Ref. Ares(2017)5877989 - 30/11/2017

Deliverable due date: M12 – Dec. 2017

D6.2 Baseline assessment & PESTEL Analysis of BYDGOSCSZ's Initial Replication Plan

WP6, Task 6.1

Transition of EU cities towards a new concept of Smart Life and Economy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Project Acronym	mySMARTLife
Project Title	**Transition of EU cities towards a new concept of Smart Life and Economy**
Project Duration	1st December 2016 – 30th November 2021 (60 Months)
Deliverable	D6.2 Baseline assessment & PESTEL Analysis of Bydgoszcz's Initial Replication Plan
Diss. Level	PU
Status	Working Verified by other WPs Final version
Due date	M12 30/11/2017
Work Package	WP6
Lead beneficiary	BYD
Contributing beneficiary(ies)	
Task description	Subtask 6.1.1: Baseline assessment of follower cities. A baseline assessment of the current situation for each follower city will be performed and therefore the feasibility and adaptation of these preliminary plans will be reviewed. To set up the baseline, a PESTEL (Political, Economic, Social, Technology, Environmental and Legal) analysis will be carried out to determine the uniqueness and the context of each follower city for these initial plans NBK will coordinate this task with the cities and supported by CAR and TEC. For this assessment of the context, each follower will be visited, and key stakeholder interviews prepared and performed. The process will continue iteratively with the active participation of local authorities and identified stakeholders.

Date	Version	Author	Comment
23/05/2017	0.1	Aurélien HENON (NBK)	TOC and questions
9/06/2017	0.2	Aurélien HENON (NBK)	First contribution guideline : one PESTEL analysis on one smart action, preliminary replication plan update and selection of smart action
9/10/2017	0.3	NBK/CAR	Guidelines and place of city level indicators.
23/11/2017	0.3_20	BYD	First smart action completed
29/11/2017	0.3_29	BYD	Last smart action completed and document completion
30/11/2017	0.3_30	NBK/CAR	Final review

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Table of Content

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table of Figures

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Table of Tables

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Abbreviations and Acronyms

Acronym	Description
CoC	Center of competence
E-buses, E-vehicles	Electrical buses, electric vehicles
GDP	Gross domestic product
GIS	Geographic information system
GUS	National statistics office of Poland
ICT	Information and communication technology
ITI	Integrated territorial investment
ITS	Intelligent transport systems
mySMARTLife	Transition of EU cities towards a new concept of Smart Life and Economy
RES	Renewable energy systems
ROI	Return on investment
SEAP	Sustainable energy plan action
SMEs	Small and medium-sized enterprises

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1. Executive Summary

mySMARTLife project aims at the development of an **Urban Transformation Strategy** to support cities in the definition of transition models, as a suitable path to reach high level of exellence in its development process, adressing the main city challenges and progressing to the **smart people** and **smart economy** concepts. To achieve this ambitious strategy, **Advanced Urban Plannings** based on prioritizations of actions are developed for three lighthouse cities and four folowers cities. As follower city, Bydgoszcz aims to develop a complete replication plan to be deployed at the end of the project. A first version of this plan was already presented on the proposal (Annex I) and several actions were already planned to foster replication. These actions included mainly city infrastructure (retrofitting, RES integration with buildings), smart grids (smart metering & data management, optimisation of the heating network), mobility (public transport, e-mobility) and non-technical actions (citizens engagement).

In order to adopt an integrated approach to evaluate the impacts that interventions have in cities from the point of view of social, economy and environmental field, a methodology is developing for lighthouse cities and replicating for followers cities. One point of this methodology is to allow a comparative analysis of these interventions so that they can be prioritized based on their impacts. For this, an evaluation framework is developing on the WP5. Starting from the definition of a smart city the indicators for smart cities focus on monitoring the evolution of a city towards an even smarter city.

On the first section, an evaluation of the current state and context of the city of Bydgoszcz was carried out on the basis of these indicators. The city of Bydgoszcz stands out notably by its engagement in the climate and energy action, good economic performance. The city has been developing rapidly in recent years due to good governance, strong economy and EU funding. It has carried out some outstanding urban regeneration projects and greatly improved public transport. However there are still some weaknesses to overcome, which include air pollution, traffic (congestion) and digital governance.

To establish their own strategy plan, follower cities have studied lighthouses cities solutions and planed how best to implement the successfully demonstrated solutions in their city. In addition, for Bydgoszcz, basis for the writing of the replication plan are the local policies and strategies, and the work carried out by Bydgoszcz in the projects derived from participation in networks of intelligent cities. From the baseline assessment of the current situation and their own strategy plan the city of Bydgoszcz has review the feasibility and adaptation of its preliminary plan. The replication plan has been updated by considering all of these data. This baseline assessment made it possible to select the most relevant smart actions.

From the preliminary replication plan actions have been selected and corrected. Not all previously anticipated action would be undertaken. These actions which would not be undertaken in the framework of the mySMARTLife projects include actions which have low smart-city potential or are very distant from realization or were just ideas not possible for implementation in near-future.

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The following actions have been selected for future implementation within the project:

- Smart Action 1: e-mobility in Bydgoszcz
- Smart Action 2: PV on public buildings
- Smart Action 3: smart lighting system
- Smart Action 4: smart rainwater system
- Smart Action 5: Open data GIS portal

In addition a PESTEL (Political, Economic, Social, Technology, Environmental and Legal) analysis have been carried out for each selected action to determine the uniqueness and the context of its application. Some actions have shown great potential for integration where others seemed limited on certain aspects. For these actions whose PESTEL analysis is not entirely favourable, the context and identified difficulties were analysed by taking inspiration from partner cities. This highlighted some solutions to apply in order to ensure the implementation of these actions. Such solutions have been integrated in the replication plan as intermediate actions.

Most of the proposed actions seem very favourable in terms of environmental benefits, good economic context and solid technological base. Political support for them is rather strong and there are possibilities of co-financing implementation of these actions. Future-proofing of these actions is also positive. However for all actions main drivers important for implementation are the political support and economic factors (impact, financing). Also legal background plays a very important role as it is in large part independent from the city administration.

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2. Introduction

2.1 Purpose and Target

The objective of this deliverable is to describe the baseline assessment and the PESTEL analysis of Bydgoszcz's Initial Replication Plan and to provide an update of this replication plan. A first part consists to evaluate the current state and context of Bydgoszcz through a city level analysis based on specific smart and cities indicator evaluation. A second part consists to define and analyse the strategic plan of Bydgoszcz according to the main targets of the SEAPs, other relevant urban planning and lighthouse cities strategic plans. Based on the city level analysis and the strategic plan of the city, the action plan is then updated as well as the lists of selected smart actions. A PESTEL Analysis is then performed for selected actions. For actions whose PESTEL analysis is not entirely favourable, the context and identified difficulties would be analyse by taking inspiration from partner cities. This highlighted some solutions to apply in order to ensure the implementation of these actions. Such solutions would be integrated in the replication plan as intermediate actions required to carry out the concerned smart action.

