

REPLICATE PROJECT

Renaissance of Places with Innovative Citizenship And Technology



This Project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N° 691735

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REnaissance of PLaces with Innovative Citizenship And Technology

Project no. 691735

H2020-SCC-2015 Smart Cities and Communities

Innovation Action (IA)

D10.2 Report on indicators for monitoring at city level

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1. REPLICATE

The REPLICATE project will generate smart city business models, and tailor-made solutions in the areas of energy, transport and ICT starting from the districts: Urumea Riveside (San Sebastián), Novoli (Florence) and Ashley, Easton and Lawrence Hill Neighbourhood (Bristol). In summary there will be pilot actions in energy efficiency, efficient and sustainable transport and integrated infrastructures, being the latter the key elements for the integration and development of cross-sectorial solutions. Three follower cities participate in the project: Essen (Germany), Nilufer (Tutkey) and Lausanne (Switzerland).

Being a demonstration project, the main concept that is on the top of the project is REPLICABILITY: it will be necessary that the project results could be applicable throughout the lighthouse cities and in other cities which want to evolve towards the 'smart city' concept, and could grow of scale too. To assure the large scale deployment of innovative technologies successfully demonstrated in the lighthouse districts specific studies will be necessary for each of the demonstrated solutions to ensure that they are scalable and can be replicated.

Prior to REPLICATE project San Sebastian, Florence and Bristol have already collaborated in a STEEP project (Systems Thinking for Comprehensive City Efficient Energy Planning) which have allowed to the cities generate Smart City Plans. STEEP project has defined a collaborative and participatory methodology to reach the objective of defining an Action Plan for particular districts of each city.

The main objective of REPLICATE project is the development and validation in three lighthouse cities (San Sebastián – Spain, Florence – Italy and Bristol – UK) of a sustainable City Business Model to enhance the transition process to a smart city in the areas of the energy efficiency, sustainable mobility and ICT/Infrastructure, in order to accelerate the deployment of innovative technologies, organisational and economic solutions to significantly increase resource and energy efficiency, improve the sustainability of urban transport and drastically reduce greenhouse gas emissions in urban areas.



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2. INTRODUCTION

The monitoring of the evolution of the sustainability performance of cities, understanding cities sustainability as a wider concept not limited to the social, economic and environmental dimensions but also considering other aspects such as governance, mobility, innovation or security among other aspects is becoming of special interest for understanding the baseline situation of cities. The definition of the baseline situation with an adequate diagnosis of the city can help to define specific objectives for each of the areas of the city in order to achieve the desirable future situation.

In the first task of WP 10 "Selection of indicator frameworks for the monitoring program and baseline analysis", an indicator framework has been selected. This framework is coherent with the general evaluation framework of the REPLICATE project and has been designed at two levels:

- 1. Indicators related to the technical performance monitoring: Project level technoeconomic and social indicators.
- 2. Indicators which correspond to the many dimensions that can be considered on a wide sustainability assessment of cities: City level indicators.

Results of task 10.1 are provided in 3 different deliverables, whose are submitted simultaneously:

- Deliverable 10.1 Report on indicators for monitoring at project level. This deliverable defines the monitoring framework of the interventions and the project indicators defined for this purpose.
- Deliverable 10.2 Report in indicators for monitoring at city level.
- Deliverable 10.3 Baseline analysis of city level indicators for follower cities and benchmarking with lighthouse cities. Based on the City level KPIs defined in deliverable 10.2; D10.3 provides the baseline assessment of the lighthouse and follower cities. Lighthouse results were used to benchmark.

This report (deliverable 10.2.) explains the city level monitoring framework definition process.

2.1 Relation to Other Project Documents

The following relationship of this deliverable with other deliverables and with other WPs developed within the Replicate project should be considered along with this document for further understanding of its contents.



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- Relation with the D10.10. "Yearly reports monitoring city level indicators for the three lighthouse cities" where the framework defined and the indicators defined in this deliverable will be used for the yearly monitoring.
- This deliverable is also related to the replication part of the project (WP8) considering that the process described here has to serve also to other cities in the case that they are interested on following a similar process.
- 2.2 Reference documents

This document is based in the following projects level documents:

Ref.	Title	Description			
REPLICATE Grant Agreement signed 240713.pdf	Grant Agreement	Grant Agreement no. 691735			
DoA REPLICATE (691735)	REPLICATE Annex 1 – DoA to the GA	Description of the Action			
REPLICATE Consortium agreement signed December 2015 (7 th December version)	Consortium Agreement	REPLICATE project – Consortium Agreement			
REPLICATE	D1.1 Project Management	REPLICATE Project			
Project Management Plan	Plan (v.1) (29/04/2016)	Management Plan			
REPLICATE	D1.4 District Management	REPLICATE District			
District Management Plans	Plan San Sebastian	Management Plans			
	D1.5 District Management Plan Florence				
	D1.6 District Management Plan Bristol				
REPLICATE	D11.1 Communication Plan	REPLICATE			
Communication Plan		Communication Plan			

These will also be stored on the shared online platform.



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Where there are contradictions, the documents listed above supersede this plan. The Grant Agreement is the contract with the European Commission so takes precedence over all other documents.

2.3 Abbrevations list

GA	Grant Agreement
СА	Consortium Agreement
DoA	Annex I-Description of the Action
EC	European Commission
H2020	Horizon 2020
КРІ	Key Performance Indicators
PC	Project Coordinator
PL	Pilot Leader
РМР	Project Management Plan
тс	Technical Coordinator
WP	Work Package
WPL	Work Package Leader



3. DELIVERABLE DESCRIPTION

Current deliverable 10.2 "Report on indicators for monitoring at city level" is focused in the City level indicators. Moreover, it explains monitoring program and how the city level indicators are integrated in the monitoring program. Figure 1 summarizes the steps followed in the city level KPI selection process detailed in this deliverable.



The city level monitoring framework definition process is described under the present document which covers:

- Section 1: State of the art on indicator frameworks for cities. The first section of the deliverable summarizes the studied sources of information about the exisiting indicator frameworks for cities. It organizes the indicators considering the dimensions they are related to and according to the scale that they apply. The preliminary proposal of city level indicators for Replicate was based on this state of the art.
- Section 2: Definition of the city level Key Performance Indicators. After making the preliminary proposal of city level indicators for Replicate, section 2 describes the validation process followed until the final city level indicators framework was defined.



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 Section 3: Definition of the monitoring framework for Replicate project. In this section the methodology that is followed in the project for the measurement and evaluation of the performance of the different interventions implemented in the lighthouse cities as well as for the measurement of the impact that the implementation of specific interventions have in their respective cities is described.

The Annex I collects the key performance indicators for cities description.

It is important to note that the baseline analysis of the city level indicator based on the framework presented in this deliverable, it is presented in deliverable 10.3 "Baseline analysis of city level indicators for follower cities and benchmarking with lighthouse cities". This deliverable presents the results of the application of the city level indicators framework of lighthouse and follower cities.



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4. State of the art on indicator frameworks for cities

This chapter explains the first step of the city level KPI selection process: how the relevant indicators have been preselected. The state of the art made has as a result a long list of indicators that have been classified according to the dimension that they define and the scale that they apply. This preselection is also included at the end of this chapter.

Figure 2 summarizes how the relevant indicators selection has been made. First, an exhaustive state of the art in existing indicator frameworks has been made. While making the bibliography search, a list with all the indicators considered in the sources of information was made and the indicators were classified according to 2 different criteria: the interesting for REPLICATE dimensions that they cover and the scale that they could be applied.



Figure 2: Relevant indicators selection process

Following chapters describes the results of the state of the art. Depending on the relevance according to the objectives, the studied information sources have been divided into main sources and other sources of information. Before of the description of studied sources of information the aspects considered while making the review are explained.



