

Article

Cities4ZERO Approach to Foresight for Fostering Smart Energy Transition on Municipal Level

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Abstract: Smart energy transition efforts at the municipal level are gaining importance and go far beyond implementing single projects. Decarbonising cities involves complex strategic planning and needs system level thinking and changes. This has been increasingly realised at the municipal level, but challenges remain regarding the tools, involvement of stakeholders and on the development of policies. The focus of the research is on the use of participatory foresight for fostering smart energy transition on a municipal level, the key benefits and success factors that participatory foresight brings, and the replicability of this approach. Within the novel Cities4ZERO framework, an overarching methodology for a smart urban decarbonisation transition, guiding cities through the process of developing the most appropriate strategies, plans, projects, as well as looking for the commitment of key local stakeholders for an effective transition–foresight framework, was developed and tested in five pilot cities. Foresight as applied within the Cities4ZERO framework creates a participatory process which brings stakeholders together to achieve unified scenarios, and a common vision for future urban decarbonisation strategies. The methodology is replicable and increases the quality of strategic energy planning by fostering long-term system thinking.

Keywords: foresight; energy transition; strategic energy planning; integrated planning; system thinking; municipality; smart city; smart zero carbon city; zero-CO₂

1. Introduction

Climate change is one of the biggest challenges of our time for all levels of policymaking. The United Nations Framework Convention on Climate Change led to a consensus between 197 states to sign a Paris Agreement on mitigation of greenhouse gas (GHG) emissions [1]. Under this agreement, each country must plan and regularly report on the contribution that it makes to mitigate global warming.

Indeed, the European Green Deal strives to transform Europe into a modern, resource-efficient and competitive economy, where (1) there are no net emissions of greenhouse gases by 2050, (2) economic growth is decoupled from resource use, and (3) no person and no place is left behind [2]. In other words, the EU considers that the climate challenge calls for a holistic approach that covers environmental, economic and social aspects. In Europe, the vast majority of GHG emissions originate from the energy sector—more specifically, from fuel combustion for public electricity, heat production and road transport [3].

System-wide transformations [4] are important to address climate change and achieve a low-carbon economy [5]. The smart zero-CO₂ concept [6] is a complex and multi-layered approach. It is a radical transition that is more demanding than simply replacing old technologies with new ones [7,8] Several

earlier studies [9–14] have highlighted that in order to move towards the zero-CO₂ vision, it is not sufficient to implement isolated solutions or one-off improvements without a wider vision and a coherent strategy.

The shift to low-carbon economy and tackling climate change calls for a well-co-ordinated, multi-level governance system, and it puts cities and integrated plans for urban regeneration at the forefront [5,11,14,15]. When preparing such comprehensive plans, one should envisage a series of interlinked actions that would lead to a lasting improvement in the economic, physical, social and environmental conditions of a city. The process is complex and touches on a range of stakeholders within all sectors in a municipality [5,14,16–18]. For example, this process can lead to the introduction of modern ICT tools and the diversification of energy production with renewable energy (RES), thus transforming the structure of energy production and distribution networks to enable small-scale production, which introduces environmentally friendly products and business models [12].

The above demands extensive planning and risk management, led by the public sector and with the involvement of stakeholders to achieve the intended environmental, economic, and societal benefits. However, earlier research has revealed that one of the main barriers to successful climate action at the local government level lies in the lack of capabilities and insufficient interaction between stakeholders [5,19]. Authors who have investigated the local barriers to energy transition in Europe have highlighted the lack of good cooperation and acceptance among partners, fragmented ownership, insufficient external financial support, lack of funding for project activities, and lack of skilled and trained personnel as particularly challenging [5,19]. Further, Mora and colleagues [14] highlighted that despite growing interest in grand climate challenges, smart cities, and almost three decades of literature on the matter, research is still unable to clearly explain what needs to be done for urban environments to be successful when designing and implementing smart city development strategies.

One of the key elements to enable cities to effectively transition towards urban decarbonisation is the need for the integration of energy planning into urban planning processes [6]. Accordingly, there is a need for an innovative strategic municipal framework capable of integrating multiple disciplines and heterogeneous stakeholders, identifying and developing the most relevant activities for an effective energy, and ultimately urban, transition [6,7,14].

Looking into the future, evidence-based policy making should be a key tool of urban policy and governance, calling for more radical and creative thinking at all levels. One of the enablers of this urban co-intelligence can be the practice of foresight: a package of methods and tools for strategic policy intelligence of organisations, policies, governments, and technologies [20]. Foresight is an action-oriented instrument for policy-making which facilitates structured anticipation, considers alternative futures in a multi-disciplinarily way, and enables collective learning in a proactive, path-breaking, interactive and participatory way [21]. We propose a Cities4ZERO Foresight methodology for fostering smart energy transition on a municipal level.

Cities4ZERO is a theoretical framework for city energy transition through a holistic and system-thinking approach. It was developed as part of the EU Horizon 2020 SmartEnCity project between 2016 and 2020 as a research and development project. Furthermore, this approach was tested and fine-tuned in five cities, with the results being communicated to almost 60 cities belonging to the SmartEnCity Network, where some have already started to implement the approach in their local settings [22]. It was developed bearing in mind the need for a systemic and easily adaptable approach and was co-developed and validated in close cooperation with the five municipalities, which include Vitoria-Gasteiz (ES), Tartu (EE), Sonderborg (DK), Asenovgrad (BG) and Lecce (IT) [15,22]. The five cities are small and mid-sized, ranging from 68,000 to 240,000 inhabitants, which is representative of EU cities in general, as more than 80% of the cities in the EU are small and mid-sized cities [5,23].

The proposed Cities4ZERO Foresight methodology discussed in the current article is filling an important gap in energy transition planning, in spite of the fact that there are different support structures and methodologies already available, such as the Covenant of Mayors framework and several EC or international initiatives [24–27]. The Covenant of Mayors framework is one of the most well-known

initiatives to tackle climate change through reducing CO₂ levels in territories. The initiative brings together local and regional authorities across Europe with a voluntary commitment to implement climate mitigation, energy, and sustainability policies. Such local strategic processes are fostered through the development of sustainable energy action plans (SEAPs) and sustainable energy and climate action plans (SECAPs, also including a climate adaptation dimension) [9,24]. There are already over 10,000 signatories, with over 6000 SEAPs/SECAPs submitted. The Covenant of Mayors evaluation report highlights that signatories already use the SEAP/SECAP not only as an energy planning instrument, but also as the basis for an all-encompassing approach to urban planning [28]. Furthermore, the idea of SEAP/SECAP being part of the corporate culture of transforming cities into “living-labs”, which requires strong coordination and vision to avoid conflicts of interest between strategies and policies, has been put forward [9].

At the same time, there still exists criticism that these climate mitigation and adaptation plans should be advanced, especially by involving “long-term decarbonisation targets, holistic energy system thinking, and retention of energy scenarios” [7]. The cross-sectoral characteristics of energy transition and climate action require a level of comprehension that a wide range of local authorities seem to be lacking and translation of energy-climate-related policies into ordinary planning instruments is still inefficient, which is also highlighted by the evaluations of SEAPs and later SECAPs [9,10,28]. These evaluations also show that the adaptation of administrative structures and the mobilisation of civil society or industry to the financing of actions, municipalities’ plans generally show some weaknesses and are lacking tailor-made strategies to ensure citizens’ and stakeholders’ participation or assigning clear roles and responsibilities to municipal officers [6].

The European Commission has also launched the European Innovation Partnership on Smart Cities and Communities (EIP-SCC), supported by the H2020 programme to foster real climate action implementation in cities [6,29]. This platform intends to engage cities, industries, SMEs, investors and researchers, and bring them together to design and deliver smart and sustainable solutions and projects. This platform mainly consists of projects which target cities’ decarbonisation through Integrated Urban Plans, and more recently through the concept of Positive Energy Districts (PEDs) [6]. The intention there is to tackle the energy and urban planning integration both at the city and district levels.

Not less important are city networks like C40 [26] or ICLEI [30] and numerous others which aim to share knowledge, build capacities, foster replication and develop methods and energy projects [7,25,31].

Still, next to already highlighted gaps related to the impact and the real effect of several initiatives in Europe fostering climate action and energy transition also at the municipal level, several authors cited concerns that municipalities focus on short-term actions expected to lead to fast results, instead of on a strategic approach and long-term view [7,9,15,18]. Additionally, there is a wide gap between theoretical efforts and practical implementation, due to a lack of political involvement, coordination of activities, and lack of funding [32]. Furthermore, urban plans generally do not address energy as a relevant dimension [32].

However, the position of municipalities is unique to enable urban decarbonisation according to their various capacities: as planners and regulators, facilitators of finance, role models, large consumers of energy, and developers of infrastructure and services [5,15]. Therefore, supporting cities in zero-CO₂ transition is the priority. The current paper proposes a novel Cities4ZERO Foresight methodology and detailed guidelines that build on the existing research and best practices of foresight, while considering the capacities and expectations of the municipalities. The key innovation of Cities4ZERO Foresight is that it has been developed as an adaptable and replicable process that can benefit many municipalities in complex strategic and urban regeneration processes, especially with a view to zero-CO₂ transition. Furthermore, Cities4ZERO Foresight allows for intelligence sharing across different cities, both with a view to mapping of global trends and the analysis of alternative futures and the potential policy responses.

This article is structured as follows. After the current introduction, a literature review is provided on the topical literature and research gaps are identified. Chapter Three outlines the Cities4ZERO Foresight

methodology for supporting energy transition and urban regeneration. Research design, data collection and case studies are presented in Chapter Four. Chapter Five discusses the implementation in the municipalities. Chapter Six synthesises the benefits and challenges, success factors and replicability of Cities4ZERO Foresight. The article concludes with policy recommendations and suggestions for further research.

2. Literature

The first modern foresight exercises were carried out in Japan in the 1970s. In the early 1990s, Japan's economic success inspired many countries, including the United States and various European and Asian countries, to launch similar foresight exercises. Technology foresight activities grew rapidly at that time, as countries sought new policy tools to deal with problems in their science, technology, and innovation systems. Large-scale exercises attracted numerous stakeholders as sources of knowledge and influence, and the prominence of these exercises led to the term 'foresight' being used more widely to describe future activities of many kinds. While few new tools and techniques were developed in these exercises, they represent an unprecedented diffusion of forecasting, planning and participatory approaches to long-term issues [33–36].

