

GrowSmarter

Transforming cities for a smart, sustainable Europe

ROAD TO REPLICATION – GUIDING CITIES ON SMART URBAN DEVELOPMENT

PROCESS AND LESSONS LEARNED IN GROWSMARTER



Deliverable: 7.4 Concluding Report of Follower Cities

Prepared by: ICLEI Europe

Date: 18 December 2019

Version: 3.5



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 646456. The sole responsibility for the content of this report lies with the author and in no way reflects the views of the European Union.

Authors: Alis Daniela Torres, Carsten Rothballer, ICLEI Europe. Replication Leads of GrowSmarter

Contributors: Victor Battistino (Valletta), Colette Cronin (Cork); Dan Dura (Suceava), Christian Nussmueller (Graz), Paulo Calcada (Porto)

With thanks to all participants of GrowSmarter, past and present, who contributed to the implementation of the replication activities. Especial thanks to Follower Cities: Graz, Cork, Porto, Suceava and Valletta for their contributions and dedicated work along the five-year replication process.

Email: alis-daniela.torres@iclei.org; carsten.rothballer@iclei.org;

EXECUTIVE SUMMARY

This report compiles the key results and most important reflections, recommendations and conclusions on the replication process within the lighthouse demonstration project GrowSmarter. It summarises the experience of the five Follower Cities (FCs) of Cork (Ireland), Graz (Austria), Porto (Portugal), Suceava (Romania) and Valletta (Malta) in their five-year journey to replicate the twelve groups of smart solutions developed by the Lighthouse Cities (LCs): Stockholm (Sweden), Cologne (Germany) and Barcelona (Spain). Building on this experience, the report serves as guide to provide overall insights for future replication and scalability of smart solutions, in alignment with the objectives of sustainable urban development of local governments in Europe and beyond.

The initial part of this report highlights the key results of the replication process carried out by the FCs, with emphasis on their smart solutions planning efforts towards the reduction of energy consumption and greenhouse gas emissions, while increasing the uptake of renewable energy. The replication process adopted in GrowSmarter followed the Integrated Management Cycle and included the development of a baseline assessment and the definition of a replication or implementation plan in each of the FCs. A tailored capacity building programme accompanied by process to support and exchange experiences with LCs phase- and measure-specific in depth. This resulted in the successful replication of eleven out of the twelve groups of solutions demonstrated by the LCs. FCs have already fully or partially implemented the different solutions or planned their concrete realisation in detail.

This experience has resulted in a set of key lessons learned by FCs shared in this report. Among them we can highlight that solutions related to integrated infrastructures and low energy districts have been more challenging to replicate in comparison to the ones on smart mobility. This has occurred mainly because energy retrofitting and smart buildings interventions, for example, are often subject of regulatory requirements and demand the engagement of citizens and building owners more intensively for a successful adoption. FCs

that replicate these measures, have successfully involved stakeholders (i.e. neighbour's associations, building owners, etc.) in early stages of the measure's design and linked the development of their actions to existing and planned energy retrofitting efforts. The replication of smart mobility solutions was often triggered by available finance, but also because cities have aligned their strategies to national as well as local goals, including low carbon and electric mobility objectives.

The replication process also showed that even after five years of interaction and knowledge exchange, Follower Cities still faced the challenge to identify or create a sustainable, local business model for some smart solutions. The role of the industry partners and the need for assessment methods to effectively analyse the co-benefits of the interventions, have restricted in some extent the effectiveness of the business models that could facilitate replication.

The second part of this report is conceived as guiding material for stakeholders interested in replicating different smart measures in the future. It provides insights about the importance of integrating Smart City strategies into the core of sustainable energy and climate action planning processes as well as sustainable urban developments. Some of the key aspects that could facilitate replication further include the definition of diverse and cross-sector governance structures that ensure smart technologies to serve as enablers for sustainable urban transformation. It is also important for cities to evaluate the replication potential of smart measures in their urban context, following systematic approaches and management cycles, which mainstream smart and sustainable action. Finally, other key aspects identified as critical for a successful replication include amongst others the involvement of stakeholders in early stages of planning, the development of internal capacity building processes, the adoption of innovative ways to initiate projects, and the transparent communication to citizens about the goals and measures implemented.

This report concludes with a set of recommendations for decision-makers in local and regional governments to accelerate the adoption, replication and upscaling of smart city measures in their territories. The replication process has been challenging for Follower Cities and partners alike due to the variety and diversity of GrowSmarter measures. Internal and external variables have influenced the replication process. Political, technical, financial and social challenges had to be overcome during the assessment and planning phase of implementation. Nevertheless, Follower Cities were able to realise the majority of the measures they initially selected to follow and replicate. Primarily based on their work, but also reflecting other actors within the broader process of replication activities, the following conclusions and recommendations could be identified that shall support the further replicability and upscaling of smart solutions within Europe and beyond.

Recommendations to local governments

- Achieve scale by being socially and environmentally more comprehensive and ambitious
- Govern smart developments effectively through the Integrated Management Cycle
- Achieve meaningful replication by building on existing city targets, processes and plans
- Embed smart measures into the core of urban planning
- Ensure new staff capacity and a cross-departmental approach
- Create an open alliance for Smart City applications
- Align and ally with national and regional energy and climate policies
- Make technical validations comparable to enable impact investments
- Find synergies with other SCC projects to implement more resource efficiently
- Develop location-specific innovation schemes
- Determine scalability based on experience of demonstration projects
- Budget public participation and stakeholder engagement in your implementation plan
- Allocate resources to mobilise public and private finance as well as create and maintain partnerships

Recommendations for national and European authorities

- Shape Smart City programmes to deliver on local sustainability and the European vision
- Support more demonstration projects as they prove to cause big changes
- Seek regular dialogues with demonstration cities to adapt framework conditions for scaling smart urban development
- Renew regulatory frameworks to reduce transaction costs for implementing smart solutions
- Recognise, incorporate and empower local policies and ambitions

Recommendations to industry and business partners

- Develop citizen-centred solutions
- Partner strategically with local businesses and entrepreneurs for local development
- Strengthen transferability of climate impact assessments of smart solutions
- Seek dialogues with cities to speak the same language and listen to their needs

CONTENTS

ROAD TO REPLICATION – GUIDING CITIES ON SMART URBAN DEVELOPMENT	1
EXECUTIVE SUMMARY	3
1. INTRODUCTION.....	8
2. GROWSMARTER REPLICATION PROCESS AND KEY RESULTS.....	10
2.1. Key results of the replication process.....	13
2.2. Learning based on experience: From assessment to implementation.....	16
2.2.1. Phase 1 – Preparation of the implementation framework.....	17
2.2.2. Phase 2 – Project inception, planning, performance and finance	23
2.2.3. Phase 3 – Political approval and stakeholder engagement.....	28
2.2.4. Phase 4 – Project implementation	31
2.2.5. Phase 5 – Monitoring and progress evaluation	34
2.3. Key challenges and mitigation action during replication process	36
3. GUIDANCE FOR REPLICATING SMART SOLUTIONS	39
3.1. What city structures facilitate replication?	39
3.2. What are the stages of the replication process? Which have proven to be effective? ...	42
3.3. How to identify and select a useful measure for replication?.....	46
3.4. How to assess the replication potential within my city?.....	47
3.5. What resources, knowledge and capacities are needed and how can they be transferred best? 48	
3.6. Which external support and engagement is helpful and at which moments?	50
4. CONCLUSIONS AND RECOMMENDATIONS FOR UPSCALING.....	52
4.1.1. Recommendations to local governments.....	52
4.1.2. Recommendations for national and European authorities.....	56
4.1.3. Recommendations to industry and business partners	58
5. SOURCES AND REFERENCES	60
6. ANNEXES	61
ANNEX 1	61
ABOUT GROWSMARTER	62

1. INTRODUCTION

The five European cities: Cork, Graz, Porto, Suceava and Valletta closely observed and accompanied the Lighthouse Cities (LCs): Stockholm, Cologne and Barcelona, in their planning, implementation, monitoring and evaluation of 12 smart solutions packages. During a tailored, five-year work programme they had the opportunity to analyse, build capacity and obtain specific knowledge for a (potential) transfer, replication and adaptation of these smart applications within their own urban areas to develop low energy districts, integrated infrastructures and smart mobility. Following the distinct phases of Smart City implementation so intensively and exclusively, the five cities became Follower Cities (FCs).

Picture 1: Geographic location of cities in GrowSmarter



The Follower Cities: Cork, Graz, Porto, Suceava and Valletta have different sizes, interests and urban sustainability goals. This has made the replication process of smart city solutions particular for each of them. All cities have great influence on their metropolitan area in terms of citizens, land-use management and energy and climate features. During the five years of the project, all Follower Cities have experienced political and structural changes in their

administration. Cork for example, is currently undergoing a boundary extension that will result in a city approximately five times larger and a population increase of more than 85,000 people.

In this context, it is very important to understand the differences among Follower Cities and Lighthouse Cities to understand how the replication process has been developed. Figure 1 describes some key attributes of the Follower Cities; which show how different they are and state the importance of individual particularities of the replication process of the GrowSmarter project.

Figure 1: GrowSmarter Follower Cities, size



2. GROWSMARTER REPLICATION PROCESS AND KEY RESULTS

The GrowSmarter replication process started from the ambition of the FCs to enhance the quality of life of their citizens and to meet their local sustainability goals. At the same time, these cities had the aim to substantially reduce their GHG emissions by improving the energy efficiency of their energy systems and by increasing the uptake of renewable energy in their territories.

Each FC analysed the 12 smart solution packages of the LCs and made an initial selection on which to study in-depth throughout the project. Moreover, each FC set up or used an existing **local, multi-stakeholder Smart City Liaison Group** to ensure appropriate and effective transfer of knowledge and experiences based on a dedicated peer-to-peer approach. The Liaison Group, which met regularly over the course of the project, consisted of staff from all relevant city departments (e.g. Mayor's Office, urban planning, environment, construction, transport, IT, economy, finance, public procurement etc.) and relevant stakeholders (e.g. city utilities, housing associations, scientific institutes, business and industry, NGOs etc.). Activities of the group included a series of bilateral meetings, together with broader workshops aiming to raise interest, inform and substantiate the Smart City concept. Furthermore, the group has been set as an important structure to identify relevant opportunities and challenges for smart solutions replication and implementation. Each FC is in full control over the composition and function of the group.

“GrowSmarter is a successful example of how the transfer of knowledge and experience in urban development can be achieved. Such projects have a high potential to intensify cooperation between administration and the private sector at local level. Within the “My Smart City” development area the city administration of Graz and private investors have agreed on several joint applications for EU and national funding projects which to a great extent are based on experience gained from GrowSmarter.”

Bertram Werle, Director for Urban Planning, Development and Construction, City of Graz

Subsequent to the establishment or adaptation of an appropriate organisational structure, the next GrowSmarter milestone was to conduct a **Replication Assessment for the deployment of smart solutions**. Within the first year, each Follower City with the support of

their Liaison Group prepared an initial [Smart City Baseline Assessment](#) with the following objectives:

- Identify and assess the full potential of replication and up-scaling of smart solutions on a city level and for specific districts;
- Provide a matrix for FCs to develop their smart city projects through in-depth understanding of the concept, approaches, opportunities, challenges, needs and success factors of Smart City applications in LCs;
- Support related and necessary local Smart City stakeholder engagement;
- Support the political and technical capacity development process through mapping the framework conditions for deploying smart solutions and identifying opportunities and needs for a knowledge transfer.
- Prepare and engage Follower Cities as ‘sounding boards’ in observing, supporting and evaluating the Lighthouse projects.