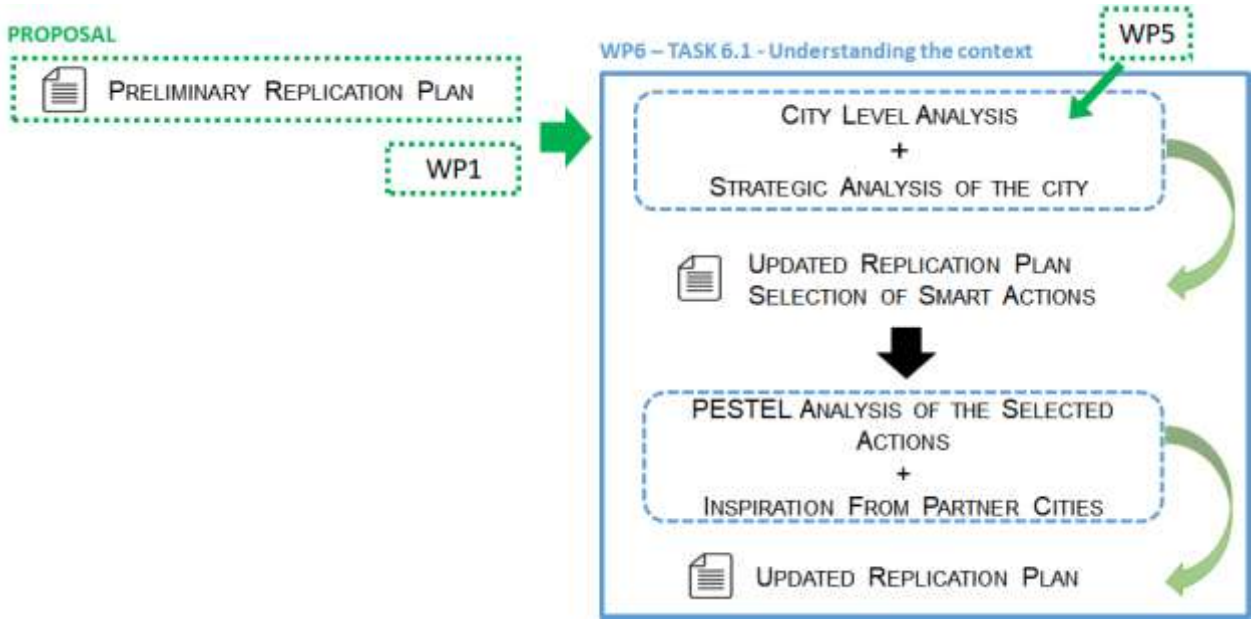

Figure 1 : Several successive steps to update the replication plan

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2.2 Contributions of partners

The following **Table 1** depicts the main contributions from participant partners in the development of this deliverable.

Table 1: Contribution of partners

Participant short name	Contributions
BYD	Overall content production and deliverable leading
NBK	Overall content reviewing and leading contribution
CAR	Overall content reviewing and leading contribution
TEC	Reviewing

2.1 Relation to other activities in the project

The following **Figure 2** depicts the main relationship of this deliverable to other activities (or deliverables) developed within the mySMARTLife project and that should be considered along with this document for further understanding of its contents.

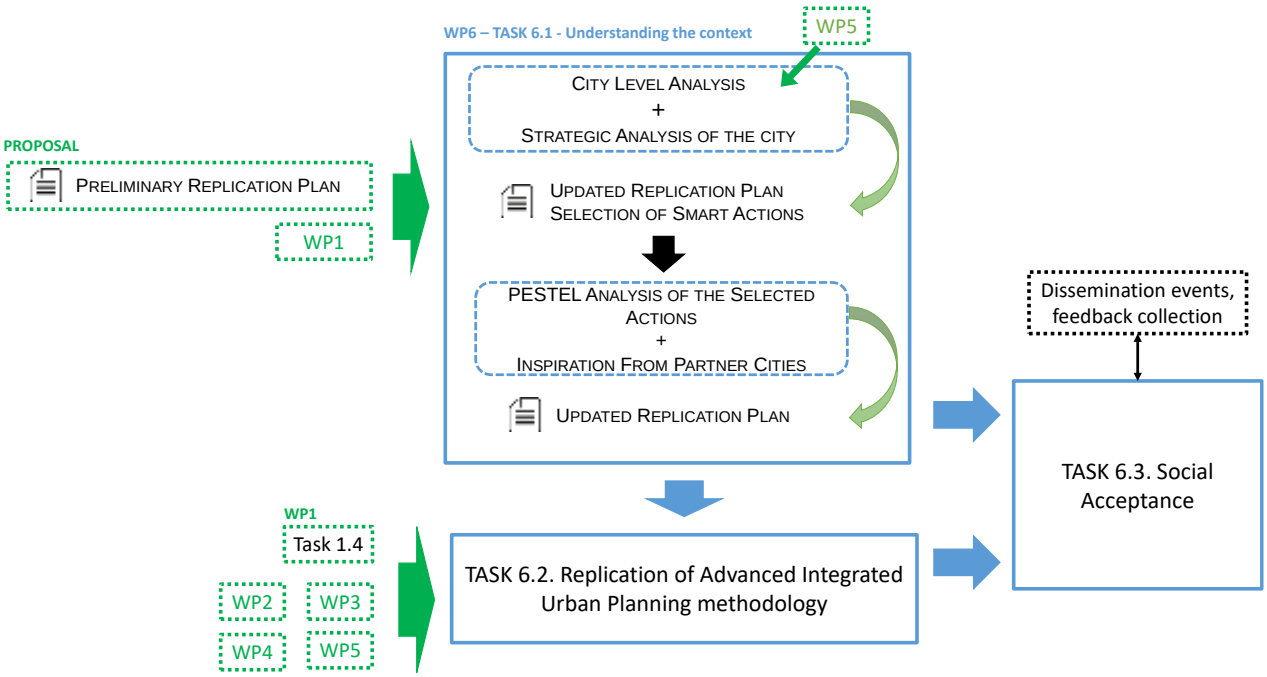

Figure 2 : Relation to others activities in the project

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3. City level analysis

In order to monitor and evaluate the effectiveness of the project actions and interventions, compared to initial situation, initial objectives and expected results, the WP5 of MySmartLife project aims to define an evaluation framework. It will be used for both Lighthouses and Followers cities evaluation. For the Followers cities it will be particularly useful for assessing and understanding the context of each city so that solutions can be chosen and adapted and for delivering adapted replication strategies and plans.

To elaborate this framework, previous work by CITYkeys and SCIS have been considered. This framework have two fold scope in order to measure and assess the project activities at Smart City Project level and Smart City level considering the five major themes defined by CITYkeys: People, Planet, Prosperity, Governance and Propagation and completed with specific smart city indicators. Starting from the definition of a smart city the indicators for smart cities focus on monitoring the evolution of a city towards an even smarter city.

The characterization of Bydgoszcz and its supporting data collection, provides the citywide integrated documentation and analysis of the current conditions required to identify the priority action lines as well as their management needs.

Through a range of city descriptors and indicators, information about the existing conditions including some of the key aspects for the sustainable development are collected and shown in a standardised manner: social, economic and environmental aspects. This information is essential to promote actions and management plans for implementing the sustainable urban regeneration model aiming in mySMARTLife project.

The characterization will follow the approach developed for the evaluation framework developed in WP5. While the overall framework and the full set of indicators will be depicted in WP5 related documents, this report includes a selected list of indicators aiming at covering the city characterisation. These indicators are divided into eight categories:

- General overview, climatic characterisation and geographic positioning
- Socio-economic characterisation
- Environmental characterization
- Governance characterisation
- Citizen engagement characterisation
- City transportation characterisation
- Energy supply characterisation

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- Urban infrastructures characterisation

Indicators from each category are presented separately on the following paragraphs. Inspired from CITYkeys (D1.4 Indicators for smart city projects and smart cities), the tables of selected city indicators are shown, discussing the application field, the title, the unit, a short description and the indicator evaluation for Bydgoszcz

- The application field is a common group where various indicators are applicable. Each application field has a dedicated paragraph.
- The title of the city indicator is phrased as evaluating a static situation. A static indicator, assessing the situation at a certain recurrence in time, will allow monitoring over various time periods.
- Important in the choice for the unit of the indicator is the comparability of indicators across a variety of cities differing in size, demography, dominant type of companies/sectors, etc. Here too, absolute values are not suitable. Consequently, most city indicators are defined as '%' or use a Likert scale.
- The description of the indicator are formulated either as a definition or as an interrogative form.

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3.1 General overview, climatic characterization and geographic positioning

Bydgoszcz is located in central-western Poland. The city of Bydgoszcz has population of 353,938 (as of 31st December 2016). It is the seat of Bydgoszcz County and the co-capital of the Kuyavian-Pomeranian Voivodeship.

Bydgoszcz is a seat of Casimir the Great University, University of Technology and Life Sciences and a conservatory (Bydgoszcz Music Academy) and the Medical College of Nicolaus Copernicus University in Toruń. Bydgoszcz Ignacy Jan Paderewski Airport is located less than 5 km from the city centre. Bydgoszcz canal connects Vistula and Oder rivers and forms part of a water system connected with the Rhine and Rotterdam.