Foresight has developed over the last few decades from narrow, technology-orientated forecasting activities to a more complex discourse that examines the possible futures of technology, markets and society, and applies a comprehensive toolbox of methodologies [34,35,37]. Modern foresight programmes increasingly aim at informing strategic decision-making activities or are included in the preparatory phases [38]. It can thus be said that foresight is different from other strands of future studies and planning exercises exactly because it addresses the implications of long term strategic actions, and seeks the participation of all stakeholders that are relevant to the topic, making (urban) planning a consensus-seeking process that results in actual decisions about the future.

Foresight has also been used in the field of energy. Studies have been carried out on a global (e.g., [39]) and national level. Technology foresight has been used to develop a vision of energy sector development in Poland [40], energy transition in Pakistan [41] and in the UK [42], to name a few. Meanwhile, methodological development is underway, e.g., in [43], a comprehensive conceptualisation of 'Energy Technology Foresight' for emerging economies was developed.

Still, most of such studies are carried out on the national level and foresight in local communities has been mainly focused on the use of natural resources or the construction of large infrastructure projects, as required by the environmental legislation of most countries [44]. Some emerging research on local government units (such as municipalities and villages) in the field of energy is on the rise and includes, for example, the study by Mohajeri and colleagues [45], where scenarios were developed for the village of Hemberg in Switzerland for the years 2030 and 2050 regarding the integration of urban form and distributed energy systems. Fernández-Güell and colleagues analysed cities as urban functional systems and discussed the use of foresight tools to formulate visions in a participatory way for cities in Spain [46].

However, such studies generally apply a limited toolset of popular foresight methods. In addition, foresight is not always seen as an enhancement or extension of traditional policy and strategic planning that is based on deliberation and discussions that lead to shared visions, which is a characteristic of successful foresight practices.

So far, the results of the foresight efforts have been mixed. The earlier national exercises in Japan and elsewhere were highly influential [36], while more recent exercises in different parts of the world have had a lesser impact on actual policymaking. Embedding foresight activities more closely into actual policymaking remains a notable challenge.

Researchers have pointed to the problems when universal foresight approaches, originating from technologically developed large economies, are applied in different socio-economic and policy-making contexts. For example, foresight and its impact are influenced by national traditions, styles, and culture [47]. One issue studied specifically is related to the size of the country or

regions undertaking foresight. The smallness of a country not only relates to its socio-economic context but also to its capacity to carry out foresight exercises [36,48,49]. Tiits and Kalvet reported a major knowledge gap that occurred in foresight exercises in smaller economies in relation to the latest strategies and priorities of the dominant research and industrial actors in the global high-tech arena. Such gaps make the adoption of the largely popular quantitative methods (such as a Delphi survey, for example) virtually impossible in smaller contexts [50]. In general, foresight researchers caution that there is no single way to conduct effective foresight exercises and that different foresight endeavours call for the application of different foresight methods. Research on foresight at the city level remains limited, but the rapid development of the smart city concept has given a boost to foresight-related research as well (see, e.g., [32]).

Due to the failure of many foresight exercises, researchers and policy-makers have started to pay attention to the success factors, although “A review of the literature reveals much in the way of foresight methodology and the rationale for foresight but little about the factors that lead to foresight success” [51].

Based on the extensive literature review, in [52], critical success factors for strategic foresight in firms were identified, confirmed by other authors [53,54], and these are relevant also for drawing conclusions on how to carry out foresight on a municipal level (Figure 1).

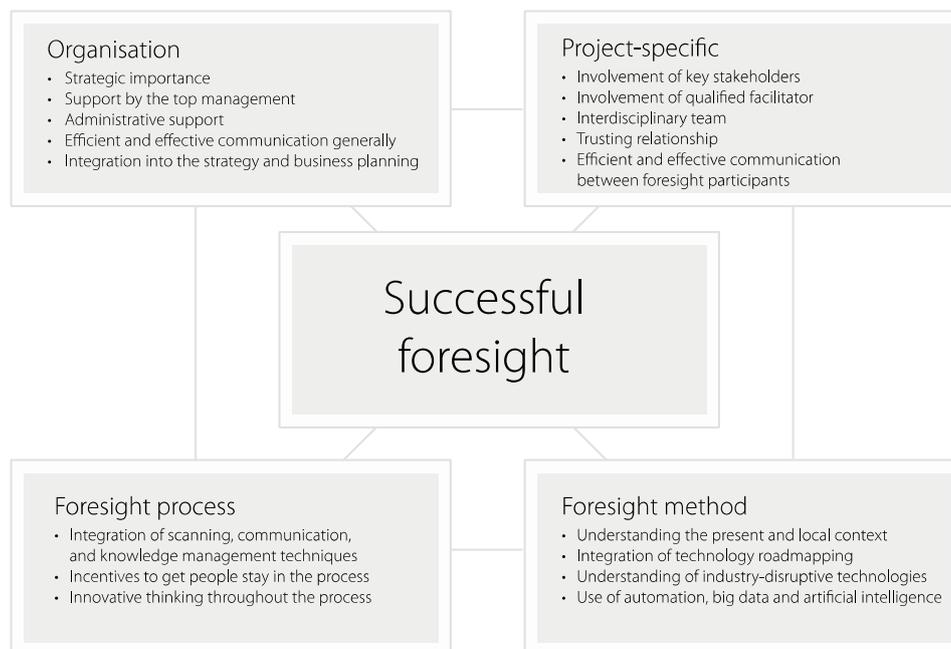


Figure 1. Success factors for strategic foresight in firms (authors based on [52–54]).

Even more topical are studies on government-led foresight. Success factors are foremost centred around the role of a public organisation leading foresight, and more specifically, about the needs to “focus on a clearly identified client”, to “establish a clear link between foresight and today’s policy agenda” and to “nurture direct links to senior policy-makers” [51]. Other researchers also stated, along similar lines, that “A fundamental condition for achieving impact is to have a committed client” [55], and their discussion of other factors and conditions critical to reaping the benefits of foresight was centred around this key statement. Calof and colleagues could not emphasise enough “an educated client with clear expectations and a strong commitment” [56], as concluded similarly by others (e.g., [57]).

The second key success domain is centred around the integration of stakeholders [57–59], particularly the creation of strong public-private partnerships: “In all the foresight programs we saw, it was important to involve both the private and public sector in the foresight program. These linkages

helped in terms of generating the information used in the foresight studies as well as helping to gain buy in for the recommendations” [56].

Selection of the appropriate methodologies and skills for the foresight is another important success factor [56]. As discussed above, this is particularly important as capacities are different on the level of countries, regions, and municipalities. Similarly, as economies and societies are becoming increasingly complex, it is recommended to involve academia and external consultants into foresight exercises as they can use modern foresight tools, data sources, and contribute to the development of foresight skills and capacity for the foresight participants.

There are very limited studies on foresight and success factors specifically at the local level. In a study of local Dutch policy-makers applying foresight methods within the context of strategic policy processes, it was concluded that “An important barrier with respect to the decision to use foresight methods at all, especially at the local level, is the low level of knowledge and expertise” and difficulties in connecting the insights of a foresight exercise to strategic policy process [60].

In sum, most of the foresight literature still focuses primarily on the process and various participatory elements of foresight exercises, while paying much less attention to the socio-economic and public-policy contexts. The insufficient attention paid to the broader public-policy context substantially limits policy learning from various foresight exercises across different countries and continents.

The above raises several research questions, which are relevant academically as well as for policymaking. First, how to use participatory foresight for fostering smart energy transition on a municipal level (RQ1)? While smart energy transition efforts on a municipal level are gaining importance, going beyond implementing single projects, decarbonising efforts involve complex strategic planning and need system level thinking and changes. Foresight is a relevant method for the involvement of stakeholders and in the development of integrated policies. Second, what key benefits does participatory foresight bring in the field of smart energy transition on a municipal level (RQ2)? As the general experience regarding the use of foresight in the public sector has brought mixed results, it is particularly important to understand the benefits of foresight for fostering smart energy transition on a municipal level. Finally, what are the key success factors for effective and efficient participatory foresight and how do we make it replicable (RQ3)? Our aim is to develop foresight-specific elements of an overarching methodology for a smart urban decarbonisation transition, guiding local authorities through the process of developing the most appropriate strategies, plans and projects, as well as looking for the commitment of key local stakeholders for an effective transition, introduced generally in [15,61]. Thus, research should aim at understanding the key success factors and replicability potential to use foresight to increase the quality of strategic energy planning by fostering long-term system thinking.

3. Cities4ZERO Foresight in the Context of a Broader Strategy Process

3.1. Cities4ZERO Framework Generally

Successfully embedding a foresight exercise into a broader strategic planning context is one of the key success factors that determines the impact of foresight in driving strategic choices and investments. Therefore, we start the discussion of Cities4ZERO Foresight methodology from a broader Cities4ZERO Framework.

Cities4ZERO is a step-by-step methodology for a smart urban decarbonisation transition, guiding the city through the process of developing the most appropriate strategies, plans and projects, as well as looking for a commitment from key local stakeholders for an effective decarbonisation transition, all from an integrated planning approach. Cities4ZERO Framework covers key questions in energy planning, such as: “How can local authorities effectively address the decarbonisation of urban environments in the long and short run? How would their interests and expertise be aligned into an integrated approach towards decarbonization?” [15,61].

Cities4ZERO Framework reflects the actual strategic energy planning dynamics in participating cities. It has been launched and disseminated as a full methodological framework for urban regeneration,

especially energy transition [15]. It was developed in the framework of H2020 Smart Cities and Communities project SmartEnCity in close collaboration with five local authorities through analysing their ad-hoc local strategic approaches to energy transition in order to determine barriers and key success factors from their transitioning experiences. These cities intend, as well as the whole methodology, “to align cities’ decarbonisation and Smart City solutions implementation, through a concept able to steer this urban transformation process: The Smart ZeroCarbon City concept”, fully explained by Urrutia and colleagues in an article introducing the whole Cities4ZERO methodology in full [15]. Cities4ZERO is meant to enable effective action in municipalities, both in planning and implementation, with this guiding concept as an overarching goal for cities [15].

