Municipal Innovation and Sustainability Readiness: Results from a Study of Mediterranean Cities

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Climate change and urbanization will shape the Mediterranean region in the 21st century. It is becoming critical for regional cities to mainstream climate and sustainability goals into their strategies, to ensure sustainable urban development and climate readiness. The Smart City model is often suggested as a pathway to integrating sustainability and innovation within municipal systems to achieve sustainable development goals. This article presents insights from a survey of 34 Mediterranean cities, on the potential for mainstreaming sustainability in cities, mainly through smart sustainability and collaborations with innovation partners such as local SMEs and startups. The study presents the aptitude and readiness of the cities for sustainability and innovation and notes key barriers such as financial constraints and lack of innovative culture within the local government. The study also reveals differences in aptitude between large and small regional cities.
Keywords: Mediterranean, Mainstreaming, Sustainability, Climate Change, Smart Cities, Innovation, SMEs

INTRODUCTION

Climate change and urbanization are shaping the Mediterranean region in the 21st century. According to the 2015 IPCC report, (IPCC, 2015), the Mediterranean region is one of the world's hotspots for climate change. Between 1970 and 2010 Fabres, et al., 2012), urbanization around the Mediterranean increased from 54% to 66%. The south and east Mediterranean is actually urbanizing more rapidly than the rest of the world. It is becoming critical for regional cities to mainstream climate and sustainability goals into their strategies, to ensure sustainable urban development and climate readiness. This article presents insights from a survey of 34 Mediterranean cities, on the potential for mainstreaming sustainability in cities, mainly through innovative sustainability and climate initiatives. In the context of

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this article, sustainability refers broadly to both climate and environmental issues, in tune with the sustainable development goals of the UN (Nilsson et. al., 2016).

The paper is organized as follows: first, we present a synthesis of the current research and understanding of smart sustainable development policies in local government and the concept of mainstreaming. The second section relates to the unique characteristics of Mediterranean cities vis a vis climate and sustainability policies. We conclude the literature review with an analysis of the role of innovations and of small to medium businesses to mainstream sustainability within local policies. In the applied part of the paper, we present the study of Mediterranean cities, and conclude with key insights and recommendations.

Table 1: Measures for supporting innovation – ICLEI survey results.

Initiative	Does Not Exist	Exists	Exists & Engages with Climate Change
Thematic working groups on specific issues/ challenges composed of staff from a variety of local government divisions	27%	48%	32%
"10% Time" or "20% Time" policies that allow employees to pursue personal projects during a fixed percentage of their work paid time	93%	7%	0%
Speaker series to bring outside ideas into local government agencies	53%	35%	16%
Discretionary project funds earmarked to support staff initiatives and new ideas	75%	20%	9%
Rewards for innovation and risk taking include as elements within performance management and assessment structures	76%	21%	7%

Source: Aylett, 2014

In the past two decades, cities have become key players in the sustainable development and climate policy arenas. Estimates indicate that cities are currently responsible for about 75% of greenhouse gases (GHG) emissions and are at the forefront of climate impacts (UNEP, 2020). Yet, despite inspiring examples from leading global cities, such as New York, Copenhagen, Vancouver or London, research shows that action at the local level, in general, has not succeeded yet in significantly reducing GHG emissions, or substantially adapting urban systems to face the impacts of a changing climate (Bloomberg and Aggarwala, 2008; Rosenzweig et al., 2011; Aylett, 2014). A worldwide survey of 350 cities, members of ICLEI, examined how climate policies are mainstreamed within municipal policies (Aylett, 2014). Their findings indicate that in most of the cases surveyed, only environmental and planning agencies were cited as being actively engaged with adaptation planning. Concurrently, in

most cities, processes of local innovation, leveraging sustainability, are still limited. These results emphasize the need for a better understanding of the internal dynamics and needs of municipal mechanisms.

Nurturing innovation is not widely disseminated within municipal policy frameworks. As can be seen in Table 1 from the ICLEI survey (Aylett, 2014), most cities do not have integrated institutionalized mechanisms for innovation, and even when they do, these are not associated with sustainability or climate issues. Apparently, innovation is not perceived, nor implemented, as a leverage for sustainability or climate action.

In view of the growing impact of climate change, the impermeability of innovation, specifically environmental innovation, is concerning in relation to municipal policies, in general and in the Mediterranean region in particular.