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4.1 Aspects considered in the review

The selection of the potential indicators for being part of the KPI of cities has been made taking into account that the framework should fulfil the following objectives:

- Provide an overview of the city performance. It should reflect clearly the most important issues of the city performance.
- Allowing making a monitoring of the evolution of this performance.
- Allowing understanding the motivations of the changes in the city performance.
- Allowing making comparisons between cities.
- It should be useful for the follower cities to understand the position in which they are in comparison with the lighthouse cities.
- Contribute to the development of future standards

As it was mentioned before, 7 dimensions have been defined in order to classify the indicators found in the review process. These 7 dimensions as a whole cover all the city performance:

- 1. Energy
- 2. Environment
- 3. Mobility
- 4. Infrastructures for innovation
- 5. Governance
- 6. Social
- 7. Economy and finance

While making the bibliography search, the indicators were also classified according to the applicability scale. For this purpose, 3 scales were considered in the review process:

- 1. National / Regional
- 2. Local / City
- 3. District

These 2 classifications were made while making the bibliography search in order to help the selection and validation of indicators that will be part of the City level KPI framework. The dimensions classification helps to ensure that all the relevant aspects related with city performance are covered and well defined by indicators. This helps to develop a KPI framework





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that provides a complete overview of the city. On the other hand, the classification of the indicators depending on the scale that they allow to analyse helps to exclude directly those indicators that are not applicable at city level.

4.2 Main sources considered

Because of their alignment with REPLICATE project, the International Standard ISO 37120; STEEP and CITYKEYS among other projects have been studied deeply during the bibliography search. A detailed description of these information sources is provided below. Here three of these sources are evaluated more in detail since there are of reference for the Replicate project and for other Smart City European projects.

4.2.1 STEEP project

San Sebastian, Florence and Bristol cities collaborated also in the STEEP project (Systems Thinking for Comprehensive City Efficient Energy Planning). STEEP project identified as an opportunity working together with these 3 cities because all three cities have a similar geographical, economical, industrial, and services conditions, and all have experience and policies in specific sustainable use and production of energy, with very ambitious carbon and energy reduction targets aligned with Europe's targets.

The STEEP project created a process model based on system thinking for district planning. That process model was applied to three city districts to better understand the relevant systems impact upon energy use and to identify the interventions which can be taken to meet the ambitious energy and carbon targets, among others. This model was enriched and validated through open innovation methodologies applied at the city level. As a basis for the development of comprehensive Smart City Plans, the learning obtained from the process model for district planning was applied at the city level. With the knowledge gathered in this process, an open-source methodology for developing integrated Smart City Plans and a list and calculation methodology of Key Performance Indicators for the monitoring of Smart City Plans were designed.

STEEP indicators framework was developed to measure how the master plans developed perform. For that purpose an indicators system which able to underline achievements and critical points was developed. This system allows judging which approaches are successful or not. STEEP framework resulted in a short but valuable list of indexes that is summarized in table 2.



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Table 2: Summary of the STEEP indicators framework

Themes	Subtheme	N° Indicators
Energy	Emissions	3
	Electricity	1
	RES	3
	Energy efficiency	3
Mobility	Public transport	2
	Private fleet	1
	Alternative transport infrastructure	3
ICT	Internet connections	2
	Info-mobility	2
	PA Digitalization	2
Governance	Services efficiency	5
	Other plans	_
PA	Energy consumption of PA	4
	Renewables	3
	Green public procurement	1
Social	City use	2
	Education	2
	Participation	-
Economy and Finance	-	5
Control	-	2
	Total	46

STEEP indicators framework was used in REPLICATE as a base to define City level KPIs. Therefore, the definition of REPLICATE dimensions and categories was mainly based on STEEP developments and several of STEEP indicators were included in REPLICATE framework and completed with indicators from other sources explained below.

4.2.2 CITYKEYS project

CITYkeys project aims to speed up the transition to low carbon, resource efficient cities by facilitating and enabling stakeholders in smart city projects and cities to learn from each other, create trust in solutions, and monitor progress, by means of a common performance



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measurement framework. Rotterdam, Tampere, Vienna, Zagreb and Zaragoza are the cities involved to define the needs, analyse existing results and develop recommendations for the use of performance indicators in CITYkeys. The project started in February 2015 and will run for 2 years.

For the development of the performance measurement framework, CITYkeys is building on existing smart city and sustainable city indicators systems. The CITYkeys assessment method and indicators are to be used to evaluate the success of Smart City projects and the possibility to replicate the projects in other contexts.

Therefore the core of the CITYkeys indicators framework will be useful to evaluate the extent to which Smart City projects are able to have an effect on social, ecological and economic factors. These sustainability issues are assessed through people, planet and prosperity impact categories respectively. However, as the project mentions, this is not enough to determine the success of a Smart City Project. Thus, CITYkeys also considers other indicators that allow assessing the importance of the city context (external factors) and quality of the development and implementation process (internal factors). These issues are considered under the Governance category or theme.

Moreover, other interesting aspect of CITYkeys for REPLICATE is that it takes into account the ability of individual Smart City project to be copied in other cities and contexts through the propagation category or theme.

Finally, each of the major themes (people, planet, prosperity, governance and propagation) were defined by subthemes as it is included in the table 3.

Themes	Subtheme	N° Indicators
People	Education	3
	Diversity and social cohesion	3
	Safety	2
	Health	3
	Quality of housing and of the built environment	7
	Access to (other) services)	8
Planet	Energy and mitigation	11
	Materials, water and land	10
	Climate resilience	1

Table 3: Summary of the CITYkeys indicators framework



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Themes	Subtheme	N° Indicators
	Waste and pollution	8
	Ecosystem	2
Prosperity	Employment	2
	Equity	2
	Green economy	4
	Economic performance	6
	Innovation	6
	Competitiveness and attractiveness	1
Governance	Multilevel governance	2
	Organization	7
	Co-creation	4
	Community engagement	0
Propagation	Replicability and scalability	10
	Factors of success	8
	Total	110

Indicators collected in this standard were studied and several of them are part of City level KPI of REPLICATE as it is explained in chapter 4.

4.2.3 ISO 37120

The International Standard ISO 37120 named "Sustainable development of communities. Indicators for city services and quality life", establishes definitions and methodologies for a set of city indicators to steer and measure delivery of city services and quality of life. This set of standardized indicators provides a uniform approach to what is measured, and how that measurement is to be undertaken. Because of this it is a very valuable source for REPLICATE project.

As the ISO establishes, the requirements contained in this International Standard are applicable to any city, municipality or local government that undertakes to measure its performance in a comparable and verifiable manner, irrespective of size and location.



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The indicators defined in the ISO can be used to track and monitor a city's progress on city service performance and quality of life and assist cities in setting the targets and monitoring achievements.

It is important to note that as a list, the ISO does not provide a value judgement, or threshold or a target numerical value for the indicators. In other words, the application of the indicators framework of this standard will provide a picture of the city at the moment of application. To monitor city progress results from different years or periods will be needed.

This standard divides the indicators into core and supporting indicators. Both types are classified into themes according to the different sectors and services provided by a city. Table 4 summarizes this information from the ISO.

Themes	N° Indicators	Core	Supporting
Economy	7	3	4
Education	7	4	3
Energy	7	4	3
Environment	8	3	5
Finance	4	1	3
Fire and emergency response	6	3	3
Governance	6	2	4
Health	7	4	3
Recreation	2	0	2
Safety	5	2	3
Shelter	3	1	2
Solid waste	10	3	7
Telecommunication and innovation	3	2	1
Transportation	9	4	5
Urban planning	4	1	3
Wastewater	5	5	0
Water and sanitation	7	4	3
Total	100	46	54

Table 4: Summary of the indicators considered by ISO 37120



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Several of these indicators were included in City level KPI indicators framework of REPLICATE.

4.3 Other sources studied in the review

Main studied sources from the state of the art were explained in previous chapter. This chapter summarizes other studied sources of information for the construction of REPLICATE city level KPI framework.

- Eurostat City Statistics: Urban Audit

Eurostat provides the European Union with statistics at European level that enable comparisons between countries and regions. Within its city statistics, the "Urban Audit" data collection provides information and comparable measurements on the different aspects of the quality of urban life in European cities.

- PLEEC European project methodology

The PLEEC (Planning for Energy Efficient Cities) project, funded by the EU Seventh Framework Programme, uses an integrative approach to achieve the sustainable, energy-efficient, smart city. By coordinating strategies and combining best practices, PLEEC will develop a general model for energy efficiency and sustainable city planning. PLEEC project provides a set of indicators in order to describe energy efficient urban development in a quantitative way, based on the definition of key fields and respective domains for energy efficient development.

- White Paper on Sustainability of Spanish Urban Planning

The White Paper on Sustainability of Spanish Urban Planning identifies the various spheres of influence of planning and the main objectives to be pursued in application of the sustainability strategies in each case.