Based on this analysis one or two potential sites/districts were selected for deployment. Furthermore, the Replication Assessment with its twenty-four guiding questions and more than fifty aspects to consider included a:

- **Smart City Replication Profile** which mapped out the overall framework conditions and potentials for replication within the city territory including existing targets/goals of urban development, renovation programmes and plans, financing opportunities as well as key policy and legislation affecting Smart City project developments;
- **Smart Solutions Selection** which systematically explored the replication potential of the initially selected smart solutions within FCs;
- **Smart District Replication Profile** was designed per potential replication site/district, mapping out the district related framework conditions relevant for the replication of the selected solutions including the local state of play regarding district level energy efficiency, use of renewables, mobility efficiency and quality of infrastructure as well as existing stakeholder participation processes with e.g. user/consumer groups; and finally;
- **Smart Solutions Specifications** which analysed the principal integration and adaptation of the solutions towards the most effective deployment at site/district level.

Based on the interests and needs identified, a **capacity building and knowledge transfer programme** was developed for the Follower Cities as well as other interested public authorities to strengthen their local capabilities for a successful replication and uptake of GrowSmarter measures throughout Europe and beyond.

The programme included amongst other elements:

- Study visits to all three Lighthouse Cities during the different stages of implementation, monitoring and evaluation.
- Organised business dialogues with companies involved in implementation of measures in Lighthouse Cities with opportunities to exchange with involved political and technical city representatives.
- A series of facilitated webinars as well as on-site replication workshops to analyse and enable selected smart measures to be transferred despite of organisational, regulatory or technical challenges (barriers).

After 2 years, the Baseline Assessments were updated and complemented by a [Replication Assessment](#) that went from the level of integrated solutions to technically validating the potential to transfer specific smart measures. Again the assessments were reviewed by the site managers of the Lighthouse Cities in order to clarify and prepare aspects that they identify as important during the demonstration process.

“The participation of Suceava as Follower City in GrowSmarter has clearly demonstrated the facilitated transfer of knowledge and best practice from the Lighthouse Cities”

Dan Dura, City of Suceava

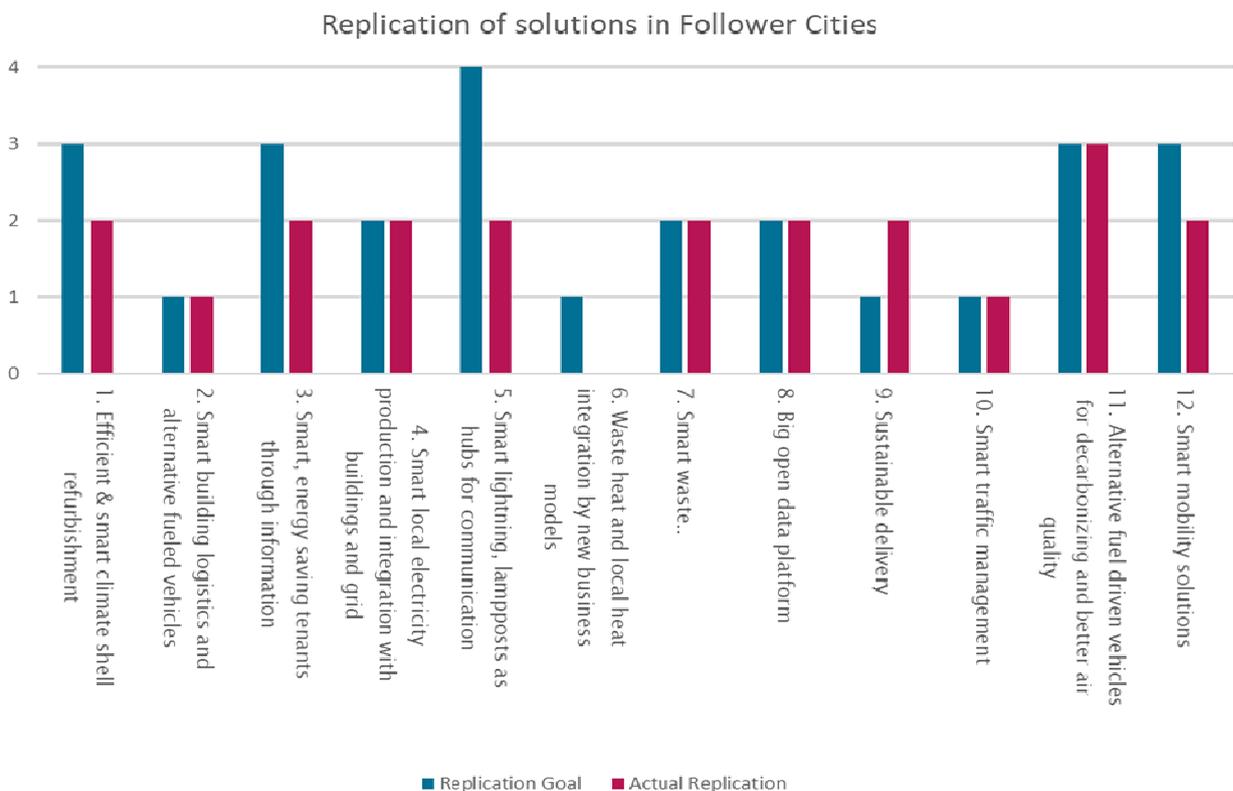
Ultimately, the replication process resulted in the development of a detailed Replication Plan ([Cork](#), [Graz](#), [Suceava](#), [Valletta](#) and [Porto](#)) which planned step-by-step the implementation of the selected smart measures in the FCs. These plans were developed in close collaboration with the Lighthouse Cities and the relevant industrial partners. **The replication plans can now serve as a checklist and indicator of progress.**

2.1. Key results of the replication process

The replication process of smart solutions from the GrowSmarter project has been diverse and with several particularities in each of the Follower Cities. Initial planning of the solutions covered all groups of demonstrated solutions: low energy districts; integrated infrastructures and sustainable urban mobility. During the replication process, cities decided to adapt or combine different measures within the smart solutions to meet their local goals and at the same time the expectations of the lighthouse project.

The diversity of measures implemented in the Lighthouse Cities and the knowledge transfer process during GrowSmarter, allowed FCs to better understand and adjust them to their urban sustainability and planning processes and activities. Figure 2 shows the results of how FCs developed their replication processes on the smart solution level. It highlights how cities defined their initial intention of replication versus what they have ultimately planned and in some cases already implemented.

Figure 2: Smart Solutions Replication Roadmap in Follower Cities.



From the total 12 groups of solutions all of them have been followed by at least one FC and 11 of them have been planned for actual replication. The process shows that measures related to integrated infrastructures and low energy districts faced (currently) more difficulties being replicated by the Follower Cities. Furthermore, fewer deviations from the initial intention of replication can be observed within the field of smart mobility solutions.

Is important to highlight that during the replication process, FCs have implemented totally or partially the different measures, or have planned their future realisation in much detail. Figure 3 and Table 1 outlines how the different solutions have been replicated (implemented or planned in detail to be implemented soon) by the Follower Cities.

The classification used to assess the replication process of the measures has been divided into 5 groups:

- **Full implementation:** measures that were implemented or are being implemented in the FC without deviation from original measure description.
- **Partially implemented:** specific parts or components of the measure implemented by FC considering local conditions.
- **Not implemented:** measures planned for replication but not implemented
- **Planned for full implementation:** measures that will be implemented in the FC in the future
- **Planned for partial implementation:** measures that will be partially or differently implemented by the FC in the future

Figure 3: Replication process of smart solutions in Follower Cities.

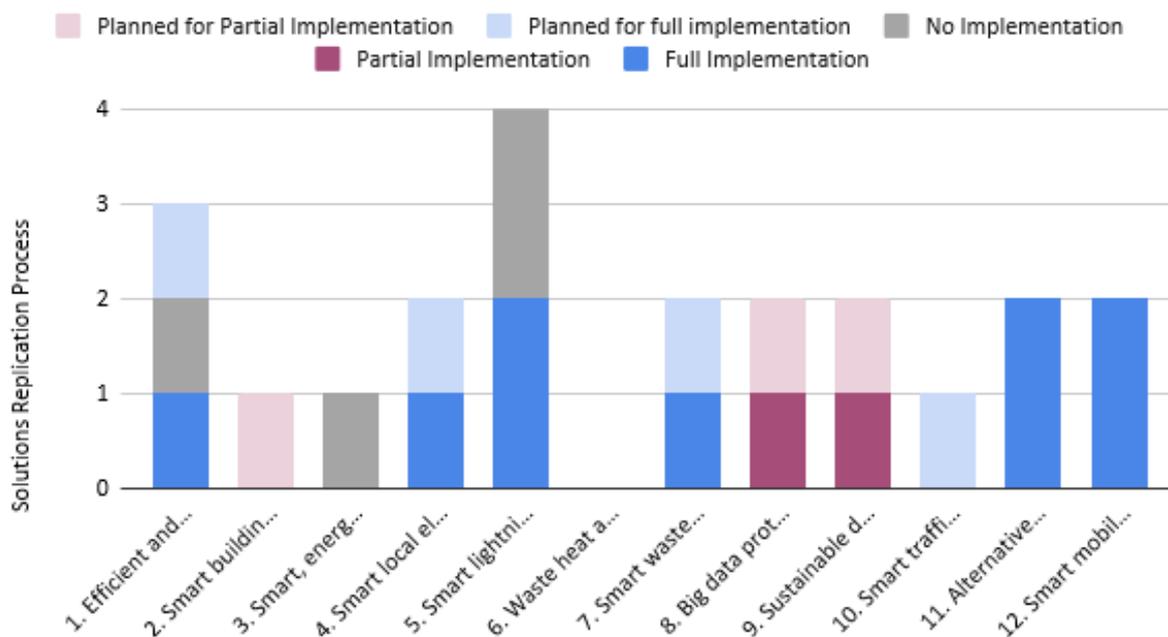


Table 1: Replication process of smart solutions in Follower Cities

1. Efficient and smart climate shell refurbishment		Not Replicated	Full implementation ongoing		Planned for full implementation
2. Smart building logistics and alternative fueled vehicles					Planned for partial implementation
3. Smart, energy saving tenants through information	Planned for full implementation	Not Replicated			Not Replicated
4. Smart local electricity production and integration with buildings and grid			Full implementation ongoing		Planned for full implementation
5. Smart lightning, lampposts as hubs for communication	Full Implementation	Not Replicated	Not Replicated		Full implementation
6. Waste heat and local heat integration by new business models		Not Replicated			
7. Smart waste collecting, turning waste to electricity, heat and biogas for vehicles.	Planned for full implementation				Planned for partial implementation
8. Big data protocol for saving energy and improving the quality of life	Planned for partial implementation	Planned for partial implementation			
9. Sustainable delivery		Partial Implementation		Partial Implementation	
10. Smart traffic management					Planned for full implementation
11. Alternative fuel driven vehicles for decarbonizing and better air quality			Full Implementation	Full Implementation	
12 Smart mobility solutions		Not Replicated	Full Implementation	Full Implementation	Not Replicated

It can be observed that low energy districts solutions, have been implemented in Cork and are planned for future implementation in Suceava. For both cases, ongoing projects of energy retrofitting and renovation for residential households in vulnerable areas and within social housing infrastructure benefited from the replication process.

Integrated infrastructure solutions in the fields of smart lighting have been fully implemented in Suceava and Porto as part of structured programmes of energy efficiency lighting transformation processes, where the smart component has been included as part of the local city strategy. Smart waste management measures have been planned in detail for future replication in Suceava. Regarding the big-data platform solutions, Graz as well as Porto have prepared future implementations of the platform, in alignment with their local realities, needs and resources available.

Smart mobility solutions were implemented in Cork and Valletta as additional part of their ongoing plans for sustainable mobility and e-mobility. In both cases, the solutions were adapted to the realities of the cities in full alignment with local, regional and national goals. It is important to mention that Valletta got inspired by GrowSmarter and went beyond their initial goals to replicate new smart mobility measures. In the Follower Cities of Suceava and Porto, specific measures of the solutions are prepared for implementation in the coming year(s).