SMART AND SUSTAINABLE CITY MODELS

The Smart City model is often suggested as a pathway to incorporating innovation within municipal systems, indeed, several of the leading frameworks, recognize the inherent synergy between innovation and sustainability. A core European model for a "smart city" framework, the European Smart Cities Model 3.0 (Vienna University of Technology, 2014), suggests the creation of an innovative urban ecosystem by identifying six dimensions of engagement and development - smart governance, smart economy, smart mobility, smart environment, smart people and smart living. This model is the result of the "Smart cities – Ranking of European medium-sized cities" report by the Centre of Regional Science at the Vienna University of Technology, (Giffinger et al., 2007). On the basis of this study, Caragliu et al. suggest that a city can be considered smart "when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance, (Caragliu et al., 2009). This "Smart City" concept leads to a new perception of innovation as a comprehensive environmental, social and economic ecosystem that does not rely on technological innovation alone.

The British Standards Organization presents a similar approach in the PAS 180 Smart Cities Vocabulary, distinguishing between *Enabling concepts* and *Applications*, as can be seen in Table 2.

To enable cities develop an ecosystem that nurtures sustainability and innovation, Zygiaris suggests a 7-layer framework model that demonstrates these interdependencies (Zygiaris, 2013). The base is the city itself, framed within municipal and statutory borders, the second layer is the green city layer – supplying resources, health and quality of the environment, followed by 4 layers of urban infrastructure and services; communication, data, integration and networks. Innovation is the

top layer of the model, reflecting the capacity of the city to support and integrate creativity, trust and collaboration. The model stipulates that successful smart city models, inherently, require successful mainstreaming of sustainability and sustainable urban development. Urban nature, accessible and sustainable natural resources and climate-neutrality are the basic requirements for residents' quality of life. The International Telecommunication Union (ITU) Focus Group on Smart Sustainable Cities (ITU, 2015; Anthopoulos, 2015) compiled a similar, multi-tier model. In the image below, the tiers are shown top to bottom with the natural environment as tier 1 and soft infrastructure (people, communities, data, software) as tier 4 (Figure 1).
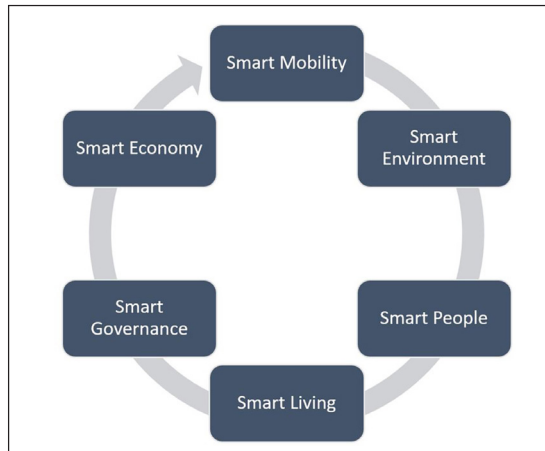

Figure 1: The European Smart Cities Model 3.0
Source: Adapted from Vienna University (2014)

Table 2: BSI, PAS 180 Smart Cities Vocabulary

Enabling Concepts – Input Channels	Applications – Output Channels
Smart city systems	Environment and Resource management processes
Public and private service delivery models	Finance and economy
Technology and infrastructure	Mobility
Governance	Community
	Education and skills
	Health and well-being

Source: BSI, PAS 180 Smart cities Vocabulary, https://www.bsigroup.com/en-GB/smart-cities/Smart-Cities-Standards-and-Publication/PAS-180-smart-cities-terminology/
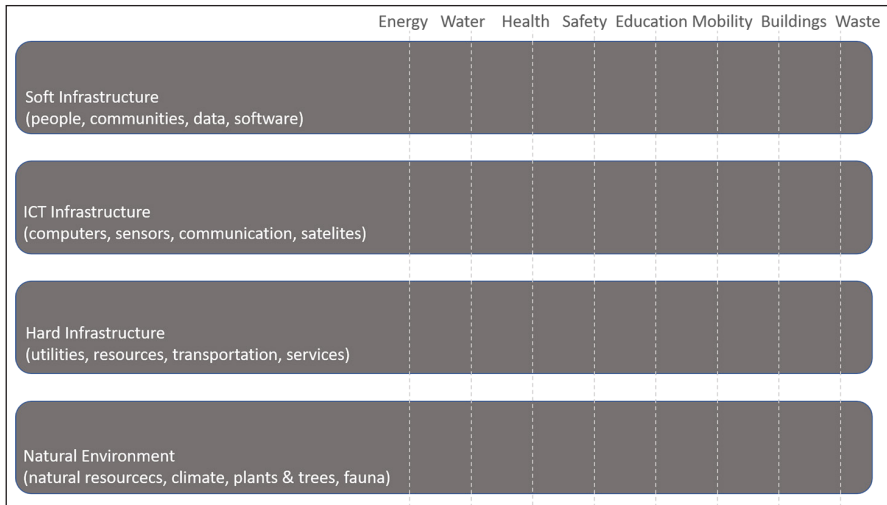
Figure 2: Multi-tier smart sustainable city ICT meta-architecture
Source: Adapted from Anthopoulos (2015)