- System of indicators and conditions for large and medium-sized cities

To develop a system of indicators that could be applied at the municipal and state levels, in addition to being consistent with the Agenda 21 goals and the municipalities belonging to the Spanish Network for Sustainable Local Development

- Emerging and Sustainable Cities Initiative (ESCI)

Was created by the Inter-American Development Bank (IDB) in 2010 in response to rapid and largely unregulated urbanization in the Latin American and Caribbean (LAC) regions, and the resulting urgent need to deal with the sustainability issues faced by the region's rapidly growing inter mediate-size cities.

- ISO 37120 Sustainable development of communities



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ISO 37120 establishes definitions and methodologies for a set of city indicators to steer and measure delivery of city services and quality of life. As part of a new series of International Standards being developed for a holistic and integrated approach to sustainable development and resilience, this set of standardized indicators provides a uniform approach to what is measured, and how that measurement is to be undertaken.

- UN Habitat: City Prosperity Index

The City Prosperity Index (CPI) of the UN Habitat states that cities can take different paths to prosperity and does not only provide indices and measurements; it also enables decision-makers to identify opportunities and potential areas along the path of prosperity.

- KPI definitions for Smart Sustainable Cities of the ITU-T

The deliverable 'Key performance indicators definitions for smart sustainable cities' of the ITU Focus Group on Smart Sustainable Cities (FG-SSC) defines the Key performance indicators applicable for the impact of Information and Communication Technology (ICT) on Smart Sustainable Cities (SSC) are defined taking into consideration the definition of SSC from ITU-T FG-SSC, City Prosperity Index of UN Habitant, and ISO draft standard DIS 37120. The proposed set of KPIs focuses specifically on a set of ICT related KPIs for smart sustainable cities and does not cover all KPIs of cities contained in the ISO draft standard.

- BREEAM Communities 2012

BREEAM Communities is a way to improve, measure and certify the social, environmental and economic sustainability of large-scale development plans by integrating sustainable design into the master planning process. The scheme is for developers, master planning professionals, local authority planners, local politicians, communities and relevant statutory bodies. BREEAM Communities is an independent, third party assessment and certification standard, rating tool.

- LEED 2009 for Neighbourhood Development

It is a certification scheme issued by the USGBC in 2009. The scheme offers a rating system for new land development projects or redevelopment projects containing residential uses, nonresidential uses, or a mix. It considers the character of a neighbourhood, including its streets, homes, workplaces, shops and public spaces, affects quality of life.

- DGNB New Urban Districts

The purpose of the certification is based on protection of the environment and conservation of resources; minimization of costs; health, comfort and well-being of building occupants and users; sustainable mobility; promotion of innovative sustainability approaches and technologies.

- HQE2R project for Urban Planning and Development



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European research and development Project on sustainable renovation of the built environment and the regeneration of urban neighbourhoods. The objectives of the project were focussed on developing a new methodology or approach together to promote sustainable development and the quality of life at the urban neighbourhood level and allowing local authorities to implement regeneration action plans in their neighbourhoods and renovation of their buildings towards sustainable development.

- Sustainability Profile of a Location (DPL)

The initiative develops and tests a challenging tool for assessing sustainability at district level.

- EU Sustainable Development Strategy (EU SDS)

The Sustainable Development Indicators (SDIs) are used to monitor the EU Sustainable Development Strategy (EU SDS) in a report published by Eurostat every two years. Indicators are intended to give an overall picture of whether the European Union has achieved progress towards sustainable development in terms of the objectives and targets defined in the strategy.

- European Common Indicators (ECI)

The European Common Indicators (ECI) – Towards a Local Sustainability Profile initiative is focused on monitoring environmental sustainability at the local level. A set of 10 environmental sustainability indicators have been developed in conjunction with stakeholders and methodologies for collecting the data for each indicator have also been produced in different European languages.

In a summarized way, more than 15 indicators frameworks were studied in the state of the art. Main conclusions about this review and the first proposal of REPLICATE city level KPIs are presented in the following chapter.

4.4 Main conclusion of the indicators framework: First proposal of Replicate city level KPIs

An extensive review of existing indicators frameworks for cities has been made in order to develop a robust city level KPIs for cities. Table 5 presents a summary of the analysed frameworks. It indicates for each framework the total number of indicators considered, the dimensions covered and the applicability scale.



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Table 5: Summary of the analysed frameworks

			Dimensions covered				Scale				
Framework	N° Indicators	Energy	Environment	Mobility	Infr. For innovat.	Governance	Social	Econ.& finance	Nat / Reg	Local /City	District
Eurostat City statistics: Urban Audit	100	х	х	x	x	x	х	х		x	
PLEEC European project methodology	60	х	х	x						х	
White Paper on Sustainability of Spanish Urban Planning	102	x	x	x		x	x			x	
System of indicators and conditions for large and medium-sized cities	52	x	x	x			x		x	x	
Emerging and Sustainable Cities Initiative (ESCI)	23	х	х	x	x	x		х		x	
ISO 37120 Sustainable development of communities	100	x	x	x	x	x	x	x		x	
UN Habitat: City Prosperity Index	35	х	х	x			x	x		x	
KPI definitions for Smart Sustainable Cities of the ITU-T	17	x	x		x		x	x		x	
BREEAM Communities 2012	40	х	х	x		x	x	х		x	x
LEED 2009 for Neighbourhood Development	56	х	х	x			x				x
DGNB New Urban Districts	45	х	x	x		x	x	х			x
HQE2R project for Urban Planning and Development	51	x	x	x		x	x				x
Sustainability Profile of a Location (DPL)	25	х	x				x	х			x
EU Sustainable Development Strategy (EU SDS)	28	х	x	x		x	x	х			
STEEP Project	46	х	х	x	x	x	x	x		x	x
CITYkeys project	110		х			x	x	x		x	x
European Energy Award	100	х	х	x		x		х		x	

From this long list of indicators an analysis of the most suitable for REPLICATE project purposes have been selected and proposed for being part of the City level KPIs framework. As a result of



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this analysis a preliminary proposal of city level KPIs was presented for validation. This proposal consisted on 54 indicators classified as the following table 6 establishes.

Table 6: First proposal of Replicate city level KPIs

Dimension	Subcategory	N° Indicators
City Description	-	4
Energy and environment	Emissions	3
	Environmental Quality	2
	Energy	1
	Renewable energy sources	2
	Energy Efficiency	3
	Services Efficiency	4
Mobility	Access to public transport	1
	Public transport use	1
	Congestion	1
	number of fossil fueled four wheels vehicles per capita	1
	number of fossil fueled two wheels vehicles per capita	1
	Number of vehicles > EURO4	1
	Alternative transport infrastructure	5
	Traffic Accident	1
Infrastructures for	Internet connections	2
innovation	Info mobility	2
	Digitalization	2
	Number of infrastructure components with installed sensors	1
Governance	-	4
Social	-	5
Economy and Finance	-	7
	Total	54

The first proposal of REPLICATE city level KPIs is the main result of the state of the art and establishes the basis for defining the final version. The validation process followed for this



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purpose and the city level KPIs framework obtained as a result is presented in following chapter.



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5. Definition of the city level Key Performance Indicators

This chapter explains the indicators validation and the city level KPIs selection steps from the City level KPI selection process. As a result of this process the city level KPIs framework for REPLICATE project was obtained.

Figure 3 summarises the steps followed of the validation and selection processes. Chapter 4.1 develops the indicators validation process, which consisted on the preparation of an Excel file that collects and explains the indicators preselected during the state of the art; an analysis of these indicators from the lighthouse cities that had as a result the validation, inclusion or exclusion of indicators. The city level KPI final selection is explained in chapter 4.2 and consisted on placing in common the results from the validation process; the presentation of the final selection of city level KPI and the definition of which indicators are mandatory and secondary.

The last step of the city level KPI selection process was the definition of the relation of city level indicators with intervention level indicators explained in Deliverable 10.1 "Report on indicators for monitoring at project level". This relation is explained in chapter 5 together with the monitoring framework defined for REPLICATE.