Bydgoszcz is one of the most important economic centres in Poland. The most significant branches of its economy are: IT, chemical and electromechanical industry. Bydgoszcz is also a headquarter of Pesa – company which manufactures railway vehicles.

Climate of Bydgoszcz is temperate. July is the warmest month, January is the coldest one. Winter is drier than summer.

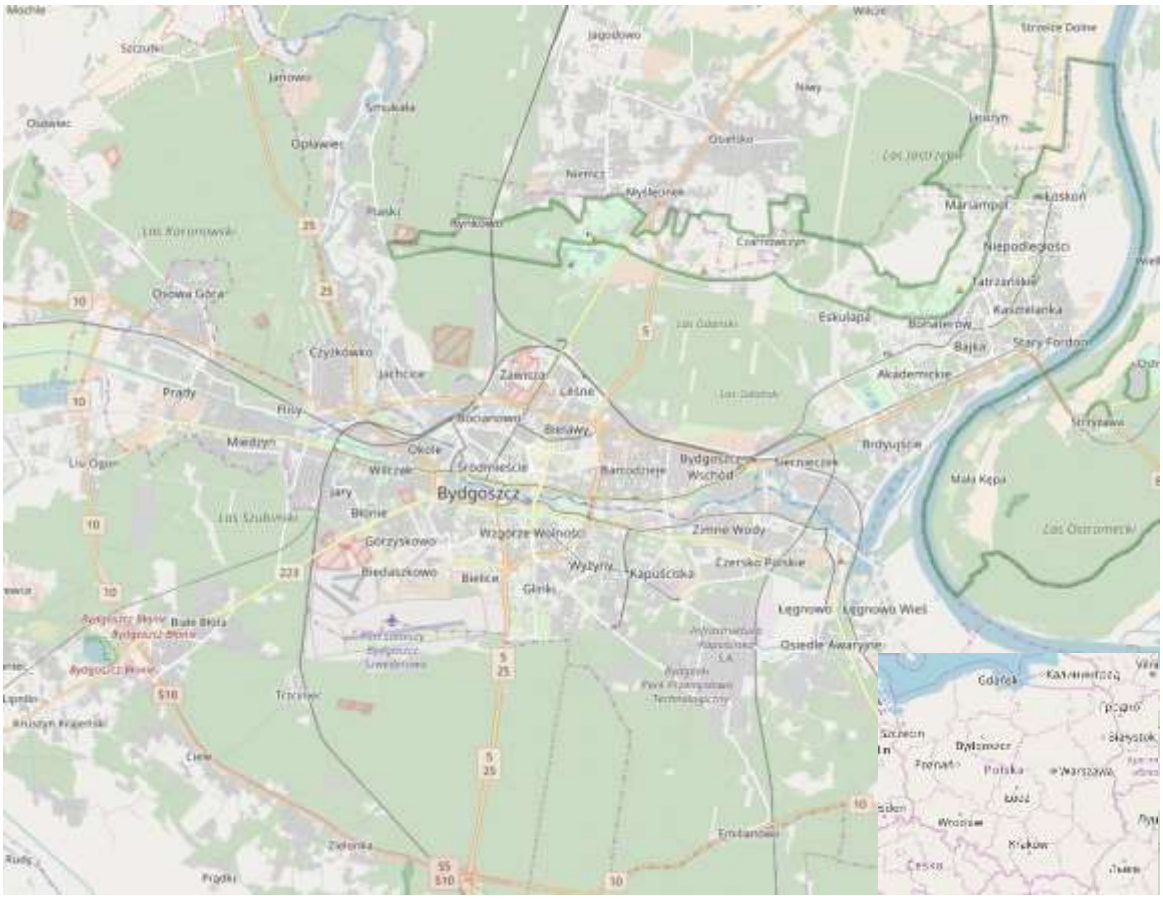

Figure 3 : General map of the city

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3.1.1 City features

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Size	km^2	Land area of city (Data source: GUS, 2016)	176
Population	Inh	Total number of persons inhabiting a city (Data source: GUS, 2016)	353,938
Population density	$Inh./km^2$	Population per unit area in the city (Data source: GUS, 2016)	2.011
People > 75 years	%	Population elder than 75 years old (Data source: GUS, 2016)	8.38
Average population age	y	Average of the age of the population (Data based on GUS, 2016)	40-44
Type of city	Typology	Typology of the city under study	urban

3.1.2 Land use

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Land consumption	nº build/km^2	Measure of land use intensity and urban areas density *residential buildings only (Data source: GUS, 2016)	131.48*
	km^2/km^2	Measure of land use intensity and urban areas density (Data Source: GUS, 2014)	0.42
Balance between residential and no-residential building use	%	Measure of land use diversity	N/A

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3.1.3 CO_2 target

Indicator title	Units	Description of the indicator	BYDGOSZCZ
CO_2 target	%	Overall CO2 emission reduction target *until 2020	20%*

3.1.4 Climate

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Climate koppen geiger classification	Group	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.	Dfb

3.2 Socio economic characterisation

Bydgoszcz is the largest economic centre in Kuyavian-Pomeranian Voivodeship and the eighth largest centre in Poland. The most significant branches of its economy are: IT, chemical and electromechanical industry. Bydgoszcz is also a headquarter of Pesa – company which manufactures railway vehicles.

Banks, financial services, insurance companies, real estate and business services, trade fairs, industrial clusters, business organizations, prestige hotel base, air links (including cargo) plays a key role in economic development. Closest municipalities (Białe Błota, Osielsko, Solec Kujawski) are well developed and their economic indicators are undoubtedly better than the average rural areas. In addition, Bydgoszcz is a workplace for 30,000 people commuting from outside.

It is the core of Bydgoszcz Metropolis - an association of 18 municipalities. Their aim is mutual implementation of actions, mainly economic. The Bydgoszcz Metropolis has population of 594,392 (as of 31st December 2016).

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Figure 4 : Municipalities forming Bydgoszcz Metropolis

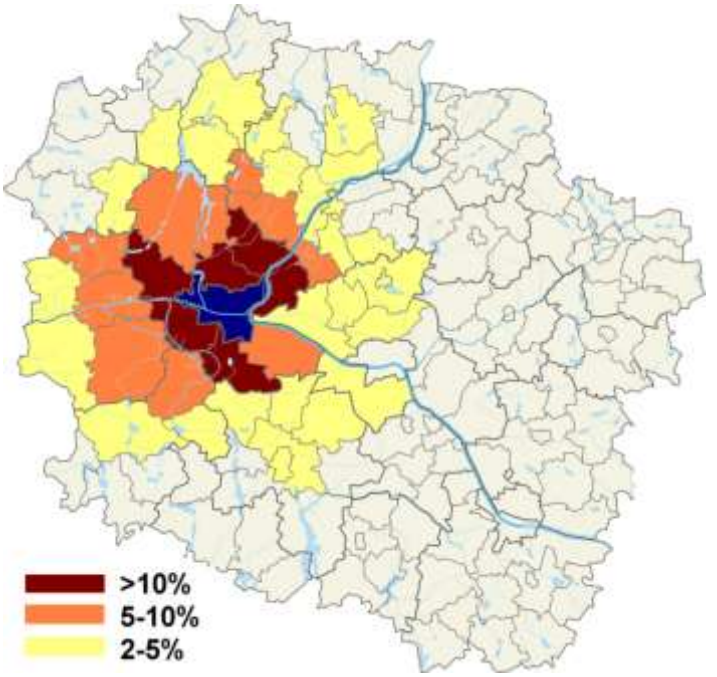

Figure 5 : Number of people employed in Bydgoszcz in ratio to the number of working-age population in municipalities (NSP 2011)

In 2004, the Bydgoszcz Industrial and Technological Park was created in Bydgoszcz. Offices and business centres used by IT and accounting and finance companies are rising in Bydgoszcz. New office centres created after 2010 include: Business Park Kraszewskiego 1, ML Office, Bydgoszcz Business Centre.

