Supplementary Material – Table S1

Indicator pool and evaluation according to pre-defined criteria

KPI Dimension	KPIs (Green: Core / Blue: Supporting)	Relevance	Availability	Measurability	Reliability	Familiarity	Score
Energy							
Energy	Energy demand and consumption	2	1	2	2	2	9
Energy	Energy savings	2	1	2	2	2	9
Energy	Reduction in annual final energy consumption	2	2	2	2	2	10
Energy	Electricity System Outage Frequency	2	2	2	2	1	9
Energy	Electricity System Outage Time	2	2	2	2	1	9
Energy	Degree of energetic self-supply by RES	2	1	2	2	1	8
Energy	Increase in local renewable energy production	2	2	2	2	2	10
Energy	Renewable energy generated within the city	2	1	2	2	2	9
Energy	Reduced energy curtailment of RES and DER	2	1	2	1	1	7
Energy	Energy intensity (consumption / GDP)	2	1	1	1	1	6
Energy	Individual building energy balance	2	2	1	1	1	7
Energy	Specific Yield	2	1	2	1	1	7
Energy	Solar gain coefficient	2	2	2	1	1	8
Energy	kWp photovoltaic installed per 100 inhabitants	2	2	2	2	2	10
Energy	System performance	2	1	1	1	1	6
Energy	Generation system efficiency	2	1	1	1	1	6
Energy	Distribution system efficiency	2	1	1	1	1	6
Energy	Consumption system efficiency	2	1	1	1	1	6
Energy	Equipment energy efficiency	2	1	1	1	1	6
Energy	Smart Storage Capacity	2	1	2	1	1	7
Energy	Battery Degradation Rate	2	1	1	1	1	6
Energy	Storage Energy Losses	2	1	2	1	1	7
Energy	Maximum Hourly Deficit (MHDx)	2	1	1	1	0	5
Energy	Capacity factor	2	1	2	1	1	7
Energy	Influence of energy storage on cutting peak demand	2	1	2	1	1	7
Energy	Storage capacity of the city's energy grid per total city energy consumption	2	1	1	1	1	6

Energy	Storage system efficiency	2	1	1	1	1	6
Energy	Buildings served by the district heating	2	1	1	1	1	6
Energy	Thermal load reduction	2	1	2	1	1	7
Energy	Heat recovery ratio	2	1	2	1	1	7
Energy	Peak demand reduction	2	1	2	1	1	7
Energy	Accuracy of energy supply and demand prediction	2	1	1	1	1	6
Energy	Integrated Building Management Systems in Buildings	2	2	2	1	1	8
Energy	Peak load and load profile of electricity demand	2	1	2	1	1	7
Energy	Peak load and load profile of thermal energy demand	2	1	2	1	1	7
Energy	Percentage of street lighting managed by a light performance management system	2	1	2	2	2	9
Energy	Energy used for lighting	1	2	2	2	2	9
Energy	Lighting energy efficiency	1	1	2	1	1	6
Energy	Percentage of buildings in the city with smart energy meters	2	1	2	2	2	9
Energy	Smart electricity meters	2	2	2	1	1	8
Energy	Percentage of waste drop-off centres (containers) equipped with telemetering	1	1	2	2	1	7
Energy	Percentage of the city population that has a door-to-door garbage collection with an individual monitoring of household waste quantities	1	1	2	2	1	7
Energy	Percentage of total amount of waste in the city that is used to generate energy	1	1	1	2	2	7
Energy	Percentage of public garbage bins that are sensor-enabled public garbage bins	1	1	1	2	2	7
Energy	Cultural Heritage building preservation	2	1	2	1	1	7
Energy	Refurbished buildings improving energy performance	2	1	1	1	1	6
Environmental							
Environmental	Greenhouse Gas Emissions	2	2	2	2	2	10
Environmental	Primary Energy Demand and Consumption	2	1	1	2	1	7
Environmental	Carbon dioxide Emission Reduction	2	2	2	2	2	10
Environmental	Reduction in lifecycle CO2 emissions	2	0	1	1	1	5
Environmental	Climate resilience measures	1	2	1	1	2	7
Environmental	Climate resilience strategy	2	2	1	1	2	8
Environmental	Decreased emissions of Nitrogen oxides (NOx)	1	1	1	2	1	6
Environmental	Nitrogen oxide emissions (Nox)	1	1	2	2	1	7
Environmental	Decreased emissions of Particulate matter (PM2,5)	2	1	1	2	1	7
Environmental	Fine particulate matter emissions (or concentration) (PM2.5)	2	1	2	2	1	8
Environmental	Number of days particulate matter PM10 concentrations exceed 50 $\mu g/m^3$	2	1	2	2	1	8
Environmental	Annual average concentration of PM10	2	1	2	2	1	8
Environmental	Sulphur dioxide levels	1	1	2	2	1	7
Environmental	O3 emissions (or concentration)	1	1	2	2	1	7
Environmental	Indoor air quality	1	0	2	1	2	6