All these models show that innovative urban policy depends on integrating environmental and technological components. A growing body of literature is indicating that SMEs (small and medium-sized enterprises) can be key players in integrating the two silos (Westman, et. al., 2021), and playing a central role in enhancing social justice, building community cohesion, and protecting ecosystems as an essential first step to create urban sustainability programs that advance transformative change. Beyond their valuable contribution to technological innovation, private businesses (both corporations and SMEs) have an important role in both addressing socio-environmental issues and in facilitating a green economy (Schaper, 2010). Despite their smaller size (in the EU, an SME is defined as a company with less than 250 employees and either a turnover of up to €50 million or a balance sheet total of up to €43 million), SMEs have a major role in urban economy and development. A recent EU study of SMEs in public collaborations found that SMEs won 86% of contracts valued below the EU threshold and 65% of contracts valued above the EU threshold (either directly or via indirect participation) (European Commission, 2019).

Public-private collaboration accelerates transformative sustainability solutions (Wamsler et al., 2013) and sustainability-oriented small businesses and start-ups impact policy-making processes at the urban level (Westman et al., 2021). Collaborations with SMEs can clearly affect the scope of urban sustainability, as long as the local policies enable and encourage such activities. Westman concludes that rethinking the role of SMEs in enhancing social justice, building community cohesion, and protecting ecosystems may be an essential first step to create urban sustainability programs that advance transformative change (Westman et al., 2021).

The current study adds important insights on the barriers and opportunities to expand local policies so they are able to deliver sustainability and climate objectives and support cross sector collaboration.

MAINSTREAMING SUSTAINABILITY THROUGH INNOVATION

The ability to realize climate and sustainability objectives depends on whether sustainability is mainstreamed as a primary policy driver (Martin, et al., 2018). Within climate and sustainable development policies, mainstreaming has been widely acknowledged as a key element for success. According to Oxford Dictionary, mainstream is "the ideas, attitudes, or activities that are shared by most people and regarded as normal or conventional". Mainstreaming sustainable development in businesses, national or local government, can be understood as having sustainability fully embedded in urban culture, processes and activities (Bucero, 2020).

Mainstreaming environmental principles is the basis on which technological and economic development can prosper. Cities seeking smart and innovative strategic frameworks need to have a sound, sustainable environmental foundation that will support both the technological layers and the health and well-being of residents and incorporate technology as a catalyst for change (Ahvenniemi, et al., 2017).

One barrier to mainstreaming sustainability is the need to introduce new ideas and technologies into established decision-making systems, dependent on local characteristics, culture and politics. Desdemoustier and his colleagues, studied adoption of Smart City applications to advance sustainable development, among 115 Belgian municipalities (Desdemoustier, et. al., 2019). The Belgian typology comprises four understandings:

Non-existent – municipalities which have not developed a clear understanding of the Smart City Model.

Technological – municipalities with a strong technological approach. A smart city is a way to implement new technologies, especially using ICT solutions.

Societal – municipalities who already transcend the technological character of the smart city phenomenon to emphasize human-centricity, sustainability and/or on governance.

Comprehensive – for municipalities developing this understanding, smart cities are a combination of concepts related to the use of technology, sustainable development, governance, creativity, and human and social capital.

The studied sample represent Belgian municipalities, in term of size (small, medium, large), and degree of urbanization (urban, rural). Results indicate that municipalities without any understanding of the smart city model or with a limited technical understanding are mostly located in small and rural municipalities. These municipalities largely reject the concept of the smart city for all purposes. On the other hand, medium and large sized municipalities mostly develop a comprehensive

understanding of the concept, including aspects of sustainability and governance. The results of this study show a dichotomy of understanding and acceptance of the smart city model between rural and urban municipalities, central and peripheral. These findings are further collaborated by Leka and Nicolaides' (2017) study of small and medium size Mediterranean cities. The study reveals that these cities are somehow marginalized during their "going smart" journey and their developmental momentum remains, largely, unexploited. Further, when analyzing smart city adoption in the Mediterranean region, it is essential to note that cities in central and northern Europe and cities in the south and east-Mediterranean regions face different needs and challenges. Consequently, it is clearly valuable to identify the unique aspects of the Mediterranean region (Monzon, 2015).