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3.2.1 Education level

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Number of high edu degrees per 100,000 population	n/100,000h	It is an indicator of well being and development = It is calculated collecting the number of higher degrees divided by one 100.000th of the total population	N/A

3.2.2 Employment

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Unemployment rate	%	Unemployment (Data source: GUS, 2016)	3,8%
Youth unemployment rate	%	Youth unemployment (Data source: http://www2.um.bydgoszcz.pl/miasto/statystyka/, 2015)	8,8%

3.2.3 Economic performance

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Costs of housing	% in €	Equity : % gross household income spent on housing *home use and energy carriers **furnishing and housekeeping	19.6* 5,1**
GDP	€/cap	Economic performance (Data source: GUS, 2015) 1 EUR = 4.21 PLN 48794 zł	11,590.02
Median disposable income	€/household	Economic wealth: Median disposable annual household income (Data source: GUS, 2016) 1 EUR = 4.21 PLN	303.15
New businesses registered	#/100.000	Economic activity, attractiveness (Data source: GUS, 2016)	775.52

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3.2.4 Equity

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Fuel poverty	%-points in €	Equity : %-points of gross household income spent on energy bills	N/A
Population Dependency Ratio	#/100	Economic development = Number of economically dependent persons (net consumers) per 100 economically active persons (net producers)	65.69
Diversity of housing	%	Diversity = % social housing of total housing stick (Data source: GUS, 2015)	7.10%

3.2.5 Innovation

Indicator title	Units	Description of the indicator	BYDGOSZCZ
New startups	#	New business (Data source: GUS, 2016) (statistic for start-ups is not separately made)	3,329
Research intensity	% in euros	Innovation = R&D expenditure as percentage of city's GDP (Data source: GUS, 2015 - National GDP)	1.0%

3.2.6 Green economy

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Green public procurement	%	Stimulating eco-innovation (2012 data based on Climate Balance)	1.8%

3.2.7 Tourism

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Tourism intensity	nights/100000	Number of night for 100000 inhabitants* *granted to foreign tourists (Data Source: GUS, 2016)	11,105.05

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3.3 Environmental characterisation

The city is located in central-western Poland, in the eastern part of the Torun-Eberswalde massif, above the rivers Brda and Vistula. The area of the city is dominated by urbanized and built-up areas, with the largest area occupied by residential areas and roads. Forest land and bushes cover almost 1/3 of the city's area. About 1/3 of Bydgoszcz pose a natural parks and protected areas.

Local air quality monitoring showed that in 2015 suspended dust PM10, suspended dust PM2,5, benzo(α)pyrene in suspended dust PM10 and ozone exceeded the permitted levels (Voivoideship Inspectorate for Environmental Protection, 3 sensors: ul. Warszawska – 1 automatic, Plac Poznański - 1 automatic, 1 manual). Due to exceedances of pollutants limits the Air protection Programme for Bydgoszcz has been prepared. Actions resulting from this plan are being carried out by the City of Bydgoszcz (including replacement of old coal fired heating stoves with new ones based on gas or district heating).

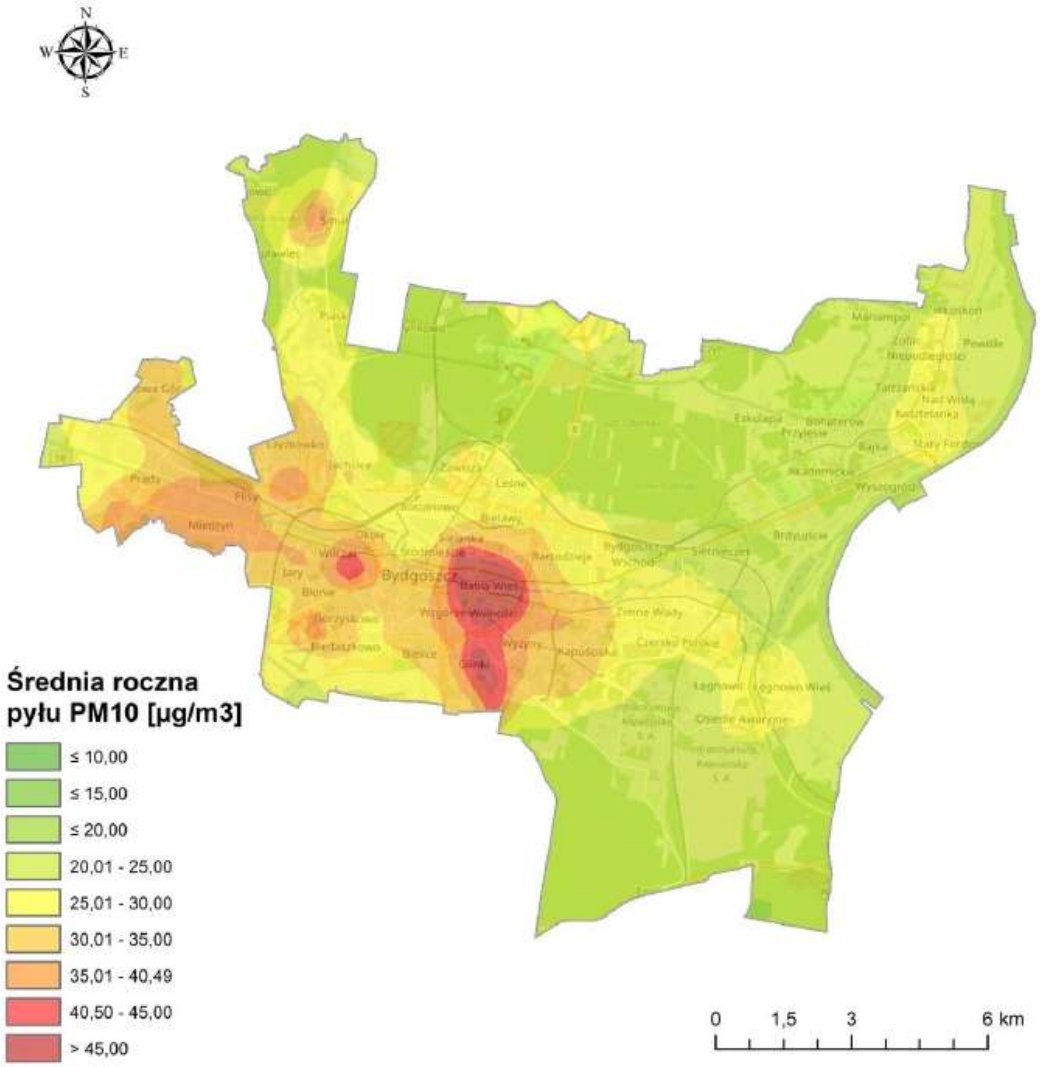

Figure 6 : Average yearly PM10 levels (in 2015).

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As for the noise, the main and most important goal that should be achieved is to bring acoustic climate of Bydgoszcz to the standards provided for by law. Achieving this will be possible through the implementation of the environmental objectives of the Programme of protection of environment against noise for the city of Bydgoszcz, and taking other actions in this regard.

The City of Bydgoszcz, as a one of the few municipalities in Poland, has no problems with management of municipal waste. With a clear and deliberate government policy Bydgoszcz and local businesses, all municipal waste generated is subjected to mechanical treatment. Bydgoszcz has 4 plants for waste treatment, and aside of that, a Municipal Thermal Waste Processing plant for Bydgoszcz - Toruń Metropolitan Area built in 2016. The plant is burning waste from the area, which is currently home to more than 700 thousand residents.

Bydgoszcz city is supplied with water from two intakes, an underground and a surface intake.

The "Las Gdański" water intake draws water from underground resources stored in the aquifer. Its upgrade was completed in 2003. New clean water reservoirs were constructed, new water treatment plant was built, third degree pumping station was modernised.

Green areas and water reservoirs (public and private ones) are 58.5% of the total area of the city. Percentage of citizens living within a maximum distance of 300m from public urban green areas of any size – 92.26%. Most of the naturally valuable areas are located on the outskirts of the city. Natural refuges in the centre are parks and historical greenery establishments on the slopes surrounding the city centre. The most attractive natural greeneries that combine nature and recreation sites are: Park over Stary Kanał in Bydgoszcz, Forest Park of Culture and Leisure in Bydgoszcz {Leśny Park Kultury i Wypoczynku w Bydgoszczy}, estuary of Brda River into Vistula. The most important natural asset of the city are rivers, which are natural axes and barriers defining the directions of development of the city and the slopes of their valleys and ice-marginal valleys.

