and support strategies for sustainable mobility—goals that are increasingly central to the creation of liveable and future-ready cities (CSI Piemonte, 2024). In sum, CSI Piemonte serves as a regional benchmark for how technology can be leveraged to create governance systems that are not only efficient but also inclusive, transparent, and participatory.

5.3 Mapping Dashboards in Urban Governance landscape

Turin, once a major industrial powerhouse, has undergone significant transformations in recent decades, shifting from a manufacturing-based economy toward a knowledge and service-driven urban model. This transition has been accompanied by both opportunities and challenges: on the one hand, the city has seen increasing investment in innovation, culture, and sustainability; on the other hand, social disparities, environmental degradation, and aging infrastructure remain pressing issues. In response, the municipality has initiated a range of digital governance tools aimed at enhancing public services, supporting urban resilience, and achieving climate-related goals.

As outlined in policy documents such as Vision Torino 2030 and the Action Plan for Sustainable Energy and Climate (PAESC), Turin's urban governance increasingly emphasizes data integration, digital infrastructure, and transparency. Within this framework, mapping dashboards have been introduced to visualize urban indicators, monitor real-time phenomena, and inform policy interventions across sectors including mobility, environment, and energy.

However, despite these advancements, Turin's efforts in participatory urban governance remain fragmented. While some platforms aim to enhance transparency and accountability, few offer genuine opportunities for co-decision or citizen-led contributions. The city's dashboard systems tend to be designed and managed by technical staff and consultants, with limited public input into their structure or function. This dynamic reflects a broader tension between technocratic approaches and communicative planning—one that this chapter explores in depth.

Mapping dashboards are playing a transformative role in reshaping urban governance by enhancing transparency, supporting evidence-based decision-making, encouraging citizen participation, and enabling continuous monitoring of urban policies. These digital tools help democratize access to data, reinforcing trust and accountability—fundamental principles of participatory governance. For instance, CSI Piemonte's open data platforms provide real-time information on urban mobility, infrastructure, and environmental conditions, allowing citizens to engage with urban issues more knowledgeably and participate in planning processes with a clearer understanding of the context (CSI Piemonte, 2024). Beyond transparency, these dashboards support evidence-based policymaking by offering visual and analytical tools that assist urban planners and decision-makers in managing traffic, allocating resources efficiently, and preparing for emergencies through the integration of spatial data (CSI Piemonte, 2024). Importantly, they also foster citizen involvement by incorporating user-friendly interfaces that invite public feedback and suggestions, promoting more inclusive and responsive urban development (CSI Piemonte,2024). Furthermore, CSI Piemonte employs these platforms to monitor and evaluate the implementation of urban policies, particularly those related to sustainability. By tracking key indicators and outcomes over time, the dashboards help assess policy effectiveness, highlight areas for improvement, and adapt strategies to evolving urban challenges (CSI Piemonte, 2024). Altogether, mapping dashboards serve as essential tools in the evolution of urban governance, enabling cities to become more transparent, data-informed, participatory, and adaptable.

5.4. the analyses of CSI Piemonte

Building on the previous discussion, we now turn to a closer analysis of CSI Piemonte's achievements, challenges, and limitations to better understand how mapping dashboards and digital platforms embody a dual role in urban governance. These tools can either reinforce technocratic processes or serve as catalysts for participatory governance, depending on how they are designed and implemented. Navigating this balance effectively requires policymakers to prioritize transparency and citizen engagement, adopting strategies that blend technological precision with inclusive and user-centered practices. CSI Piemonte's initiatives exemplify this delicate interplay, offering valuable insights into how digital platforms can be harnessed to create more equitable and responsive models of urban governance. By aligning technological innovation with efforts to empower citizens, CSI Piemonte has positioned itself as a pioneer in using digital tools to support inclusive urban development. This analysis highlights the transformative potential of mapping dashboards—not merely as instruments of control or efficiency, but as platforms that can shape more democratic, sustainable, and citizen-focused cities.

5.4.1 Historical Context and Establishment

CSI Piemonte was originally established to meet the growing demand for an integrated information technology system capable of streamlining administrative processes and enhancing service delivery for both citizens and businesses. Since its inception, the organization has evolved significantly, expanding its scope beyond its foundational objectives to become a leading provider of digital services across multiple sectors, including healthcare, education, and cultural heritage (CSI Piemonte, 2024). Its trajectory mirrors broader national and international trends toward digitalization in public administration, aligning closely with Italy's strategic goals for innovation and modernization in the public sector.

5.4.2 Organizational Structure and Workforce

With over 1,000 professionals, CSI Piemonte operates as a consortium of more than 135 public institutions, including regional and local governments, universities, and healthcare facilities. This diverse collaboration ensures that the consortium's initiatives are tailored to the unique needs of the Piedmont region (CSI Piemonte, 2024).

The organization manages a state-of-the-art data center classified as TIA-942 Rating 3, ensuring high reliability and security. Additionally, it provides cloud services certified on the ACN (Agency for National Cybersecurity) marketplace, further enhancing its reputation as a secure and innovative service provider (CSI Piemonte, 2024.)

5.4.3 Health monitoring

Category	Description
Health Monitoring Activities	- Periodic Visits: Conducted according to the established health protocol. - Specialist Visits: Arranged upon the request of the company doctor. - Extraordinary Visits: Initiated upon employee request.
Support Services	- Telephone Support: Provided by the company doctor for vulnerable individuals. - Special Health Surveillance: Tailored for individuals with specific vulnerabilities.
Listening Service (Since 2018)	- Offers professional guidance for issues related to work, individual, or family discomfort. - Managed by a team of psychologists, psychotherapists, and doctors. - Facilitates pathways for in-depth analysis and reflection.
2023 Medical Visits	407 medical visits conducted in 2023, reflecting comprehensive health monitoring and support.