Environmental	Air quality index (Air pollution)	2	1	2	2	1	8
Environmental	Reduced exposure to noise pollution	2	1	1	1	2	7
Environmental	Noise pollution	2	1	2	2	2	9
Environmental	EMF Exposure	1	0	2	1	0	4
Environmental	Urban Heat Island	1	1	2	2	1	7
Environmental	Reduction in the amount of solid waste collected	1	1	2	1	2	7
Environmental	Municipal solid waste	2	1	2	2	2	9
Environmental	Recycling Rate	2	1	2	2	2	9
Environmental	Percentage of city population with regular solid waste collection (residential)	1	1	2	1	1	6
Environmental	Percentage of the city's solid waste that is treated in energy-from-waste plants	2	1	2	1	1	7
Environmental	Percentage of the city's solid waste that is biologically treated and used as compost or biogas	1	1	2	1	1	6
Environmental	Percentage of electrical and thermal energy produced from wastewater treatment, solid waste and other liquid waste treatment and other waste heat resources, as a share of the city's total energy mix	2	1	1	1	1	6
Environmental	Electrical and thermal energy (GJ) produced from solid waste or other liquid waste treatment per year	2	1	2	1	1	7
Environmental	Solid Waste Treatment	1	1	2	1	1	6
Economic							
Economic	Grants	1	2	2	1	2	8
Economic	Total Investments	2	2	2	2	2	10
Economic	Total Annual costs	2	1	2	2	2	9
Economic	€M reduction compared to planned investment	2	1	1	1	2	7
Economic	Total annual revenues	1	1	2	1	2	7
Economic	Payback period	2	1	2	2	2	9
Economic	Return on Investment (ROI)	2	1	2	2	1	8
Economic	Net Present Value (NPV)	1	1	2	2	1	7
Economic	Internal rate of return (IRR)	1	1	2	2	1	7
Economic	Gross Domestic Product	1	2	1	2	1	7
Economic	Percentage of the ICT sector on GDP	1	1	1	1	1	5
Economic	Improved competitiveness of electricity market	1	1	1	1	1	5
Economic	Average electricity price for companies and consumers	2	2	2	1	2	9
Economic	Increased use of local workforce	1	2	2	1	2	8
Economic	Percentage of the total Distributed Energy Resources capacity traded	2	1	2	2	2	9
Economic	Local job creation	2	2	1	2	2	9
Economic	Green jobs	1	2	1	1	1	6
Economic	City's unemployment rate (CI: core indicator)	0	2	1	2	2	7
Economic	Energy poverty	2	1	1	1	2	7
Economic	Percentage of population living below the international poverty line (CI)	0	1	1	1	2	5