3.3.1 City environmental impact

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Greenhouse gas emissions per capita	tonnes CO2/capita	-	6.72
Greenhouse gas emissions (tertiary)	Mtonnes CO2/year	-	2.39
Greenhouse gas emissions (transport)	Mtonnes CO2/year	-	0,56
Greenhouse gas emissions (Residential)	Mtonnes CO2/year	-	0.79

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Greenhouse gas emissions in buildings, equipment/facilities and Industries	Mtonnes CO2/year	-	1.79
Greenhouse gas emissions (Public lighting)	Mtonnes CO2/year	-	0.026
Greenhouse gas emissions (Municipal)	Mtonnes CO2/year	-	0.79
Greenhouse gas emissions (Industry)	Mtonnes CO2/year	-	0.36
Transport greenhouse gas emissions per capita	t /(pers.·a)	Measure of the total greenhouse gas emissions per capita due to public and private transport.	1.56
Percentage of renewable energy use in public transport	%	Measure of the use of renewable energy in public transport.	0%

3.3.2 Water resources

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Water consumption	m3/cap/day	Water resources (Data source: GUS, 2016)	0.09
Water re-used (rain/grey water)	% of houses	Water resources	N/A

3.3.3 Air pollution

Indicator title	Units	Description of the indicator	BYDGOSZCZ
NOx emissions	g/cap	Air pollution (NO2 for Industry; Data source: WIOŚ, GUS, 2015)	5.551,03
PM2,5 emissions	g/cap	Air pollution (Data source: Air Protection Programme – data for year 2015, assuming 90% share of PM2,5 in PM10)	3,225.50
Air quality index	index	Annual concentration of relevant air pollutants	N/A

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3.3.4 Noise pollution

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Exposure to noise pollution	%of people	Noise pollution. dB night time measured at receiver *transport **trams ***industry (Data source: Program ochrony środowiska przed hałasem dla miasta Bydgoszcz, 2013)	2.44%* 0.1%** 0.06%***

3.3.5 Waste

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Amount of solid waste collected	tonnes/capita/year	Waste (Data source: Analiza stanu gospodarki odpadami komunalnymi dla Miasta Bydgoszczy za rok 2016 r.)	0.418
Recycling rate	% tonnes	Lower amount of waste. Percentage of city's solid waste that is recycled *paper, metal, plastics and glass **non-hazardous construction and demolition waste (Data source: Analiza stanu gospodarki odpadami komunalnymi dla Miasta Bydgoszczy za rok 2016 r.)	23.99%* 90.04%**

3.3.6 Land consumption

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Brownfield use	% of km2	Share of brownfield area that has been redeveloped in the past period as percentage of total brownfield area	N/A
Compactness	inhabitants or workplaces / m2	Efficient city plan	N/A

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3.3.7 Urban heat island effect

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Urban Heat Island	°C UHImax	Maximum hourly difference in air temperature within the city compared to the countryside during the summer months Mean difference for period 2006-2009 (Data source: Dudek S., Kuśmierek-Tomaszewska R., Żarski J., 2010, *Charakterystyka miejskiej wyspy ciepła na przykładzie Bydgoszczy,* Ekologia i Technika, 18/4, 180-185.)	1.2

3.3.8 Food consumption

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Local food production	% of tonnes	Share of food consumption produced within a radius of 100 km	N/A

3.4 Governance characterisation

The City of Bydgoszcz is very active in supporting sustainable development and applying for EU funding to provide low-carbon economy, higher air quality or better energy efficiency.

Sustainable Energy Action Plan 2012-2020 supports all activities connected with urban planning. Low-carbon economy plan for the City of Bydgoszcz 2014 – 2020+ promotes sustainability by CO2 reduction and optimal use of energy.

Sustainable development of the public transport plan for Bydgoski County 2016 activates smart mobility in the city. Climatic bilanses (developed every year) monitor the implementation of the actions envisaged in the Climate Protection and Adaptation to the effects of climate change Plan. The city invested major resources in developing, as a result many strategies were created:

- Strategy of development of Bydgoszcz
- Heat, electricity and gas fuels supply for Bydgoszcz
- Spatial planning
- Clean City Program
- Climate Protection Program
- Environmental Protection Program for the City of Bydgoszcz

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- Waste management plan for the city of Bydgoszcz for the years 2005-2012 and many other.

3.4.1 Urban planning

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Existence of an Agenda 21	YES/NO	Has the city elaborated an Agenda 21?	NO
Existence of local sustainability plans	YES/NO	Is there any specific sustainability plan in the city?	YES
Existence of Smart Cities strategies	YES/NO	Is there any specific Smart Cities strategy in the city? *Special Team for Smart Cities was created in 2015	NO*
Signature and compliance of the Covenant of Mayors	YES/NO	Has the city signed the Covenant of Mayors. And Is the city complying with it? (both questions need to be aswered)	YES YES
Existence of plans/programs to promote energy efficient buildings	Number of plans	Is there any specific plan for promoting energy efficient buildings in the city?	1
"Existence of plans/programs to promote sustainable mobility"	YES/NO	-	YES2016
	Number of plans	Is there any specific plan for promoting sustainable mobility in the city?	2
Existence of regulations for development of energy efficient districts	Number of regulations	Is there any specific regulation for developing energy efficient districts in the city?	0
Existence of regulations for development of sustainable mobility	Number of regulations	Is there any specific regulation for developing sustainable mobility in the city?	2
Existence of local/national Energy	YES/NO	Is there any specific EPC for buildings in the city?	YES

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Performance Certificate (EPC)			
Share of Green Public Procurement	%	Percentage annual procurement using environmental criteria as share of total annual procurement of the city administration	N/A
Climate resilience measures	Qualitative Likert scale	Adaptability to climate change	4
Smart city policy	Qualitative Likert scale	The extent to which the city has a supportive smart city policy	2
Preservation of cultural heritage	Qualitative Likert scale	Identity of place based on its history = the extent to which preservation of cultural heritage of cultural heritage of the city is considered in urban planning	4

3.4.2 Level of correspondence

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Level of correspondence between local energy codes	YES/NO	Is there any discrepancy between different local energy codes for buildings?	NO
Level of correspondence with national regulation	YES/NO	Is there any discrepancy between local codes and national regulation?	NO
Level of correspondence with European legislation	YES/NO	Is there any discrepancy between local codes and European legislation?	NO
Level of correspondence with international construction standards	YES/NO	Is there any discrepancy between local codes and international construction standards?	NO

3.4.3 Citizen participation

Indicator title	Units	Description of the indicator	BYDGOSZCZ

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Voter participation	%	The percentage of people that voted in the last municipal election as share of total population eligible to vote (Voivodeship level; Data source: GUS, 2015)	44.46%

3.4.4 Governance collaboration

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Cross-departmental integration	Qualitative Likert scale	The extent to which administrative departments contribute to “Smart City” initiatives and management	3

3.4.5 Online government data

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Availability of government data	Qualitative Likert scale	The extent to which government information is published (Likert scale 1 – 5; 1=poor; 5=excellent)	4

3.4.6 Open government dataset

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Quantity of open data	#/100.000	Quantity of open data sets provided by city's open data portal	0

3.5 Citizens engagement characterisation

Inhabitants of the City of Bydgoszcz can participate in actions undertaken in communities in which they live each day. They can take part in the processes of establishing of groups, institution and public sector organizations by electoral participation, public activity and general citizen involvement.

Act Of Revitalization of the City of Bydgoszcz (established in 2015) says that social participation involves the preparation, conduct and evaluation of revitalization in a way that ensures the active participation of stakeholders (inhabitants of the City of Bydgoszcz, entities conducting or intending to conduct business or social activity in the municipality area, public authorities). This participation should consist learning about

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stakeholders needs, ensuring necessary information for stakeholders, initiating and assisting in the development of dialogue with them.