Table 7 CSI Piemonte Health care support system. (CSI Piemonte, 2024)

For the third consecutive year, CSI enters the "Italy’s Best Employers" ranking Improved positioning from 178th to 160thplace compared to 2023. 18th position in the Internet, IT and Telecommunications category. Promoted by Corriere dellaSera newspaper, the survey involved thousands of Italians who evaluated the working conditions within their company.

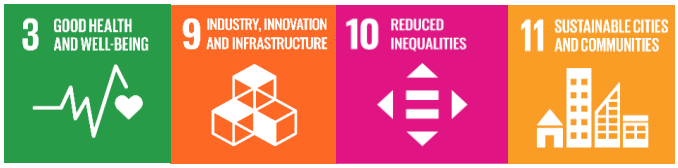
Final Result:

Improved positioning from 178th to 160thplace compared to 2023

Category	Description
Recognition	CSI featured in the "Italy’s Best Employers" ranking for the third consecutive year.
Ranking Improvement (2023)	- Improved from 178th place to 160th place overall. - Ranked 18th in the Internet, IT, and Telecommunications category.
Survey Details	Promoted by Corriere della Sera, the survey evaluated workplace conditions based on factors like: - Workload - Salary - Career prospects - Relationships with colleagues.
Significance	- Enhances CSI's reputation as an innovative and employee-focused organization. - Strengthens its image as a company attentive to people's needs

Table 8 the final result of CSI improvements. (CSI Piemonte, 2024)

5.4.4 Digital health and welfare



CSI main commitment concerns constant service management for Digital Health, in particular governance and evolution of the Information System of the Regional Health Department,the information asset supporting the Regional Health Service programming and monitoring activities as well as the service management such as the Electronic Health Recordand Salute Piemonte (online services for citizens), AMCO(accounting and administrative system) e SIRECOM (Monitoring and Control Regional Information System).

Category	Description
Title	Innovations in Digital Health and Welfare Management: Governance and Evolution in Urban Systems
Main Commitment	CSI focuses on managing and evolving the Digital Health Information System for the Regional Health Department. This includes programming and monitoring the Regional Health Service and managing critical services like: Electronic Health Records, Salute Piemonte, AMCO, and SiRECOM.
Key Areas of Focus	- Digital Welfare Innovations (2023): 1. Scelta Sociale: Assists citizens with residential and home care support. 2. Regional Civil Service: Handles enrolment and remuneration for regional project volunteers. 3. Dalia App: Supports women at risk of violence. - SiRE Architecture: Ensures constant governance and evolution of this system.
Evolution Projects (2023)	- Integration Projects: AURA and ANA for unified health records across all regional systems (e.g., Family Doctor selection, exemptions). - Payment Systems: Integration of PagoPA for health payments, enabling a streamlined single payment model. - Health Screening: Adjustments for HPV and other national health screening programs. - Hospital Discharge Forms: Adaptations for rehabilitation flow data with new pathways. - Supervisory Committees: Development of a system to manage inspections of health and welfare structures.

Significance for digital dashboards And citizen engagement	- Enhances citizen-centric service delivery through integrated digital solutions. - Supports urban health governance by creating efficient monitoring and management tools. - Innovates in regional service accessibility and accountability, aligning with urban digital transformation strategies.
Research Implications	- Role of digital health systems in shaping urban health policy. - Intersections of technology, governance, and public service in urban contexts. - Frameworks for integrating welfare and health management within urban systems.
Challenges Identified	- Integrating diverse digital systems while maintaining data security. - Ensuring citizen engagement and accessibility in digital transformation. - Adapting infrastructure for evolving health programs and policies.

Table 8 the result of Digital Health and Welfare of CSI Piemonte. (CSI Piemonte, 2024)

5.4.5 The Electronic Health Record

The Electronic Health Record is the enabling platform for the online service ecosystem.

CSI has been responsible for the governance of the architecture of the EHR, also with reference to the Electronic Health Record 2.0 national project and the services to be provided to operators and citizens. The EHR reached a high level of integration with the health services of the Regional Health Units and is currently fed by the data and documents produces by the Units themselves. (CSI Piemonte, 2024)

The offer regarding the EHR is constantly evolving and it is part of a wider ranging project SalutePiemonte, the single point of access to the digital services of the Piedmont health system.

Category	Description
Electronic Health Record (EHR)	- Serves as the enabling platform for the online service ecosystem. - Governed by CSI with alignment to the EHR 2.0 National Project. - Highly integrated with Regional Health Units, continuously updated with data and documents generated by the Units. - Part of the broader SalutePiemonte Project, a unified digital access point for Piedmont health services.
Citizen Services via EHR	Citizens can: - Consult medical history. - Manage EHR documents and data. - Display and print digital prescriptions. - Book and pay for health services. - Manage vaccination history and authorize third-party access. - Collect medicines at pharmacies. - Handle medical exemptions and participate in screening programs.
Itinerant Scelta Sociale Initiative	- Launched by the Regional Department for Social Policies. - Staff members assist citizens at Piedmont street markets in submitting home care and residents' voucher requests. - Provides direct support for completing forms and submitting documentation.
Regional Civil Service	- Supports the Information System for managing Civil Service. - Facilitates projects addressing youth problems, focusing on minors and at-risk youths to counter social exclusion. - First experimentation call for innovative deployment of youth interventions.
App Dalia	- A new web app developed to support Centers Against Violence on Women. - Provides tools and resources for women facing violence or emergencies. - Ensures timeliness, safety, security, and anonymity for users.
Significance for digital dashboards And citizen engagement	- Enhances accessibility and inclusivity of digital health and welfare services. - Integrates social and health policies into urban systems for citizen well-being. - Leverages digital solutions to address social issues like youth exclusion and violence against women.