A summary of the measures implemented in the different Follower Cities is described in Annex 1.

2.2. Learning based on experience: From assessment to implementation

This sub-chapter describes the key aspects included in each of the replication processes for the different smart solutions (Low Energy Districts; Integrated Infrastructure & ICT and Sustainable Urban Mobility) adopted by Follower Cities. It provides condensed guidance and tips to cities working on the planning of smart city solutions in order to progress from assessment to implementation.

Highlights from GrowSmarter Follower Cities experience and key lessons learned are included for each of the replication planning steps described in Table 2.

Table 2: Key steps and activities in the replication process

REPLICATION PLAN STEPS AND KEY ACTIVITIES
<p>Phase 1: Preparation of the implementation framework Objective: Set the basis for a successful implementation of the measure.</p> <p>Policy and regulatory screening</p> <p>Stakeholder 's roles definition</p>
<p>Phase 2: Project inception planning, performance and finance Objective: Outline key structural aspects for the measure's implementation.</p> <p>Governance designation</p> <p>Targets and goals setting (short- to long-term)</p> <p>Technology and infrastructure planning</p> <p>Definition of key performance indicators (KPIs)</p> <p>Cost-benefit analysis</p> <p>Business and financial model definition</p>

Phase 3: Political approval and stakeholder engagement
Objective: Obtain and maintain political and stakeholder commitment for the implementation.

Political commitment
Strategic intermediaries
Public participation and citizen engagement
Capacity building of city staff

Phase 4: Project implementation
Objective: Plan the effective implementation of the defined measure.

Implementation plan
Procurement model
Contract negotiation and management

Phase 5: Monitoring and progress evaluation
Objective: Plan the monitoring, evaluation and reporting of the implementation of the measure.

Project monitoring
Project evaluation
Internal and external reporting

Source: ICLEI Europe, 2019.

2.2.1. Phase 1 – Preparation of the implementation framework

The preparation process of the framework for implementing smart solutions has been critical during the replication process. This has allowed cities to set the basis for a successful implementation of the measure:

Established policy instruments driving the development of smart city solutions

In all Follower Cities, different policy instruments have driven the development of the smart solutions. As shown in Table 3, the Follower Cities have different policy instruments that have driven - directly or indirectly - the replication process of the different smart solutions.

Table 3: Key Policy Instruments Driving Smart Solutions Replication at Follower Cities.

City	Urban Sustainability and Development Instruments.	Sustainable Energy and Climate Related Policy Instruments	Smart City Policies and instruments.	GHG emissions target
Suceava	Local Development Strategy (ISDS) 2017	Sustainable Energy Action Plan, SEAP (2013) Local Action Plan (electro mobility) – 2012 Sustainable Urban Mobility Plan (SUMP) 2015	No particular strategy of the city. URBACT III project called: SMART IMPACT	Reduce the greenhouse gas emissions by at least 20% by 2020
Cork	Cork City Development Plan 2015-2021	Sustainable Energy and Climate Action Plan SECAP (2018)	Smart Gateway Initiative Digital Cities Challenge Programme	40% reduction in emissions by 2030.
Graz		Grazer Mobilitätskonzept 2020"/Graz Mobility Concept 2020	The Smart City Urban Development Strategy of Graz included in the official urban development plan (2013) Digital Agenda Graz	2050: The required total energy is produced 100% on regional level and from renewable energy sources.
Porto	Porto's Sustainability Strategy" (2009) Local Action Plan CSI (City Sustainable Investment) URBACT initiative	Porto ´s Sustainable Energy Action Plan (SEAP-P), 2015	The Porto Smart City Strategy	
Valletta		National Electromobility Action Plan (2013) Air Quality Plans and Measures		

Source: Follower Cities Replication Plans

Sustainability, energy and climate instruments such as Sustainable Energy and Climate Action Plans have fostered the development of measures especially in the fields of low energy districts with a particular focus on smart buildings as climate mitigation actions. Energy efficiency related programmes and strategies, have driven smart lighting projects in Follower Cities towards the reduction of energy costs on a local level.

Sustainable Urban Mobility Plans (SUMPs) have promoted sustainable mobility actions, including smart transport and shared mobility projects. Finally, Smart City related policies, plans and projects, have driven the development of smart solutions in the fields of integrated infrastructures, highlighting the importance of connectivity, big data platforms and urban infrastructure adjustments to Smart City developments.

In addition to local policy instruments, Follower Cities such as Cork, Valletta and Suceava have aligned their urban sustainability goals to national and regional policy guidelines on climate change and energy efficiency.

Graz's commitment to the development of smart districts

“Graz is a fast-growing city with limited settlement areas. Local urban development therefore aims at the densification central, infrastructural well-equipped locations. Energy-efficient, resource-saving and low-emission urban quarters with the highest quality of life are currently realized under the umbrella of the Smart City Graz strategy. Current examples for such urban development areas in the West of Graz are MySmartCity Graz (Waagner Biro) and Graz Reininghaus.

Key-Measures for the Smart City Graz were defined for the fields of economy, society, ecology, mobility, energy as well as supply and disposal of buildings. In addition, the creation of high-quality living space, the provision of attractive public space, the creation of green footpaths and bicycle lanes, the best possible connections to public transport as well as the reduction of motorized private transport are crucial objectives for Graz. Other important aspects of the Smart City Graz strategy are the building culture, the architectural design and the utilisation of innovative building technologies.”

Siegfried Nagl, Mayor of Graz

Suceava integrated planning processes towards sustainable and smart solutions implementation

The Rumanian city has three key policy instruments that have driven smart solutions in their territory, especially in the fields of energy and environmental management. The Sustainable Energy Action Plan, Sustainable Urban Mobility Plan (SUMP) and Local Development Strategy (ISDS) have shaped the strategies of the municipality on climate action, sustainability and city services efficiency. These instruments have opened the possibility to embed smart solutions in the core of the city planning processes and execution. These documents include measures, actions and indicators for future local development in the period of 2016 – 2023.

Cork the connected city – Innovative, inclusive and incredible

- The City of Cork has defined their city vision statements, which include the concepts of sustainability and digital strategies and goals, including:
- To nurture and incentivise people to use open data in creative, innovative and sustainable ways;
- To develop specific programmes and incentives to generate awareness generally for digitisation and specifically in different industries;
- To create the ‘cutest commuters’ in Ireland through an open and intuitive transport ecosystem;
- To develop world class interconnected infrastructure.

It is important to mention that policies and strategies are sometimes linked to regulatory frameworks that could enhance or restrict the development of different measures. For example, Follower Cities that have planned to replicate urban freight related management measures (S2 on smart building logistics or S9 sustainable delivery) have identified that implementation may require local regulatory interventions on carriage of goods and services and control of traffic flows in accordance with local transport planning. Therefore it is relevant to also identify the regulatory barriers that could influence the implementation process before mobilizing finance for the replication.

Identification of key stakeholders to access topical expertise for replication

During the preparation phase of the replication plan, the Follower Cities identified key stakeholders that could support the implementation of the measures in their territories.

Table 4 describes in general examples of the key stakeholders that facilitate the cities replication planning process.

Table 4: Key stakeholders in the local government recommended to engage for smart measures replication

Key stakeholders in the local government recommended to engage for smart measures replication		
<u>Urban Planning and Housing department</u> : Key to identify and integrate smart solutions development opportunities in on-going and future city developments.		
<u>Environment and Climate Change departments</u> : Beneficial to engage as in charge of local environmental management, processes (waste, water, environmental quality, etc); the implementation and environmental impact assessment of projects and measures aligned to local plans, policies and regulations.		
<u>Transport and Mobility departments</u> : Responsible of transport and mobility on a local /regional level are key to design and implement sustainable solutions measures.		
<u>Information and Communication Technology (ICT) departments</u> : Vital for identifying synergies and defining joint strategies for the digital transformation processes and (future) public services.		
<u>International Relations departments</u> : Useful to engage as in charge of managing EU funds and projects that can provide synergies between projects for further collaboration and potential financing alternatives.		
Key stakeholders beyond a local government		
Low Energy Districts	Integrated Infrastructures	Sustainable Mobility
National/regional energy agencies and authorities	City services operators (i.e waste management)	Local public and private transport operators
Energy utilities	Urban infrastructure operators	Local traffic police
Network operators	ICT companies (telecom operators, IT companies, start-ups)	Local start-ups
Commerce and Trade		Car manufacturers
Housing associations		Universities and research

Source: Follower Cities Replication Plans

The FCs implemented different stakeholder engagement methods and consultation methodologies during replication processes. Cork for example, is involving stakeholders with defined statutory structures (City Public Participation Network and the Local Community

Development Committee), while Suceava, develops information campaigns and meetings organically together with leading stakeholders. All cities ratify the importance of stakeholder identification and engagement processes as key for measures planning and replication.

Key lessons learned during phase 1 – preparation of the implementation framework

Low Energy Districts

- Involve building owners, housing associations and tenants in the process. They are key stakeholders that need to be heard and engaged, if the measures shall be (socially) accepted and properly used to work effectively.
- Link the measures implementation to national and regional energy efficiency and building retrofitting processes through tailored stakeholder engagement processes with national and regional authorities.

Integrated Infrastructures

- Identify key industry partners including local start-ups that could support the technological needs to implement the different solutions, with emphasis on localising the smart component of the solutions.
- Take advantage of existing policy instruments that facilitate urban infrastructure renovation or upgrade in order to embed smart solutions in the core of urban infrastructure development programmes.
- Sustainable Mobility
- Recognize the multi-level governance reality of smart mobility solutions. Engage stakeholders beyond local actors. It has proven to be important to involve national and regional transport authorities for the success of the measures' implementation.
- Invest in communication campaigns and citizen information processes to foster sustainable mobility patterns within cities. The most effective campaigns were district focused.
- Align mobility projects with national policies to facilitate smart solutions projects implementation and mobilise finance.

Picture 2: Follower Cities and Lighthouse cities met for a workshop in Graz, June 2018



2.2.2. Phase 2 – Project inception, planning, performance and finance

The development of smart solutions as local projects within city administration plans, requires several structures and studies to facilitate its development. A correct governance model and a structured project inception and management has been defined as a crucial step for replicating smart measures in cities.

The replication process for all Follower Cities was focused on the replication potential of a particular district or neighbourhood within the city boundaries. It is important to highlight that this step allows to better identify and assess the feasibility of measures to be implemented. In addition, these locations are part of structured urban regeneration or rehabilitation programmes and thus strategically chosen.

Designate governance of measures with cross-departmental impact

The different smart measures planning requires specific governance models and actions, which are most of the time specific for each local government related to the size and country of origin. For measures where leadership for implementation may be divided into two or three departments in the city, clear governance models have to be defined. For example, in the implementation of the big data platform in the integrated infrastructures solutions. The development of the platform may fall under the responsibility of the ICT department, but depending on its scope of action (i.e transport management or environmental management) other departments might be interesting in leading the process as well. Approaches and experience of Lighthouse Cities has been transferred to Follower Cities especially in this regard, but FCs like Porto already established appropriate governance models and platforms of exchange.

Porto Digital

Within this strategy, Porto Digital, a company owned by the Municipality of Porto, has emerged as the main organisation for the creation of a multidisciplinary and cross-sectorial strategy for the implementation of the Smart City concepts. The aim of Porto Digital is to contribute decisively to a structural change in the operating mode of the city, to make it ready for improvement and address the challenges. Porto Digital acts at several levels, to ensure that citizens, academia, industry and Public Authorities can cooperate, benefit and be active partners in the process of creating a Smarter City.

Achieving meaningful replication by building on existing city targets

The replication of the different measures in Follower Cities are strongly linked to urban short- and long-term targets established in the different policies fields and plans for climate action, sustainable urban development or sustainable urban mobility. This has made the implementation of the measures meaningful and the planning process even more concrete.