3.5.1 Channels of communication

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Number of local associations per capita	Number of consultations / inhab.	Total number of citizen associations in the city	0.0028
Number of information contact points for citizens	Number of information points	Total number of information contact points, related to municipal citizen offices, information about energy efficiency, mobility, environment, etc.	8
Number of municipal websites for citizens	Number of municipal websites	Total number of municipal websites for citizens (citizen participation portal, open data, transparency, etc.)	9
Number of interactive social media initiatives	Number of social media links	Total number of municipality links in social media channel as Facebook, Twitter, YouTube, etc.	15
Number of discussion forums	Number of forums	Total number of discussion forums dedicated to the citizens	0

3.5.2 Accesibility of services

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Access to public amenities	%	Basic services available close to home = Share of population with access to at least one type of public amenity within 500m	N/A
Access to commercial amenities	%	Basic services available close to home = Share of population with access to at least six types of commercial amenities providing goods for daily use within 500m.	N/A

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3.6 City transportation characterisation

Length of Bydgoszcz's road network is approximately 800km, with a hard surface over 530 km in length (national roads 7%, 1.6% provincial, county 23.4%, municipal 62.7% and internal 5.3%). Length of two- and multi-lane sections is about 50km, which represents approximately 9% of the total length of paved streets. The system of local public transport in in Bydgoszcz contains: 7 day tram lines, 30 bus lines, 2 inter-municipal lines, 5 night lines and 3 lines of water buses.

Bus transport is run mainly through the streets of the city's primary road system. 77% of transportation services is offered by the municipal transport (an internal company) - Miejski Zakład Komunikacji Sp. z o.o. (Municipal Department of Communications Sp. z o.o.), the other by private companies PKS and Mobilis. On the city's road network operate 37 regular bus lines, including the night ones. In the city there are 6 lines in length exceeding 15 km route, with 4 of them combining Fordon district with the city centre or with other large districts in the west - east axis and one line in the north - south axis. In addition, 2 lines connect the peripheral parts of the city centre and 3 lines move between the City Centre and the largest districts adjacent to it. The average age of the bus fleet is 7.57 years, with over 22% of vehicles purchased within the last 5 years. In addition, 74% of the total 180 vehicles is low-floor vehicles. All vehicles are equipped with sound-based passenger information system. The most popular place of exchange of passengers is a bus stop fitted with a bus lay-by. Due to location of the bus and tram loops and the course of public transport in Bydgoszcz, there are several interchanges, of which the largest are: Rondo Grunwald, Szubińska - Żwirki i Wigury, a stop on ul. Wyścigowa along with the tram terminal and Rondo Jagiellonów. In Bydgoszcz, there is no area-prioritization system for modes of public transport, with the singular exceptions at intersections with detection of rail vehicles. Trackage space is also unused for purposes of development of common tram-bus lanes (PAT-s).

7 tram lines operate within the city of Bydgoszcz, their total length being 72.2 km, while the active length of the track is 29.2 km. The rail infrastructure is based on the track rail spacing of 1000 mm. Within the infrastructure included are: tram depot, 12 loops, 4 bridge crossings and 2 overpasses. Depot has the ability to handle up to 170 units wagon - now it is used in 70% of its capacity. In order to reduce the loss of time, increase the comfort of travel, increase travel speed, efficiency and safety of transit, applied are: integrated hubs, priorities at intersections with traffic lights and dedicated tram tracks. The average distance between stops is 539 meters - for comparison, for bus transport it is 735m. Unfavorable point in the network of the city is a stretch of Rondo Jagiellonów - an intersection between Gdańska-Jagiellońska-Focha, through which runs 6 of 7 lines designated in the city's common space with vehicular traffic. The share of tram transport in total conveyance is 28.5%. Indicator of rail transport's density is 0.2km/1000 citizens. Another indicator describing conditions of travel is traffic speed and average operation speed, which are respectively: 18.4 km/h and 14.0 km/h.

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Pedestrian traffic in the total travel within the city varies from ~ 16% to ~ 54%, depending on the nature of the group type of homogeneous transport behaviour. At a distance of 0.5 kilometers, virtually all trips are made on foot, while at the distance above 5km only occasionally. In Bydgoszcz, there are two underpasses, footbridges - occasionally used by pedestrians - over railway lines, streets and the Bydgoszcz Canal (Kanał Bydgoski), as well as tunnels under railway embankments.

Bydgoszcz is a major railway hub through which run the lines of great importance for the country. In the area of the city, 6 railway stations and 8 stops are located.

Water Transport runs through Bydgoszcz's waterway - Brda River. 3 lines of water bus were started, which are serviced by 3 vessels "M / S Bydgoszcz" - historic motor-powered vessel and two solar-powered ships "Słonecznik" and "Słonecznik II". The route of water bus runs through Bydgoszcz Canal and Brda River, and along the way passes 9 stops of Bydgoszcz Floodway - Marina Gwiazda, Śluza Okole, Jachcice, Astoria, WSG, Rybi Rynek, PKS, Tesco and Słoneczny Młyn. All water bus lines function in the spring-summer season (May to September).

3.6.1 Mobility city profile

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Total number of public transport vehicles	Number of vehicles	Number of public vehicles that are destinated to public transport (bus, taxis…)	2,558
Number of fossil fuelled four wheels vehicles per capita	n/ cao	Number of fossil fuelled vehicles (four wheels) of the city divided by type: public and private	0.55
Vehicle fuel efficiency	kWh/100km	Total energy consumed for vehicles/total amount of vehicle kilometres completed	N/A
Fuel mix	%	Percentage of the market share of transport fuel for each type of fuel used in given period (data: POPiHN, 2017)	61.50% diesel 20.83% petrol 17.67% LPG
Average occupancy	number of passengers per vehicle	Average of number of passengers per vehicle per trip	N/A
Average vehicle speed	km/h	Average network speed by vehicle (peak/off-peak) (data: ITS Nov.2017)	31.78/38.83

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3.6.2 Sustainable transport

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Number of Electric Vehicles (EV) in the city	n/100.000	Number of electric vehicles in the city per 100.000 including private, public and service (taxi and first mile) vehicles including also motobikes	61.13
Public transport use	#/cap/year	Annual number of public transport trips per capita *average data for past 5 years	99,000,000*
Access to public transport	%of people	Share of population with access to a public transport stop within 500m	N/A
Access to vehicle sharing solutions	#/100 000 people	Number of vehicles available for sharing per 100.000 inhabitants	0
Length of bike route network	km/100000 people	% of bicycle paths and lanes in relation to the length of streets (excluding motorways) (Data source: GUS, 2016)	23.36

3.6.3 Charging points

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Total kWh recharged in the EV charging stations	kWh	"Number of kWh recharged during a year in the public and private	N/A
Charging points per eVehicle	%	Percentage of charging points per vehicle	0.0046
Total charging points	#	Total number of charging points (data: UM Bydgoszcz)	1

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3.6.4 Transport problems

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Congestion	% in hours	Increase in overall travel times when compared to free flow situation uncongested situation) (Data Source: Planu zrównoważonego rozwoju publicznego transportu zbiorowego dla miasta Bydgoszczy za Studium transportowe miasta Bydgoszczy wraz z oceną stanu bezpieczeństwa ruchu drogowego).	5-588%
Traffic accidents	#/100 000 people	Number of transportation fatalities per 100 000 population (Data source: KWP, 2016)	72.3

3.7 Energy supply characterisation

Rational use of energy, in particular renewable energy, is one of the essential components of sustainable development with valuable eco-energy effects. The increase in the share of renewable energy in the fuel and energy balance of municipalities and cities contributes to improving the efficiency and saving of energy resources, improves the environment by reducing pollution to air and water and reduces waste. Therefore, to support the development of these targets is becoming an increasingly important challenge for the city.

The balance of thermal power demand for the entire city of Bydgoszcz, broken down by categories of recipients of heat and types of coverage are presented in the table below.