Table 9 the final result of The Electronic Health Record of CSI Piemonte. (CSI Piemonte, 2024)

5.4.6 Environment

CSI has always taken measures to reduce its environmental impact and in particular the consumption of the data centre and the technological installations.

Since 2017 it has an Energy Management System with ISO 50001certification that provides strategies and rules. In 2023 the data centre absorbs 78% of electricity consumption of the headquarters of Torino. The growth of the physical, virtual and cloud servers require the installation of new processing and storage hardware.

5.4.7 Green data centre and Sustainability results table

Category	Details
Energy Management System	ISO 50001 certified Energy Management System since 2017, providing strategies and rules for energy management.
Data Center Energy Consumption (2023)	Datacenter accounts for 78% of electricity consumption at the Torino headquarters.
Physical & Cloud Infrastructure Growth	Growth in physical, virtual, and cloud servers necessitates new processing and storage hardware installation.
Power Usage Effectiveness (PUE) 2023	PUE of 1.47 in 2023, an excellent result among Public Administration datacenters.
ICT Yearly Consumption Reduction (5 years)	11.7% reduction in ICT yearly energy consumption over the past five years.
Daily Consumption Reduction per Server (5 years)	61% reduction in daily energy consumption per server over the past five years.
Hardware Increase	4% increase in hardware installations.
Total Managed Servers	12,000 managed servers.
Data Center Evolution	New electricity line design, creation of a green room, and a high-density, energy-efficient datacenter room.
Office and External Areas - Structural	Seismic adaptation, redevelopment of common spaces, and protection of the arboreal heritage at CSI Next.
Office and External Areas - Energy Efficiency	Installation of new LED lighting and new fixtures.

Table 10 the final result of Green data centre and Sustainability results table of CSI Piemonte. (CSI Piemonte, 2024)

5.4.8 Environment | Sustainable mobility

Category	Details
Jojob Carpooling Service	Provides lower travel costs for home-work journeys and offers digital vouchers.
Municipal Transport Agreement	Renewal of agreement with the Municipal transport company for purchasing city passes.
Regional Travel Ticket Co-financing	Participation in the regional tender for co-financing of travel tickets.
Company Cars - Eco-Friendly Transition	Car replacement with eco-friendly models starting in 2022 and reduction in service cars from 2021 to 2023.
Hybrid Company Cars	33 hybrid company cars in the current fleet.
Employee Bicycle Parking	155 employees have access to bicycle parking in the internal courtyard.

Table 11 the final result of Environment and sustainability of CSI Piemonte. (CSI Piemonte, 2024)

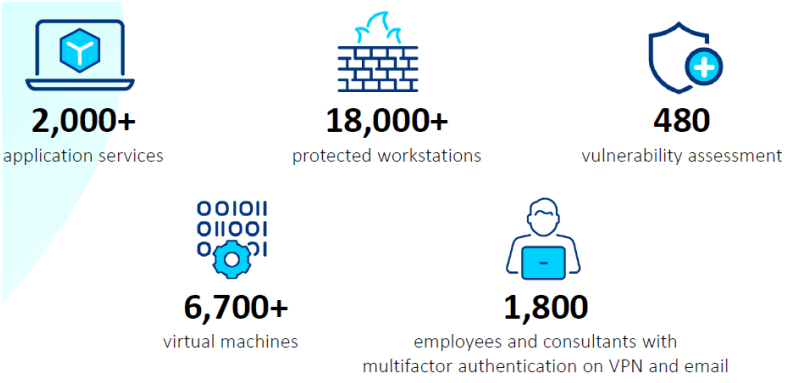
5.4.9 Innovation and digital transformation | Camilla, the new face of public administration

Camilla is CSI digital assistant, based on generative AI and created with the most advanced graphic models for the development of realistic digital avatars. She was designed to understand natural language and reply simply and in a friendly way. Camilla wants to become the citizens' personal assistant,to provide useful information and support them in the use of digital services, completely redesigning the contact experience between people and public administrations.

Innovation and digital transformation | CTE Next

In 2023 as well, the Casa delleTecnologieEmergenti(House of Emerging Technologies) of Turin confirmed its role as a place where start-ups, enterprises, institutions and partners of the initiative could innovate, meet, experiment and discuss.

Results:



5.4.10 Innovation and Digital Transformation Summary table

Category	Details	Results
CTE Next - House of Emerging Technologies	In 2023, CTE Next in Turin continued as a hub for innovation, enabling startups, enterprises, institutions, and partners to collaborate, experiment, and discuss.	300 events in two years, 12 startups involved, and over 9,000 participants.
Cloud and Security Company	CSI is a qualified cloud provider meeting 100% of the Italian National Cybersecurity Agency requirements for infrastructure, services, and processes. It offers certified, simple, economical, and reliable services for public administration with new End Point Detection & Response systems and multi-factor authentication for remote access and email.	100% compliance with ACN requirements for infrastructure, services, and processes.
Nivola - Open Source Cloud Platform	Nivola is CSI's open-source platform, certified for providing cloud infrastructure and services aimed at simplifying cloud service use for public administration. It is listed on Developers Italia, the Italian public administration's open-source software portal.	180+ customers currently use the Nivola platform.
Vulnerability Assessment	Enhanced cyber perimeter resilience through updated technologies like Next Generation Firewall, advanced analysis tools at CSI's SOC, and incident simulation scenarios to counteract threats.	444 security dynamic tests, 352 security event notifications on national info-sharing platforms, and 33 communications on csirt.piemonte.it.