SMART AND SUSTAINABLE CITY FRAMEWORKS IN THE MEDITERRANEAN

In 2018, Reckien (Reckien et al., 2018) surveyed 885 cities across Europe. Their analysis shows that most cities have some sort of climate plan. It is interesting to note that cities which have climate targets instated in their policies usually have combined strategic climate plans. However, out of the 885 cities, only 88 are Mediterranean cities, and most of their plans are predominantly in the mitigation category, focused mostly on energy planning. The relatively limited mainstreaming in Mediterranean cities is also apparent in the Sustainable Cities Index of Arcadis (Arcadis Sustainable Cities Mobility Index , 2017), where only six Mediterranean cities are listed out of 32 European and 100 global cities, none in the first two deciles and only two in the third decile. Other rankings, both for smart cities and sustainable cities (IMD, 2020), also reveal sparse placement of Mediterranean cities.

On the one hand, leading cities in the region are incorporating smart city frameworks as central development drivers. Barcelona is undoubtedly the epitome smart city, home of the Smart Cities Expo World Congress, followed by cities such as Tel Aviv Yafo, Turin, Marseilles and Santander, cities that are in effect upgrading and improving their management tools, infrastructure and services. The 'smart city' concept is an appealing call for action – replacing established structures and technologies that are no longer sufficient, with new ones, cutting costs using new tools and initiating sustainability-oriented projects. This call for action and innovation is reflected in persuasive case studies, success stories and awards to leading cities, but is this call spreading across all cities?

Indeed, while some municipalities are highly proactive in pursuing "smart cities" practices, others are still watching. A comparison of several Mediterranean cities' smart city efforts reveals significant variance of needs between cities (Stratigea and Panagiotopoulou, 2015). Smaller, less global cities in the region, exhibit categorically different aptitudes and readiness for 'smart' efforts affected by unfavorable eco-

nomic circumstances, lack of knowledge and skills in ICTs and their applications, lack of technical expertise etc. Apparently, the Smart City model, as a driver for innovation, fits the needs of the 'smart' ecosystem better than the needs of the municipal ecosystem.

Apparently, there is substantial disparity in the dissemination and adoption of smart city strategies to attain sustainable development goals. Several studies of European and Mediterranean cities, including the current study, demonstrate these phenomena, exhibiting significant variations in terms of municipal maturity, resilience, technological maturity and infrastructures, size and geographic and demographic contexts (Butler, & Hackney, 2015, Stratigea et al., 2017).

THE STUDY

The study of sustainability mainstreaming and innovation readiness in 34 Mediterranean cities is part of the SME4SMARTCITIES research project, an initiative of ENI CBC MED, led by a consortium of six organizations from across the Mediterranean. As presented above, the aptitude and readiness of policy makers is a key determinant to mainstreaming policy. The current study explores the perceived readiness and aptitude of Mediterranean cities, in terms of barriers and practices, to embracing innovation as means of mainstreaming sustainability.

Two key axes delineate the study:
- *Readiness* - The extent cities feel ready for urban and environmental innovation.
- *Barriers* - The challenges encountered in applying urban and environmental innovation.

The main research questions investigated were what are the barriers and opportunities perceived by city officials for adopting sustainable and smart city solutions, and how do these understandings influence collaborations with local and regional SMEs.

Study Methods and Data Collection

The survey used a mixture of open-ended and closed questions to explore the aptitude and readiness of policy makers of Mediterranean cities, to embracing innovation as means of mainstreaming sustainability. Interviews were conducted, mostly online, during 2020, using mixed-mode questionnaire with both Likert-type questions and open text questions. The participants were municipal managers responsible for innovation integration or environmental and climate issues, from 34 cities in the Mediterranean region, from El Puerto de Santa Maria in southern Spain to Eilat in southern Israel. The cities were recruited through a convenience sample, comprising of the project partners and their associate cities: Spain, Italy, Israel and the Palestinian Authority. The participating cities were grouped in two categories; large cities with over 100,000 inhabitants and small to medium sized cities with less

than 100,000 inhabitants. The following table presents the participating cities according to country and size:

Table 3: Distribution of study respondents by country and size of city

Countries	Cities over 100K	Cities 20K-100K	Total
Spain	6	3	9
Italy	4	7	11
Israel	5	4	9
Palestinian Authority	2	3	5
Total	17	17	34

Survey responses were coded and the particulars of the respondent were removed for confidentiality purposes. Statistical analysis was performed on the quantitative data; qualitative responses were analyzed by content analysis.

KEY FINDINGS

Readiness

This section presents findings on the extent to which cities feel ready to adopt and implement environmental and climate innovation pathways.

Environment, sustainability and innovation readiness

The first part of the interview pertained to the prevalence of environmental practices within the municipalities. As can be seen in Table 4, 54% of participating city officials indicated they are successful in implementing sustainability solutions and 58% indicated that they have good collaboration with local businesses. However, when they were asked about specific practices, innovative in essence, they ranked them lower. Apparently, sustainability may be well-established in more traditional practices and less through innovation and smart options.