The focus has been on small and mid-sized municipalities in Europe—as these are representative of most European cities—and on the replicability of the methodological framework on other municipalities. The actual effects of the full implementation of transition will take several years, yet the application of the Cities4ZERO framework in participating cities has already mobilised the respective local communities towards a shared diagnosis, vision, and planning process; the cornerstone towards a promising urban transition [15].

The Cities4ZERO Framework suggests a pragmatic approach for municipalities structured on three stages: (1) the strategic stage, dealing with the development of the city strategy towards decarbonisation, (2) the design stage (project level) and (3) the intervention and assessment stage (project and city level); the latter two develop key projects relevant for the implementation of the decarbonisation vision and strategy [15].

The involvement of stakeholders is one of the key success factors for any systemic transformation. Therefore, in the Cities4ZERO Framework, the strategic city diagnosis in Step 3 is expected to involve the cooperation of local stakeholder partnership organised in thematic working groups. Step 3 is expected to identify critical topics and the main inputs for scenarios and city vision generation in Step 4. The focus of the subsequent chapters in the current research article is on Cities4ZERO Foresight, i.e., Step 3 and Step 4 of the Cities4ZERO strategic stage (Figure 2).

Foresight is about gathering intelligence and analysing future scenarios, leading to a common vision for making present-day decisions and mobilising joint actions. Building on the literature review and considering the experience of recent foresight exercises, the Cities4ZERO Foresight focuses on the use of participatory foresight methods to support the cities’ strategic planning processes. Therefore, Cities4ZERO Foresight is designed to contribute to the preparation of the cities’ strategic action plans (step 5 “Plan” on Figure 2). Cities4ZERO Foresight pays attention to the local socio-economic situation, taking into account global trends, and making sure the approach is manageable on the municipal level.

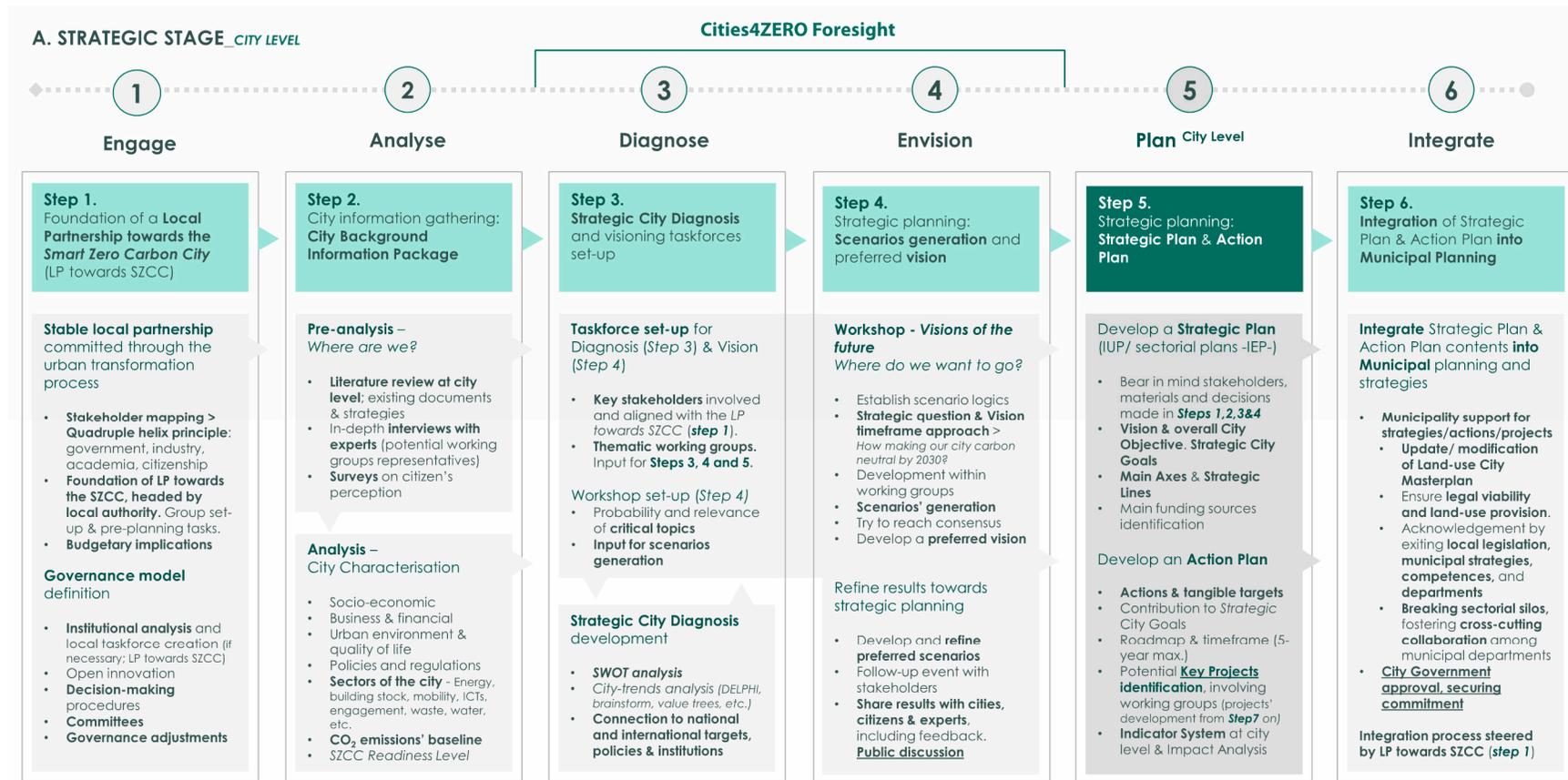


Figure 2. Cities4ZERO Foresight in the context of a broader strategy process (authors based on [15]).

3.2. Cities4ZERO Foresight

Cities4ZERO Foresight is structured into four main phases: Phase 1 of the Cities4ZERO Foresight exercise is about with setting up the scene for the whole foresight exercise (Table 1). This starts with establishing a dedicated steering group for the coordination of the foresight exercise. Thereafter, a strategic diagnosis is initiated that involves horizon scanning for the identification of global trends that are likely to call for change in cities, and an analysis of the strengths and weaknesses of the city itself. Meanwhile, relevant linkages to regional/national/international targets, policies, and institutions in the field of decarbonisation are explored as a part of the analysis of the external environment. The results of the above analysis are summarised as a ‘Strengths, Weaknesses, Opportunities, and Threats’ (SWOT) analysis that brings the strengths and weaknesses of the city together with global trends that reflect on opportunities and threats. (Figure 3).

Table 1. Cities4ZERO Foresight methodology step-by-step.

Phase 1. SETTING UP THE SCENE
<p>1. Set up the integrated energy planning steering group</p> <ul style="list-style-type: none"> • Key partners in energy transition according to the minimum topics of: energy, mobility, ICT, governance, and citizen involvement • Decide on involving external expert/consultant <p>2. Set the strategic question</p> <ul style="list-style-type: none"> • “How can we make our city carbon-neutral by 2030?” • Time horizon: at least 10–15 years ahead <p>3. Analyse/review the base situation, city characterisation, context analysis</p> <ul style="list-style-type: none"> • Requires desktop analysis and validation within the steering group <p>4. Identify the driving forces of change</p> <ul style="list-style-type: none"> • Analyse today’s smart city trends and issues by applying the “external opportunities” and “external threats” logic of a standard SWOT analysis • Identify the most influential trends and/or drivers, e.g., globalisation, urbanisation, technological breakthroughs, resource scarcity, oil price change or digitisation • Assess and rank the trends within the task force • Remember: Opportunities and threats are external to your activity. Do not mix trends with internal factors. Energy transition projects pay attention to social, economic and legal factors/barriers. <p>5. Determine main strengths and weaknesses</p> <ul style="list-style-type: none"> • Identify specific socio-economic positive and negative aspects that characterise your development as a smart decarbonised city. • Combined with the findings of step 4, the SWOT and/or ‘Political, Economic, Social, Technological, Legal and Environmental’ (PESTLE) etc. analysis should then provide sufficient input into scenario planning • After combining information from step 4 and step 5, assess the probability and relevance of each of the main trends • This should be validated in the steering group <p>6. Attract relevant stakeholders</p> <ul style="list-style-type: none"> • City planners, politicians, businesses, service providers, academia, and community representatives • It is important to get a variety of insights from various fields of expertise • Remember that bringing together various stakeholders and guiding their individual choices towards consensus is one of the main benefits of foresight. Additionally, the main steering group members of the whole strategic process should be heavily involved in the scenario building task. <p>7. Prepare for the workshop</p> <ul style="list-style-type: none"> • Validate the findings of steps 4 and 5 (i.e., SWOT) among the involved stakeholders, e.g., by conducting a survey or using the Delphi method. This gives an input for speculating on the most likely visions of the future in the scenario planning workshop.

Table 1. Cont.