5.1 Validation process of the KPIs

In order to make the final selection of the city level KPIs of REPLICATE, project partners reviewed the indicators framework proposed. For this purpose, an Excel file was created (Figure 4). This Excel file collects the information needed for assessing the interest of including or excluding an indicator from the framework:

- Name of the indicator
- Unit
- Description
- Measurement method
- Source (from the state of the art)

	INDICATOR	Supporting measures	UNITS	DESCRIPTION	MEASUREMENT METHOD	SOURCE	EXPECTED DATA SOURCE
CITY DESCRIPTION	Population of the city	population	inhabitants	Total number of persons inhabiting a city		STEEP	Eurostat
	Population increase rate		%	Increase of the population of the last year		REPLICATE	
	Tourism intensity	commuters + tourists	nights/100.00 0	Number of tourist nights per year per 100.000 inhabitants		UNECE; European Green	tourism tax information, European Cities Marketing Benchmarking
	Climate koppen geiger classification		-	The Köppen climate classification scheme divides climates into five main groups (A, B, C, D, E), each having several types and subtypes. Each particular climate type is represented by a two- to four-letter symbol.	-	REPLICATE	
	Population Density		Number of people per km2	Number of people per km2	Population density is calculated as the ratio of number of inhabitants (numerator) divided by the overall area of the city (km²) (denominator).	STEEP, CITYKEYS, FIN Indicators	City statistics

- Expected source of data

Figure 4: Fragment of the Excel file prepared for indicators validation.

Experts from lighthouse and follower cities participated in the validation process. Table 7 summarizes the indicators validation results. It follows the same structure of "Table 6: First proposal of Replicate city level KPIs" but includes in grey the number of indicators of the first proposal, in green the indicators added during validation and in red the indicators subtracted. Final number of indicators per dimension and category is indicated in light blue.



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Table 7: indicators validation results

Dimension	Subcategory	N° Indicators
City Description	-	4+1= <mark>5</mark>
Energy and environment	Emissions	3 -2 =1
	Environmental Quality	2
	Energy	1
	Renewable energy sources	2+1= <mark>3</mark>
	Energy Efficiency	3
	Services Efficiency	4
Mobility	Access to public transport	1
	Public transport use	1
	Congestion	1 -1 =0
	number of fossil fueled four wheels vehicles per capita	1
	number of fossil fueled two wheels vehicles per capita	1
	Number of vehicles > EURO4	1 -1 =0
	Alternative transport infrastructure	5+1= <mark>6</mark>
	Traffic Accident	1
	Modal Split	0+3= <mark>3</mark>
Infrastructures for	Internet connections	2
innovation	Info mobility	2
	Digitalization	2-1=1
	Number of infrastructure components with installed sensors	1
Governance	-	4 +1 =5
Social	-	5
Economy and Finance	-	7
	Total	54+ 7-5 = 56

As a result of the validation process, 56 indicators were selected to be part of the monitoring framework at city level. During the validation process, 5 indicators were eliminated from the framework and 7 indicators were added. Project partners agreed in the finally selected



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indicators. City Level Key Performance Indicators framework for REPLICATE is presented in following chapter.

It has to be mentioned that many other indicators have been discarded during this process even if there can be considered as interesting. Here, as an example, indicators related to the Citizen co-creation for Innovation such as the followings can be considered by other cities that are interested on replicating the process defined in this project.

- Number of smart city related business incubators per capita
- Number of smart city related startups per capita
- Public and private resources supporting city based smart city related business
- Citizen participation in solving city problems:
 - o Number of citizen proposals per capita
 - o Public infrastructures for gathering and analyzing citizen participation

But considering that the city indicator monitoring has to be maintained during various years, an effort has been made in order to keep limited the final set of indicators.



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5.2 Final selection of KPIs for REPLICATE

As it was explained before, selected indicators are classified into 7 different categories/dimensions:

- City Description: 5 indicators.
- Energy and Environment: 14 indicators.
- Mobility: 14 indicators.
- Infrastructures for innovation: 6 indicators.
- Governance: 5 indicators.
- Social: 5 indicators.
- Economy and Finance: 7 indicators.

The complete City Level Key Performance Indicators framework for REPLICATE is included in figure 5.





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Figure 5: City Level Key Performance Indicators framework for REPLICATE

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It is important to note that, from the KPI list, Indicators are classified in Mandatory or Secondary according to the interest of the information that they provide. Representatives of cities project partners decided about this issue during the validation process of the city level KPI. Figure 6 highlights the mandatory indicators of the framework. In a summarized way, 42 of the 56 indicators of the monitoring framework are considered mandatory in REPLICATE project.



Figure 6: Mandatory indicators of the City level KPI monitoring framework. Highlighted in dark blue.



For each of the indicators included in the City Level Key Performance Indicators framework for REPLICATE, Annex I includes a sheet with information. A description, measurement method, data sources, etc., for each indicator are included in the sheets, which follows the format described in figure 7.



Figure 7: Description format of each KPI from the indicator framework

Selected monitoring framework as a whole provides a very completed overview of the state of cities; it allows tracing the evolution of the cities and understanding better the reasons of this evolution; it allows to measure the success of the interventions and to compare with other cities.

The selection of the potential indicators for being part of the KPI of cities has been made taking into account that the framework should fulfil the following objectives:

- Provide an overview of the city performance. It should reflect clearly the most important issues of the city performance.
- Allowing making a monitoring of the evolution of this performance.
- Allowing understanding the motivations of the changes in the city performance.



- Allowing making comparisons between cities.
- It should be useful for the follower cities to understand the position in which they are in comparison with the lighthouse cities.

Presented city level indicators were used to perform the city level baseline analysis of the lighthouse cities. The analysis of the lighthouse cities was also useful to establish benchmarks for the follower cities, serving as a first input to the "Replication" WP8.

On the other hand, chapter 5 "Definition of the monitoring framework for Replicate project" describes the monitoring framework selected to be implemented in next steps of the project and the role of city level KPIs within the monitoring framework.



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6. Definition of the monitoring framework for Replicate project

This framework describes the methodology that is followed in the project for the measurement and evaluation of the performance of the different interventions implemented in the lighthouse cities as well as for the measurement of the impact that the implementation of specific interventions have in their respective cities. This monitoring framework will be common for the three lighthouse cities involved in the project and has to be replicable also for the follower cities as well as for other cities that can be interested on following an equivalent process. Besides, this technical monitoring protocol is defined in order to be able to provide information to existing and developing databases such as the CONCERTO technical monitoring database on the Smart Cities Information System.

The next figure describes the framework for the monitoring and the links between different levels of KPIs.



Figure 8: Monitoring framework of the REPLICATE project

First of all, it is important to note that two different levels are differentiated in the monitoring framework depending on the scale that is being monitored. These two levels are corresponded with the two levels evaluated in the project; (1) City level and (2) interventions level.



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The first level of the monitoring refers to the city level which corresponds to the many dimensions that can be considered on a wider sustainability assessment of cities including economy and finance, energy and environment, mobility, governance, etc. This set of key performance indicators will serve for the baseline analysis of each city and for the comparison and benchmarking between different types of cities. In the same way it will be useful to measure the evolution of the city in the following years and in order to measure the improvements that will happen in the city due to the implementation of the most relevant interventions at city or district scale proposed in the project.

On the other hand Monitoring at intervention level and the key performance indicators at this level are explained in detail in the deliverable 10.1 Report on indicators for monitoring at project level. These indicators are useful for a detailed evaluation of the technical and financial viability of the different interventions. Data aggregation and de definition of the technical, environmental, economic and social indicators to monitor each of the interventions are defined in detail in the next sections. Within the intervention level it will be necessary to distinguish between the parameters that will be measured and a more reduced set of KPIs that will be provided. The parameters are related to the information that will be gathered in order to calculate the KPIs for this level. Those parameters can be classified in the next three dimensions; economic dimension, social dimension and another dimension related to physical parameters. This information will consist in most cases of real-time data (i.e. energy consumption in buildings, temperatures, etc.) or estimated using surveys or other periodic information. With this information the intervention level KPIs will be calculated and can be aggregated when necessary into sectoral KPIs in order to make easier the evaluation of the effects that will have in the city level KPIs.

Finally, the link between the two levels, i.e. how and to what extent the implementation of interventions at district scale will affect to other wider socioeconomis aspects of the city, and how this will be reflected as a change of the value of these city level indicators seems to be one of the biggest challenges in the field. With this regard, the way that the indicators for both levels have been selected and defined is very relevant. In the same way, it can be said that the evaluation of impacts of the different interventions at city level will follow different methodologies, depending on which indicators are being reported.

For city level indicators that are related to areas such as mobility or energy, the impact evaluation method will be a simplified methodology, and in cases indicators at intervention level and at city level will be the same or at least comparable.