Table 12 the final result of Innovation and Digital Transformation Summary table of CSI Piemonte. (CSI Piemonte, 2024)

5.4.11 Research and Development Piedmont 2030

Thanks to the collaboration of CSI with the Piemonte Innova Foundation, a task force has been set up, with which the Piedmont Region supports and accompanies the Piedmont municipalities in accessing funds for digital transformation, starting from the National Recovery and Resilience Plan calls.

Title	Results
Municipalities	418
assistance days	144
files on digital maturity of local PAs	20+
information workshop	4

Table 13 the final result of Research and Development of Piedmont (CSI Piemonte, 2024)

5.4.12 Territorial development

The results of the initiative highlight several key achievements One significant outcome was the establishment of a new Regional Single Headquarters, which served as a cornerstone for consolidating operations. In parallel, advancements were made in network and security technologies, ensuring a more robust and secure infrastructure. Another major milestone was the support provided for the renewal of the Wi-Pie backbone, a critical component of regional connectivity. Additionally, the development and implementation of MUDE Open facilitated the dematerialization of environmental procedures, streamlining processes and improving efficiency. Furthermore, significant progress was achieved in the evolution of information systems, particularly in areas related to active policies, employment, professional training, agriculture, and car tax management, reflecting a comprehensive approach to addressing diverse regional needs.

The initiative also delivered several innovative online services aimed at enhancing accessibility and efficiency. New online registry services were introduced to streamline administrative tasks for citizens. The Merc@TO platform was developed, providing a modern solution for managing marketplace activities. Additionally, the migration to the Nivola cloud marked a significant step in adopting cloud-based technologies, ensuring scalability and improved data management. The CittàFacile platform was launched to simplify interactions and improve accessibility for urban services. Lastly, the Lighthouse system was implemented to enhance fund management and monitoring, offering greater transparency and efficiency in resource allocation and oversight.

The results also include significant advancements in technological infrastructure and collaboration with educational institutions. The LAN network infrastructure was upgraded, alongside the implementation of VOIP devices and gateways, ensuring modernized and efficient communication systems. Interventions were carried out to enhance the security level of services, addressing the growing need for robust cybersecurity measures. Collaborative efforts with universities played a pivotal role in driving regional development. For instance, cybersecurity services were specifically tailored for the University of Turin, while facility management improvements were implemented for the Polytechnic of Turin. Additionally, the University of Eastern Piedmont benefited from comprehensive digital transformation initiatives. These technological advancements were made possible through the coordinated efforts of all educational institutions, demonstrating the power of collaboration in fostering innovation and progress.

Regional and National Impact

CSI Piemonte has played a critical role in the digital transformation of public administration not only within the Piedmont region but also at the national level. By developing the first regional online network, the consortium has set benchmarks for technological integration in Italy. Its smart data platform for big data and its management of a regional connectivity network illustrate its capacity to address complex challenges in public administration (CSI Piemonte, 2024).

CSI Piemonte represents a model of innovation and collaboration in public administration. Its history, services, and continued commitment to digital transformation highlight its importance to the Piedmont region and beyond. By leveraging advanced technologies such as cloud computing, cybersecurity, and AI, CSI Piemonte continues to enhance the efficiency and effectiveness of public services.

5.5 CSI as a model

5.6 Mapping Dashboards in Turin: Platforms and Functions of CSI Piemonte

Dashboard	Managing Entity	Focus Areas	Purpose	Current Interactive Features	Communicative Planning Perspective
Dalia	CSI Piemonte	Energy use, mobility, waste collection, public services	Provides open, multi-sectoral data visualizations to support evidence-based governance	Users can view standardized indicators but cannot provide feedback or engage in discussion	While Dalia improves transparency, it reflects a top-down model of governance. From a communicative planning perspective, it should incorporate dialogic features—such as citizen feedback loops, participatory mapping tools, or community forums—to foster shared interpretation and collaborative planning.
Scelta Sociale	Public Administration	Welfare services and benefits	Enables citizens to compare and select among available social support options	Offers limited choice-based interaction without deeper input mechanisms	Although it empowers users to compare services, the platform adopts a consumerist model rather than an inclusive planning one. To align with communicative principles, it should integrate participatory needs assessments, user-generated service reviews, and co-design tools for tailoring social programs.
GreenTo	Municipality of Turin	Neighborhood-level sustainability indicators (e.g., energy consumption, green coverage)	Monitors environmental performance across districts to inform policy and planning	Users can explore spatial data by neighborhood, but cannot annotate, comment, or co-create content	GreenTo supports environmental awareness and spatial equity, but lacks avenues for citizen expression. To align with communicative planning, it could allow local groups to contribute lived experiences, suggest indicators, or participate in sustainability dialogues via interactive mapping layers.

Table 14 Communicative Planning Perspective table of CSI Piemonte. (CSI Piemonte, 2024)

5.6.1 what is the role of citizens and citizens partnership, especially in city governance in Turin

Citizen participation and partnerships play a pivotal role in urban governance in Turin, exemplified by innovative initiatives such as the Co-City project. This project was designed to address urban poverty and the underutilization of public spaces by fostering collaboration between residents, public entities, and private stakeholders. At its core, Co-City implemented "pacts of collaboration," formal agreements between the city and citizen groups to jointly manage and regenerate public spaces, including parks, abandoned buildings, and educational facilities. These agreements employed co-design processes that distributed decision-making powers and responsibilities among the city and civic actors, promoting mutual accountability and sustainable urban outcomes.