Sustainable mobility goals of Valletta

Valletta's goal towards the replication of selected GrowSmarter mobility solutions, was focused on the city's aim to foster a modal shift and multimodality, adapting them towards local particularities and reshaping the priority of the different measures' implementation. An additional driver in the decision-making has been the alignment of the city's activities with the national mobility planning process, for example the national Electromobility Action Plan

and the Air Quality Plans and Measures. Furthermore, the measures selected were aligned with the development and synergies of other EU projects for sustainable mobility such as MODUS, DEMO EV or PROMETEUS. In conclusion, replication can be even more effective, when building on existing local, regional and national plans and operationalising synergies with other EU projects.

Emissions reduction goals of Cork

The City of Cork has established a 43% GHG emissions reduction goal for 2030. Energy savings in buildings will contribute 45% of Ireland's total energy savings targets for 2020. The energy retrofitting of buildings in the private and public sector hold the greatest potential for energy savings. Therefore, replication of measures related to a deep retrofitting of buildings and renewable energy systems development has been included as part of the long-term climate action measures described in SECAP for the Cork City Council. The SECAP aims for a medium depth retrofitting of all social houses by 2040. The realisation of this target will depend on public funding and therefore the city is taking a phased approach. Thus the demonstration and application of GrowSmarter technologies are a meaningful opportunity to learn and validate in order to influence further steps of Cork's refurbishment programme.

Refined technology and infrastructure planning through the intention of replication

Technology and infrastructure planning has been a key step in the replication of smart solutions measures in Follower Cities. The process included the scoping of the technology to be used in the different districts and areas where the solution was going to be replicated. For example, in Cork, the smart buildings shell refurbishment processes required a detailed planning of technologies such as insulation techniques, heat pumps, led-lighting upgrade, monitoring equipment, etc.

In Porto for example, the technology plan for the big data platform: Open Urban Platform (OUP) and the Visualization Tool (VT) included the following steps:

- Define users and their needs for data collection and adaptive steering in city environments;
- Analyse the existence of optical fibre and electricity;
- Procure sensors to be able to both collect data, but also for applications and adaptive steering of city environments (OUP does not use proprietary standards and therefore

connectors can be developed from any data source and for every sensor/service interface);

- Install and connect the sensors to OUP module;
- Analyse data and develop applications/solutions in the platform;
- Test and evaluate applications in the connected street environment to get instant feedback on their performance.

During this process, the Follower Cities worked in close collaboration with technology providers to develop clear planning processes to guarantee the correct and sustainable implementation of the different measures. Experiences from the Follower Cities were also key to identify effective planning processes.

Defining key performance indicators is defining the success from replication to up-scaling

The Follower Cities have identified different sets of key performance indicators (KPIs) such as GHG emission reductions to define the boundaries of the measures' application. Subsequently, these indicators were complemented by aspects relevant to their projects and replication goals. For example, in Cork's implementation of smart building measures, KPIs targeted their beneficiaries (social housing residents) and were linked to local SECAP goals (number of square meters of social houses/apartments retrofitted, BER rating improvement, energy performance, alternative sources of energy installed, energy performance improvement, among others).

Suceava, for example, was very careful in defining the KPIs for implementing their smart lighting measure in order to demonstrate to decision-makers as well as citizens the real benefits of the project in terms of energy, emissions and economic savings as much as possible. The more meaningful the KPIs are to decision-makers (and voters) the higher the chance that a limited number of replicated measures get scaled up once proven to be successful.

Suceava Smart Lighting KPIs

Number charging point installed (28) , number of LED in use for the public lighting system (4186), number of EV's (13), number of LED systems in public buildings (9221). Energy consumption related to the municipal public lighting was reduced by 1,814 MWh/year and CO₂ emissions related to the municipal public lighting was reduced by 1,271 t/year. Furthermore, these KPIs should be evaluated against the increase of the quality of life and the reduction of negative effect of traffic against the environment.

Further work needs to be done by Follower Cities during the implementation of smart solutions in reformulating or adapting pre-defined KPIs to the performance results of the implementation. Good guidance and a list of smart city project indicators was produced by [City Keys](#) (2017) as well as the [EU SCIS Monitoring KPI Guide](#) (2018).

Cost-benefit analysis could only partly shape the business and financial model

A cost-benefit analysis has not been developed systematically by the Follower Cities for the different measures identified as replicable. This is due to most measures being in the planning phase and only at the very end of the project the technical and social validation could be fully concluded and communicated. This limitation was already identified and also noted by the City Interest Group members of GrowSmarter. The lack of validated data for a cost-benefit analysis was sought to mitigate through a more intense dialogue between the industry partners and cities.

Moreover, the financial model definition in Follower Cities differ from one smart solution to another. Measures implemented or planned to be replicated, have required detailed financial models designed by the cities. In the case of low energy districts measures, the energy savings as well as the CO₂ price have been crucial for the model's financial sustainability. For sustainable mobility measures, other factors such as availability of funding from other EU projects, have influenced the decision-making, and as far as integrated infrastructures solutions are concerned, such as smart lighting or waste management, the savings from the optimization of city services has effectively driving the business model. On the contrary business models related to the Open Data Platforms, require complex models and investment of public and private actors.

Key lessons learned during phase 2: project inception, planning, performance and finance

Low Energy Districts

- Especially for building retrofitting, the (early) engagement and leadership of the planning and housing department is crucial for successful implementation of measures. This includes the management and follow up of the contracts with industry partners.
- KPIs beyond energy and climate impact should be defined to leverage the impact of the measures implementation in city sustainability. The linkage of measures implementation

goals with targets from local plans or programmes, especially on energy and carbon or building retrofitting programmes, facilitate replication.

Integrated Infrastructures

- Find synergies with existing national and European programmes as well as private companies offering Energy Service Contracts for LED substitution of local public lighting systems. This will reduce costs and will allow the integration of smart sensors to benefit from further energy efficiency through e.g. dimming.
- Define a data governance model for the big-data platform your city is looking for based on city goals, structures and innovation capacity.
- Take advantage of the availability of structural funds on a national and regional level to secure smart solutions financing.

Sustainable Mobility

- Use electric mobility policies on a national level to foster the development of smart solutions. Financing of mobility solutions can be secured via national or European funding schemes.
- Define KPIs for performance evaluation beyond energy and climate, linked to urban mobility and sustainability goals of the city, for example: modal shift, accidents, air pollution levels, among others.
- The participation of the transport authority is key, but future implementation requires an alignment and responsibility allocation from urban planning departments and others.

2.2.3. Phase 3 – Political approval and stakeholder engagement

Political approval and stakeholder engagement is a decisive step within the replication process of smart solutions. However, to obtain political and stakeholders' approval at this stage, the commitment has to be prepared and maintained by strategic involvement of actors also in other phases of the Integrated Management Cycle. This finding supports the introduction of a strong overall governance model for Smart Cities (see 3.1 and 3.2 below).

Obtain political approval by strategic interlinkages and broader coalition building

The replication of smart measures in the Follower Cities have received political support of different levels. Measures linked to strategic smart, sustainability and climate action plans have obtained a higher level of commitment and support from the Mayors and Councils of the involved cities. More particular, measures related to energy efficiency in residential buildings (i.e social housing) and targeting the reduction of traffic emissions and air pollution (i.e. through car-sharing) have had strong political support in all Follower Cities. In Cork, for example, there is strong political commitment from the Council regarding the upgrading of social housing. This has facilitated the implementation of deep retrofitting actions in social housing buildings in the city. However, the political focus and priorities can also change throughout different election periods. Therefore, it is recommendable to follow smart solutions openly in order to provide informed technical suggestions, in case of changes in the political agenda of a city.

Suceava commitment for CO₂ emissions reductions

Based on the decision nr. 177 from 31st May 2018 of the Local Council of Suceava City, the Mayor of Suceava City has signed the documents of the European Covenant of Mayors and thus establishing a CO₂ reduction target of at least 40% by 2030. This decision emphasises yet again for Suceava to continue the implementation of smart measures regarding energy efficiency and renewable energy within all relevant sectors and public services. Suceava is now benefitting further from having explored the replication of several smart solutions simultaneously and is now able to substantiate the political ambition under the Covenant of Mayors.

Partner strategically with entrepreneurs for local transposition and development

In the replication plans the Follower Cities recognize the importance of finding local industry partners, SMEs or start-ups that can support the transposition, adaptation and/or further development of the selected measures within their own territories. For example, the City of Graz acknowledges that urban development projects including smart solutions can only be implemented successfully in cooperation with private players. However, such Public-Private Partnerships (PPP) do not arise automatically and their implementation is often only triggered by public (co-)funding of integrated urban development.

Porto Living Lab

The Porto Living Lab is the result of a long term partnership between the Porto Municipality and the University of Porto, with a strong support from local industry. This Living Lab aims to turn Porto into a Smart City by providing it with a wide range of sensors and communication equipment, thus creating the conditions for future research and development using advanced technologies for data collection through mobile platforms, wireless communication and large-scale information processing.

Budget public participation and citizen engagement in your implementation plan

Follower Cities have included in all their plans, strategic campaigns and engagement processes for citizen's participation for all type of measures. This is particular applicable for Low Energy Districts related measures targeting households and public buildings. The Follower Cities have allocated specific budgets in their implementation plans for communication and dissemination activities to key stakeholders.

Integrated infrastructure measures also require specific citizen engagement actions, especially in the smart waste management linked to the active cooperation and participation of tenants to ensure and achieve success. In the case of sustainable mobility, the focus lay on solutions such as car- or bike-sharing. Here the engagement of citizens with a vision to enforce a modal shift is important for an effective adoption of the technologies. Since this is a complex and demanding matter, the City of Valletta for instance, develops its communication campaigns together with industry partners.

Build the capacity of city staff to foster technical up-take

The GrowSmarter project and the replication process itself has been recognized by the Follower Cities (as well as the Lighthouse Cities) as an important knowledge transfer and capacity building process for all stakeholders involved. During the planning of the measures, Follower Cities were provided with specific information and virtual as well as physical capacity building sessions on the application and roll out of selected technologies. Especially, the operational teams or third parties in charge of works in the field were encouraged to take part.

Key lessons learned during Phase 3 – political approval and stakeholder engagement

Low Energy Districts

- Engage industry partners in capacity building processes from and for local authorities in charge of the implementation of the measure.
- For low energy developments, partnerships with associations of private owners and other public entities are critical to gain approval and implement the solutions.

Integrated Infrastructures

- Develop local campaigns to promote the benefits of the different technologies and infrastructures of smart solutions, targeting political decision-makers as well as citizens, best with different methods and content.
- Provide appropriate training to existing and new city staff to enable a comprehensive and specific capacity to prepare, implement and evaluate smart solutions.

Sustainable Mobility

- Engage citizens directly and through solution providers to reach a major scope of action and to foster sustainable mobility patterns in the city.
- Foster consensus and secure political support from the Mayor and City Council to implement in particular mobility measure that affect public spaces (e.g. parking spaces), as these likely will be contested.

2.2.4. Phase 4 – Project implementation

Implementing smart solutions in the different Follower Cities is a challenge due to their diverse framework conditions, but also to turn planned actions into accepted and established services for citizens with different backgrounds. Effective implementation requires a profound understanding of project risks and the knowledge about an appropriate procurement model that allows an accurate and still adaptive realisation of measures and their contract management during the operation.

Procurement model, contract negotiation and management

Procurement models differ from city to city, but in all cases, it reflects a degree of difficulty especially because there are different departments involved. For the Low Energy District measures (building retrofitting) for example, this process was challenging due to the timelines of construction versus the availability of funding from grants or other sources. In the City of Cork, for example, the contract for the deep retrofitting measures in social housing buildings include specific requirements for payments, schedule of work and penalties to try to mitigate the risk of the contract. The Housing Maintenance team manage the contracts on behalf of the City Council.