Phase 2. SCENARIOS OF THE FUTURE
<p>8. Introduce the purpose</p> <ul style="list-style-type: none"> Specify the aim and the expected results of the workshop and present an overview of how a mutual vision of city energy planning will be formed during the exercise.
<p>9. Get the stakeholders on the same page</p> <ul style="list-style-type: none"> Present the overall context, focusing on the threats and opportunities that were identified in steps 4–5 and possibly validated in step 7. Use brainstorming time, during which the participants could add e.g., post-its to the “opportunities” and “threats” sections Remember that the threats and opportunities should not sound slogan-like. This action does not reflect the preferred courses of action—not yet.
<p>10. Establish scenario logics</p> <ul style="list-style-type: none"> Agree on 2 of the most impactful but uncertain trends that will be used for the 2×2 matrix to create scenarios. The task that already started before the workshop in step 4 should be continued in step 10. In the end, you should have 3–4 major scenarios to develop further Remember that this is the most time-consuming part
<p>11. Create groups</p> <ul style="list-style-type: none"> Make sure that each group has the main stakeholder groups represented Assign leaders for each group If feasible, the leaders of each group could be members of the task force Each group leader will summarise their group work in a scenario description
<p>12. Create different scenarios</p> <ul style="list-style-type: none"> Each group will work with one specific scenario based on the 2×2 matrix You may also choose the format where all groups discuss all the scenarios and you can later integrate the results The aim of the group work is to describe a future scenario whereby the city successfully takes advantage of the most important opportunities while avoiding the major threats Groups also map main preconditions that are needed for the scenario Tips: Name each scenario, name 2–3 magazine headlines from the future for each scenario, propose timeline, legend or story for each scenario; extra effort will be needed after the workshop to write up the scenarios.
<p>13. Conclusions</p> <ul style="list-style-type: none"> The leaders of the working groups will introduce their best scenarios and their preconditions (ca. 15 min each). This will be followed by a discussion of the most attractive and realistic scenarios.
<p>14. Develop the scenarios</p> <ul style="list-style-type: none"> Create an approximately 4-page summary for each scenario that will feed into the next steps (may happen between several workshops). Additional desk research and expert interviews, if needed; complete and elaborate the selected scenarios by describing them in detail; developing further keywords identified during the workshop, adding numbers for trends etc.

Table 1. Cont.

Phase 3. SHARED VISION
<p>15. Develop a preferred vision</p> <ul style="list-style-type: none"> Summarise the scenarios identified The goal is to reach an agreement, a common vision (may be organised in groups) <p>16. Move to a strategic planning</p> <ul style="list-style-type: none"> What present-day decisions should we make to shape the outcome in the preferred direction, enhancing the desired future or taking actions to prevent non-desirable futures? What are the most important milestones? Draw conclusions on the main results of the (previous) workshop
Phase 4. STRATEGIES AND ACTIONS
<p>17. Organise a follow-up event</p> <ul style="list-style-type: none"> Feeling of joint ownership of the chosen strategies is important Follow-up meeting to present the advanced scenario(s) specified in steps 14–15 to your stakeholders, asking them for feedback and gathering more in-depth ideas for strategic planning <p>18. Share results</p> <ul style="list-style-type: none"> Share results on dedicated channels <p>19. Specify next steps</p> <ul style="list-style-type: none"> Specify next steps in the strategic planning process

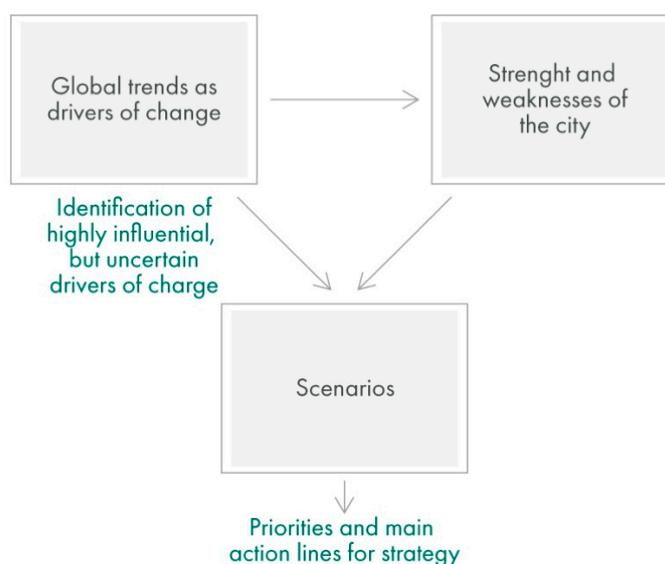


Figure 3. Cities4ZERO Foresight process from SWOT. Analysis to the scenario analysis that informs strategy (authors).

In Phase 2, two highly influential external drivers, for which it is uncertain if they will materialise, are selected as axes for subsequent scenario analyses. All other elements of the SWOT are also integrated into scenario discussion. This allows cities to address the uncertainties to be ready for different future developments that may have vastly different consequences.

Building upon the main outputs from the strategic city diagnosis, local working groups will participate in a city visioning workshop, co-developing an agreed-upon vision for the future of the city. Assuming the role of city managers, the working groups will generate different future scenarios for the city based on the SWOT analysis, while addressing the formulated strategic question within the agreed timeframe; e.g., how are we transforming our city to become carbon neutral by 2040? What can we do by 2030 as a mid-way milestone? The stakeholders will compare the analysis on probability and

the relevance of the trends performed in the strategic city diagnosis before generating the different future scenarios. The local steering group must gather the inputs and further develop each of the scenarios suggested by the working groups. Once the inputs are structured, the final scenarios are presented (again) in Phase 3, to the local stakeholders, starting a discussion to select the preferred “master scenario”, which can be one or a combination of those final scenarios. According to that master scenario, the group will develop a city vision, ideally because of reaching a consensus among all stakeholders. This scenario will be the basis of developing the strategic plan for the city. This strategic plan of the city will transform the city vision into specific goals and actions (Phase 4 and beyond).

4. Research Design and Data Collection

4.1. Methodology

The article applies case-study design as a research method [62], to represent a test of a theorisation of foresight in the framework of urban energy transition, using the existing conceptual and theoretical framework to answer the research questions through practical case studies. Those case studies are expected to confirm, challenge, or extend a theory where even a single case can represent a valuable contribution to knowledge- and theory-building.

Case study design usually applies mixed methods, but qualitative research is generally preferred. Indeed, in the current research, qualitative methods are the best to capture the situation and the main explanatory factors for the emerging practices. If a tool or methodology was effective, it can be illustrated by the achievement of final anticipated outcome and some output numbers. However, quantitative approaches run short in explaining why something happened, what influenced the process, or capturing the true benefits of the complex interactive process of foresight. Qualitative observations based on qualitative interviews enable the foresight coordinator(s) to explore the situation and the main explaining factors for the emerging practices.

The research team gathered information about foresight in five small (50,000–100,000 inhabitants) and medium-sized (100,000–500,000 inhabitants) cities introduced in detail in Chapter 4.3 through participatory observation and qualitative interviews, by: (1) organising and analysing information from the preliminary horizon scanning exercise; (2) regular biweekly contacts with all city representatives from the beginning of the methodological preparations throughout the practical application of the methodology in their planning processes over more than a two-year period; (3) gathering detailed reports from the cities with their foresight results and synthesising the information; (4) interviewing the main foresight task force leaders in each city through a uniform questionnaire focusing on the identified benefits of the methodology, its key success factors, main lessons and their assessment of how adaptable the methodology was in their local context.

4.2. Cities4ZERO Foresight Implementation

For the implementation, a step-by-step guideline was prepared for the participating case study cities following the literature review of foresight methodologies and specificities of municipal level [63]. Regular consultations with the representatives for each partner city steering group (corresponding to step 1 of Cities4ZERO Foresight methodology, see Table 1) were held in order to analyse the suitability of the use of foresight methodology in the local context and to identify challenges to the implementation. When all cities had set up their steering groups and were ready to put the next steps into practice, the research team organised an online tutorial for cities in order to explain the detailed guidelines for carrying out the next steps as highlighted in Table 1. Cities were advised to follow the guidelines to ensure that the end result will be comparable between cities; however, they also were given leeway to modify the specific instructions to suit their city needs as required.

The Cities4ZERO Foresight guidelines were generally followed. As the first step, the trends that will potentially have the greatest impact on the development of smart and decarbonising cities in the coming decade were mapped based on literature. Out of these trends, the ones that referred to

external factors (i.e., the opportunities and threats of a standard SWOT analysis) were included in a web survey. The collected trends were grouped into four categories defined (1) by the research team as minimum important fields in energy transition (2) by the fields that SmartEnCity project partners had to consider while taking actions in decarbonisation—energy, mobility, information and communication technologies, smart city governance and engagement.

The survey was validated by a group of experts to assess the quality of the listed factors and to add any trends that were important yet missing from the survey. The survey was then circulated among the five case study cities and related experts for identifying the probability (i.e., likelihood that the trend will become reality in the coming decade) and relevance (the importance of the trend for smart city development in the coming decade) of each of the statements. The aim was to have a result with the most desirable visions of the future of smart cities and to use these insights in further strategic planning processes. In the next sub-chapter, more details are provided on the background of each of the cases and on the implementation of the foresight.

4.3. Case Descriptions

The five case study cities are similar in their sizes (68,000–240,000 inhabitants) but different in many other factors related to their regional, economic, social, and legal context (Table 2). The sample represents cities from Southern-Central Europe as well as from the Northern Europe. Climatic conditions, advancements in energy policies on a national level, regulations affecting the extent of public services, society engagement practices etc. vary among the case study cities. At the same time, all cities are willing to advance their knowledge and planning approaches to demonstrate their ambition to become decarbonised and to take advantage of integrated energy planning.

Of these cities, three perform as “lighthouses” in the SmartEnCity project, where Vitoria-Gasteiz (ES), Tartu (EE), and Sonderborg (DK) seek to intervene through pilot projects in specific districts, as well as updating their city strategies; and two act as the “follower” ones, Asenovgrad (BG) and Lecce (IT), willing to learn from the experiences of lighthouse cities to update their city strategies, and start with specific district interventions in a later stage [15,22].

Table 2. Cities implementing Cities4ZERO Foresight (authors, partially based on [15,63]).