Table 4: Estimation of implementation of innovation and sustainability: Likert type scale 1-5

Innovation / Sustainability channel	Median	Average ± SD
Implementing sustainability solutions	4	3.55±0.71
Collaboration with local businesses	4	3.69±1.12
Green Urban Innovation	3	3.24±0.76
Smart city practices	3	3.32±1.07
Green Procurement	3	2.92±0.81
CleanTech	3	2.86±1.09
Circular Economy	3	2.78±1.09

Environmental issues and applied solutions

Participants were asked to indicate both the environmental issues that *needed* to be addressed and the ones that *were being* addressed. As can be seen in Figure 2, there is a clear distinction between the issues indicated in the two cases.

The issues noted in both cases, are predominantly similar - sustainable mobility, urban nature, waste management, air quality and energy. However, there is a distinct difference between the pertinence of the issues in the two cases. On the one hand, participants indicated a broad list of problem areas in relation to issues that need to be addressed, while, on the other hand, the majority of solutions actually implemented, were in *sustainable energy*, ranked no. 5 on the list of issues, and no. 1, with a significant gap over other areas, on the solution list. Sustainable energy is obviously the most lucrative area for municipalities, probably due to financial backing from the EU and high business interest. Conversely, sustainable mobility and innovation development, revealed an opposed trend; sustainable mobility ranked no. 1 on the list of issues, and at the end of the list, on solutions, innovation development was ranked no. 2 on the list of issues, and at the end of the list, on solutions. It should be noted, that most climate adaptation issues, also exhibited comparable trends (adaptation to climate change, water management, air quality), interestingly, the same disparity between issues and solutions was also associated with citizen engagement.
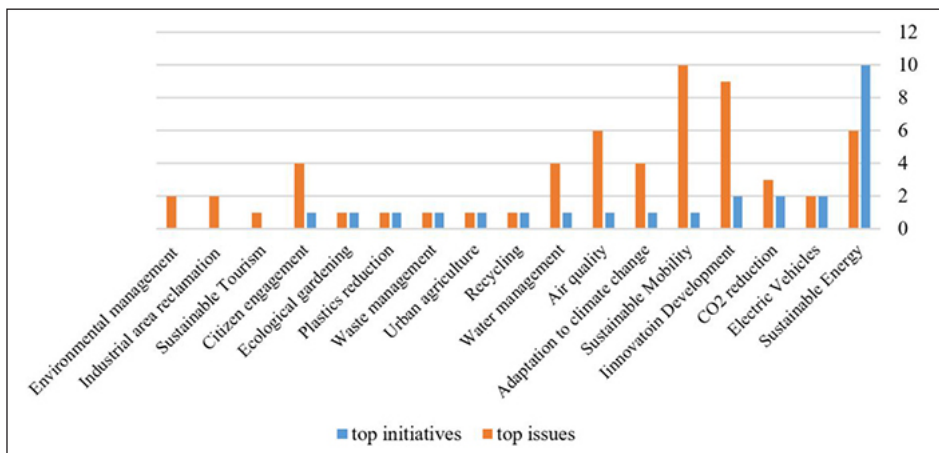

Figure 3: Top areas of environmental initiatives

Key factors for successful smart innovation in cities

Respondents were asked to note key factors that are required for smart innovation to succeed in their city, in a free text interview (Figure 4). 26% of participating city officials articulated that finding economic resources and funding is a crucial key factor and 24% indicated that the leadership of the city mayor and CEO is a crucial

key factor. Although, economic factors were identified as the leading determinants for success, all other factors relate to governance and to the specific norms and culture of the municipality, including the need to develop better understanding and capacity of the new ecosystems, indicating – a knowledge and understanding barrier between "Tech" language and "administrative" language.

In order to embrace innovation and sustainable development practices, leadership of the city mayor and CEO are dominant and essential, twined with clear strategic vision and plans. Cooperation is also a distinct key factor, both within the municipality and with external agents through the establishment of public/private contact networks; with SMEs, local stakeholders, research institutions and the municipal teams.
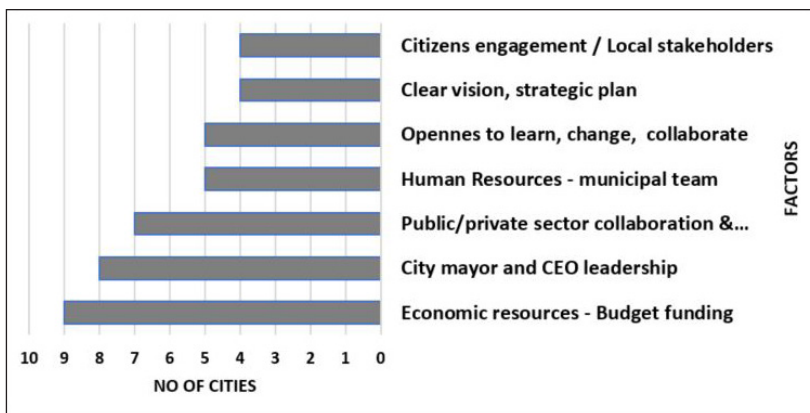