Table 2 - Balance of thermal power demand for the entire city of Bydgoszcz

Details		Heat demand [MW]							
		Network Gas	municipal heating system	C. Osowa Góra	GE outside KPEC	Local boiler houses, coal heating	Other fuel	RES + heat recovery	TOTAL
Houses heated	individually	91.2	11.6	0.9	0.0	291.2	4.1	0.2	749.5
	collectively	6.0	337.4	6.8	0.0	0.1	0.0	0.0	
Public utility buildings		34.0	107.3	1.1	0.0	0.2	1.7	0.0	144.2
Commercial services and manufacturing		71.8	150.3	6.1	106.8	16.9	7.6	13.9	373.3
TOTAL		202.9	606.6	14.8	106.8	308.4	13.3	14.1	1,267.0

Source: Assumptions for the Plan of Bydgoszcz's demand for heat, electricity and gas by 2025

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The largest share in covering the heat requirements of the city is the city district heating system operating on the basis of four sources using coal as a primary medium. Local boiling stations and individual coal heating are listed as second.

Thermal energy consumption in the city is estimated at 9,889 TJ, including residential buildings at 5,246 TJ.

Based on this data and a total usable flat area of Bydgoszcz, individual thermal power (in [W/m2]) and thermal energy (in [kWh/m2]) demand in residential buildings can be calculated - they both amount to: approximately 94 W / m2 and 183 kWh/m2.

Estimated annual energy potential of currently produced energy on the basis of local and renewable energy carriers in Bydgoszcz is ca. 26 414.2 MWh (main sources are hydro energy and biomass). It is estimated that the current share of renewable and local energy targets covering the heat demand amounts to approximately 1% and in the future can achieve the target level of approximately 15%.

The city of Bydgoszcz gradually increases the energy efficiency of municipal buildings (flats, schools, kindergartens, nurseries, etc.) in the normal course of business through thermo-modernization works consisting in replacing windows, doors, insulation of walls, roofs, replacement of heating and hot water systems replacement of windows in 2006 - 1578 doors - 135 external wall insulation - 64 buildings, renovations of internal heating and hot water systems - 36 buildings - a total cost of the task PLN9,450 thousand replacement of windows in 2007 - 1,041 doors - 117 external wall insulation - 92 buildings, renovations of internal heating and hot water systems - 33 buildings - a total cost of the task PLN 19,723.7 thousand roof and exterior wall insulation, roof replacement, modernisation of installations in 2008 - 2 buildings - the total cost of the task PLN 28.120 thousand thermo-modernization works in 2009 carried out in 39 residential buildings, 4 restaurants and 5 public buildings for a total cost of PLN 12,354.474 thousand thermo-modernization works in 2012 carried out in 6 public buildings for the total cost of PLN 959.499 thousand thermo-modernization works in 2011 carried out in 16 residential buildings for the total cost of PLN 10,648 thousand.

3.7.1 City energy profile

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Final energy consumption per capita	MWh/capita	-	16.0
Final energy consumption (Transport)	TWh/year	-	2.260
Final energy consumption (Buildings,	TWh/year	-	3.442

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equipments/facilities and Industries)			
Final energy consumption (Municipal)	TWh/year	-	0.122
Final energy consumption (Tertiary)	TWh/year	-	0.793
Final energy consumption (Residential)	TWh/year	-	1.954
Final energy consumption (Public lighting)	TWh/year	-	0.026
Final energy consumption (Industry)	TWh/year	-	0.547
Final energy consumption (electricity)	TWh/year	-	1.120
Final energy consumption (Heat/Cold)	TWh/year	-	0.890
Final energy consumption (Fossil fuels)	TWh/year	-	3.653
Total buildings energy consumption per year	GWh/inhab.year	Residential consumption in the city for heating and electricity uses	0.0028
Final energy consumption per capita	MWh/capita	-	16.0
Primary energy consumption in the city per year	GWh of PE/year	Gross inland consumption of the city excluding non-energy uses	8,096.129
Primary energy consumption per capita	MWh/capita	-	.8
Primary energy consumption (Transport)	TWh/year	-	2.499

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Primary energy consumption (Buildings, equipments/facilities and Industries)	TWh/year	-	5.597
Primary energy consumption (Municipal)	TWh/year	-	0.203
Primary energy consumption (Tertiary)	TWh/year	-	1.717
Primary energy consumption (Residential)	TWh/year	-	2.418
Primary energy consumption (Public lighting)	TWh/year	-	0.078
Primary energy consumption (Industry)	TWh/year	-	1.182
Primary energy consumption (electricity)	TWh/year	-	3.361

3.7.2 Renewable energy

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Final energy consumption (Renewables)	TWh/year	-	0.213
Share of local energy production to overall final energy consumption	%	-	58.33%
Renewable electricity generated within the city	%	The percentage of electric energy derived from renewable sources, as a share of the city's total energy consumption	0.37

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Non-RES Heat/ Cold production	TWh/year	-	…
RES Heat/Cold production	TWh/year	-	…
Non-RES Electricity production	TWh/year	-	..
RES Electricity production	TWh/year	-	…
Renewable energy per carrier	GWh/RES_supplier	Energy that each renewable system provides to the city *Biomass **PV	*21.229 **0.037
Percentage of renewable energy	%	Amount of energy coming from the renewable sources	0.37
Green electricity purchased	%	The percentage of green electricity purchased, as a share of the city's total electricity consumption	0

3.7.3 Energy mismatch

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Maximum Hourly Deficit (MHDx)	kWh	Energy mismatch: The maximum yearly value of how much the hourly local electricity demand overrides the local renewable electricity supply during one single hour	N/A

3.7.4 Energy monitoring

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Smart energy meters	% of buildings	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.	N/A

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3.7.5 Potential of retrofitting

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Refurbished buildings improving energy performance	% of refurbished buildings	Number of buildings subject to refurbishment improving their energy profile above the EPBD (Energy Performance of Buildings Directive) requirements	N/A

3.7.6 Energy systems

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Number of connections to a district heating network	% of buildings	Number of houses connected to a district heating network of the city	N/A

3.8 Urban infrastructure characterisation

The City of Bydgoszcz follows a path of creating a sustainable urban infrastructure. The upgrades have already started. Traffic and parking management systems are implemented as Intelligent Transport Systems. This project also includes public transport and public bicycles management. There are also more than 30 places with public free WiFi connection in the City of Bydgoszcz.

3.8.1 Liveability of neighbourhoods

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Use of ground floors	m2	Liveability of neighbourhoods	N/A

3.8.2 Green spaces

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Green and blue space	m2	Nature and recreation possibilities (Data Source: SUiKZPMB, 2009)	65,140,000

3.8.3 Traffic management

Indicator title	Units	Description of the indicator	BYDGOSZCZ

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Traffic management system	YES/NO	Is there an automated traffic management system in the city?	YES
Parking management system	YES/NO	Is there an automated parking management system in the city?	YES
Public bicycles management system	YES/NO	Is there an automated public bicycles management system in the city?	YES
Public transport management system	YES/NO	Is there an automated public transport management system in the city?	YES
Number of public transport stops with real time info	%	Number of public transport stops with real time information. ICT applied to public transport needs accuracy and territorial coverage	20.4%

3.8.4 Lighting management

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Lighting system connected	YES/NO	Is there an automated lighting management system in the city?	YES

3.8.5 Waste management

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Waste management system	YES/NO	Is there an automated waste management system in the city?	NO

3.8.6 Communication infrastructure

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Access to public free WiFi	%	Attractiveness, accessibility of online services	1.51%
Access to high speed internet	%	ensure good city connectivity and the provision of efficient digital infrastructures	75.7%

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		(Data Source: GUS, Społeczeństwo informacyjne w Polsce w 2016 r.)	
Number of phone connections per 100,000 inh	Connections/100.000 hab.	Total number of cell phone connections in the city in relation to the population of the city	N/A
Number of Internet connections per 100,000 inh	Connections/100.000 hab.	Total number of internet connections in the city in relation to the population of the city	N/A

3.8.7 Urban platforms

Indicator title	Units	Description of the indicator	BYDGOSZCZ
Cybersecurity	Qualitative Likert scale	Data protection, security of ICT systems	4
Data privacy	Qualitative Likert scale	The level of cybersecurity of the cities' systems	4
Number of data publishers	#	Number of data publishers that publish data into the existing urban platform	8
Number of sensors/devices connected**	#	Number of IoT sensors/devices from any field that are connected in the current urban platform (data: ITS)	2,830
Number of services deployed	#	Number of available services in the current urban platform	2
Number of available Open APIs	#	Number of available APIs in the current urban platform	0
Number of available Open Data sources	#	Number of available Open Data sources in the current urban platform	0
Number of accesses to the urban platform APIs	#	Number of accesses that have been made into the APIs of the urban platforms	0

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4. Applying strategic analysis

4.1 Replication plan update

Associated with document Ref. Ares(2016)5909815 - 13/10/2016

The replication plan is to define the needs and possibilities derive from cooperation in the project. Replication plan will be evaluating within the project while benefiting from the partners experience and knowledge, realization of city investments and financing possibilities. The base for drafting the replication plan are local policies and strategies as well as the work results of recently set up smart city team that was formed when Bydgoszcz started to get engaged in smart city.