The contract awarding procedure for the different measures is specific for each City Council (tender, service contract, concession, etc.). The departments that are in charge of implementing and operating the smart measure should develop the procedure in close cooperation or with assistance from the finance and procurement department due to the comprehensive public procurement policies and regulations.

Suceava technical documentation preparation for smart lighting services

During the project implementation phase specific technical documentation (which include technical specification, construction and safety requirements, allocated budget, time schedule of execution, project management, indicators and expected results) were designed. This documentations (feasibility study and technical project) were part of the tender documentation which were design and approved according to national legislation for public procurement.

The procedures were "open tenders" published on Romanian national portal for public acquisition. There were an "ex-ante" verification for the procedures and also the representatives from regional and national level took part of the evaluation team depending on the project budget value.

Also for the first time ever new evaluation criteria (as for example "energy efficiency " or "energy consumption") have been included and used into the tender procedures for public procurement of EV's and LED systems in order to increase the energy efficiency and reduce the CO₂ emissions.

Key lessons learned during Phase 4 - project implementation

Low Energy Districts

- Develop energy audits and feasibility studies before retrofitting any building. This has proven to be a driver to mobilize investments needed for the development of the projects and to assess impacts after its implementation.

Integrated Infrastructures

- Rely on the experience and ask advice from procurement departments in the city administration to define the best model that suits the particular requirements of smart infrastructure related projects, in terms of ownership of assets, operational models to develop and maintain urban infrastructure as well as to determine who owns the data that is collected and monitored.
- Develop technical documentation and procedures to embed smart solutions related impacts and performance management in the processes of offers and tenders.

Sustainable Mobility

- Explore the possibility to create incentives or discouragement schemes for particular transport options that foster the roll-out of smart mobility measures (e.g. last mile services).
- Embed environmental and carbon criteria in the procurement of transport and mobility solutions.

Picture 3: Replication workshop in Valletta, November 2018



2.2.5. Phase 5 – Monitoring and progress evaluation

The identification of tools and mechanisms to monitor, report and validate the impact of the implemented measures as well as to evaluate the process of implementation is an important and final step to enable further replication and up-scaling of solutions. Follower Cities have defined in their replication plans, monitoring strategies and follow up mechanisms to guarantee the correct implementation of the different measures in their territories.

Define project monitoring and data collection

All Follower Cities have defined in their replication plans, the relevance of project evaluation metrics and methods to guarantee a measure-specific monitoring. For measures related to Low Energy Districts, especially such as building retrofitting, dedicated measurements were designed or are foreseen that will impact on the data collection, reporting and evaluation process including the payments for works on time and performance validation.

Involve third parties in the project evaluation and impact assessment when necessary

In some Follower Cities, audit, project evaluation and monitoring activities of smart solutions can require the involvement of external parties either due to the lack of internal resources (e.g. Suceava Municipality) or in order to substantiate the validation through a third party. In the case of measures like deep retrofit of buildings, the evaluation can be done in two ways. Firstly, there is a post work Building Energy Requirement certificate that is completed by an independent body to reflect the improvements. Secondly, the improvement of the overall building performance is validated during the use of the building.

Internal reporting as important as external reporting

Follower Cities have implemented several mechanisms to guarantee the reporting of their results for mainly three main purposes. Firstly, to guarantee an appropriate information flow to key stakeholders participating in the project, secondly to meet the reporting requirements to financing sources (e.g. public funding through structural funds) and thirdly to report the performances in relation to achieving urban targets (e.g. energy, climate etc.).

Key lessons learned during Phase 5 – monitoring and progress evaluation

Low Energy Districts

- Chose appropriate KPIs that are able to serve for internal as well as external reporting requests of assessment and validation.

Integrated Infrastructures

- Take advantage and use the data generated by smart infrastructure solutions to build new and effective KPIs that feed monitoring and reporting systems as well as urban decision-making processes.

Sustainable Mobility

- Identify the different levels of impact assessment goals that sustainable mobility measures may have in the context of sustainable mobility solutions.

Picture 4: GrowSmarter Follower Cities visit Barcelona for a study visit. April, 2019



2.3. Key challenges and mitigation action during replication process

During the replication process several challenges were encountered from which we can highlight:

Regulatory frameworks determine transaction costs and implementation planning

The replication of certain measures have been restricted due to the existence of regulatory frameworks that impede specific actions specially in the field of sustainable mobility (traffic restrictions rules) and building retrofitting (national building codes, historic buildings prohibitions, property ownership, ownership acts). These framework conditions either lead to higher transaction costs for replication or freeze an advancement of activities at an early planning stage until regulatory changes are introduced. Also in GrowSmarter, several measures were assessed by the Follower Cities, but did not advance up to the implementation planning. Advocacy efforts on national and European level seek to achieve change within a mid-term horizon.

Planning implementation despite of constant information flows throughout five years

Follower Cities have constantly worked in identifying and assessing appropriate business models and partnerships to facilitate the implementation of the measures. However, only at the end of the five-year project, following an economical evaluation and technical validation of a two-year monitoring period, all the information was available for each solution and measure. Thus FCs were defining business models and planning partnerships with pre-assumptions which not always succeeded in the end. Constraints for accessing suitable public and/or private finance increased the complexity of replication. Individual dialogues and workshops have sought to reduce the uncertainties as much as possible. The overall results of FCs' replication show that the more time-intensive process was worth the effort.

Cost-benefit analysis could only partly shape the business and financial model

Follower Cities have developed different cost-benefit analysis for selected measures. The lack of existing methodologies, the project timeframe and a lack of quantitative information on the sustainability impacts of the different measures has made this process uneven among measures. Implementation plans for measures replication, should include the development

of CBAs as a tool to enhance business models sustainability of the smart measures. Experience of Lighthouse Cities in this regard might not have been effectively transferred.

Moreover, the financial model definition in Follower Cities differ from one smart solution to another. Measures implemented or planned to be replicated, have required detailed financial models designed by the cities. In the case of low energy districts measures, the energy savings as well as the CO₂ price have been crucial for the model's financial sustainability. For sustainable mobility measures, other factors such as availability of funding from other EU projects, have influenced the decision-making, and as far as integrated infrastructures solutions are concerned, such as smart lighting or waste management, the savings from the optimization of city services has effectively driving the business model. On the contrary business models related to the Open Data Platforms, require complex models and investment of public and private actors.

Strengthen transferability of climate impact assessments of smart solutions

The baseline scenario of GHG emissions reduction potential of the selected measures could not be developed thoroughly during the replication process. The integrated nature and complexity of the different measures and the sometimes impossibility to transfer specific methodologies for this type of assessment, did not allow Follower Cities to effectively develop the baseline, compare and evaluate the future impact after a potential implementation. As this information is decisive for the political decision-making to approve measures and respective finance, stronger efforts should be made on the transferability of accounting and verifying GHG methodologies on smart solutions.

Collaboration among Follower Cities and industry partners

A strong collaboration between industrial partners and Follower Cities should not be assumed to be straight forward during the replication process of lighthouse demonstration projects. A lot of facilitation is required due to the following aspects among others: the complexity of urban development projects, integrated nature of the smart solutions, the implementation timeline within the Lighthouse Cities including technical constrains and delays during the implementation, the technology readiness, the geographical scope of services provision and the business opportunity potential to replicate some measures.

Therefore, some Follower Cities experienced, that local partnerships are even more important and reliable, as many external industry partners involved in the LC demonstration sites, may also not have the mandate and/or strategy in place to provide products and services beyond their original selling territory. For instance, this can apply for an energy utility that is publicly owned by a city, but also an international company with different national branches that have individual market strategies. In the mid-term these replication barriers are likely to be solved, but for the short-term the continuous build-up of locally rooted public private partnerships has proven to be the best implementation strategy.

3. GUIDANCE FOR REPLICATING SMART SOLUTIONS

3.1. What city structures facilitate replication?

Broaden, deepen and intensify efforts through the Smart City

The majority of local authorities developed their Smart City ambitions, programme and projects based on climate and energy targets. Often this is connected to the desire to broaden, deepen and/or intensify related activities after an established planning process has taken place and is renewed. Many smart solutions like open electricity and thermal grids, smart (district) building management systems or alternative fuel driven vehicles have emerged and are the result of the second or third generation of Sustainable Energy and Climate Action Plans (SECAPs) and Sustainable Urban Mobility Plans (SUMPs). GrowSmarter's evaluation results have now proven that many (but not all) smart solutions are meeting the expectations to significantly increase energy efficiency and integrate more volatile renewables, while reducing costs and greenhouse gas emissions.

Coordinate synergies conceptually and organisationally

At the same time, the Smart City concept presents the chance to go beyond traditional energy and climate responsibilities within cities and combine efforts, experience and resources with other topics (and departments) that are linked, but where synergies are under-explored and not conceptually and organisationally coordinated. Studies of Smart City concepts and analysis of their environmental indicators show that links to safeguarding and enhancing the quantity and quality of natural (and urban) resources like soil, water and sometimes even — although politically in focus — air quality standards, are missing.

Extend boundaries to realise more comprehensive social and environmental ambitions

As Smart City strategies have been consolidated over the last five years, (re)newed concepts can and should intensify and extend the conceptual boundaries to include more natural resources, integrate nature-based solutions, adaptation efforts, elements of resilience and public procurement as a major instrument of implementing and ensuring more comprehensive social and environmental ambitions. In the end, the Smart City should be used as a tool to advance sustainable urban development as a whole. However, to do so

effectively, adequate cross-sector and -departmental coordination structures need to be put in place.

Apply cross-sector and -departmental approaches

Within a city, responsibilities for smart developments are likely to belong to staff in different administrative departments and organized units of municipal utilities. This means that disciplinary silos still need to be bridged in daily work in order to bring the different streams together, which may demand changes to inter-departmental dynamics and working processes. Understanding these streams of action as part of a shared, iterative planning cycle can support a more collaborative approach, where planning and implementation are not undertaken independently, but instead that efforts are made to actively align them. This makes it more likely that interactions between different sectorial strategies will be picked up and jointly addressed during planning – whether in the form of trade-offs, conflicts, co-benefits or synergies – thereby increasing the effectiveness of the resulting integrated Smart City plans, and demonstrating opportunities to achieve multiple political wins and thus short and long-term consensus and support in the City Council.

Build appropriate steering and working groups

The starting point for a successful smart urban development that seeks to replicate existing or creates new concepts and solutions is to identify clear organisational roles and responsibilities. Although of course new structures can be established, it might be useful to adapt an already-existing organisational structure created for a related purpose (e.g. a climate and energy management team, environmental management unit, or urban sustainability agenda coordination group) to ensure effective development, replication and implementation of smart solutions. For instance, in Cologne the climate coordination unit is leading efforts, in Graz the Executive Office for Urban Planning and Development and Construction is in charge and in Cork City Council the IT department. If a city organisation has developed a SECAP, it likely already has relevant steering and working groups in place, which can be used. However, their composition, scope of work and leadership may need adaptation to improve the integration of a digital strategy and appliances.

Ensure political support and consensus by involvement

Similarly to sustainability or climate mitigation and adaptation processes, a steering committee can prove itself to be beneficial consisting of the (Lord) Mayor and/or political representatives from different parties. Its function should be to provide strategic direction and the necessary political support to the process, allocate mandates and resources as well as to mainstream policies across different departments, or even with relevant external or related organisations including city utilities.