Figure 4: Key factors to the successful embracing of innovation in municipalities

Respondents indicated an array of crucial key factors. One city official explained that four elements need to be fulfilled together to enable innovation in the city: 1. *Leadership*: "a clear vision of the innovation and putting the right people in the right place to execute this vision"; 2. *Citizens' participation*: "without the support of the people, and without the emphasis on their awareness of the importance of smart innovation we cannot progress"; 3. *Involvement of the private sector*: "This can help provide capital and support the financial needs of innovation, in addition to sharing experiences those companies have that might not exist within the public sector"; 4. *Sustainability and continuation*: "Smart cities and smart innovation should become a priority for governmental organizations. This will guarantee the continuation and the sustainability of projects especially when they save resources and support the economy". Another respondent outlined similar criteria but rephrased them differently: "applying information and communication technologies, improving the quality of life of citizens, increasing the competitiveness of its industrial fabric and guaranteeing environmental sustainability. These objectives require fostering a change in

the management model". The need for integrative, holistic approach was articulated further: "greater technical, political and social coordination, strategically planning with an integrated approach beyond the departmentalization of municipal services, involving the social and economic fabric throughout the process, always keeping people and quality of life as a priority axis."

Barriers

This section presents findings on the challenges encountered in adopting smart initiatives by municipalities and in applying environmental innovation in their cities (Figure 5).

Figure 5: Top barriers to advance smart initiatives

Barriers to Innovation for climate and sustainability

Participating city officials were asked to note barriers to adopting innovative practices and technologies for climate and sustainability challenges. The principal barrier, as can be seen in the graph above, is financial resources and economic considerations, followed by the administrative aspects, such as bureaucracy, administration processes and organizational culture.

> "There is an ongoing lack of availability of investment in innovation projects."
> "Increasing economic and financial constraints also due to the COVID emer gency period."

Technological know-how was indicated as another barrier. Officials explained that they experience deficiency in communication and understanding when evaluating innovative solutions in comparison to traditional processes. City officials find it challenging to be up-to-date with rapid technological innovation and to be proficient with tech language, and they find that SME managers find it hard to be proficient with the public administration language and administration processes such as tenders and forms, creating a barrier on both sides:

"Municipality's management is currently a barrier to sustainable develop-
ment, since they are not knowledgeable in the field".

"Knowledge gaps - companies do not know who to turn to, city professionals
do not necessarily know the appropriate technologies."

Legislation and national policies were a barrier for some cities in Israel and the
Palestinian Authority but not for EU cities.

Innovation for climate and sustainability

Respondents were asked to indicate barriers to working with innovation stake-
holders and SMEs in the fields of sustainability and climate change (Figure 6). Most
of the respondents - 62% of city officials - reported 'no barriers' to working with
innovative SMEs. The barrier that were noted, relate mostly to technical barriers
due largely to legislation and ethics (such as complex tender processes and anti-
corruption laws), financial resources, and bureaucratic processes:

"No barriers to working with SMEs and startups, the municipality is open to
all suggestions."

"We always try to collaborate with them. We try to identify companies with
good references and try to facilitate and encourage synergies between com-
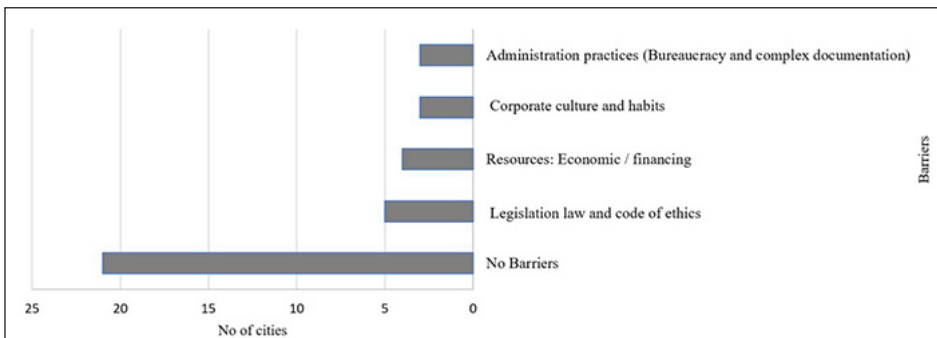panies."