Evaluation of the impact of the interventions in social or economic indicators for the city is more complex in some cases. In this case, the effects that an investment on a particular sector will have on the local economy and on the citizen needs to be evaluated more carefully. The



impacts will be different if an investment is made by a local company, which employs local citizens and redistributes the profits between employees (eg a local cooperative), than on a company whose employees and profit do not revert directly on the city. It is also important to know if the investor company will subcontract local companies or not, if their employees will be local, as well as their subcontractors, etc. To evaluate social and economic impacts of an intervention at city level, a value chain analysis of the investment and of the project implementation over its lifetime is therefore needed.

The figure below illustrates the building value chain as an example. Economic data for each of the suppliers, discerning whenever possible if the business is local or not and the type of business entity would be helpful.



Figure 9: The building value chain: interactions between actors in the process of value chain (source: BIPIE)

Once this data is collected, the impact evaluation methodology employed could vary depending on the local socioeconomic data available. If just basic data is available in the city, the number of direct and indirect economic activity and jobs generated by the investment could be inferred



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from the gathered supply chain data. If detailed data on the city is available there is a possibility to calculate these direct and indirect impacts in more detail, and also the induced impacts at city level.

Taking this in mind, the potential link between the data generated during the interventions monitorization and the city level indicators has been studied. As a result of this study, the city level indicators have been classified in 4 different categories:

- 1. Not considered to relate with project level indicators. For different reasons (i. e. not related to project indicators, because the relation is very complex, etc.), this city indicator is not going to be considered in the link between the 2 levels, (36 KPI).
- 2. Considered to relate with project level indicators through a direct relation. This means that a direct relation exists between the data or the indicators obtained at intervention level and the city level indicators, (8 KPI).
- 3. Considered to relate with project level indicators through a direct calculation. This means that the relation is not direct but could be made through simple or direct calculations, (5 KPI).
- 4. Considered to relate with project level indicators through impact assessment methods. This category is the one for which the relation is more complex. The link between intervention and city indicators will be made through value chain analysis and impact assessment methods, (2 KPI)

None of the indicators that define City Description and Governance dimensions are linked with intervention level. The Governance indicators are clearly not related to the interventions because they are focused in the strategies and plans that the city have. On the other hand, City description indicators could be briefly affected by interventions, but will be difficult or even not possible to understand in which measure the changes in the indicator annual values are due to the interventions and not because of other issues that affect these indicators in a stronger way.

The dimensions of energy and environment, mobility, infrastructures for innovation, social and economy and finance have indicators linked with intervention level data/indicators. Therefore, the monitoring done at intervention will provide relevant information to understand how project interventions affect the city performance.



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7. Conclusions

As one of the main conclusions it can be seen that the defined monitoring program has served to integrate and relate between each other in an effective way the monitoring at the two different scales that are included in the project, the city scale and the intervention scale. Besides it can be appreciated that depending on the dimension of the city evaluated, it has been impossible in some cases to stablish links between all the indicators of the two scales. This is a well-known problem in this field; however it is understood that with the flexible framework that has been developed, in a way that allows stablishing different types of relations between the indicators of the two scales, results in a reasonable number of relations.

Besides, it is important to notice that trying to keep a reduced number of indicators for city baseline analysis is a critical but difficult step of the process and that depending on the specific objectives of each city, several indicators can result more interesting than others. Another aspect is that data gathering process for the definition of the value of several indicators can result time consuming or even impossible with the available results for some cities but not for others. This is why some of the indicators have been defined as optional.

Finally, the baseline analysis of the city level indicators was performed in the same task of the WP (provided in Deliverable 10.3 "Baseline analysis of city level indicators for follower cities and benchmarking with lighthouse cities"), taking into account this framework and key performance indicators. The generation of city information along the European cities can result interesting in order to establish data for a benchmark that can be used by the follower cities.


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9. Annex I: Key Performance Indicators for Cities description

9.1 City Description Indicators

Population increase rate	Poputation of the city	Tourism intensity	Climate koppen geiger classification	Population density			
Population of the city (Inhabitants)							
Description							
Total number of persons inhabiting a city.							
Source							
STEEP project.							
Expected Data Source							
EUROSTAT							
Considered to relate with project level indicators							
No.							

Population increase rate (%)

Description

Increase of the population of the last year.

Source

STEEP project.

Expected Data Source

(-)

Considered to relate with project level indicators



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Tourism intensity (nights/100.000)

Description

Number of tourist nights per year per 100.000 inhabitants.

Source

CITYKEYS, UNECE; European Green.

Expected Data Source

City's tourism office, tourism tax information, European Cities Marketing Benchmarking Report.

Considered to relate with project level indicators

No.

Climate koppen geiger classification (-)



Description

The Köppen climate classification scheme divides climates into five main groups (A, B, C, D, E), each having several types and subtypes. Each particular climate type is represented by a two- to four-letter symbol.

Source

STEEP project.

Expected Data Source

(-)

Considered to relate with project level indicators



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Population Density (People per km2)



Description

Number of people per km2.

Measurement method

Population density is calculated as the ratio of number of inhabitants (numerator) divided by the overall area of the city (km²) (denominator).

Source

STEEP, CITYKEYS, FIN Indicators.

Expected Data Source

City statistics.

Considered to relate with project level indicators



9.2 Energy and Environment

ŧ	Emissions	Air Quality		Energy	Renewable energy sources			
tonme	CO2 emissions	PM10 concentration	Noise pollution	Annual final energy consumption	Green electricity purchased	Renewable electricity generated within the city	Renewable heat generated within the city	
Ē								
년 88	Energy efficiency Services efficiency							
hergy	smart energy meters	Refurbished buildings improving energy performance	N° of connections to a district heating network	Municipal solid waste per capita	Recycling rate	Liters of water used per capita	Water losses	
ű								

9.2.1 Emissions

Carbon Dioxide emissions (*t CO₂/cap/year*)



Description

 CO_2 emissions in tonnes per capita per year.

Measurement method

The CO_2 emissions measured in tonnes per capita shall be measured as the total amount of direct CO_2 emissions in tonnes (equivalent carbon dioxide units) generated over a calendar year by all activities within the city, including indirect emissions outside city boundaries (numerator) divided by the current city population (denominator).

Source

STEEP, CITYKEYS, ISO 37120; Smart city Wheel; SCI; FIN indicators; DESIRE; RFSC; UNECE; European Green Capital Award study; City Protocol; GCIF.

Expected Data Source

The CO_2 -emissions can be calculated from the energy consumption figures of indicator 'annual final energy consumption', using conversion factors for various forms of energy.

Considered to relate with project level indicators

Yes. (Total Greenhouse gas emissions of the intervention)

The relation will be made through direct calculations.



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9.2.2 Air quality

PM10 concentration ($\mu g/m^3$ or days above threshold)

Description



PM10 particulate concentration.

Source

STEEP,Based on CITYKEYS, Siemens Green City Index; European Smart cities v1.0 (2007); European Green

Expected Data Source

The urban audit database contains information on the number of days particulate matter PM10 and PM2,5 concentrations exceed $50\mu g/m3'$ and the 'annual average concentration of PM10 ($\mu g/m3$)'.

Considered to relate with project level indicators



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Noise pollution (% of population)



Description

Share of the population affected by noise >55 dB(a) at night time.

Measurement method

Noise pollution shall be calculated by mapping the noise level at night (Ln) likely to cause annoyance as given in ISO 1996–2:1987, identifying the areas of the city where Ln is greater than 55 dB(A) and estimating the population of those areas as a percentage of the total city population. The result shall be expressed as the percentage of the population affected by noise pollution. (ISO/DIS 37120, 2013)

Source

STEEP, CITYKEYS, ISO 37120; FIN Indicators; Rotterdam SCP; OECD; ClimateCon; European Green Capital Award study; City Protocol; URBES

Expected Data Source

The urban audit database contains information on the 'number of inhabitants exposed to road/rail/air traffic noise >65 dB(A) at day time/>55 dB(A) at night time'.

Considered to relate with project level indicators



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9.2.3 Energy

Annual final energy consumption (*MWh/cap/yr*)



Description

Annual final energy consumption for all uses and forms of energy. Provided per each fuel and per each sector.