Economic	Certified companies involved in the project	1	2	1	2	1	7
Economic	Share of certified companies	1	1	1	2	1	6
Economic	Green public procurement	1	1	1	1	1	5
Economic	Share of Green Public Procurement	1	1	1	1	1	5
Economic	CO2 reduction cost efficiency	2	1	1	1	2	7
Economic	Financial benefit for the end- user	2	1	2	1	1	7
Economic	Involvement of extraordinary professionals	1	1	1	1	1	5
Economic	Innovation hubs in the city	1	2	1	2	1	7
Economic	R&D expenditure	1	2	2	1	1	7
Economic	New business creation	2	2	1	2	2	9
Economic	New startups	1	2	2	2	2	9
Economic	Stimulating an innovative environment	2	1	1	1	1	6
Economic	Awareness of economic benefits of reduced energy consumption	2	1	1	1	2	7
Economic	Incentives for final users for low carbon measures	2	1	2	1	1	7
Economic	Energy consumption reduction cost	2	1	2	1	1	7
Economic	Expenditure in local economy (ELE)	1	1	2	1	1	6
Economic	Impact in business unit (IBU)	1	1	1	1	1	5
Economic	Number of patents per 100 000 population per year (SI)	2	2	2	2	2	10
Economic	Expenditures by the municipality for a transition towards a smart city	2	2	2	1	2	9
Economic	Annual amount of revenues collected from the sharing economy as a percentage of own-source revenue	1	1	1	1	1	5
ICT							
ICT	Increased reliability	2	1	1	1	1	6
ICT	Increased Power Quality and Quality of Supply (DSO+TSO)	1	1	2	1	1	6
ICT	Increased system flexibility for energy players	2	1	2	1	1	7
ICT	Reduction of energy price by ICT related technologies	2	1	2	1	1	7
ICT	Peak load reduction	2	1	2	1	1	7
ICT	Increased hosting capacity for RES, electric vehicles and other new loads	2	1	2	2	1	8
ICT	Consumers engagement	2	1	1	1	1	6
ICT	Developer engagement	2	1	1	1	1	6
ICT	Cybersecurity & Level of Improvement (4ocalize Cybersecurity)	2	2	1	1	1	7
ICT	Data privacy – Data Safety & Level of Improvement (Improved Data Privacy)	2	2	1	2	2	9
ICT	No. of operational apps that promote citizen engagements (adjusted the "Number of APIs connected to the Decision Support Tool (DST)")	2	1	1	1	1	6
ICT	Flexibility in delivery services & Level of Improvement (Improved Flexibility)	2	2	1	1	1	7
ICT	Monitoring use of EV/FC charging stations	2	1	2	1	1	7
ICT	Number of sensors integrated/devices connected	2	1	2	1	1	7
ICT	Number of available Open Data sets/sources	2	1	2	1	1	7

Category	Indicator						Total
ICT	ICT Response time	2	2	2	1	1	8
ICT	ICT Availability	2	1	2	1	1	7
ICT	ICT Storage Capacity	2	1	2	1	1	7
ICT	Improved Interoperability	2	2	1	1	1	7
ICT	Cloud Solutions/Services	2	1	1	1	1	6
ICT	Data Center Capacity	1	1	1	2	1	6
ICT	Use of Open Data platform	2	1	1	1	1	6
ICT	Quality of Open Data	2	2	1	2	1	8
ICT	Open data based solutions	2	1	1	1	1	6
ICT	Electricity Supply ICT Monitoring	1	2	1	2	1	7
ICT	Demand Response Penetration	1	1	1	1	1	5
ICT	Platform downtime	2	1	2	2	1	8
Mobility							
Mobility	Energy consumption data aggregated by sector fuel	2	1	1	1	1	6
Mobility	Kilometres of high capacity public transport system per 100 000 population	1	1	2	2	2	8
Mobility	Passenger-kilometres public transport and private vehicle	1	2	1	2	2	8
Mobility	Electric Vehicles & Low-Carbon Emission Vehicles deployed in the area	2	1	2	2	2	9
Mobility	Number of Evs charging stations and solar powered V2G charging stations deployed in the area	2	2	2	2	2	10
Mobility	Impact of ICT apps into mobility	2	1	1	1	1	6
Mobility	Car pooling locations	2	2	2	1	1	8
Mobility	Clean mobility utilization	2	1	2	1	1	7
Mobility	Modal split (passengers, vehicles, trips)	2	1	2	2	1	8
Mobility	Access to vehicle sharing solutions for city travel & Level of Improvement	2	2	1	1	1	7
Mobility	Annual number of public transport per capita	1	2	2	1	2	8
Mobility	Length of bike route network: Kilometres of bicycle paths and lanes per 100 000 population	1	2	2	2	2	9
Mobility	Number of personal automobiles per capita	1	2	2	2	2	9
Mobility	Number of bikes (from bike sharing service) every 100 inhab	1	1	2	2	2	8
Mobility	Public Transport Network	1	2	2	2	1	8
Mobility	Public Transport Network Convenience OR Access to public transport	1	1	2	2	1	7
Mobility	Percentage of commuters using a travel mode to work other than a personal vehicle (SI)	1	1	2	1	2	7
Mobility	Average commute time (SI)	0	1	2	1	2	6
Mobility	Number of users of sharing economy transportation per 100,000 population	1	1	2	1	1	6
Mobility	Availability of real-time traffic information	1	1	1	1	2	6
Mobility	Yearly **km** of Shared Vehicles	2	2	2	2	2	10
Mobility	Percentage of vehicles registered in the city that are autonomous vehicles	0	2	2	2	1	7