Appoint a Smart City Manager and ensure new staff capacities

Furthermore, a Smart City Manager should be appointed to coordinate both technical planning, implementation, monitoring and reporting towards the steering committee. Thus it should be a person with some technical expertise, but also skilled in moderation, communication and making connections across disciplines in order to maintain and enhance communication with relevant departments. While an energy manager or similar may have led the development and implementation of a SECAP, a Smart City concept demands a good overview on state-of-the-art innovations and digitalisation. Depending on strategic considerations and resources, a Smart City Manager could also function as co-lead to a SECAP or Sustainability Manager. In any case a Smart City Manager must have support from local political leaders (e.g. a Council decision to approve/endorse the appointment), as well as the necessary skills, time and resources to carry out her/his duties, including staff for delegated tasks. If a clear reallocation and/or new staff capacity is not ensured, reflections from GrowSmarter conclude that a successful and systematic development, replication and/or up-scaling of smart solutions is likely to fail.

Thematic working groups complement action

If a cross-departmental Coordination Group coordinating overarching activities and stakeholder input already exists, it would make sense for its mandate to continue. However, its focus must expand to include the digital dimension. Thematic working groups on e.g. smart buildings, ICT or smart mobility could (permanently or ad hoc) complement specific action fields and/or projects. In addition to monitoring, reporting and evaluating technical achievements against political targets, this group would also work to understand the city's development from multiple sectoral perspectives and to provide corresponding data. Ideally,

it would also facilitate ‘mainstreaming’ or integrate smart solutions into other existing policies, plans and municipal targets.

Create an open alliance for Smart City applications

Last but not least, the city’s internal organisational structure for smart urban development, can effectively be enhanced by engaging external stakeholders. A respective participatory structure can be formed through an open alliance dedicated to contribute to a set of agreed Smart City targets or a more exclusive group of strategic, local players from the business, industry, banking, academic and civic sector. For instance, Porto has established Digital Porto as a private non-profit association. It was created in 2004 by the Municipality of Porto, the University of Porto and the Portuguese Business Association (AEP), in cooperation with the company Metro of Porto, in order to promote ICT projects within the context of the City of Porto and its metropolitan area. It enables open innovation, cross fertilization of ideas between city stakeholders and fosters the concept of a city as a living lab. Similarly, the establishment of stakeholder liaison groups within each Follower City, as a first step in the GrowSmarter replication process, has been proven very useful for (baseline) assessment and planning process.

3.2. What are the stages of the replication process? Which have proven to be effective?

Conceptually, the replication process of GrowSmarter followed ICLEI’s Integrated Management Cycle (IMC), which has been developed and used by local authorities for more than 20 years to coordinate and embed long- and short-term objectives and policies effectively and sustainably into urban governance structures and processes. GrowSmarter enabled to reflect and adapt the IMC to the context of smart city developments.

According to the IMC Smart City Governance can be distinguished into five major stages or phases, namely:

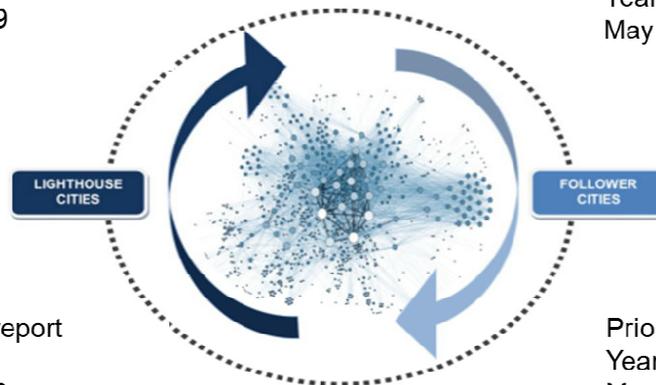
- I. Commit, mobilise and assess baseline,**
- II. Prioritise and set targets,**
- III. Plan action and gain political approval,**
- IV. Implement, monitor and report as well as**
- V. Review, upscale and advocate.**

This logic determined the GrowSmarter replication roadmap and its capacity building programme in content and time (see Figure 4). Moreover, and although not particularly part of the work programme of GrowSmarter, it is important to highlight that replication of smart solutions should be analysed and pursued from the perspectives of Lighthouse and Follower Cities alike. However, both (may) have different entry points into the replication cycle and establish different dimensions of scale.

Figure 4: GrowSmarter capacity and replication roadmap following ICLEI's Integrated Management Cycle

Review, upscale and advocate
Year 5
Dec 2018 – Dec 2019

Baseline assessment
Year 1
May 2015 – February 2016



Implement, monitor, report
Year 4
Nov 2017 – Nov 2018

Priorities and Target setting
Year 2
March - September 2016

Action Plan and Political Approval
Year 3
Oct 2016 – Oct 2017

While Lighthouse Cities were requested (by the H2020 funding criteria) to identify smart solutions based on their SEAPs, SECAPs or similar urban development plans - which then received (co-)finance to demonstrate and pilot a limited number of smart applications - Follower Cities had (more) time and were resourced to conduct a comprehensive assessment of their city, select suitable neighbourhoods and prioritise measures for replication. Therefore, the latter were (often) able to plan implementation with a higher scale, whereas Lighthouse Cities are now at a stage to scale-up and roll out applications also based on the technical and economical evaluation of the measures.

Integrated Management Cycle effective for SC development and governance

In relation to the replication process one of the key conclusions of GrowSmarter is that the Integrated Management Cycle provides a suitable and guiding structure for Smart City development as well as governance. Therefore, cities should carefully analyse and gain consciousness at which stage they are in relation to the implementation of their overall Smart City concept as well as specific solutions. Even if cities have not (yet) applied the IMC in its full dimension, some stages are likely to have been completed already so that the revolving process can be established or complemented further.

Furthermore, each stage has further sub-steps that help to streamline integrated management and Smart City governance. Based on the experience gained through GrowSmarter (and reflections from and with other Smart City projects), the sub-steps which have been identified and are highly recommended for any Smart City to analyse and apply are described in Table 5:

Table 5: Sub-steps to streamline integrated management and Smart City Governance

<p>I. Commit, mobilise and assess baseline</p> <ul style="list-style-type: none"> - Secure the political commitment for a sustainable city through smart solutions - Set up an overall institutional and governance structure - Identify and engage key stakeholders/strategic intermediaries for the Smart City development - Design a communication and engagement plan - Examine the relevant, existing legal obligations and policy instruments - Assess the regional, city and city district context and map out challenges and responses - Review relevant existing objectives, strategies, programmes and projects as well as their impact - Analyse the technical and economic performance of (other cities') smart solutions - Assess the application/replication potential of smart solutions on a city and district level - Collect sectorial data on district level to set the baseline for performance
<p>II. Prioritise and set targets</p> <ul style="list-style-type: none"> - Engage politicians and their bodies and determine a Smart City vision (10-15 years) - Prioritise through stakeholder engagement - Set long- to short-term targets for all three dimensions of sustainability, reflect priorities and define key performance indicators (KPIs) - Identify direct and indirect European, national and local financing opportunities - Build capacity of technical staff to plan, implement and monitor smart appliances

III. Plan action and gain political approval

- Conduct market dialogues with technology providers and exchange with other cities and their networks also considering joint procurement
- Select technologies and plan infrastructures in accordance to the degree of added value and integration potential with existing and future infrastructures to avoid expensive lock-in developments, double funding or rebound effects
- Conduct a cost-benefit analysis and define the business and financial model (for each smart appliance)
- Design the work and time plan for implementation
- Write up an overall Smart City Action Plan (3-5 years) for budgeting and political approval

IV. Implement, monitor and report

- Create and/or adapt enabling policy instruments and regulations
- Inform, activate and engage stakeholders including citizens for the successful implementation of single or bundles of smart measures
- Design (single) projects with stakeholder participation
- Select a suitable partnership model (e.g. Public-Private-Partnership, community cooperative) and mobilise investments
- Choose a suitable public procurement process and model, and define the performance (in accordance to the KPIs), data ownership and/or free (!) access etc.
- Issue the public tender, select and inform
- Negotiate and manage the contract or concession
- Monitor the progress and performance of the project (independently)
- Report regularly and at least once a year internally (within the technical and political governance structure) as well as externally

V. Review, upscale and advocate

- Evaluate the performance and impact (on sustainability) of single and bundles of sectoral solutions
- Implement internal and external audits (where useful) and their response action
- Review the cost-benefits to determine upscaling, adaptation or closure of activities
- Evaluate the overall process and cooperate horizontally and vertically in governance structures to achieve a higher degree of integration, synergies and impact
- Update the Smart City strategy and/or the Smart City Action Plan while entering into a subsequent integrated management cycle
- Showcase, gain recognition and advocate for suitable policies, instruments and finance that ensure and enhance a sustainable city through sustainable smart solutions

3.3. How to identify and select a useful measure for replication?

Within the framework of GrowSmarter, the Follower Cities explored and by the vast majority identified suitable measures early in the project period taking a number of factors into account: Issues such as economic and social feasibility, local conditions and possibilities for political commitment and support. The following conclusions can be drawn at the end of this demonstration project.

Assemble and understand citizens' and stakeholders' needs

A needs assessment from the perspective of a public authority and/or involving Smart City stakeholder groups as well as citizens, is one way to ensure public and private commitment and support. *"You have to identify your needs as the first thing to do, before even starting the work on identifying which solutions to replicate"*, explains Smart City Manager Dan Dura from Suceava. Subsequently, necessary economic resources for a successful replication can also more easily be mobilised and politically justified. Suceava was the FC in GrowSmarter that managed to replicate the highest number of measures.

Study your and others' local framework conditions before you select for replicate

Follower Cities concluded that it is extremely important to know and understand the local conditions, when identifying and selecting smart measures for replication and up-scaling. Respectively the Dan Dura from Suceava advise that it is necessary to *"adapt things and not only transfer directly. All solutions must be adjusted to local realities."* This opinion was seconded by the assessment of other FCs, which highlighted that it is only only necessity to understand ones own local framework conditions, but also the framework conditions of a measure within the Lighthouse City.

Collect feasibility data and proactively conduct (informal) dialogues

Furthermore, financing was viewed to be critical, when choosing the solutions most desirable to replicate. The importance of having a *"clear plan for how to finance the implementation of such smart solutions"*, has to be clear from the start explains Christian Nußmüller, Head of Unit, EU-Programmes and International Cooperation from the City of Graz. It came not as a surprise to any of the Follower Cities, but at the end of the project, it is even clearer than before that the solutions linked to existing initiatives, financing schemes

or national/regional legal framework conditions (e.g. ownership structures, housing subsidy schemes etc.) were most decisive for a successful replication. This highlights the relevance of economic and social feasibility studies conducted through GrowSmarter. Follower Cities as well as City Interest Group members expressed the desire to have data sets to evaluate the feasibility of smart measures at an earlier stage within the replication process. However, as these were not available, individual and informal exchanges during the project meetings, study visits, webinars and workshops as well as the analysis of public and confidential reports were used for the selection processes. Consequently, also some deviations occurred between initial considerations and final choices.

Enter openly into the replication process

Follower Cities highlighted that an approach which is more focused on observing and finding inspiration through peers in other (Lighthouse) Cities proves to be effective and can be applied independently from the nature of the smart solution. Participation, even as an observer, was described as very useful for identifying and choosing what solutions to replicate. *“I would advise everyone, especially cities and small countries to go into Smart City demonstration projects with an open mind and not limit themselves to their original scope”*, says Victor Battistino from Transport Malta representing the FC Valletta. Inspired by GrowSmarter, Valletta took advantage of this approach by implementing car-sharing throughout Malta, which they originally not intended at the beginning of the replication process.

3.4. How to assess the replication potential within my city?

Assessing the replication potential in each city connects to how cities identify the measures useful for replication and what city structures facilitate replication. Topics such as economic feasibility, respect for local conditions and political and administrative backing for smart city solutions were also among the major issues when determining the replication potential.