Figure 6: Barriers to working with SME and Start-ups

Differences between large and medium size cities

Though these results are of a sample of only 34 cities, they indicate clear differ-
ences between large and smaller to medium cities of the region. Tables 5-6 compare
the ranking of main barriers to implementation of innovative sustainability solu-
tions, of the two groups of cities.

Table 5: Differences between large and medium size cities – Likert type scale 1-5

Topic	Cities < 100K residents		Cities > 100K residents	
	Median	Average ± SD	Median	Average ± SD
Barriers to innovation				
Coordination between departments	4	3.21±1.21	3	3.00±1.36
Citizen behavior/engagement	3	2.63±1.01	2	2.35±1.13
National law	4	3.68±1.07	3.5	3.05±1.07
Implementation of innovation				
Implementation of sustainability initiatives	3	3.40±0.63	4	3.70±0.75
Implementation of smart city practices	3	2.95±1.03	4	3.65±0.95

Interestingly, in smaller cities (less than 100,000 population), the coordination between departments, citizen behavior/engagement and national law were considered to be slightly larger barriers than in larger cities (above 100,000). Small to medium Mediterranean cities experience a higher level of difficulty, lower levels of confidence and readiness and lower level of internal collaboration, than larger cities. These finding support the dichotomy described by Stratigea (Stratigea et al., 2017)

Smaller cities also reported less engagement and success in the implementation of sustainability initiatives compared to larger cities. This was analyzed by using a t-test on the two samples, presented in the table below, showing that on Clean Tech implementation, and on defining the city as a good example for both Clean-Tech solutions and Sustainable Innovation solutions, the means of the large cities are significantly larger than the small cities, as follows:

Table 6: Differences between large and medium size cities – Likert type scale 1-5

	Large Cities		Small Cities	
	Mean	SD	Mean	SD
City implements Clean-Tech solutions*	3.28	1.02	2.54	1.05
City is a good example for Clean-Tech solutions*	3.18	0.88	2.38	1.12
City is a good example for sustainable urban innovation*	3.60	0.99	2.85	0.70

Note: Significance was tested using independent sample t-test; *$p < 0.05$

DISCUSSION

Today, Mediterranean cities are lagging behind North European cities in addressing climate change challenges and mainstreaming sustainability. There are certainly differences both in economic abilities and in needs, between the two regions. The emerging convergence of sustainability and innovation may offer a stronger incentive for Mediterranean cities to promote expansive environmental practices. The preliminary study of 34 cities set out to identify the readiness of municipalities to incorporate innovation as a driver for sustainability and climate policy.

There was much interest in adopting innovative solutions, but less experience, with only one fifth of the participating authorities indicated they were already working to develop innovative and large-scale environmental initiatives. These were predominantly the larger municipalities. The smaller cities tend to veer more towards the challenges and barriers that hinder such initiatives.

Readiness to Embrace Innovation and Green Solutions

In general, the participating cities, large and small, indicated a positive attitude to incorporating innovation as a leverage to sustainability. They seem to be familiar with both sustainability and climate challenges and the concept of innovation ecosystems. Large cities have more experience in incorporating innovative projects in these areas, especially relating to sustainable energy. The study revealed an interesting discrepancy between issues that need to be addressed and issues that are being addressed. Opportunities for sustainable energy are prevalent and already lucrative, whereas, the hard-core environmental areas, such as nature and waste, are not as attractive. This disparity can create opportunities for both municipalities and innovative SMEs to work together in developing appropriate solutions. The participants noted economic and governance issues that can hinder collaboration but overall, they demonstrated an interest in innovative and sustainable initiatives to address these needs, indicating only few barriers for collaborations with external sources.

Overall, we found that the concerns for mainstreaming innovative sustainability are about capacity rather than technology. Cities have difficulty in creating an innovation-oriented climate because of limited resources, knowledge and communication issues and because of the effort required to drive change. However, the COVID-19 crisis has shown how quickly local authorities can re-organize, adapt and respond in a most impressive way. When in crisis, barriers fall.

In addition to the initiatives of leading innovative Mediterranean cities such as Barcelona, Genoa, or Tel Aviv-Yafo, other participant cities show desire to embrace innovation and use it for their benefit. Large cities are more open to risk taking, show slightly better communications and collaboration between departments and slightly better citizen engagement than smaller cities. Still, small cities show initiatives and readiness to participate in national and regional programs.

A Path to Resolve Challenges and Barriers

When asked to pinpoint major challenges and barriers, participants noted issues with enablers - factors that cut across all activities, rather than any specific application areas (such as electricity, air quality or waste). Funding for innovative projects emerged as a significant barrier for innovative environmental and climate initiatives. This was collaborated by the dominance of sustainable energy enterprises that come with substantial funding opportunities, contrary to other issues, such as mobility and climate that are perceived as more pertinent, are less addressed and resolved.