Mobility	Percentage of roads conforming with autonomous driving systems	0	1	2	2	1	6
Mobility	Total number of transport vehicles for passengers	1	2	2	2	2	9
Mobility	Public charging points per eVehicle (EV)	2	2	2	2	2	10
Mobility	Annual Energy delivered by charging points -	2	1	2	2	2	9
Mobility	Total Number of recharges per year (public EV charging stations	2	1	2	1	1	7
Mobility	Total operating time for EV charging operations	2	1	2	2	1	8
Mobility	Average duration of EV charging operations	2	1	2	2	1	8
Mobility	Total Occupancy time of EV charging points	2	1	2	2	1	8
Mobility	Average Occupancy time of EV charging points	2	1	2	2	1	8
Mobility	Charging points powered by renewable energy sources (number and rate)	2	2	2	2	2	10
Mobility	Availability rate of the Solar Road	2	1	2	1	1	7
Mobility	Annual energy produced by **each** charging point or solar road	2	1	2	2	2	9
Mobility	Annual number of passengers (or users) of new infrastructure	2	1	2	2	1	8
Mobility	Use of e-buses	2	2	2	1	1	8
Mobility	Availability rate of e-buses	2	1	2	2	1	8
Mobility	Shared Electric Vehicles Penetration Rate	2	2	2	1	1	8
Social							
Social	People reached	2	1	2	2	2	9
Social	Increased consciousness of citizenship	2	1	1	1	1	6
Social	Increased participation of vulnerable groups	1	2	1	1	2	7
Social	Connection to the existing cultural heritage	2	2	1	1	2	8
Social	Ease of use for end users of the solution	2	1	1	1	2	7
Social	Thermal comfort	2	1	1	1	1	6
Social	Comfort conditions	2	1	1	0	1	5
Social	Increased environmental awareness	2	1	1	1	2	7
Social	Local community involvement in the implementation and planning phase	2	1	1	1	2	7
Social	Increased citizen awareness of the potential of smart city projects	2	1	1	1	1	6
Social	Number of city officials and urban experts trained to conduct the meaningful and ethical engagement of citizens	2	1	1	1	1	6
Social	Provision of a 6ocalized multi stakeholder co-creation and co-production Field Guide for Citizen Engagement	2	1	1	1	1	6
Social	Participation of citizens, citizen representative groups and citizen ambassadors in the co-creation of local/micro KPIs for Citizen Engagement	2	1	1	1	1	6
Social	Number of municipal educational activities on the themes of Smart City every 1000 inhabitants	1	1	2	1	2	7
Social	Number of municipal websites for citizens	0	2	2	1	2	7
Social	Number of interactive social media initiatives	0	2	2	1	1	6
Social	% of citizens' participation in online decision making	2	1	2	1	1	7
Social	Residents project satisfaction	2	1	1	0	1	5