Measurement method

Energy consumption shall be calculated per year as the total use of final energy (MWh) within a city (numerator) divided by the amount of residents in city (denominator). All forms of energy need to be taken into account, including electricity consumption, natural gas or thermal energy for heating and cooling and fuels. These will be given in different units of energy (kWh, GJ, m3), but they all have to be calculated or converted to MWh of energy in order to be able to sum up the separately calculated energy consumptions and achieve the total energy consumption of the city.

Energy consumption per year in megawatt hours per capita.

The total energy consumption has to be provided also broken down into energy consumption of each sectors: buildings, transport, industry, public services, ICT, etc., and also broken down into energy sources (electricity, Natural Gas, etc.)

Source

STEEP, CITYKEYS, ISO/DIS 37120, Eurbanlab, etc.

Expected Data Source

Data has to be collected from many different sources:

- Buildings (public, residential, commercial)
- Transport (public, private)
- Industry
- ICT

Considered to relate with project level indicators

Yes. (Total Final energy consumption of the system: The relation will be made through direct calculations. Total primary energy consumption of the intervention: Indirectly related indicator)



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9.2.4 Renewable energy sources

Green Electricity purchased (%) Description The percentage of green electricity purchased, as a share of the city's total electtricity consumption. Source STEEP Expected Data Source (-) Considered to relate with project level indicators No.



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Renewable electricity generated within the city (%)



Description

The percentage of electric energy derived from renewable sources, as a share of the city's total energy consumption.

Measurement method

The share of renewable electricity produced within the city is calculated as the total consumption of electricity generated from renewable sources (numerator) divided by total energy consumption (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Consumption of renewable sources includes solar, wind, hydro, tide and wave energy, and combustibles used for electric generation, such as biomass. (ISO/DIS 37120, 2013).

Source

STEEP, Based on CITYKEYS, ISO/DIS 37120, etc.

Expected Data Source

Data available from local utility provider, city energy or environment office, and from various international sources, such as the International Energy Agency (IEA), and the World Bank. (ISO/DIS 37120, 2013)

Considered to relate with project level indicators

Yes. (Total Energy Generation [output] -electricity and Thermal and electric separately, Degree of energetic self-supply by RES)

The relation will be made through direct calculations.



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Renewable heat generated within the city (%)



Description

The percentage of heat energy derived from renewable sources, as a share of the city's total heat consumption.

Measurement method

The share of renewable heat produced within the city is calculated as the total consumption of heat generated from renewable sources (numerator) divided by total heat consumption (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Consumption of renewable sources includes solar, biomass, geothermal, etc. (ISO/DIS 37120, 2013).

Source

STEEP, Based on CITYLEYS, ISO/DIS 37120, etc.

Expected Data Source

Data available from local utility provider, city energy or environment office, and from various international sources, such as the International Energy Agency (IEA), and the World Bank. (ISO/DIS 37120, 2013)

Considered to relate with project level indicators

Yes. (Total Energy Generation [output] – Heat and Thermal output of solar thermal plant; and Degree of energetic self-supply by CHP – Heat [%])

The relation will be made through direct calculations.



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9.2.5 Energy Efficiency

Smart energy meters (% of buildings)



Description

This indicator is the percentage of smart meters coverage on the energy distribution network; it could be distinguished for electric and methane or heat networks.

Source

STEEP.

Expected Data Source

Electricity and gas network manager, providers, national electricity managing bodies.

Considered to relate with project level indicators



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Refurbished buildings improving energy performance (%

of refurbished buildings)

Description

Number of buildings subject to refurbishment improving their energy profile above the EPBD requirements.

Measurement method

It is calculated as the share of square meters retrofitted versus the total surface of the buildings refurbished.

Source

STEEP.

Expected Data Source

Municipal departments, builders.

Considered to relate with project level indicators

Yes. N° of refurbished buildings [n°]

Direct relation exists.



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Number of connections to a district heating network (% of buildings)



Description

Number of houses connected to a district heating network of the city.

Source

REPLICATE.

Expected Data Source

Data available from local utility provider, city energy or environment office.

Considered to relate with project level indicators

Yes. N° of buildings connected to the disctrit heating [Ud]

Direct relation exists.



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9.2.6 Services efficiency

Municipal solid waste per capita (t/cap/yr)

Description

The amount of municipal solid waste generated per capita annually.

Measurement method

This indicator shall be calculated as the total amount of solid waste (household and commercial) generated in tonnes (numerator) divided by the total city population (denominator).

Source

STEEP, CITYKEYS, Siemens Green City Index; Smart city Profiles; Rotterdam SCP; Transform; Desire; OECD; ClimateCon; SCI.

Expected Data Source

EU member countries are estimating their recycling rates and levels of municipal solid waste through measuring and model calculation methods. Environmental department, department resonsoble for waste collection. The urban audit database contains information on 'municipal waste generated (domestic and commercial)'.

Considered to relate with project level indicators



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Recycling rate (% of tonnes)



Description

Percentage of city's solid waste that is recycled.

Measurement method

The percentage of city's solid waste that is recycled shall be calculated as the total amount of the city's solid waste that is recycled in tonnes (numerator) divided by the total amount of solid waste produced in the city in tonnes (denominator). The result shall then be multiplied by 100 and expressed as a percentage.

Source

STEEP, CITYKEYS, Siemens Green City Index; Smart city Profiles; Rotterdam SCP; Transform; Desire; OECD; ClimateCon; SCI;.

Expected Data Source

This information should be obtained from municipal bodies, public services and major private contractors dealing with solid waste collection and disposal. Data may be obtained from specific studies carried out on solid waste for specific projects.

Considered to relate with project level indicators



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Liters of water used per capita (litres/cap/year)



Description

Total water consumption per capita per year.

Measurement method

The indicator shall be calculated as the total amount of the city's water consumption in litres per day (numerator) divided by the total city population (denominator).

Source

STEEP, CITYKEYS, Siemens Green City Index; Smart city Profiles; Rotterdam SCP; Transform; Desire; OECD; ClimateCon; SCI.

Expected Data Source

This information should be obtained from the main water supply companies, which maintain record on water supplied, delivered, consumed and ultimately paid by the end-users. The urban audit database also contains information on the 'Total use of water'.

Considered to relate with project level indicators



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Water losses (%)



Description

Percentage of water loss of the total water consumption.

Measurement method

This indicator shall be calculated as the volume of water supplied minus the volume of customer billed water (numerator) divided by the total volume of water supplied (denominator). The result shall then be multiplied by 100 and expressed as a percentage.

Source

STEEP, CITYKEYS, Siemens Green City Index; UNECE; FIN Indicators; City Protocol; GCIF; URBES.

Expected Data Source

Data should be obtained from water utilities servicing the city.

Considered to relate with project level indicators



9.3 Mobility

Mob ility	-	Access to PT	PT use	FF 4 wheels vehicles	FF 2 wheels vehicles	Modal Split		
		Access to Public Transport	Number of annual PT trips per capita	N° of fossil fuelled four wheels vehicles per capita	N° of fossil fuelled two wheels vehicles per capita	Average modal split- passengers	Average modal split vehicles	Average modal split trips
		Alternative Transport I	nfrastructure					Iraffic Accidents
		l ength of bike route network	Number of electric charging stations for EV	Number of electric vehicles in the city	Percentage of FV per sector (private, public and service)	km2 restricted areas	Access to vehicle sharing solutions	I raffic Accidents

9.3.1 Access to Public Transport

Access to public transport (% of people)

Description

Share of population with access to a public transport stop within 500m.

Measurement method

(Number of inhabitants with a transportation stop <500m/total population)*100% NB.

It is calculated as the sum of buildings with a point of access within 500m, multiplied by its inhabitants. A point of access is defined as the location where a mode of transportation can be accessed.

Source

CITYKEYS,, Rotterdam SCP; Covenant of mayors; OECD; City Protocol; GCIF; 2000-Watt.

Expected Data Source

It might be possible to use city software and perform the exercise with the help of a computer. One could also obtain a map of the area, point the transportation stops (available at the public transport utilities), draw circles around them and use city resident information (available in city administrative documents) to analyse which buildings outside this area are houses and how many people are registered to them.

Considered to relate with project level indicators



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9.3.2 Public Transport use

Number of annual PT trips per capita (trips/cap/year)

Description

Annual number of public transport trips per capita.

Measurement method

This indicator shall be calculated as the total annual number of transport trips originating in the city – "ridership of public transport" – (numerator), divided by the total city population (denominator).