	Socio-Economic and Institutional Context	Positioning Foresight into Energy Transition Planning Process
Tartu, Estonia	<p>Tartu is the second-largest city in Estonia, with a population of 100,000 inhabitants and a total area of 38.86 km². Tartu belongs into to continental climate/humid climate and temperature in the north of Europe and is a low population density district.</p> <p>Tartu is the home of several knowledge-intensive organisations and it is known for its extensive implementation of smart technologies in the urban environment. Tartu is putting a lot of emphasis on green transition, preparing a long-term sustainable energy action plan until 2030 and having green agenda strongly visible in the programme for 2024, when Tartu is acting as the European Capital of Culture.</p>	<p>The foresight exercise was organised as part of a wider energy planning process that was called “Tartu Energy 2030+”. The Tartu Energy 2030+ strategy was developed in the framework of 3 different initiatives: compiling the interim report for the city’s already existing SEAP (sustainable energy action plan), renewing the SEAP into a SECAP (sustainable energy and climate action plan) and creating an IEP (integrated energy plan) according to Cities4ZERO methodology. The aim was to put Tartu in the context of global developments and devise an action plan for reducing CO₂ emissions at least by 40% by the year 2030.</p>
Sonderborg, Denmark	<p>Sonderborg is the sixteenth largest municipality in Denmark, with approximately 77,000 inhabitants, located in the Southern Denmark region. Sonderborg has an oceanic climate in the north of Europe and is also a low population density district.</p> <p>The municipality holds an extensive agriculture sector, some of Denmark’s largest industrial companies (i.e., Danfoss), and some of the most beautiful natural resorts of the country, with a coast of approximately 200 km (offshore wind potential) and vast forests (local biomass potential). The city of Sonderborg has been working with the “ProjectZero” roadmap since 2007, aiming to become carbon neutral by 2029; one of the worldwide pioneer cities in this regard.</p>	<p>The foresight for Sonderborg was a part of the creation of the Integrated Energy Plan (IEP) for Sonderborg, named Roadmap2025. Roadmap2025 identified 52 specific energy/climate actions to be implemented to reach 75% CO₂ emission reduction in Sonderborg by 2025 compared to the 2007 baseline. Both Roadmap2025 and the scenario process are focused on Sonderborg’s main future goal: to become CO₂ neutral by 2029. Therefore, the scenario process was developed considering the goal of carbon neutrality by 2029 and became an integrated part of the Roadmap2025 process.</p>
Vitoria-Gasteiz, Spain	<p>Vitoria-Gasteiz is the administrative capital of the Basque Country in northern Spain. It has a population of 240,000 inhabitants, with an area of 276.81 km². Vitoria-Gasteiz is a compact, moderately dense city, which has an extensive background in the planning and implementation of environmental policies, being awarded the European Green Capital in 2012.</p> <p>Vitoria-Gasteiz has an oceanic climate in the south of Europe and high population density. Vitoria-Gasteiz is committed to becoming a carbon-neutral city by 2050.</p>	<p>Foresight was as a part of their Integrated Energy Transition Action Plan 2030 (PATEI 2030 in Spanish), as a mid-way checkpoint towards their carbon neutrality strategy to be achieved in 2050. This document is continuing the SEAP of the city (Plan de Lucha contra el Cambio Climático 2010–2020), and the energy transition diagnosis released in November 2018. PATEI 2030 aims to cover the mitigation section of the future SECAP of Vitoria-Gasteiz, intended to be released in 2021.</p>

Table 2. Cont.

	Socio-Economic and Institutional Context	Positioning Foresight into Energy Transition Planning Process
Lecce, Italy	<p>Lecce is a historic city of 95,200 inhabitants in southern Italy, the capital of the Lecce province, the second largest province in the region by population, as well as one of the most important cities of Apulia. Lecce covers an area of approximately 238.39 km². Lecce has a warm Mediterranean climate. It is also an important agricultural centre, chiefly for its olive oil and wine production, as well as an industrial centre specialising in ceramic production.</p> <p>The municipality has a great potential to exploit renewable energy (RES), with solar energy being the most relevant one. Lecce SEAP from 2007 targets renewable energy production, green spaces, energy savings in buildings through building refurbishment, street lighting refurbishment and smart mobility through electric public transportation improvement, cycle paths extension and promotion of natural gas vehicles.</p>	<p>The foresight exercise was organised as a part of the Energy Planning Process, to provide input for the IEP. The main goal of Lecce is to implement the IEP, which defines the energy strategies of the City across different areas. The final output will be the IEP of Lecce Municipality, targeting a CO₂ reduction of at least 40% by 2030, compared to 2007.</p>
Asenovgrad, Bulgaria	<p>The Municipality of Asenovgrad occupies the southeast part of the Province of Plovdiv at the foot of Rhodope Mountains. Its territory is 615 km² and the population is 68,000 inhabitants. Asenovgrad has a cool continental climate/subarctic climate and is a rural city. The town of Asenovgrad is the municipal centre. The main policy priorities of Asenovgrad Municipality are the development of the economy, human resources development and the development of infrastructure and environmental protection. As with the other four cities, Asenovgrad is also a signatory of the Covenant of Mayors and has developed and submitted a sustainable energy action plan with an overall CO₂ emission reduction target of 28% by 2020.</p> <p>Asenovgrad has also been developing an Integrated Plan for Urban Regeneration and Development with three zones of intervention identified: social intervention zone, zone of public functions with high public importance and zone of high economic development potential.</p>	<p>The foresight experience in Asenovgrad is based on the existing Integrated Plan for Urban Development and Regeneration (IPUDR) with the main aim to update and enrich it according to the results of scenario formulation process, with priority areas and concrete projects that help to reach the foreseen targets by the year 2027 and to formulate a long term vision of the municipality till 2050. As a result of the process, four main priority areas have been identified, namely biomass utilisation, wind and solar utilisation, building energy refurbishment and financing mechanisms, and concrete projects will be formulated to help deliver results and reach targets.</p>

5. Results

5.1. Steering Group Set-up

The first step in the Cities4ZERO Foresight is the establishment of a local steering group headed by the local authority, which will lead the whole process (step 1 of Table 1). The local steering group is expected to engage key local stakeholders, including representatives from all ‘quadruple helix’ branches (government, industry, academia and citizens), as well as define the governance model for the regeneration process. It was suggested in the guidelines that next to creating a strong leadership of the local steering group for energy transition planning, it is also advisable to include an external facilitator in order to carry out workshops that are part of the foresight methodology.

All five cities established such dedicated steering groups with members having different skills and competence and, in most cases, (three out of five), external experts were fully involved from the beginning of the foresight exercises. The involvement of the external facilitators proved to be one of the key success factors, as indicated by the cities later. The guidelines did not suggest a specific size of the steering group. However, in practice, all cities opted for steering groups with around ten members that consisted of city government members, research and expert organisations. In three cases, the university was involved in the daily operation of the energy transition planning steering group.

In almost all cases, the coordination was facilitated by local expert organisations, like energy agencies or consulting companies. Even though coordination lead from the city government level would have been ideal per the guidelines, representatives of the cities were committed enough. In three cases, the political level was included into steering groups or later working groups (the Mayor and Vice-Mayor were included). In one case, all departments necessary for the planned strategy implementation in the future were taking part in the steering group work; and in all other cases, city government was represented by two to four members, mostly being engineers, planning department officials and project managers.

The roles of the city representatives were clear. Most mentioned roles for the members from the city government were responsible for the municipal strategic planning process and validating strategic lines and actions. In two cases, they also had an important role in the promotion of the process, logistic organisation of workshops and attendance. As mentioned, overall coordination, communication with task groups with a wider set of stakeholders, working with preparatory materials, diagnosis, preliminary projects’ identification, climate proofing and energy modelling were the tasks of expert organisations. In one case, the university and the energy consulting company were modelling the energy scenarios and calculating CO₂ emissions from the different scenarios.

It can be concluded from the five different city cases that a decently sized and heterogenous set of members working daily with the process is important. Additionally, in making the foresight workshop(s) a success, the experiences from the five case studies have proven the usefulness of involving external experts to moderate the events, forming part of foresight techniques. Hiring these professionals helps to mobilise stakeholders, increase the efficiency of groupwork, and encourage participants to speak their mind.

“The process needs a strong and sharp workshop-leader with knowledge about the subjects and the process.” (steering group representative 1, City A)

The involvement of an external experienced moderator, especially in the phase of scenario workshop(s) (see Steps 7–17 from Table 1), helps to reduce hesitations that cities may have, especially when using foresight for the first time. Despite thorough preparation by the research team to guide the cities, all the cities were feeling hesitant and doubtful before the practical exercise. They were anxious about whether they were well positioned to carry out the task which includes a large set of important stakeholders, including local and, in some cases, national politicians.

“To speak in open cards the group admits that the whole task was quite frightening at the beginning, especially for the team members who were not used to such participative planning methods and working with scenario creation.” (steering group representative 2, City B)

“The process is complex, should count a strong and sharp workshop-leader, but more than that the local expert groups by different sector, with knowledge about the subjects and the process, and willed to guide the initiative.” (steering group representative 3, City C)

One of the shortcomings observed in the practical foresight cases was that in all cases, representatives from the energy business sector were not included in the steering group. Still, in most cases, they were approached during the stakeholder engagement phase of the foresight exercise. Therefore, the full ‘quadruple helix’ collaboration model as suggested by Cities4ZERO did not succeed fully at the task force level. In future applications of the proposed methodology, cities should make more effort to have all sectors represented in the daily working group of the city energy transition process.

5.2. Setting up the Scene: Horizon Scanning

A crucial step in any foresight exercise is open dialogue on potential futures on which the development of strategic approaches can be built upon. One of the main methods is horizon scanning, which gathers the necessary information about possible future developments and is generally carried out based on desk and web research. In the context of Cities4ZERO Foresight, experts were asked to identify major trends that could have a significant impact on making “a city carbon-neutral by 2030+” in a 10–15-year perspective (steps 2–4 of Table 1).

Such a trend analysis was also carried out in all five pilot cities. The analysis was based on a literature review carried out by the research team, but also included an expert survey for assessing the relevance and probability of identified trends. The online survey was distributed within the smart city domain to 60 experts in five countries which the case study cities represented. As a result, 49 responses were collected, chiefly from local/regional public authorities and enterprises. Experts were also asked about their level of expertise in various smart city areas (i.e., energy, mobility and ICT) and most of the experts that participated considered themselves “very knowledgeable” or “knowledgeable” of the energy topics.

The experts were asked to give feedback on the relevance of individual trends that were identified as a result of the literature review. To cut down on the number of statements and to keep the most relevant ones, all statements that scored less than 50% in “highly relevant” were removed. The remaining statements were divided into two categories based on the expected likelihood that a specific trend would materialise (more than 50% likely vs. less than 50% likely):

- Certain trends with a high impact that serves as useful background information about trends in urban planning; there were 24 trends identified, divided between energy, mobility, ICT and governance and societal engagement. As an example, likely and highly relevant trends included conclusions such as “Cities will become active players in their local energy markets” and “Contrary to developing countries, transport fuel demand in developed countries will drop”.
- Uncertain trends with a high impact can be considered as ‘wild cards’ in future scenario-building workshops; there were 11 “wild card” trends identified, divided between energy, mobility, ICT and governance and societal engagement.