Social	Degree of satisfaction	2	1	1	1	2	7
Social	Residents involvement degree	2	1	1	1	1	6
Social	Residents energy awareness	2	1	1	1	1	6
Social	Stakeholder willingness to retrofit	2	1	1	0	2	6
Social	Active/proactive citizens's behaviour	2	1	1	1	1	6
Social	Citizens' perception in the social factors	1	1	1	1	1	5
Social	Range of people from diverse social backgrouds reached	1	1	1	1	2	6
Social	Annual number of citizens engaged in the planning process per 100 000 population	2	1	2	1	1	7
Governance							
Governance	Leadership	1	2	1	1	0	5
Governance	Balanced project team	1	2	1	1	2	7
Governance	Involvement of the city administration	2	2	1	1	1	7
Governance	Clear division of responsibility	1	2	1	1	1	6
Governance	Market orientation	1	2	1	1	1	6
Governance	Cross-departmental integration	1	2	1	1	1	6
Governance	Establishment within the administration	1	2	1	1	1	6
Governance	Monitoring and evaluation	2	2	1	1	2	8
Governance	Bottom-up or top-down initiative	0	1	1	1	1	4
Governance	Participatory governance	1	1	2	1	1	6
Governance	Citizen participation	1	1	2	1	2	7
Governance	Open public participation	0	1	2	2	1	6
Governance	Smart city policy	2	2	1	1	1	7
Governance	Municipal involvement Financial support	1	2	1	1	2	7
Governance	Smart city policy	2	2	1	1	1	7
Governance	Legal Framework compatibility	2	2	1	1	1	7
Governance	Natural disaster prevention policy	1	2	0	1	2	6
Governance	Open goverment dataset	2	1	1	2	1	7
Governance	Policy makers response to e-Mobility demonstrators	2	1	1	1	1	6
Governance	Perception of satisfaction with urban planning methodology	1	1	1	1	1	5
Governance	Targeted people reached in urban planning methodology	0	1	1	2	1	5
Governance	Perception of satisfaction with coaching / mentoring activity	1	1	1	1	1	5
Governance	People reached in urban coaching/mentoring activities	1	1	1	2	1	6
Governance	New rules / regulations due to the project	2	1	1	1	1	6
Governance	Signature and compliance with the Covenant of Mayors	2	2	1	1	1	7
Governance	Existence of plans/programs to promote energy efficient buildings	2	2	1	2	2	9
Governance	Existence of regulations for development of energy efficient districts	2	1	1	2	1	7

Governance	Existence of plans/programs to promote sustainable mobility	1	2	1	2	2	8
Governance	Existence of regulations for development of sustainable mobility	1	1	1	2	1	6
Governance	Annual number of online visits to the municipal open data portal per 100 000 population	2	2	2	2	2	10
Governance	Percentage of city services accessible and that can be requested online (e-Governance)	2	2	2	2	1	9
Governance	Average response time to inquiries made through the city's non-emergency inquiry system (days)	0	1	2	2	1	6
Governance	Average time for building permit approval (days)	1	1	2	1	2	7
Governance	Percentage of service contracts providing city services which contain an open data policy	1	1	2	1	1	6
Governance	Public Sector e-Procurement	1	1	2	1	1	6
Governance	Smart city integrated services	2	1	2	1	1	7
Propagation							
Propagation	Social compatibility	2	1	1	1	2	7
Propagation	Technical compatibility	2	2	1	2	1	8
Propagation	Ease of use for end users of the solution	2	1	1	1	2	7
Propagation	Ease of use for professional stakeholders	1	1	1	1	1	5
Propagation	Trialability	1	1	1	1	1	5
Propagation	Advantages for end users	2	1	1	1	2	7
Propagation	Advantages for stakeholders	2	1	1	1	2	7
Propagation	Visibility of Results	2	1	1	1	2	7
Propagation	Solution(s) to development issues	2	2	1	1	1	7
Propagation	Market demand	2	2	1	2	2	9
Propagation	Changing professional norms	2	2	1	1	1	7
Propagation	Changing societal norms	1	1	1	1	1	5
Propagation	Diffusion to other locations	2	1	1	2	2	8
Propagation	Diffusion to other actors	1	1	1	1	1	5
Propagation	New forms of financing	2	1	1	1	2	7
Propagation	Smart city project visitors	2	1	1	1	2	7