The project yielded several key outcomes. First, it empowered over 200 civic actors, including NGOs, local organizations, and informal groups, by providing training and access to legal and institutional tools necessary for urban regeneration efforts. Second, it fostered trust and social inclusion by facilitating collaboration between 90 city officials and a diverse range of social actors, addressing urban poverty through an integrated, multi-sectoral governance approach. Lastly, the initiative engaged communities by involving residents in enhancing green spaces, promoting public art, and repurposing underutilized infrastructure, ensuring that projects were closely aligned with local needs and priorities.

5.6.2 The Role of Communicative Planning in Reimagining Dashboard Governance

Communicative planning offers a counterpoint to the prevailing dashboard logic. It suggests that planning should not only be data-informed but also deliberative, inclusive, and open to negotiation among stakeholders. In this view, urban dashboards could function not just as monitoring instruments, but as platforms for dialogue and collaborative problem-solving.

In Turin, this potential has been partly realized through projects such as Co-City, which introduced pacts of collaboration between the municipality and citizens for managing underutilized public spaces. While not based on dashboards per se, Co-City's participatory logic—centered on co-design, mutual learning, and shared accountability—offers a model for how digital platforms might evolve to better reflect communicative planning principles.

To integrate such approaches into dashboard governance, Turin would need to Redesign platforms to include two-way communication channels, allowing citizens to submit data, annotate maps, and propose interventions.Co-develop indicators in collaboration with community groups, ensuring that the metrics reflect diverse priorities.Embed participatory features such as comment functions, public voting, or scenario simulations that allow for grassroots feedback and influence.

Such changes would move Turin's dashboards away from static monitoring tools toward dynamic, participatory interfaces—supporting not just smarter governance, but more democratic governance.

5.6.3 Final comparison table of mapping dashboards in case of Technocratic Urban Governance and Citizen Engagement

Aspect	Technocratic Urban Governance	Platform for Citizen Engagement
Purpose	- Data-driven decision-making - Monitoring and control of urban systems - Centralized governance	- Promoting transparency - Empowering citizens through data access - Facilitating collaboration and dialogue
Features	- Aggregates and visualizes urban data - Focuses on efficiency and accountability - Real-time monitoring of city functions	- Allows citizen input (e.g., reporting issues) - Enables participatory mapping and local knowledge contributions
Examples	- Traffic and waste management dashboards - Emergency response monitoring	- Platforms like SeeClickFix - Participatory GIS (e.g., OpenStreetMap)
Advantages	- Enhances operational efficiency - Informs evidence-based policies - Improves accountability	- Encourages community involvement - Increases government transparency - Supports advocacy and local empowerment
Challenges	- Overemphasis on data metrics - Marginalizes community perspectives - Limited inclusivity in decision-making	- Digital divides exclude marginalized groups - Requires ongoing engagement efforts - Risk of superficial involvement

Table 15 the final Final comparison of mapping dashboards in case of Technocratic Urban Governance and Citizen Engagement

Chapter 6 : Findings and Conclusions

Urban governance in cities like Turin is increasingly shaped by innovative initiatives that aim to address pressing social, economic, and environmental challenges. In this context, citizen participation, digital transformation, and cross-sectoral collaboration have emerged as key pillars of successful urban planning and management. Notably, projects such as Co-City in Turin exemplify how collaboration between public entities, private stakeholders, and local communities can lead to tangible improvements in urban spaces, social inclusion, and civic empowerment. However, while Turin has made significant strides, challenges remain in expanding funding, integrating digital innovation, and fostering broader collaboration across sectors. Drawing comparisons with cities like Copenhagen and Helsinki—both of which excel in data-driven governance and structured innovation funding—this analysis explores potential areas for growth in Turin's urban governance model. By leveraging these insights, Turin can build on its successes and further enhance its efforts to create a more inclusive, resilient, and digitally connected.

6.1 Key Findings

Copenhagen has set an ambitious goal of achieving carbon neutrality by 2025, supported by cutting-edge tools like the Copenhagen Solutions Lab. This platform integrates real-time data streams from sensors across the city to optimize urban systems. One of its key applications is in smart traffic management, where real-time traffic data is used to reduce congestion and emissions. By prioritizing cycling and public transport, the city not only promotes sustainable mobility but also minimizes its carbon footprint (World Economic Forum, 2023). Additionally, the city has implemented energy efficiency monitoring systems that track energy usage in public buildings. These systems provide actionable insights, enabling targeted measures to improve energy performance (SPUR, 2021).

Helsinki, in contrast, has adopted a strategy centred on transparency and public collaboration, with a target of achieving carbon neutrality by 2030. A cornerstone of this strategy is the Helsinki Region Infoshare (HRI) platform, which provides open access to a wealth of data. This platform encourages public participation by empowering citizens with information. Participatory budgeting initiatives in Helsinki exemplify this approach, as dashboards enable residents to monitor the progress of community projects and provide feedback (Helsinki-Uusimaa Regional Council, 2023). Additionally, Helsinki has focused on promoting green mobility through programs such as bike-sharing and electric buses. The city uses dashboards to monitor and optimize these initiatives, ensuring they align with sustainability objectives (Eurocities, 2023).