This analysis served as an input for cities to continue with their city diagnosis; in all cases, such preliminary trend analysis served as an important input for further analysis of these trends as a part of a local preparatory work.

5.3. Setting up the Scene: City Diagnosis

In this stage, thorough diagnosis of the city is carried out. Even though global trends and challenges may reflect the opportunities and threats of an individual SWOT analysis, the city should

also consider their own internal strengths and weaknesses when gathering input for the strategic plan. Hence, further data were collected according to the guidelines (steps 3–5, Table 1) to compose a SWOT analysis of a city that would inform the energy transition planning.

In this phase, all cities conducted a SWOT analysis that informed the subsequent scenario work for the energy transition planning. All city task forces relied primarily on desk research, reviewing appropriate baseline documents, existing local or national strategies, assessing relevant trends from the previous joint trend analysis and adding new ones; validating the scenario development workshop preparatory materials in the steering group. In one case, a SWOT was generated jointly with a broader set of stakeholders as a part of a scenario development workshop. In other cases, a SWOT was prepared within the main task force and only briefly validated and used as supporting material during the foresight workshop that involved a wider group of stakeholders. Both approaches worked well and no difference in the final outcome was noticed in this practice. Rather, the importance lay in dedicating sufficient time and professional care to prepare the baseline and SWOT for the energy transition planning which guaranteed that all critical stakeholders did not question or could rather quickly agree on its relevance.

Still, all piloting cities realised that a thorough background analysis is crucial for the attraction of relevant stakeholders, for the generation of visions of future(s), and for the subsequent development of strategies.

What is more, thorough preparatory work ensures that all relevant aspects will be put on the table during the joint vision building process and that the stakeholders are all on the same page when taking the next steps.

“We followed the methodology step by step and this was a very useful tool to steer the process. Such kind of involvement process (in such a volume) was quite extraordinary as besides ordinary partners for the City government a huge attempt was made to attract representatives from a wide range of organisations from different sectors. Therefore, this very thorough work done for preparing the steps was really helpful once the partners gathered together. This guaranteed a really smooth process during the workshops. Even collectively defining the vision was not as difficult as can be anticipated from the theory of foresight. The process was also clear to the participants.” (foresight participant 1, City B)

As the discussion in 5.5 details, the workshops that are conducted for the scenario planning and the final consensus on a vision are usually very demanding. In the guidelines, one full day was recommended for the joint trend analysis and scenario development discussion. It was advised to hold an additional half-day event to reach a jointly developed vision on the city’s decarbonisation plan, as these workshops should engage a set of key stakeholders to ensure that all relevant fields in energy transition would be covered. Such events should include the high-level, but hard-to-engage, politicians. Therefore, it is especially important to fill the time effectively to get the maximum benefit from the co-development process, and the proper analytical key is crucial input.

“The biggest challenge was to capture and keep the attention of all the participants during the duration of all the event” (foresight participant 2, City D).

5.4. Stakeholder Involvement

One of the key criteria for successful foresight is the integration of stakeholders (step 6, Table 1). The experience of the piloting cities reveals that stakeholder engagement into joint scenario development and the strategic planning process was clearly the most challenging part of the foresight steps. At the same time, the cities admitted that the most important benefit for them was related to proper engagement of key stakeholders and sensing that they had joint ownership towards the long-term energy plan and the implementation of the respective strategies in the future.

“The greatest benefit of such an exercise is probably building the community feeling, and showing that every opinion counts./—/Collective decision making can bring a lot of benefits especially at later

stages of the planning process, but more importantly, in implementing the plan as target groups have generated this plan by themselves.” (foresight participant 3, City B)

“We have so far implemented the foresight process (methodology) twice. First time in 2007 and second time in 2018 at the beginning of our integrated energy plan creation process. In both cases the workshop and the foresight methodology have created a strong common platform for understanding and assessing the future uncertainties.” (foresight participant 4, City A)

“It helped in building trust among local stakeholders in municipality that their opinion matters and will be taken into account when developing and implementing local community development plans.” (foresight participant 5, City E)

From the ‘quadruple helix’ perspective, the closest working collaboration was created between government (municipality) and academia (including also experts and consultants), while the business representatives, citizens and their representative organisations were the hardest to engage.

“We have realised that some key target groups were still missing from the planning process. (meant industry, retailers, hospital).—/Even though the whole key group jointly worked with the stakeholder identification, we now feel that even more time should have been dedicated to this phase.—/Therefore, indeed, even more thorough analysis at this stage would have avoided the situation where the group is doing this at the moment, when the plan is almost ready and working groups have delivered their results. Currently the group is working towards the greater involvement of “forerunners” (biggest energy consumers) to validate the action plan with them also.” (steering group representative 2, City B)

“—/more representatives of schools and educational establishments should had been invited. Furthermore, the presence of some representatives of the neighbour Municipalities and regional institutions could have been constructive to create a collaborative work at a wider level.” (foresight participant 6, City D)

All cities admitted that even more thorough analysis of the stakeholders and going beyond the usual co-operation partners is especially beneficial.

“A selection of stakeholders had been prepared, using a preliminary contact list owned by Municipality and considering the expertise and the needs to cover all the strategic areas of the integrated energy plan. Having had a preliminary list was very useful as a starting base and, even though this work was accurately conducted, more time could had been spent analysing the actors involved and what contributions they could bring to the discussion, considering also the possibility to contact and involve some stakeholders not part of a preliminary list.” (foresight participant 2, City D)

“Even though stakeholder involvement process was a major part of the efforts of the working group, it is assessed that more work is needed in the identification part, especially for evaluating the potential role of specific stakeholder groups for identification of concrete actions and their implementation in practice.” (foresight participant 5, City E)

5.5. Scenarios of the Future: Scenario Development Workshops

In Cities4ZERO Foresight framework, first, qualitative steps are taken to develop descriptive scenarios (steps 8–13, Table 1) that can be developed further and validated with quantitative approaches. While there are benefits to extending the foresight over the long term (e.g., up to a year), it is also challenging to engage large expert groups for such an extended time. Therefore, in the Cities4ZERO Foresight framework, public workshops on scenario planning and long-term energy transition vision planning were undertaken, after a thorough preparatory phase, within a limited time span.

Ideally, cities were expected to jointly develop a long-term vision statement beyond the decarbonisation target, which was in these cases was in the range of reducing CO₂ level by 40% to zero CO₂ in one case.

The primary aim of this stage of the Cities4ZERO Foresight is to establish city energy transition scenarios. Working groups had to describe future scenarios where the city successfully takes advantage of the most important opportunities while avoiding major threats. In addition, each group mapped the main preconditions that are needed for this scenario to become reality. This, in turn, was to become a basis for further elaboration by the main steering groups within cities and also for further joint vision building, especially when foresight was divided between several workshops, as was the case for two cities.

All cities followed the step-by-step guideline for scenario development workshops. At the same time, cities could choose their own way, especially regarding the number of workshops. According to the guidelines, it was recommended to organise more than one scenario-planning workshop with the stakeholders to allow for the stakeholders to get to know each other and build openness and trust in the local planning processes. The first workshop could focus on exploring trends and developing scenarios, while the second workshop could concentrate on the agreement of a shared vision, and plan the subsequent strategic actions. It was vital not to extend the workshops too far from each other and communicate openly with all relevant stakeholders between several workshops. Two out of five cities planned two workshops from the beginning and the experience of other cities confirmed that more value could be created with such an approach.

“We had one workshop and feel that although it was very beneficial, more efforts are needed and for this reason it is planned to have a second workshop, to use it as a fine-tuning tool before update and enrichment with energy and sustainability actions of the integrated planning document.” (foresight participant 5, City E)

“The decision to organize a single, more focused, workshop had the aim to speed up the process that faced some slowdowns at the beginning of the year, due to some political and governance problems. Even though the results obtained were satisfying, the possibility to organize two workshops could had been useful to create a more participative collaboration with the stakeholders involved, as there could had been more time to make them part of the process (e.g., discuss and select with their help the trends to be voted during a preliminary event).” (foresight participant 6, City D)

“The process is painful and need a strong and sharp workshop-leader with knowledge about the subjects and the process. Painful because you as an organizer, will not know where the (sometimes frustration) process will end and how the participants will respond to it during the process. Dividing the process into two separate workshops might help you overcome this challenge.” (foresight participant 4, City A)

At the same time, both approaches—having just one full day for the whole participatory scenario development exercise or having more workshops to complete the exercise step-by-step—were satisfactorily used in the piloting cities. The partner cities were able to achieve the desired outcome by combining the steps in a way that suited their needs.

“At the beginning the process could had seemed not easy to be explained and developed during a single event, but the more the foresight methodology was studied and deepened, also thanks to the frontrunners experiences, the clearer it became how to organize an effective workshop”. (foresight participant 2, City D)

“This (2 workshops) was seen as risky at first as people who we targeted were high level officials in the city, also politicians and entrepreneurs and it is difficult to keep them engaged for the whole day... In the end almost 70 different people participated in both workshops, a lot of them were attending both. This was even more positive result than anticipated at first/—/. In both workshops almost everybody stayed until the end of the workshop and had sparkle in their eyes. Probably, the greater challenge is to guarantee, that collective decisions really find their way to the action plan as further smaller working groups had not so many participants as was seen in the scenario planning workshops.” (foresight participant 1, City B)

5.6. Master Scenario and Shared Vision

For a start, cities were instructed to select for the scenario axes those opportunities or threats outlined in SWOT which are likely to have a strong impact on the city, yet it is uncertain if this development will actually materialise (steps 14–16, Table 1). By doing so, cities could prepare for different futures.