Map urban needs and assess framework conditions including ownership structures

The main considerations that influenced the Follower Cities in regards to assessing the local replication potential, was the mix between the city’s urban needs and the internal and external framework conditions they are working in. For example, the City of Graz has a large

share of its building stock that is owned by non-public housing cooperatives and the publicly subsidizes refurbishment standard is on a comparatively high level in Austria. The buildings are of a similar generation to the publicly owned housing in Sweden - where energy efficient refurbishment has been a success - and therefore the potential for an energy friendly refurbishment in combination with the complementing installation of smart solutions would be huge. However, the ownership structure is very different, which resulted that Graz had to conclude that they could not replicate the extensive and advanced smart energy refurbishment measures just yet. But the city explains: *“Even though we are not replicating them right now, the potential is still there. It is not going to be in the close run, but rather within the next decade. In the medium or long-term smart refurbishment of existing building stock will be a big issue for Graz and we can build on the experience of GrowSmarter.”*

Use on-going processes and investments for replication and up-scaling

Furthermore the assessment of the replication potential is influenced by the interplay of positive impacts of a smart solution within a specific, local area and the proximity to the (current,) political agenda. In addition, considerations on replication and up-scaling have been more favourable, when it was realistic to implement the measure quickly (3-5 years) and/or could be connected to on-going infrastructure investments. For instance, this was the case with car-sharing scheme in Valletta or smart lighting system in Suceava, where knowledge and findings of GrowSmarter influenced the procurement procedures of both cities. The transfer of know-how into the implementation of climate-shell refurbishment in Cork’s social housing districts was especially driven by the positive, local impacts of the solution on the tenants in combination with the existing framework of climate and energy targets of the city.

3.5. What resources, knowledge and capacities are needed and how can they be transferred best?

Resources and expertise have to match ambition

Neither a city nor their advisors should underestimate the need for specifically reserved and dedicated resources and the diverse range of expertise that is necessary for implementing smart solutions, if not an entire Smart City concept. Due to the integrative nature of the measures, generalist as well as technical specialists are needed, and professional facilitators are essential to organise a successful joint implementation and replication process of

different departments and stakeholders. Hence, existing knowledge and capacities within a city should be analysed and adequately planned in accordance with the extent of Smart City ambitions. This applies for the demonstration process within LCs as for the replication efforts within FCs alike.

Demonstration is required for political commitment

One of the most critical aspect for many Follower Cities was the need for political buy-in in order to begin or implement of a successful replication process until the end. Hence, political approval and commitment was in many cases seen as a resource in itself, but also as a decisive step within replication where the exchange with peers and the physical demonstration of GrowSmarter could help provide answers to environmental, social or economic concerns. As expressed by Victor Battistino, Valletta: *“It’s difficult to convince a political decision-maker to install charging infrastructure, if he or she has not seen it working in other places, with all its implications on the cities’ network. For us, that means experiences from other cities are valuable – experiences from Lighthouses are required to replicate.”* Thus demonstration sites are valuable resources for political decision-making processes in the implementing city as well as others alike.

Choose exchange formats that catalyses local actions

Transferring technical knowledge in different formats and having the ability as well as capacity to do so was also seen as a highly influencing factor. Process orientated study visits, solution focused webinars and FC specific replication workshops have been proven to be useful and were appreciated by all the Follower Cities as an effective fora for transferring technical expertise. Already at the beginning of the project, the FCs possessed topical knowhow due to the fact that some city departments and/or local partners such as universities or businesses were already working on smart solutions. Therefore the knowledge transfer had to be individually tailored to provided added value and complementing information to enable the replication of solutions. The different formats supported the transfer and allowed to go into depth on barriers, mitigating actions and opportunities where needed. When concluding on the replication workshop arranged in Graz, for instance, the Follower City made clear, that it *“had major success with implementing a replication workshop sharing knowledge from GrowSmarter with local stakeholders. It was very useful to have experts from Lighthouse Cities joining us in Graz to give impulses for*

decision-makers and experts to be in touch with each other.” That experience of local workshops acting as catalysers was shared between the different cities.

Allocate resources to mobilise public and private finance as well as create and maintain partnerships

Obviously, the European and national funding schemes and conditions that could serve to replicate and scale-up implementation of smart solutions differs between the FCs. In those cases where it is difficult to mobilise public finance for applying the knowhow gained and roll-out the actual implementation, it is even more important to create partnerships with local industry and science as well as banks and innovative financing schemes such as crowdfunding. Some Follower Cities experienced, that local partnerships are even more important and reliable, as many external industry partners involved in the LC demonstration sites, either don't have the mandate and/or strategy in place to provide products and services beyond their original selling territory. For instance, this can apply for an energy utility that is publicly owned by a city, but also an international company with different national branches that have individual market strategies. In the mid-term these replication barriers are likely to be solved, but for the short-term the continuous build-up of locally rooted public private partnerships has proven to be the best implementation strategy.

3.6. Which external support and engagement is helpful and at which moments?

Targeted support is most effective when jointly shaped

All Follower Cities in GrowSmarter have received external support in different ways to assist them in their work toward replicating smart solutions. From facilitated workshops at home to study trips abroad, they have engaged with the Lighthouse Cities and industry partners throughout the different stages of the project. Structured and phase-bound templates for analysing the replication potential and planning local applications are useful to be suggested by external knowledge brokers, but should be confirmed by the FC. For some, the need for external support was only at specific times, as in the design phase or when technical documentation was needed. With this support given, the cities' own experts could work on the individual solutions and solve any issues with only occasional assistance needed from project partners.

Meet stakeholders affected by the demonstration to assess and plan replication

Naturally, FCs benefited from the EU-project resources on top of the – sometimes – limited financial and personal capacities available in their city departments. Furthermore, the added value of exchanging with local stakeholders affected by and tapping into the expertise of different experts from across Europe working on solutions they would like to implement, was extremely helpful for assessing and planning replication.

Form technical and political peer groups and exchange at different phases

The Follower Cities generally viewed the external support and engagement mostly as a question of transferring knowledge and working with each other. Having five cities with different framework conditions for replication, however, that undergo a similar process, helped to strengthen the technical and sometimes even political peer-exchange. Furthermore, the facilitated networking during all phases of the demonstration project has shown to help a lot. Thus, external supporters as well as cities should build in exchanges throughout the different phases of a demonstration in order not to lose any valuable reflections within the process.

Demonstration sites benefit from external perspectives for up-scaling

Last but not least, it is worth to highlighted that also the Lighthouse Cities and industry partners benefited from the external perspective and from being constantly exposed to different questions within different phases of the project to reflect about their actions. This has not only sharpened their internal decision-making in terms of implementing the solution at the demonstration site, but also to better assess and strategise the up-scaling potential.

4. CONCLUSIONS AND RECOMMENDATIONS FOR UPSCALING

The replication process has been challenging for Follower Cities and partners alike due to the variety and diversity of GrowSmarter measures. Internal and external variables have influenced the replication process. Political, technical, financial and social challenges had to be overcome during the assessment and planning phase of implementation. Nevertheless, Follower Cities were able to realise the majority of the measures they initially selected to follow and replicate. Primarily based on their work, but also reflecting other actors within the broader process of replication activities, the following conclusions and recommendations could be identified that shall support the further replicability and upscaling of smart solutions within Europe and beyond.

4.1.1. Recommendations to local governments

Achieve scale by being socially and environmentally more comprehensive and ambitious

Sharpen the Smart City as a means of sustainable urban development by being socially and environmentally more comprehensive and ambitious. A particular effort should be made to ensure the affordability, social acceptance and accessibility of smart solutions. Tackling deliberately local challenges such as sustainable housing would enable, if not already guarantee a broader scale, as political consensus is fostered as well as a diversification and higher sums of finance are available. As Smart City strategies have been environmentally consolidated over the last five years with the emphasis on climate mitigation, renewables and energy efficiency, refined concepts can and should intensify and extend the conceptual boundaries to include, maintain and improve the quality of soil, air, water or urban biodiversity. By recognising and strategically including the nexus of smart solutions to other natural resources, the positive (or negative) impact can be validated and where beneficial scaled. The integration of nature-based solutions, adaptation efforts or elements of resilience should be considered. Public procurement as a major instrument of implementing and ensuring more comprehensive social and environmental ambitions should be used. As such, the Smart City concept could strengthen its claim to advance sustainable urban development as a whole.

Govern smart developments effectively through the Integrated Management Cycle

First of its kind demonstration, replication and up-scaling of smart solutions are complex to handle due to their integrated, but often also destructive nature towards established governance, business and partnership models. Hence, more dialogue, facilitation and guidance are needed. The results of the replication process of GrowSmarter and similar experiences show that the Integrated Management Cycle provides a suitable and effective guiding structure for Smart City governance and smart urban developments. The revolving five major phases of the Integrated Management Cycle are, namely: I) Commit, mobilise and assess baseline, II) Prioritise and set targets, III) Plan action and gain political approval, IV) Implement, monitor and report as well as, V) Review, upscale and advocate. Cities should carefully analyse and gain consciousness at which stage they are in relation to the implementation of their overall Smart City concept as well as specific solutions in order to steer internal and external decision-making processes more effectively towards the desired impact.

Achieve meaningful replication by building on existing city targets, processes and plans

Many smart solutions can meaningfully contribute to further pursue already established urban ambitions on, for instance, climate, energy, mobility, health, e-governance, accessibility or public involvement. Therefore, these interlinkages and benefits should be actively and more deliberately identified and utilised within local governments' policy, technical and stakeholder processes, topical plans, budget considerations and allocations as well as implementation procedures. Doing so the road of replication for different smart solutions can easier gain momentum and scale.

Embed smart measures into the core of urban planning

The replication process shows that cities with specific climate, energy and sustainability plans (e.g. SEAP, SECAPS and SUMP) have more success in replicating smart measures than cities without them. This is also a result of measures' alignment and inclusion in these plans and an existence of a governance model to implement and follow up its implementation. Further work in the integration of smart solutions as key mitigation and adaptation actions in SECAPS or smart mobility measures as part of SUMP can not only facilitate the uptake and

adoption of smart measures, but also increase the impact of these plans as the results of lighthouse projects have proven.

Ensure new staff capacity and a cross-departmental approach

Different smart solutions commonly require the engagement and leadership of different technical staff including generalists and specialists. Several municipal departments have to be involved to implement a Smart City concept. A functioning cross-departmental approach, which is politically as well as technically rooted, determines the success and swiftness of scaling-up smart applications. Depending on the solution, the management of the refined, topical planning and following implementation, monitoring and reporting could be mandated into the existing structure of city departments. However, the governance of the overall concept as well as the review and (re-)direction of the impact demands a cross-departmental approach and management structure. The build-up of an overarching Steering Group, complemented by topic-specific working groups is recommended. Furthermore, the appointment of a technical generalist in the coordinating function of a Smart City Manager or even Site Managers (within a specific urban area) would enhance the effectiveness of the implementation. In any case, Smart City efforts will be slow or even fail, if not new and technically appropriate staff capacity is assigned to match a highly demanding job with the city's ambition.

Create an open alliance for Smart City applications

The city's internal organisational structure for smart urban development, can effectively be enhanced by engaging external stakeholders. A respective participatory structure can be formed through an open alliance dedicated to contribute to a set of agreed Smart City targets or through a more exclusive group of strategic, local players from the business, industry, banking, academia and the civil society.

Align and ally with national and regional energy and climate policies

Cities should explore the potential added value of aligning their urban goals to national energy and climate plans or digitalisation efforts, if equally ambitious in the short- and long-term. Otherwise they may demonstrate the feasibility of alternative and more ambitious pathways. In both cases, it should facilitate the access to funding for implementation. Especially in the fields of energy efficiency for public and residential buildings, as well as for sustainable mobility, with a focus on shared mobility and its related infrastructures. In this

way, and as additional benefit, part of the smart measures will be mainstreamed into local and national planning processes, which could enable the up-scaling of the most effective solutions even further. Last but not least, the alignment and respective dialogues and (lighthouse) demonstrations, would likely help to adapt the regulatory framework for a faster realisation of smart solutions.