A close analysis of Copenhagen and Helsinki reveals several shared practices. Both cities rely heavily on the integration of technology to enable informed decision-making. Their dashboards are central to monitoring and optimizing green mobility systems, helping to reduce emissions and promote sustainable urban transportation. Additionally, both cities use data-driven approaches to track their progress toward carbon neutrality, ensuring that sustainability targets are met. Despite these similarities, their strategies diverge in significant ways. Copenhagen places a strong emphasis on real-time operational management, using its dashboards to optimize energy use and traffic systems. This focus on efficiency reflects the city's pragmatic

approach to achieving immediate results. Helsinki, on the other hand, prioritizes participatory governance. Its emphasis on transparency and public involvement reflects a commitment to fostering collaboration between the city government and its residents. While Copenhagen's dashboards prioritize operational functionality, Helsinki's are designed to build trust and encourage civic engagement.These comparative insights highlight the adaptability of mapping dashboards in addressing diverse urban challenges. While Copenhagen's approach demonstrates the value of real-time data integration in operational management, Helsinki underscores the importance of involving citizens in the decision-making process. Together, these examples illustrate how cities can tailor dashboard technologies to their unique priorities and contexts. highlights disparities between cities, showing that while some are progressing well on certain goals, others face significant challenges.The analysis of Copenhagen and Helsinki underscores the transformative potential of mapping dashboards in advancing urban sustainability. By leveraging real-time data and fostering public collaboration, these cities demonstrate how technological innovation can be harnessed to address pressing environmental challenges. For Turin, the findings offer a roadmap for integrating similar tools. A strategic combination of operational efficiency and participatory governance could enable the city to achieve its sustainability goals while engaging its residents in meaningful ways.

Aspect	Copenhagen	Helsinki	Comparative Insight / Implication
Carbon Neutrality Target	2025	2030	Both cities have ambitious targets, but timelines differ.
Core Platform	Copenhagen Solutions Lab	Helsinki Region Infoshare (HRI)	Both cities use data-driven platforms as core enablers of sustainability.
Technological Focus	Real-time operational management via sensors (traffic, energy)	Transparency, open data, public dashboards	Copenhagen emphasizes efficiency, Helsinki emphasizes openness.
Mobility Strategies	Smart traffic management; prioritization of cycling and public transport	Green mobility programs like bike-sharing and electric buses	Both support sustainable transport; implementation strategies differ.
Energy Management	Energy efficiency systems in public buildings with real-time tracking	Focus not explicitly on buildings; emphasis on participation and feedback mechanisms	Copenhagen is more technical-operational, Helsinki more social-collaborative.
Citizen Participation	Indirect (optimization-focused)	Direct (participatory budgeting, citizen feedback)	Copenhagen focuses on results, Helsinki on inclusive processes.
Use of Dashboards	Operational monitoring (energy, traffic)	Trust-building and transparency (tracking public projects)	Both use dashboards but for different governance models.
Governance Approach	Technocratic, efficiency-driven	Participatory, citizen-centered	Reflects two distinct yet complementary visions of smart city governance.
Key Outcomes	Reduced congestion and emissions; enhanced energy efficiency	Empowered citizens; optimized green mobility initiatives	Technological innovation supports both operational and social goals.
Lessons for Turin	Embrace real-time data for efficiency; adopt dashboards for traffic and energy systems	Foster public trust via transparency; involve citizens in sustainability efforts	Turin could blend both models for a hybrid approach—leveraging tech while promoting civic engagement.
Overall Finding	Real-time integration for pragmatic impact	Citizen empowerment for long-term engagement	Mapping dashboards are versatile tools adaptable to different urban challenges and governance models.

Table 16 Operational Efficiency vs. Participatory Governance

6.2 The contribution of mapping dashboards

Mapping dashboards have evolved into strategic instruments in the pursuit of urban sustainability, particularly within the framework of the 2019 SDG Index and Dashboards Report for European Cities. Their significance lies not merely in their capacity to visualize complex datasets, but in their ability to democratize information and foster inclusive urban governance. By rendering environmental, economic, and social indicators into accessible visual formats—such as color-coded maps, interactive graphs, and real-time updates—these tools enable diverse urban actors to engage with and interpret city-level data. This is especially relevant through the lens of communicative planning, which emphasizes dialogue, mutual learning, and shared decision-making among stakeholders. In cities like Turin, where dashboards such as those developed by CSI Piemonte support monitoring of sustainability performance and SDG progress, the communicative planning model is not just theoretical—it manifests in practice. These platforms facilitate a shared understanding of urban challenges by revealing spatial patterns—such as Northern European cities outperforming on climate action (SDG 13), while Southern cities face persistent struggles with urban equity (SDG 11). Importantly, Turin's dashboards are not just static repositories of data but function as dynamic tools for accountability, stakeholder engagement, and policy responsiveness. They create a feedback loop: data informs citizens, citizens influence discourse, and discourse refines policy, all grounded in spatial awareness and collective participation. Dashboards in this context are not only technocratic tools for tracking indicators; they are dialogic mediums that enable planners, local governments, researchers, and residents to engage in a co-produced understanding of sustainability. By standardizing data while allowing regional customization, they strike a balance between comparability and contextual sensitivity. As seen in Turin, this approach empowers not only the municipality but also community members to participate in identifying priorities, co-shaping interventions, and evaluating outcomes—an embodiment of communicative planning in digital practice. Rather than merely presenting performance metrics, these dashboards activate a participatory ecosystem where urban governance is shaped not from above, but through iterative, evidence-based conversation across institutional and societal boundaries.

6.3 Contribution to the SDG Report's Goals:

Mapping and city dashboards play a pivotal role in advancing the mission of the 2019 SDG Index and Dashboards Report for European Cities. They provide actionable insights for urban policymakers, enabling data-driven decision-making and strategic planning. Additionally, these tools facilitate collaboration between cities by showcasing successful strategies that can be adapted and replicated. The intuitive design of dashboards enhances the report's accessibility and impact, making complex data comprehensible to a broad audience. Beyond serving as reporting tools, dashboards act as powerful enablers for tracking, planning, and achieving sustainable urban development objectives.

6.4 In conclusion

This research underscores the transformative potential of mapping dashboards in advancing sustainable urban development. While Helsinki and Copenhagen exemplify how data-driven governance and citizen engagement can accelerate progress toward sustainability goals, Turin faces unique challenges that hinder its ability to fully leverage these digital tools. By analyzing best practices and identifying gaps in Turin's current strategies, this study highlights the need for a more integrated, participatory approach to digital governance.