It is important to note that while all five cities developed their scenarios independently, the main themes of the scenario axes were recurring. While one of the axes mostly explored relations between CO₂ levels, regulation, and new technologies, the other key axis focused on a societal dimension, such as consumer awareness, cooperation, individualism vs. collectivism etc. (Figure 4). This reflects the findings that broader research on urban foresight has realised; in the new generation of cities, the focus of development is changing from the infrastructure and technological aspects [32]. It is the interconnected ecosystems of citizens, businesses and the public sector that engages in social inclusion activities that play a key role [64].

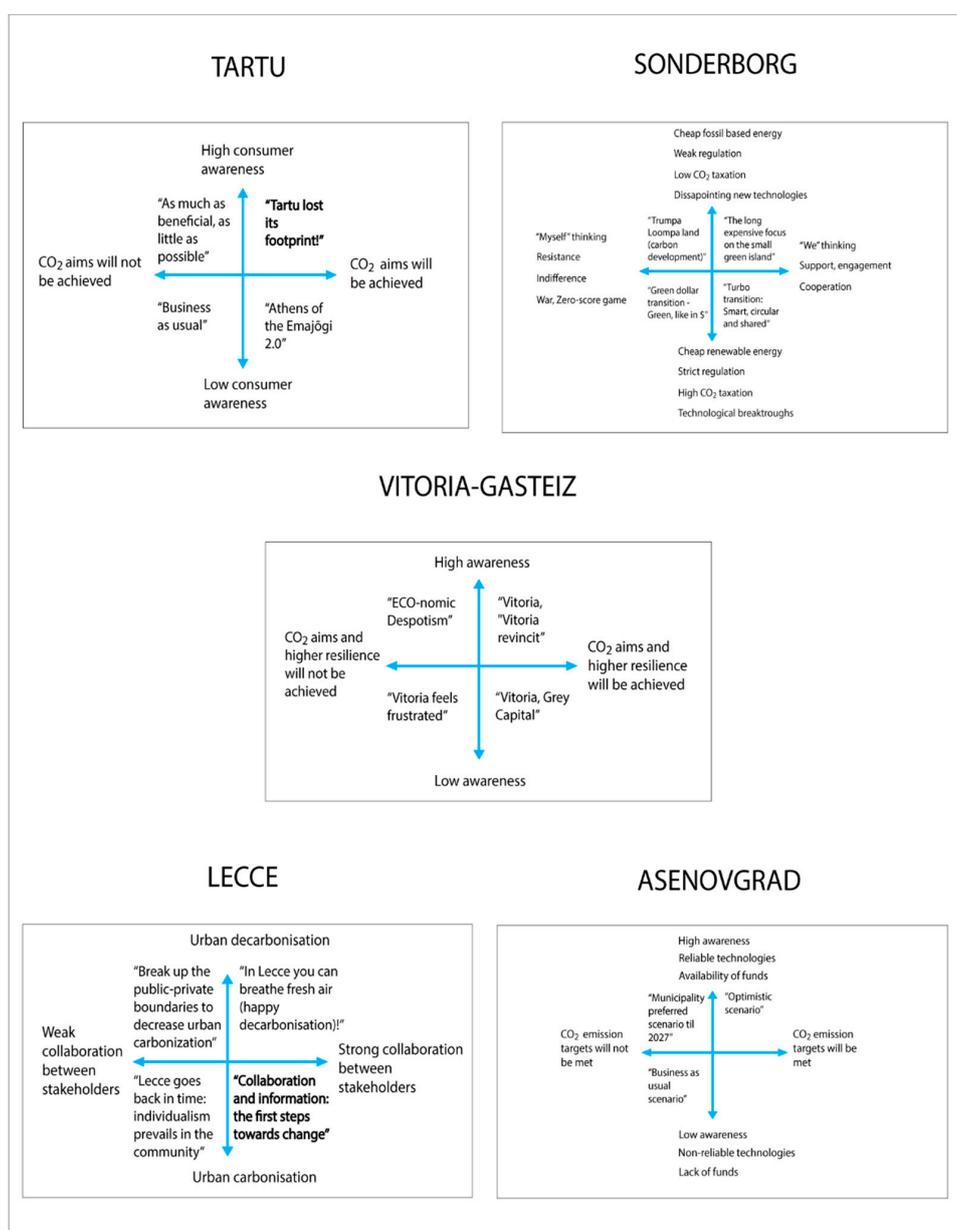


Figure 4. Cities4ZERO Foresight strategic aspects influencing the scenarios in the cities (authors; for details see [63]).

Reaching an integrated “master” or goal scenario is a valuable input for starting off the planning phase and working on questions such as what present-day decisions should a city/each stakeholder make to shape the outcome in the preferred direction, enhancing the desired future or taking actions to prevent non-desirable futures? What are the most important milestones (in each domain: energy, mobility, ICT, governance and citizen engagement)? The foresight method refers to elaboration of a master scenario as a vital part of the exercise (see Section 3.2).

In three cases, a favourable master scenario was chosen out of the rest. Thereafter, two cities also explicitly worked on a joint city vision statement which will reflect the master scenario and a joint long-term commitment to integrated energy transition actions. For example, one city developed four scenarios and consolidated those scenarios to provide input for their integrated energy planning process. So, while no master scenario was selected, the discussion helped to support the development of a long-term strategy to achieve their goals.

All piloting cities developed four different scenarios, representing the direction of future vision, and two cities also developed a shared vision statement. As an example: “In 2030, Tartu will be a green forerunner with a smart developing community and good energy.”

Foresight experience in cities showed that the main value of the scenario creation process lies in thinking through all development possibilities together, and agreeing on the direction which would be the most desirable, establishing a sturdy foundation to step into the next phase of integrated planning.

“The scenario-creation process helped us and partners identify strengths and weaknesses looking towards 2029, create and integrate the four different scenarios into the Roadmap-process. During the process, the scenarios were used to communicate potential shared pictures of our future city (2029) and they were also used for testing the 50+ enabler projects generated during the IEP/Roadmap process.”
(foresight participant 4, City A)

5.7. Strategies and Actions: Integration of Results Into Strategic Planning

One of the frequent disappointments with the foresight exercises is that the results are not used for actual policymaking. Therefore, in Cities4ZERO Foresight, follow-up steps are foreseen, focusing on the strategic planning which will transform the city vision into specific goals, such as the development of strategic axes and lines that will lead to a strategic plan, and connect the foresight exercise with a follow-up action plan (steps 17–18, Table 1).

Accordingly, scenario planning workshops will not be the end of the process and there are further steps that need to be followed to ensure successful strategic planning process. Cities would benefit from making sure that contact with the engaged stakeholders continues, preferably in further working groups who will start defining specific strategic and action lines along the identified future paths. There is a need for follow-up meetings and workshops with the wider stakeholder groups.

The respective activities were also undertaken in the piloting cities. One case study city had three more meetings with the stakeholder groups and several working group level meetings with a narrower set of experts. Another city engaged intensively in eight working groups during another half-year period after the foresight workshop. Three other cities are planning at least two larger and several expert working group meetings during the further strategic planning process.

Accordingly, the pilot exercises have confirmed that it is important to continue to co-create with key city stakeholders, making them aware and committed for an effective implementation.

“I would suggest other cities to integrate the foresight/scenario process in their IEP-process (meant integrated energy planning) and secure a broad participation of local and national stakeholders. Publish/communicate the outcome to all future participants as part of creating a common shared picture of the future.” (foresight participant 4, City A)

By the publication of this research, one city had already validated its energy transition roadmap with the city council [64–67], and four other cities were in the full strategic planning phase with the

confidence to get the integrated energy strategic and action plans adopted in their city council by the end of 2020.

The foresight experience and process in the piloting cities is summarised in Table 3.

Table 3. Foresight in case study cities.

	Tartu	Sonderborg	Vitoria-Gasteiz	Lecce	Asenovgrad
No of foresight workshops	2	1	2	1	1
Foresight process duration	Sept–Dec 2018	March–May 2018	Nov 2019–Feb 2020	Nov 2018–Sept 2019	May–September 2019
Steering group size	12 members from 4 different organisations	10 members from 4 different organisations	10 members from 5 different organisations	7 members from 2 different organisations	2 organisations involved
Most well represented stakeholder categories	Environment, mobility, government, economy, people, living, City council	Homeowners, housing companies, private rental homes, private transportation, companies, farmers, heavy transport, energy	Energy generation and removable, mobility, urban planning and residential sector, and governance, strong participation of city council	Energy, urban lighting, mobility, ICT and new technologies, natural resources, waste management, government, people	Local Industry, Asenovgrad and Kuklen Municipalities
Less represented stakeholders	Main biggest energy consumers from the private sector; university	City council	Citizens and local communities	Schools and educational establishments; neighbouring municipalities	Citizen representation organisations
Diagnosis (used methods)	Using SmartEnCity global trend survey results as an input; review of existing local strategic plans, creation of SWOT in each main energy domain	A review of the outcome of a similar process conducted in 2007; preparing inspirational talks for the workshop; preparing trend list for the workshop	New global smart city trend analysis based on literature review; SWOT in each main energy domain	SWOT in each main energy domain; new online survey about future trends among local stakeholders	SWOT in each main energy domain
No. of stakeholders involved	90 (combined 2 workshops)	40	40	40	10
External moderator used	Yes	Yes	Yes	No	No
Master scenario developed	Yes	No	Yes	Yes	No
Joint city vision defined within scenario development workshop	Yes	No	Yes	No	No
Process specifics	Scenarios could be edited by stakeholders in between workshops	SWOT developed during the workshop and for each scenario	SWOT and trends based, scenarios created and edited by stakeholders	Scenario axes defined before the workshop through an online survey about trends	Four main priority areas have been identified for the existing IUPRD

6. Discussion and Conclusions

The current research was motivated by the fact that there are too few comprehensive and interdisciplinary practical guides for foresight exercises that focus on energy transitions on the local level. Researchers generally hold a view that urban planning today is unwilling to engage directly with long-term plans [7] and only some very recent research has started to look at 'Energy Vision Strategies' for the EU Green New Deal involving similar methodologies to foresight [32]. Thus, there is considerable value in research that aims at understanding the key success factors and conditions that increase the use of replicable foresight exercises by fostering long-term system thinking, and the quality of strategic energy planning and its elements: economy, mobility, environment, people, living, governance [7]. The research focused on three key questions—on the use of the participatory foresight for fostering smart energy transition on a local level (RQ1), its benefits in the field of smart energy transition (RQ2), and on the key success factors for effective and efficient participatory foresight and replicability of the foresight framework developed (RQ3).