Source

STEEP, CITYKEYS, City Protocol; ISO 37120; GCIF.

Expected Data Source

Transport data should be gathered from a number of sources, including: official transport surveys, revenue collection systems (e.g. number of fares purchased), and national censuses.

Considered to relate with project level indicators

Yes. Number of trips [ud]

Direct relation exists.



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9.3.3 Number of fossil fuelled four wheels vehicles per capita

Number of fossil fuelled four wheels vehicles per capita (n/person)



Description

Number of fossil fuelled vehicles (four wheels) of the city divided by type: public and private.

Measurement method

Number of fossil fuelled vehicles (four wheels) of the city distinguishing by type (public and private) and divided by the population.

Source

STEEP.

Expected Data Source

National register for vehicles

Considered to relate with project level indicators



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9.3.4 Number of fossil fuelled two wheels vehicles per capita

Number of fossil fuelled two wheels vehicles per capita (n/person)						
Description						
Number of fossil fuelled vehicles of the city divided by type: public and private.						
Measurement method						
Number of fossil fuelled vehicles (two wheels) of the city distinguishing by type (public and private) and divided by the population.						
Source						
STEEP.						
Expected Data Source						
National register for vehicles						
Considered to relate with project level indicators						
No.						



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9.3.5 Modal Split

Average modal split-passengers (% of passenger km)

Description

Percentage of passenger-km of each mode. Modes: walk, bicycle, bus, tram, metro, train, car (driver and passenger), motorcycle.

Measurement method

The data can be collected through surveys, e.g. asking travellers to record their travel modes and route each day in a travel diary. Apart from surveys, other approaches can also be used e.g. network modelling.

Source

Civitas.

Expected Data Source

Municipal mobility department.

Considered to relate with project level indicators



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Average modal split vehicles (% of vehicles km)

Description

Percentage of vehicle - km for each mode. Modes: walk, bicycle, bus, tram, metro, train, car (driver and passenger), motorcycle.

Measurement method

The data can be collected through surveys, e.g. asking travellers to record their travel modes and route each day in a travel diary. Apart from surveys, other approaches can also be used e.g. network modelling.

Source

Civitas.

Expected Data Source

Municipal mobility department.

Considered to relate with project level indicators



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Average modal split trips (% trips)

Description

Percentage of trips for each mode. Modes: walk, bicycle, bus, tram, metro, train, car (driver and passenger), motorcycle.

Measurement method

The data can be collected through surveys, e.g. asking travellers to record their travel modes and route each day in a travel diary. Apart from surveys, other approaches can also be used e.g. network modelling.

Source

Civitas.

Expected Data Source

Municipal mobility department.

Considered to relate with project level indicators



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9.3.6 Alternative transport infrastructure

Length of bike route network (% in km)



Description

% of bicycle paths and lanes in relation to the length of streets (excluding motorways)

Measurement method

The indicator shall be calculated as the total kilometres of bicycle paths and lanes (numerator) divided by one 100 000th of the city's total population (denominator). The result shall be expressed as the kilometres of bicycle paths and lanes per 100 000 population.

Source

STEEP, CITYKEYS,FIN Indicators; Transform; OECD; UNECE; Covenant of Mayors; European Green Capital Award study; City Protocol; URBES; ISO 37120

Expected Data Source

The department of traffic/mobility will have information on the length of streets and bicycle lanes/paths. Information might also be available on the local city website, e.g. for Vienna (1). The urban audit database also has information on the length of bicycle network (dedicated cycle paths and lanes).

Considered to relate with project level indicators



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Number of electric charging stations for EV

(n/100.000)

Description

Number of electric charging stations for EV.

Source

STEEP.

Expected Data Source

municipal mobility department.

Considered to relate with project level indicators

Yes. Number of electric charging points [Ud]

Direct relation exists.

Number of electric vehicles in the city

(*n*/100.000)

Description

Number of electric vehicles in the city including private, public and service (taxi and first mile) vehicles including also motorbikes.

Source

REPLICATE.

Expected Data Source

(-)

Considered to relate with project level indicators

Yes. Number of electric vehicles [Ud]

Direct relation exists.



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Percentage of EV per sector (private, public and service (taxi and first mile)) (%)

Description

Number of electric vehicles related to total number of vehicles.

Measurement method

Total number of all type EV (per sector)/ Total number vehicles

Source

REMOURBAN.

Expected Data Source

(-)

Considered to relate with project level indicators

Yes. Number of electric vehicles [Ud]

Direct relation exists.



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Surface of restricted areas (km²/km² of the city)



Description

One of the best ways to promote alternative mobility and public transport use is to restrict the access to selected areas. The indicator estimates the size of the area influenced by restrictions of different kind.

Optionally the pedestrian zones could be distinguished from the limited traffic zones.

Source

STEEP.

Expected Data Source

municipal mobility department.

Considered to relate with project level indicators



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Access to vehicle sharing solutions (n/100.000)



Description

Access to vehicle sharing solutions for city travel.

Measurement method

Number of vehicles per 100.000.

Source

CITYKEYS.

Expected Data Source

Consult vehicle sharing companies in the city for the total number of vehicles available. Some companies might be run by the government and information might be available on the city website.

Considered to relate with project level indicators



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9.3.7 Traffic Accidents

Traffic Accidents (n/100.000)



Description

Number of transportation fatalities per 100.000 population.

Measurement method

This indicator shall be calculated as the number of fatalities related to transportation of any kind (numerator), divided by one 100 000th of the city's total population (denominator). The result shall be expressed as the number of transportation fatalities per 100 000 population.

Source

CITYKEYS, Civitas; Rotterdam SCP; European Green Capital Award study; 2Decide; CASBEE_City_2012; UNECE; ,GCIF; COMIND; URBES.

Expected Data Source

City statistics bureau, municipal traffic department and police office. The urban audit database contains information on the number of deaths in road accidents.

Considered to relate with project level indicators

Yes. Injuries and deaths caused by transport accidents [Ud]

Direct relation exists.



9.4 Infrastructures for innovation

Infrastructures for innovation	Internet connections		Infomobility		Digitalisation Components with sensors	
	N° internet connections per 100.000 population	Access to public tree WiFi	Number of P1 stops with real time info	e-ticketing	Number of users of digital services	N° of infrastructure components with installed sensors

9.4.1 Internet connections

Number of internet connections per 100,000 population (n/100.000h)

Description

Number of internet connections per 100.000 population.

Source

STEEP

Expected Data Source

Internet and telecomunications providers. Other sources could be official estimates, other censuses or telecommunications data.

Considered to relate with project level indicators



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Access to public free WiFi (% of m²)

Description

Public space Wi-Fi coverage.

Measurement method

The measure could be done in % or in square km and evaluates the public areas reached by the WIFI.

Source

STEEP, City Protocol.

Expected Data Source

Informatic services department.

Considered to relate with project level indicators

No.

9.4.2 Infomobility

Number of PT stops with real time info (%)



Description

Number of PT stops with real time information. ICT applied to public transport needs accuracy and territorial coverage.

Source

STEEP.

Expected Data Source

Public transport company.

Considered to relate with project level indicators



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e-ticketing (Y/N or %)



Description

The presence of thee-ticketing service.

Measurement method

The mandatory field is the presence (yes or no) of the service, while an optional evaluation could be, if it's in place, the number of e-tickets versus the total number of trips sold.

Source

STEEP.

Expected Data Source

Municipal administration.

Considered to relate with project level indicators


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9.4.3 Digitalisation

Number of users of digital services (*n*/100.000 persons)

Description

The number of users of these digital services is an index of their vailability.

Measurement method

Number of users of these digital services divided by 100.000 persons.

Source

STEEP.

Expected Data Source

Municipal administration.

Considered to relate with project level indicators

Yes. Number of final users involved (services) [Ud]

Direct relation exists.



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9.4.4 Number of infrastructure components with installed sensors

Number of infrastructure components with installed sensors (n/100.000 persons)							
Description							
The components cover the traffic, public transit demand, parking, waste, water and public lighting.							
Source							
REMOURBAN.							
Expected Data Source							
(-)							
Considered to relate with project level indicators							
No.							



9.5 Governance



Climate resilience strategy (Likert scale)



Description

The extent to which the city has developed and implemented a climate resilient strategy.

Measurement method

The indicator provides a qualitative measure and is rated on a seven -point Likert scale. This Likert scale is based on the steps suggested by the "Mayors adapt" initiative for climate change adaptation in urban areas (Mayors Adapt 2015a,b).