Governance emerges as the next area for attention, both as an obstacle but also as the pathway to resolution. Bureaucracy and to a smaller extent issues of legislative barriers, vision and strategy, municipal work culture and technological infrastructure, were all noted as barriers. Emphasizing communication, collaboration and learning, fueled by political will and a mental climate for green innovation, led by the mayor and CEO and assisted by an integrated professional municipal team that work in open collaboration across the municipality, reveals a road to resolve the challenges.

Sharing up-to-date knowledge, skills and nurturing a sense of ability, can be acted on with relative ease since enough experience and knowledge has been gained, and there is a wealth of case studies, solutions, initiatives and networks for cities to engage in. Cities can learn by direct experience and by the experience of other cities. These are catalysts for overcoming the barriers. We already seem to have entered the second wave of municipal innovation adoption. The pioneers have already shown the value. Now is the turn of more cities to reap the benefits. If there is the political will and understanding that every authority has great human, social, economic and environmental potential, the way is paved for innovative and environmental solutions that will yield great benefit.

Discourse and collaboration between cities, especially between stronger, experienced innovative cities and less experienced cities, holds potential for varied Mediterranean cities. Clusters or regional models offer a suitable platform for engagement. Similarly, collaboration between solution providers to create clusters of innovative, sustainable solutions can make it easier for cities to find and implement solutions. Instead of competing and creating a sense of overwhelming confusion, they can cooperate through integrated solutions.

The study results indicate that there is a positive aptitude for incorporating sustainable innovation by cities across the Mediterranean, more so in larger cities than smaller ones. Although there are already municipalities with successful initiatives, even they concede that challenges, barriers and gaps remain. None of the study participants indicated they have no need for innovation or for a green environment. Many did express the lack of up-to-date knowledge and barriers to collaboration with entities outside the municipality. If cities and SMEs work together to resolve the major challenges, they may enjoy a beneficial breakthrough in areas such as mobility, nurturing urban nature, and addressing climate change.

Funding issues certainly came up as a prominent barrier to sustainable innovation; this aspect may be linked to limited understanding of the new and emerging sustainable innovation ecosystem. As noted, numerous cities in the region have already bridged the innovation gap and are benefiting from new economic opportunities. As an example, cities in the region are working vigorously towards zero energy dependency by increasing energy use efficiency and establishing sustainable electricity generation systems in their territory. The city of Malaga has implemented energy management systems in public service buildings, in single-family homes in social buildings and in city facilities such as public lighting and irrigation facilities. Malaga has also established photovoltaic energy installations. The city reports savings of 16% for street lighting and savings of 40% in electricity consumption of public buildings and traffic lights (Malaga Smart). An annual saving of 1.5 million euros in the electricity consumption of public lighting was achieved in 2015. Kfar Sava in central Israel is setting up dozens of solar systems on the roofs of public facilities (Image 1), along with public engagement and communication, to generate revenue and to become an energy self-sufficient city.

Image 1: Innovative use of sports ground for the production of solar-based electricity, providing a win-win solution with revenue for the municipality in Kfar Sava, Israel. Source: City of Kfar Sava

SUMMARY RECOMMENDATIONS

Readiness to embrace innovative and green solutions:
- Municipalities are open to innovative sustainable initiatives to economic, social and environmental issues

- Barriers in across the board, issues: financing, knowledge, work processes, communication
- Large gap between needs and execution in all application fields, except for breakthrough in sustainable self-sufficient energy
- Larger cities have better internal collaboration, citizen engagement and are more open to risk taking
- Openness for working with SMEs, gaps of knowledge, admin processes, resources
- Constraints for mainstreaming innovative sustainability are about capacity rather than technology

A Path to Resolve Challenges and Barriers:
- Communication, collaboration and learning are key
- Fueled by political will and a mental climate for green innovation, led by the mayor and CEO
- Assisted by an integrated professional municipal team in open collaboration across the municipality
- Creating clusters of collaboration - regional clusters, large and small cities, diverse SMEs creating solutions together
- Crucial role for knowledge management - horizontal coordination, sharing knowledge, skills, learning from experience, nurturing a sense of ability
- Solve funding barriers by revenue generating solutions, nurturing local economy, collaboration in city clusters

NOTES

1. Smart Cities Expo World Congress in Barcelona, http://www.smartcityexpo.com/
2. http://www.enicbcmed.eu/projects/sme4smartcities
3. http://www.enicbcmed.eu/
4. The interviewing process was stretched over nine month due to COVID19 restrictions
5. Malaga Smart - Energy (malaga.eu)

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