Regarding RQ1, a novel Cities4ZERO Foresight methodology and detailed guidelines were developed, focusing on the analytical depth, feasibility, participatory elements, and the integration of the results into the policy process. The framework builds on the existing research and best practices of foresight, while considering the capacities and expectations of the municipalities. When Cities4ZERO Foresight was developed, another aim was to create a process that is adaptable and replicable, which could benefit many municipalities in complex strategic and urban regeneration processes.

Five cities embarked on a foresight exercise according to the Cities4ZERO Foresight methodology to shape the priorities and integrated energy plans. As the foresight exercise focuses on describing a variety of potential futures with relevant stakeholders agreeing on a shared vision and shaping the outcomes in the preferred direction; the method was expected to provide valuable strategic input for these integrated energy plans. It was also anticipated that foresight will help to specify interventions in city level integrated energy action plans adopted by local councils. Based on the piloting in the five cities, it can be said that such an approach to foresight is feasible and can be used to foster policy responses to complicated socio-economic processes, such as energy transition.

Foresight brings considerable benefits into energy policy planning on municipal levels (RQ2). Implementation of the Cities4ZERO Foresight framework shows that foresight can be valuable and can make a substantial contribution to the urban planning processes. For example, the foresight process facilitates the collection of future intelligence, brings together relevant stakeholders, describes a variety of potential futures, works towards creating a consensus, builds common visions, mobilises joint actions, shapes the city's development path, makes present-day decisions towards the preferred outcome, creates a sense of ownership among the involved stakeholders, and provides input for actual strategies and initiatives.

The above benefits of foresight were evident in the five city cases, although evaluating some key benefits is still premature and the assessment is based on what the city energy planning task force representatives argued at the end of the process. Four cities out of five are still in the strategic planning phase, but one city has adopted their integrated energy plan in the city council and are implementing jointly developed actions along the path/scenario which was selected to guide the projects in the coming years. Cities4ZERO Foresight is applicable and practical guide which can help cities, their politicians, and planners use participatory methods to gain more intelligence and facilitate mutual trust and commitment towards securing long-term visions. The key benefit is the proper engagement of important stakeholders and sensing that they had built joint ownership towards the long-term energy plan, as well as stronger confidence in implementing strategies in the future.

Foresight has great potential to foster the further implementation of integrated energy action plans, as "target groups have generated this plan by themselves" (city steering group member) and "feel their work count" (steering group member). This benefit justifies why this rather complex and time-consuming exercise could be undertaken and made an integral part of each important strategy

development process in a city. This is even more true in the case of working towards low carbon goals which require a very different set of expertise on one hand and strong commitment on the other.

Several conclusions can be drawn regarding the key success factors (RQ3). First, the experience in five distinct cities showed that in almost all cases, foresight coordination was facilitated by local expert organisations, such as energy agencies or consulting companies involved in the process. This is quite characteristic in city planning processes [18,32,68]. However, our research confirms that it is of utmost importance to pay strong attention to “committing the client” (see Chapter Two), i.e., the city government, in order to ensure that developed carbon neutralisation recommendations would feed into policies. Even though coordination led from the city government level would have been ideally expected to a greater extent, city representatives’ involvement was sufficient. The piloting also confirms that the amount and interdisciplinary nature of knowledge needed for foresight co-ordination calls for well- and heterogeneously represented groups, ideally representing the whole ‘quadruple helix’ which may in turn act as one important success factor of the whole process.

Creating a participatory process is one of the benefits of foresight [68]. Cities4ZERO Foresight sees the participatory process as a key element in urban regeneration and agrees that successful visions need to be pluralistic in nature [7,13]. Meanwhile, because proper engagement and overcoming “silos” in naturally complicated planning processes are still considered as a considerable barrier in smart and integrated strategy development processes [69,70], the committed and representative steering group and stakeholders are crucial to that process. The importance of this was demonstrated in the foresight experiment in all five piloting cities.

Based on city experiences in this research, the key groups to involve in the foresight are city planners, politicians, businesses/industry, service providers, academia, and community representatives. The successful setting up of working groups in domains that are part of the energy planning process, as well as a strong commitment from the municipal level i.e., the “client”, are vital. As the foresight approach proposed in this article very much focuses on participation seeking, networking, common vision-building and a feeling of joint ownership over planned strategic lines and actions, stakeholder involvement is one of the most crucial phases to ensure the success of the whole foresight exercise. Much effort needs to be put into mapping the relevant stakeholders and bringing various players to the table, both in terms of organisation types (city government, companies, universities, umbrella organisations, citizen initiatives etc.) and other relevant areas for integrated energy transition (energy, transport, ICTs etc.).

The role of an outside facilitator or external expert to help to moderate public foresight workshops and steer the overall process cannot be underestimated. This research experience has proven the usefulness of involving external experts to moderate the events, especially in the case of public scenario development workshops. Hiring these professionals helps to mobilise stakeholders, increases the efficiency of groupwork and encourages participants to speak their mind, as was highlighted by those cities who used this option.

The piloting in the cities also confirmed the importance of putting sufficient emphasis on analysis before the local level scenario and vision development starts, as it makes the scenario development process easier and adds analytical depth. As argued through the practical exercise in five cities, foresight is not just dealing with stakeholders and carrying out foresight workshops, but it involves thorough preparation to set the status of the issue at hand—“understanding the present”. This starts from a joint international trend analysis and then applying this knowledge to analysing the current status in each city. This was the phase where the foresight methodology was adapted to the local context if it was deemed relevant and all cities agreed to its adoption. This phase was crucial for guaranteeing the success and smooth operation of the foresight workshop(s) with wider stakeholder engagement.

This piloting also showed that scenario-planning was a beneficial tool within foresight for cities. Scenario-planning helps to create future models of the city and its development by identifying the preferred vision of the future and what establishing what needs to be done in the present to achieve that vision. Here, not only quantitative approaches are important [7,8], but the qualitative value of

joint scenario development can be considered the core which builds understanding from the broad set of audiences and later enables further expert groups to work with more quantified methods to translate scenarios into potential actions.

Even though foresight methodologies do not prescribe the number of events or participants, this experiment shows that it will be beneficial to plan more than one scenario-planning workshop with the stakeholders. This will allow the stakeholders to get to know each other, building openness and trust in the local planning processes. One of the expected successful outcomes of the vision workshops was to reach an agreement on scenarios, which would help the city to make better planning decisions towards decarbonising their energy system. This can be done by helping participants to understand what they need to do, effectively communicate their plans to other planners and stakeholders, and facilitate better collaboration with other planners and stakeholders [70].

Ideally, cities were expected to jointly develop long-term vision statements beyond the decarbonisation target. Both models—having just one full day for the whole participatory scenario development exercise and having more workshops to complete the exercise step-by-step—were satisfactorily used in the case study cities. Despite the deviation from the recommendation, the partner cities were able to achieve the desired outcome, which ultimately is the strategic energy action plan for the city. Each city appeared to have accomplished the same outcome by combining the Cities4ZERO Foresight steps in a way that suited their needs.

What is also interesting is that the five cities independently created similar scenario matrices to guide their cities' future energy transition. Even though this research focuses on the foresight methodology and does not explore smart city trends, this case study proved that some trends seem to prevail more strongly than others, which in turn highlights that local governments, regardless of city level differences, have to deal with similar challenges while in energy transition. This justifies the need for common tools and methodologies which can help them in this process.

While there were minor differences regarding the implementation of the Cities4ZERO Foresight framework—due to integrating their plan with the local situation—it became clear that the framework can be replicated for any municipality. Comparing the results of cities, one can see that each city developed an integrated energy plan which was the intended outcome of the foresight method. Given that the goal of foresight is to develop a common vision, this can be considered a success, even though in some cases, this common vision was not put into a specific statement but rather emanated through agreements over scenarios. Furthermore, the methodological guidelines that were taken into consideration based on the foresight literature and previous research about its methodologies and tools were very useful tools for helping cities to navigate a complex and time-consuming process. All cities claimed that the methodology was thorough and very helpful—the “detailed step-by-step methodology was easy to follow” (steering group member)—and in analysing the processes in each city, only a few adjustments were made to the approach by different cities, which in the end did not play a significant role in the final outcome.

However, this research still has limits. The framework has been tested so far only in five cities. Even though the foresight as a method is not new, the way it is integrated and promoted within the Cities4ZERO Foresight framework is still too new to validate its definite impact on how cities can actually reach their energy and decarbonisation targets. Furthermore, even though the emphasis of this research was investigating the suitability, benefits, challenges, and city level attitudes on the foresight methodology, the process inevitably produced other interesting results which may require further research. For example, it was seen how the megatrend analysis equally helped all cities, but still several context factors modified those trends while working with specific SWOTs. By investigating how similar the scenario matrices were that stakeholders developed from very diverse local contexts, this poses intriguing new research topics which require continuous investigation on how these similar challenges can be tackled in different contexts.

Domains outside the focus of this report also open new possibilities for research. One interesting and recent trend that could potentially influence foresight is related to the unprecedented availability

of open and big data. Big and open linked data are often identified as a key driver of government innovation [71]. Foresight exercises could also take advantage of the developments in the fields of open and big data. For example, a data ecosystem is being used to enable the data-driven support of the heat transition in the Netherlands [72]. However, the processing of extremely large data sets that may be analysed computationally to reveal patterns, trends, and associations [73–75] faces considerable challenges and demands technical, legal and other competencies [76]. In general, still, the use of big data for public policy is at an early stage, with expectations far outstripping the current reality [77], and this is especially true for local level policymaking.

In conclusion, this study shows that Cities4ZERO Foresight as proposed to cities and adjusted to energy transition planning is a helpful and replicable tool for diverse municipalities in terms of their size, climatic, social and economic factors. The Cities4ZERO Foresight methodology to guide urban regeneration in a holistic way has great potential to help achieve the longed-for climate goals in cities and turn strategic visions into actual policy making.

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