Mapping dashboards hold the promise of bridging the gap between technocratic decision-making and citizen participation. When designed inclusively, these tools can empower residents, enhance transparency, and support evidence-based policymaking. For Turin, adopting comprehensive and user-friendly dashboards could significantly improve its performance on key sustainability indicators, including air quality, waste management, and social equity.

To achieve these outcomes, Turin must prioritize the integration of real-time data across sectors, foster public-private partnerships, and actively involve citizens in urban governance. Expanding the scope of dashboards to cover biodiversity, social inclusion, and green economy metrics will ensure a holistic approach to sustainable development. Additionally, aligning. digital innovation with participatory frameworks will create a resilient, inclusive, and environmentally sustainable urban future

By embracing these strategies, Turin can enhance its urban resilience and sustainability performance, positioning itself alongside leading European cities in achieving the Sustainable Development Goals.

Category	Findings	Conclusions
Urban Governance	Turin has made progress in participatory governance through projects like Co-City but lacks structured innovation funding.	Strengthening funding mechanisms and partnerships is essential for sustainable urban projects.
Digital Innovation	Copenhagen and Helsinki leverage data-driven governance models, while Turin's digital transformation is still in progress.	Investing in smart city initiatives, IoT systems, and data-driven governance can enhance transparency and engagement.
Cross-Sectoral Collaboration	Collaborative governance is beneficial but remains limited across administrative departments and sectors.	Expanding cross-sectoral cooperation can lead to more holistic urban problem-solving.
Climate Action & Green Mobility	Turin needs stronger climate neutrality commitments and better urban mobility strategies.	Decarbonizing urban mobility and integrating clean transportation solutions are necessary steps.
Economic Inclusion	Socioeconomic disparities persist due to high unemployment and insufficient affordable housing.	Social entrepreneurship programs and investments in housing are critical to improving equity.
Use of Mapping Dashboards	Cities like Helsinki and Copenhagen leverage mapping dashboards for governance, but Turin lags in implementation.	Digital dashboards can enhance decision-making, citizen participation, and policy transparency.
SDG Performance Monitoring	There is no structured system for tracking SDG progress effectively.	Establishing SDG monitoring committees and using visualization tools can improve performance tracking.

Table 17Findings and Conclusions on Turin’s Urban Governance and SDG Performance

Category	Challenges	Future Measures & Recommendations
Governance & Policy	Limited coordination of SDG-aligned policies at the municipal level, resulting in fragmented efforts.	Strengthen municipal alignment on SDG policies and improve cross-sector collaboration.
Air Quality	Persistent pollution due to industrial emissions and heavy reliance on private vehicles.	Invest in sustainable mobility and stricter emission controls.
Economic Disparities	High unemployment and urban poverty exacerbate inequality.	Develop targeted job creation and social inclusion programs.
Mapping Dashboards	Existing dashboards lack interactive, real-time data capabilities.	Integrate real-time monitoring and predictive analytics for better urban planning.

Table 18 Challenges, Future Measures, and Additional Dashboards for Turin

Dashboard Focus	Purpose
Climate Risk & Adaptation Dashboard	Tracks flood risks, heat islands, and disaster preparedness (SDG 13).
Green Economy Metrics Dashboard	Monitors green jobs, circular economy growth, and biodiversity impact (SDGs 12 & 15).
Citizen Engagement & Social Inclusion Dashboard	Analyzes housing affordability, social inequality, and community engagement (SDG 10).

Table 19 Proposed Additional Dashboards for Turin

The development of mapping dashboards has opened new pathways for integrating citizen participation into urban planning processes. While technocratic paradigms still dominate many governance systems, digital platforms offer the potential to democratize urban governance by granting citizens access to information, enabling them to interpret data, and actively engage in planning activities. Through interactive visualizations and open data interfaces, mapping dashboards empower communities to engage with their local environments, contribute insights through crowdsourced data, and advocate for inclusive development (Goodspeed, 2020). These platforms function as enablers of communicative planning, which emphasizes dialogue, deliberation, and mutual understanding among diverse urban stakeholders (Healey, 1997). When co-designed with users, participatory dashboards serve as boundary objects—tools that bridge expert knowledge and local experience—facilitating collaborative decision-making processes (Star & Griesemer, 1989). Examining digital platforms in cities like Helsinki, Copenhagen, and Turin underscores their importance in fostering inclusive urban development. Case studies such as the Climate Watch Dashboards in Copenhagen and Helsinki illustrate how cities can leverage dashboards not only to disseminate information but also to support public consultations and co-create urban initiatives. The effectiveness of such tools depends heavily on their design and the extent to which they are accessible and inclusive to all user groups.

In Turin, the CSI Piemonte platform exemplifies how digital governance can support the development of citizen-centered dashboards that encourage engagement and enhance the design of urban policies. At the same time, citizens play an essential role in the data ecosystem, often contributing voluntarily to real-time data collection that informs both planning and policymaking. By fostering this reciprocal relationship between digital tools and public participation, cities can better assess current conditions and forecast future needs, ultimately strengthening urban governance through data-informed, collaborative decision-making.