Make technical validations comparable to enable impact investments

Cities should work with standardized methodologies and KPIs, in particular for GHG emission accounting, in order to verify, broaden and deepen the values and benefits of the implemented measures towards sustainability. This will allow them to assess and compare the impact of (different) measures implemented, meet their local targets more effectively by being able to better determine the impact of investments and access to new funding opportunities due to this development.

Find synergies with other SCC projects to implement more resource efficiently

Experiences of Follower and Fellow Cities show that several measures have been implemented also due to the existence and influence of other EU and nationally funded initiatives. Thus cities should not limit their replication focus to only one demonstration project, but explore openly further options in accordance to their baseline assessment, target and priority setting. The almost five-year process from LC demonstration to a verified impact that allows an informed decision on replication and up-scaling, clearly asks for an open and diversified exploration and exploitation process of smart solutions.

Develop location-specific innovation schemes

Innovation funds for smart solutions tackling local environment problems and climate change have emerged in the last years. The replicability and scalability of measures could also be enhanced, if innovation action and initiatives allow more flexibility in the design and scope on location-specific smart and sustainability components. Co-creation strategies and models could meaningfully contribute to this process.

Determine scalability based on experience of demonstration projects

Smart solutions can be more intentionally and impact-driven scaled based on the experiences of demonstration projects. LCs and FCs alike have been more successful in

replicating and scaling solutions due to deeper understanding of the technical needs, implementation process with stakeholders as well as verified impacts. Therefore, do demonstrate, test and physically implement innovation, while transferring knowledge to others. At the same time do enquire, follow and visit demonstration sites to assess the potential for replication and scale at home.

Budget public participation and stakeholder engagement in your implementation plan

Citizen and stakeholder participation is always recognized and highlighted as an important factor for a successful implementation of smart solutions. Hence, assemble and understand citizens' and stakeholders' needs and choose exchange formats that catalyses local actions. However, the degree to organize, effort to facilitate as well as the amount of and intensity in time that internal and external engagement processes demand, is often completely underestimated and therefore also underfinanced. Thus appropriately resource public and private actor participation processes including target group, site and sometimes even solution-specific communication campaigns to inform, activate and accompany stakeholders during the implementation phase and beyond.

Allocate resources to mobilise public and private finance as well as create and maintain partnerships

Obviously, the European and national funding schemes and conditions that could serve to replicate and scale-up implementation of smart solutions differs between different cities and countries. In those cases, where it is difficult to mobilise public finance for applying the knowhow gained and roll-out the actual implementation, it is even more important to create partnerships with local industry and science as well as banks and innovative financing schemes such as crowdfunding.

4.1.2. Recommendations for national and European authorities

Shape Smart City programmes to deliver on local sustainability and the European vision

The demonstration of smart solutions through SCC Lighthouse projects is not an end goal in itself, nor should competitiveness between cities and regions and export opportunities outside Europe dominate the funding programme's exploitation strategy and call's specifications. Reflections about the replication process in GrowSmarter and sister projects rather recommend that SCC solutions should as a primary objective contribute to put the

bold and joint vision of Europe and its individual national and local governments on sustainability into practise. Thus demonstration projects should ambitiously deliver on realising climate neutrality, social cohesion and green growth. The better SCC solutions are able to demonstrate that smart grids deliver climate neutral districts, positive energy buildings can be affordable in a mixed neighbourhood or jobs within renewables and energy efficiency services do equally offer well-paid, skilled employment to coal and carbon-intensive regions in transition, the better the political and social acceptance and potential for scale.

Support more demonstration projects as they prove to cause big changes

Neither a city nor their dedicated funding programmes should underestimate the need for additional resources in order to implement first of its kind smart solutions. Already due to the integrative nature of the measures, supplementary resources for facilitation are needed so that new process within different departments and between local stakeholders can be successfully organised. At the same time, the Smart City concept proves to meaningful deliver on the energy and climate responsibilities within cities (and therefore nations). Results of the lighthouse projects not only show a concrete impact at the demonstration site, but subsequently also an accelerated transition in the urban development of the entire city. Moreover, the demonstration sites prove to facilitate the political support in other cities. Therefore, more physical demonstration projects should be funded.

Seek regular dialogues with demonstration cities to adapt framework conditions for scaling smart urban development

One of the principal objectives of the SCC is to help spread successful smart solutions to other urban areas and cities across Europe. It is therefore imperative that this replication process is well supported through policies and instruments at the European and national level. Thus it is recommended, that the knowledge transfer between all governmental levels take place regularly and systematically. In particular, national and European authorities should seek the interaction with local authorities that are part of demonstration projects funded by European and national funding programmes in order to transpose lessons learnt into European Directives and national regulations. The existing efforts of the European Commission on promoting and sometimes requiring a closer collaboration between projects working on similar topics, and sharing opportunities for learning cities is appreciated. The

funding available for a peer-to-peer exchange between cities and study visits should be kept, if not enhanced.

Renew regulatory frameworks to reduce transaction costs for implementing smart solutions

The replication of some smart measures have been restricted due to the existence of regulatory frameworks that impede specific actions, especially in the field of sustainable mobility (traffic restrictions rules) and building retrofitting (national building codes, historic buildings prohibitions, property ownership, ownership acts). These framework conditions either lead to higher transaction costs for replication or freeze an advancement of activities at an early planning stage until regulatory changes are introduced.

Recognise, incorporate and empower local policies and ambitions

Numerous cities throughout Europe are committed to sustainable development. Often they also walk the talk of the digital transition, climate neutrality or a fossil-free, smart energy system much faster than the national level is able to do. Therefore, national and European authorities should recognise and use the municipal willingness for a rapid transformation much more actively and systematically, build on ambitious targets of cities and regions by incorporate them in national planning processes as well as empower local policies through mandates and resources to contribute with their substantial knowhow and experience.

4.1.3. Recommendations to industry and business partners

Develop citizen-centred solutions

Replication of measures in cities require a deep understanding of citizen's needs, hand to hand with local governments. Private actors should work and collaborate with local governments to develop meaningful solutions to citizens, based on the city's goals and vision. The creation of physical innovation spaces to showcase the benefits of different smart measures has proven to be an effective catalyse for scale.

Partner strategically with local businesses and entrepreneurs for local development

In the replication plans the Follower Cities recognize the importance of finding local industry partners, SMEs or start-ups that can support the transposition, adaptation and further development of the selected measures within their own territories. Furthermore, replication is linked to the availability of technological solutions and the appetite of local market in different cities. Local partners may provide access to local demands and implement measures potentially more cost effectively. Involving local partners such as SMEs usually also enhance the political support as well as offer other options of start-up financing, if needed.

Strengthen transferability of climate impact assessments of smart solutions

The baseline scenario of GHG emissions' reduction potential of single and combined smart measures need to be developed more consistently and communicated clearer and more transparent. The integrated nature and complexity of different measures and the sometimes impossibility to transfer specific methodologies for an assessment in other locations, did not always allow Follower Cities to effectively compare and evaluate the potential impact of a solution. As this information is decisive for the political decision-making to approve measures and respective finance, stronger efforts should be made on the transferability of accounting and verifying GHG methodologies on smart solutions.

Seek dialogues with cities to speak the same language and listen to their needs

A strong collaboration between industrial partners and Follower Cities should not be assumed to be straight forward as the replication process of lighthouse demonstration projects showed. A lot of facilitation is required due to the following aspects among others: the complexity of urban development projects, integrated nature of the smart solutions, the implementation timeline within the Lighthouse Cities including technical constrains and delays during the implementation, the technology readiness, the geographical scope of services provision and the business opportunity potential to replicate some measures. Acknowledging this, it is recommended that market actors regularly dialogue with political and technical decision-makers to gain a good understanding of the cities' interests and needs in implementing their vision on smart urban development.

5. SOURCES AND REFERENCES

List of References		
Name of document	Link	Finalised
<ul style="list-style-type: none"> • GrowSmarter factsheets 	http://www.grow-smarter.eu/solutions/	2016–2019
<ul style="list-style-type: none"> • Cork Replication Plan • Graz Replication Plan • Porto Replication Plan • Suceava Replication Plan • Valletta Replication Plan • Replication Assessment Reports of the Follower Cities 2015 • Replication Assessment Reports of the Follower Cities 2017 	http://www.grow-smarter.eu/inform/reports/	Feb 2016, June 2017, Dec 2018, Dec 2019
<ul style="list-style-type: none"> • Concluding Report Low Energy Districts • Concluding Report Integrated infrastructures • Concluding report Sustainable Urban Mobility 	www.grow-smarter.eu/insights	Nov 2019
<ul style="list-style-type: none"> • Report on technical and social validation 	www.grow-smarter.eu/insights	
<ul style="list-style-type: none"> • Project brochure, D8.3 • Project result Brochure, D8.10 	http://www.grow-smarter.eu/inform/press-corner/	Update 2017, Nov 2019

6. ANNEXES

Annex 1:

Solution	Smart Solutions	Porto	Graz	Cork	Valetta	Suceava
Low Energy Districts	1. Efficient and smart climate shell refurbishment		Not Replicated	Full implementation ongoing Measure 1.1 - Energy efficient refurbishment of buildings		Planned for full implementation Measure 1.1 - Energy efficient refurbishment of buildings
Integrated Infrastructure	5. Smart lightning, lampposts as hubs for communication	Full Implementation. Measure 5.2 Combined electrical charging and street lighting poles + w ifi	Not Replicated	Not Replicated		Full implementation. Combination of measures 5.1 Smart Streetlighting and 5.2 Combined electrical charging and street lighting poles + w ifi
	6. Waste heat and local heat integration by new business models		Not Replicated			
	7. Smart waste collecting, turning waste to electricity, heat and biogas for vehicles.	Planned for full implementation Combination of Measures: 7.1 Optical Sorting of Waste, 7.2 Introduction of AWCS and, 7.3 Waste collection statistics for individual households.				Planned for partial replication Combination of Measures: 7.1 Optical Sorting of Waste and 7.3 Waste collection statistics for individual households.
	8. Big data protocol for saving energy and improving the quality of life	Planned for partial replication Measure 8.1 Big consolidated open data platform	Planned for partial Replication Measure 8.1 Big consolidated open data platform			
Mobility measures	9. Sustainable delivery		Partial Implementation. Adaptation of measure 9.1: Integrated multi-mode transport for light goods		Partial Implementation Combination of measures 9.1 Integrated multi-mode transport for light goods and 9.2 Micro distribution of freight & charging infrastructure	
	10. Smart traffic management					Planned for full implementation Measure 10.1 Traffic management through MFD (macroscopic fundamental diagram)
	11. Alternative fuel driven vehicles for decarbonizing and better air quality			Full Implementation. Measure 11.1 Developing charging infrastructure & E-mobility management system	Full Implementation Measure 11.1 Developing charging infrastructure & E-mobility management system	
	12 Smart mobility solutions		Not Replicated	Full Implementation Combination of measures 12.2 Electrical and cargo bike pool, 12.3 Mobility station and 12.4 Electrical and conventional car and bike sharing	Full Implementation Combination of measures 12.2 Electrical and cargo bike pool, 12.3 Mobility station and 12.4 Electrical and conventional car and bike sharing	Not Replicated



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 646456. The sole responsibility for the content of this report lies with the author and in no way reflects the views of the European Union.



About GrowSmarter

GrowSmarter brings together cities and industry to integrate, demonstrate and stimulate the uptake of '12 smart city solutions' in energy, infrastructure and transport, to provide other European cities with insights and create a ready market to support the transition to a smart, sustainable Europe.

GrowSmarter project partners



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 646456. The sole responsibility for the content of this report lies with the author and in no way reflects the views of the European Union.