No action taken – 1 – 2 – 3 – 4 – 5 – 6 – 7 – implementation, monitoring and evaluation on the way.

1. No action has been taken yet.

2. The ground for adaptation has been prepared (the basis for a successful adaptation process).

- 3. Risks and vulnerabilities have been assessed.
- 4. Adaptation options have been identified.
- 5. Adaptation options have been selected.
- 6. Adaptation options are being implemented.
- 7. Monitoring and evaluation is being carried out.

Source

CITYKEYS, Eurbanlab.

Expected Data Source

Environmental/sustainability/climate department/service.

Considered to relate with project level indicators



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Existence of local sustainability plans (YES/NO) Description Is there any specific sustainability plan in the city? Source REMOURBAN. Expected Data Source (-) Considered to relate with project level indicators No.

Existence of Smart Cities strategies (YES/NO)

Description

Is there any specific Smart Cities strategy in the city?

Source

REMOURBAN.

Expected Data Source

(-)

Considered to relate with project level indicators



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Existence of an Agenda 21 (YES/NO)

Description

Has the city elaborated an Agenda 21?

Source

REMOURBAN.

Expected Data Source

(-)

Considered to relate with project level indicators

No.

Signature and compliance of the Covenant of Mayors (YES/NO)



Description

Has the city signed the Covenant of Mayors. And Is the city complying with it? (both questions need to be aswered)

Source

REMOURBAN.

Expected Data Source

(-)

Considered to relate with project level indicators



9.6 Social



Population dependence ratio (n/100)
Description
Number of economically dependent persons (net consumers) per 100 economically active persons (net producers).
Measurement method
100 x ((Population (0-14) + Population (65+)) / Population (15-64) (un.org).
Source
CITYKEYS, GCIF.
Expected Data Source
City's statistics office.
Considered to relate with project level indicators
No.



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Number of high education degrees per 100,000

population (*n*/100.000*h*)

Description

It is an indicator of well being and development.

Measurement method

It is calculated collecting the number of higher degrees divided by one 100.000th of the total population.

Source

STEEP.

Expected Data Source

Ministry and department for education, censuses.

Considered to relate with project level indicators

No.

Affordability of housing (% of people)



Description

% of population living in affordable housing

Measurement method

The indicator shall be calculated as the number of people living in affordable housing (numerator) divided by the city population (denominator). The result shall then be multiplied by 100 and expressed as a percentage.

Source

CITYKEYS, Eurbanlab; UNECE; SCI.

Expected Data Source

Ministry and department for education, censuses.

Considered to relate with project level indicators



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Fuel poverty (% of households)

Description

The percentage of households unable to afford the most basic levels of energy

Measurement method

The fuel poverty ratio of a single household under this method is defined as: energy poverty=fuel costs/income.

Where this ratio has a value greater than 0.1, the household is considered to be fuel poor. In order to obtain the value, on the one hand the cost in households due to the energy consumption should be estimated (the energy costs include all building related energy, i.e. for heating/cooling, warm water and electricity) for a reference existing building (only de existing buildings in order to identify the highest energy consumption costs) of the city. On the other hand the number of households living in the lower level range of income should be calculated for the city as well as the value of the income that represents this level. If the división of these values is >0.1 it suggest that those households can be considered that are in fuel poverty. Energy poverty (%) = ((IF(fuel costs of the reference existing building/average of the lower level range income)>0,1) x N° of households living in the lower level range income)/ total number of households in the city.

Source

CITYKEYS, Eurbanlab; Transform.

Expected Data Source

The cost of energy is modelled rather than based on actual spending. It is calculated by combining the fuel requirements of the household with corresponding fuel prices.

Household income data may be available from the city statistical office.

Considered to relate with project level indicators



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Open public participation (*n*/100.000)

Description

Number of public participation processes per 100.000 per year.

Measurement method

(Total amount of open public participation processes/City population)*100.000

Source

CITYKEYS, City Protocol.

Expected Data Source

City administration.

Considered to relate with project level indicators



9.7 Economy and finance

a a							
onomy	City's unemployment rate	Expenditures by the municipality for the transition towards smart city	Incentives for final users for low carbon measures	Share ol green public procurement	Gross Domestic Product	Percentage of the ICT sector on GDP	Median disposable income
ыщ							

City's unemployment rate (% of people)



Description

Percentage of the labour force unemployed.

Measurement method

Number of working-age city residents who during the survey reference period were not in paid employment or self-employment, but available for work, and seeking work (numerator) divided by the total labour force (denominator). The result shall be multiplied by 100 and expressed as a percentage (ISO/DIS 37120, 2013).

Source

STEEP, CITYKEYS, ISO 37120, ClimateCon; SCI; European Green Capital Award study; City Protocol; UN HABITAT CPI.

Expected Data Source

Statistics from local labour bureau, city statistical office.

Considered to relate with project level indicators

Yes. (Direct total and local jobs created).

Relation will be made through impact assessment methods.



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Expenditures by the municipality for the transition towards smart city (€/persons)

Description

Annual expenditures by the municipality for a transition towards a smart city.

Measurement method

(Total annual expenditures by the municipality for a transition towards a Smart city/total population)

Source

CITYKEYS, Smart city Profiles.

Expected Data Source

City administration.

Considered to relate with project level indicators

Yes. Total investment per intervention. Excl. VAT $[{\ensuremath{\in}}]$

Relation through direct calculations.



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Incentives for final users for low carbon measures (RE, Energy Efficiency, mobility) (€/persons)



Description

Incentives for final users for low carbon measures (RE, Energy Efficiency, mobility).

Measurement method

This indicator is calculated per capita as the total amount of euros financed annually to private sector for energy efficiency within the municipal boundaries divided for the population number.

Source

STEEP.

Expected Data Source

Municipal departments, national and regional energy agencies.

Considered to relate with project level indicators



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Share of green public procurement (% in M euros)

Description

Percentage annual procurement using environmental criteria as share of total annual procurement of the city administration.

Measurement method

(Million EUR annual procurement using environmental criteria/Million EUR total annual procurement of the city administration)*100

Source

CITYKEYS, FIN Indicators.

Expected Data Source

A first entry could be the city's corporate facilities department (but this might be limited to its own sustainable purchasing (i.e. printing paper, catering etc.). Information on the rest of the organisation will likely be scattered over different departments (e.g. the transport department for sustainable procurement of roads; the housing department for sustainable procurement of a large-scale urban development project, etc.).

Considered to relate with project level indicators



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Gross Domestic Product (€/persons)



Description

City's gross domestic product per capita.

Source

STEEP, CITYKEYS, Triple Helix Model; Green Digital Charter; ClimateCon; City Protocol; UN Habitat CPI; GCIF; READY; UNECE.

Expected Data Source

Datasets needed: GDP and population. Cities statistics bureau, national statistics bureau if it provides geographical disaggregation or Eurostat NUTS3 level as proxy if no other data is available.

Considered to relate with project level indicators

Yes. Economic indicators and Direct total and local jobs created [n° jobs / year].

Relation will be made through impact assessment methods.



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Percentage of the ICT sector on GDP (%)

Description

Gross value added (at basic prices) minus other taxes less other subsidies on production on ICT sector (based on NACE Rev. 2).

Measurement method

(Million EUR annual procurement using environmental criteria/Million EUR total annual procurement of the city administration)*100

Source

REMOURBAN.

Expected Data Source

A first entry could be the city's corporate facilities department (but this might be limited to its own sustainable purchasing (i.e. printing paper, catering etc.). Information on the rest of the organisation will likely be scattered over different departments (e.g. the transport department for sustainable procurement of roads; the housing department for sustainable procurement of a large-scale urban development project, etc.).

Considered to relate with project level indicators



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Median disposable income (€/household)



Description

Median disposable annual household income.

Measurement method

In general, individual data are rarely available so income classes are used. Knowing the number of households in each class, the class of the median income is known. The "exact" amount of median income can be approximated by replacing the steps (caused by the classes) in the cumulative frequency curve by a smooth curve of distribution, at least for the class in which the median is situated.

Source

CITYKEYS, ClimateCon; European Green Capital Award study; GCIF; COMIND; Triple Helix Model.

Expected Data Source

The information might be available at the Urban Audit database, the cities statistics bureau.

Considered to relate with project level indicators