However, for Turin to match the digital strides made by cities like Copenhagen and Helsinki, targeted efforts are needed. Unlike its northern counterparts—both of which benefit from substantial innovation funding—Turin faces resource limitations that hinder large-scale digital transformation. Establishing dedicated urban innovation funds and expanding public-private partnerships would be critical steps in scaling up transformative projects. Leveraging private sector expertise and investment can help build a more sustainable and expansive urban innovation framework. Furthermore, deeper integration of digital technologies—such as advanced analytics, Internet of Things (IoT) systems, and smart city platforms—could increase both transparency and public participation, aligning Turin's urban management with more inclusive and responsive governance models. Strengthening cross-sectoral collaboration is also essential. Building on the success of collaborative efforts like Co-City, Turin should foster tighter coordination among government departments, civil society, and local communities. Such collaboration is vital to addressing complex urban challenges—ranging from housing and mobility to social equity—in a holistic, interconnected manner. Ultimately, by embracing digital innovation, broadening partnerships, and reinforcing participatory planning, Turin can chart a more resilient, inclusive, and forward-looking path for its urban future.

6.5 Mapping Dashboards as Mediators of Communicative Planning and Citizen Engagement:

In the evolving landscape of urban governance, the integration of digital tools has become more than a technological upgrade—it reflects a broader shift in how cities are imagined, governed, and co-produced by institutions and citizens. Among these tools, mapping dashboards have emerged as critical interfaces that connect the theoretical foundations of communicative planning with the practical demands of citizen engagement. Communicative planning, as developed by scholars like Healey (1997), moves beyond traditional, expert-led models by emphasizing dialogue, mutual learning, and inclusive decision-making. It argues that urban planning should not only rely on professional expertise but also actively incorporate local knowledge, values, and experiences through participatory and deliberative processes. In this context, mapping dashboards function as boundary objects that facilitate a shared understanding between planners and citizens, helping to transform urban data into common ground for discussion, negotiation, and collaboration.

Throughout this research, I have examined how mapping dashboards are shaping the way cities govern themselves. The central question I explored was whether these tools are merely reinforcing top-down, technocratic approaches to planning or if they can truly open space for citizen participation. This question guided my investigation into how these dashboards are designed, who uses them, and what values they ultimately reflect.

To understand this dynamic, I grounded my analysis in the theory of communicative planning—a model that emphasizes openness, mutual learning, and shared responsibility in urban decision-making. In this approach, citizens are not passive recipients of information or decisions but active contributors to the planning process. Dashboards, from this perspective, become more than just interfaces for viewing data; they can serve as boundary objects that connect expert knowledge with lived experience.

Using this framework, I focused on Turin as my main case study, while drawing comparative insights from Helsinki and Copenhagen—two cities known for their strong sustainability agendas and more advanced digital platforms. In Turin, I analyzed dashboards developed by CSI Piemonte, such as Scelta Sociale and Dalia. These tools show a growing awareness of the potential for digital platforms to enhance transparency and simplify access to services. Some of them even incorporate participatory features that allow users to give feedback or interact with certain urban systems. However, the dominant design logic of most dashboards in Turin still leans toward technocratic control, with limited space for genuine co-creation or civic empowerment.

By contrast, Helsinki stood out as a clear example of how dashboards can be integrated into a more participatory governance model. Platforms like Helsinki Region Infoshare make large amounts of data open to the public and are designed to support community involvement in budgeting and decision-making. These dashboards reflect the principles of communicative planning, turning urban data into a shared language for dialogue between institutions and residents.

Copenhagen, while equally advanced, takes a slightly different path. Its dashboards are highly functional and used to manage real-time systems like mobility and energy. They are extremely

effective in optimizing urban performance, but the participatory features are less pronounced than in Helsinki. While transparent and well-executed, they reflect a planning culture more focused on operational efficiency than on public deliberation.

Back in Turin, the example of CSI Piemonte shows that the city has the technical capabilities to develop robust digital tools. What remains underdeveloped is their integration into participatory governance frameworks. Projects like Co-City show that Turin does value experimentation and collaboration, but this ethos has not yet been fully embedded in its digital ecosystem. There is room for growth here—not just in creating more dashboards, but in rethinking how those platforms can be designed to reflect the values of inclusion and shared responsibility.

Ultimately, this research has shown that dashboards are not inherently democratic or technocratic. Their role depends on the intentions behind their design and the governance cultures in which they are embedded. In cities where participation, transparency, and collaboration are central values—like in Helsinki—dashboards tend to reinforce those ideals. Where efficiency and institutional control dominate, dashboards tend to serve as instruments of centralized management, even if they are publicly accessible.

For Turin to move forward, it must build on its existing digital foundation and align its dashboards more closely with the principles of communicative planning. This means developing platforms that not only inform but also engage; tools that don't just visualize data, but invite people into the conversation. By doing so, mapping dashboards can become much more than monitoring instruments—they can act as bridges between institutions and citizens, helping to co-produce urban futures that are more just, inclusive, and sustainable.

6.6 Future Opportunities

To build on its successes and further improve its SDG performance, Turin could explore expanding its mapping dashboards to include more interactive features, similar to those seen in Helsinki and Copenhagen. Incorporating real-time public feedback, open-data visualizations, and predictive analytics would not only increase the effectiveness of decision-making but also enhance public trust. By fostering stronger partnerships between the city administration and residents, Turin can create a more transparent, responsive, and sustainable urban environment, ultimately positioning itself as a leader in sustainable urban development.

6.7 What Additional Dashboards Could Help Turin?

On the one hand, we can develop Climate Risk and Adaptation which is a dashboard dedicated to tracking climate resilience, especially focusing on flood risk, urban heat islands, and disaster preparedness, would help Turin adapt to climate change and meet SDG 13 more effectively. On the other hand, developing Green Economy Metrics is beneficial ,While there are some indicators related to energy efficiency, expanding the dashboard to include metrics for green jobs, circular economy practices, and biodiversity could support more targeted actions towards SDG 12 and SDG 15.Finally, Citizen Engagement and Social Inclusion is A dashboard that tracks social inequality, housing affordability, and citizen engagement metrics could improve transparency and guide the city's policy-making towards achieving SDG 10 (Reduced Inequalities)

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