4.1.1 Main targets of the SEAPs or other relevant urban planning

The city started to work on climate protection issues as a result of involvement in international project LAKS Local Accountability for Kyoto Goals. In 2010 the City Council approved the MAP, in 2011 the city joined the Covenant of Mayors, and in 2012 the city carried out GHG emission inventory, created SEAP. CO2 reduction target was defined as 20% until 2020 and reduction of energy consumption by 20% by 2020 (referential year 2005). The monitoring of the implementation of SEAP in 2013 showed that CO2 reduction increased by 5,6% comparing and energy consumption by 15,4% comparing to referential year 2015. In 2015 the Low Economy Plan was approved that is now called SEAP-PGN. The plan lists the investment based on SEAP and Financial Prognosis for the city 2015-2038, that is general estimated volume of c.a. 1,5 mld. It is predicted that such investments would limit the CO2 by 24% and energy consumption of 8,5% till 2020. There are 4 specific aims to be achieved by 2020: reduction of CO2 emission by 20%, reduction for energy consumption per person, increase of energy production from RES by 15%, achievement of CAFÉ directive air pollution standards.

4.1.2 Which actions and solutions (technical and non-technical) that are going to be implemented in mySMARTLife project are already in the city planning for a near future?

City of Bydgoszcz already realized the investment that are considered as smart solutions:

- ITS Intelligent Transportation System – steering of the traffic with visual monitoring, management of the public transport with dynamic information, parking information, directing for alternative roads.
- Intelligent public lighting.
- Smart metering and smart grids – municipal heating and municipal waterworks.
- City Bikes.
- Participatory Budget.

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- Energy Management e.g. climate protection policies, group order for heat, gas and energy demand for Bydgoszcz, energy database

Bydgoszcz plans to implement energy management in the city, so most of above mentioned activities that improve energy efficiency and generate the energy savings are to be implemented in the future. The city is engaged in application for Interreg Central Europe programme: CitiEnGov- energy management structures, energy database, RES promotion, energy information for citizens. Energy Guardians – energy management in schools, smart metering, CESBA Central – sustainable buildings certification. Moreover Low Emission Plan:

2014 – 2020 + mentions the following activities, from which some has been implemented already:

- energy audits for the public buildings – 120 000 €
- increase of energy efficiency and use of RES and intelligent management of public buildings - 50 000 000 €
- monitoring of energy use in public buildings – 700 000 €
- exchange of equipment and lighting
- thermo modernisation of residential buildings – 48 000 000 €
- elimination of low emission – programme KAWKA – 3 500 000 €
- reduction of low emission according to air protection plan – 33 000 000 €
- retrofitting of street lighting – 7 000 000 € (SOWA NFOŚiGW
- exchanging the public transport vehicles 2 300 000 €
- enhancing the city tram system (including building new tram lines, modernisation of existing ones, new vehicles, ITS system, central steering system etc.) 300 000 000 €
- retrofitting the bus vehicles (use of bio fuel)
- development of transportation network (park and ride, BIT-City) 21 000 000 €
- construction and modernisation of roads 256 850 000 €
- construction of bike roads, pedestrian corridors 25 400 000 €

Heating

- exploitation of cogeneration in construction of new energy source in Osowa Góra 7 000 000 €
- improvement of energy efficiency through modernisation of municipal heat network 13 200 000 €

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- improvement of energy efficiency through modernisation of municipal heat network using cogeneration 11 600 000 €
- reduction of air pollutants through application of new technologies in the heating objects 1 600 000 €
- smart energy management through modernisation of energy grids 9 500 000 €

Others

- construction of incineration plant 125 000 000 €
- applying in public procurement criteria of energy efficiency and GHG emission
- advisory services for citizens regarding energy efficiency and OZE 100 000 €
- trainings in energy efficiency, OZE, climate change 600 000 €
- promotional and communication activities regarding energy e.g. Energy Days 700 000 €

Future activities

- Construction of the small water power plant 2,5 MW 6 000 000 €
- Construction of photovoltaic plants (including roofs of public buildings) 1 400 000 €
- Construction of the e-vehicles charging stations, costs not defined

4.1.3 Which actions from the set of actions that are going to be implemented in mySMARTLife project are closer to the city interests, so could be replicated in the future?

- In a field of energy efficiency, we are eager to learn from Hamburg. The city interest will be the following applications: public lighting, smart metering, smart meter data management, integration of public lighting data in urban platform, high performance buildings, improvement of energy efficiency of the buildings, single window/desk for energy retrofitting, citizens' participation for energy efficiency**,** smart grid maintenance, **intersection** energy data – geodata.
- For the heat and cooling: municipal cooling system, optimization of RES and waste heat in the District Heating.
- For the public transport: ITS, e-public transportation, electrical boat, car sharing (neighbours, public), pedestrian and bicycle connections.
- Social aspects and data availability: Citizens' participation, evaluation of participation processes, urban platform, community on the move, Hamburg Cloud (Open Data, Citizen Topics).

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4.1.4 Which of these actions will/could be replicated in the city after the project?

City infrastructure – Smart Grids – Nantes – Hamburg

Smart metering and availability of data for citizens

Bydgoszcz Waterworks company in 2017-2018 plans to implement fixed-line system water meter reading, IT system, internet and phone connection, help to engage citizens in management of water use. It is planned that users can view their data regarding water use. Costs depend on the selection of technology.

City infrastructure

District heating and cooling – Nantes – Hamburg

Municipal heat company plans to implement telemeter technology for steering the heating system, modernization of network and grids. The activities are included in investment plan of the company. The previously realised project “Modernization of heating networks” was co-financed from EU Cohesion Fund Operational Programme Infrastructure and Environment 2012-2015 – modernization of 7 km of networks, savings 24,5 TJ of heat per year, reduction of CO2 by 4,42 tons, costs 18,2 mln PLN. The plans are to modernize all grids and networks using the smart technologies. Similar actions in Warsaw was cofinanced from NFOŚiGW, it is also possible to apply for EU Cohesion Fund and Integrated Regional Investment Programme. Estimated costs of modernization per one heating grid is c.a. 12 000 €.

There are also plans for introducing district cooling system which do not yet exist in Bydgoszcz.

Public lighting – street lighting, integration of public lighting data in urban platform – Hamburg - Helsinki Modernization of rest of public lighting (the ownerships barriers) and enhancement of smart steering of public lighting, it is estimated that implementation for the rest of lighting which are now in ownership of energy company is about 26 000 000 €, remaining ones that belongs to the municipality c.a. 4 200 000 €. It is possible to co-finance the investment from Integrated Territorial Investment Programme that foresee 1 200 000 € (that will cover the costs for c.a. 500 lamps). There is also an idea to create citizens’ application for notification on emergencies and damages. Buildings and Districts – Domotics – Smart Controls – Hamburg - Helsinki

BTBS – would like to enhance the existing PMS (Promar Monitoring System) which optimizes the power consumption in all types of buildings. The main idea of the system is based on delivering one tool integrating all measuring devices and automations, of any producer, which are responsible for controlling and managing installations in buildings. The system allows also on analyzing data which helps to optimize media consumption in buildings.

Mobility- intelligent transport system – Helsinki

Management of Municipal Roads and Public Communication Company plans to enhance ITS for other city areas, inclusion of parking meters to ITS, inclusion of a wage monitoring to ITS, automatic registry of red

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light crossing, speed measurement, inclusion of city bike system, development of supportive system for public communication, monitoring S.O.S, voice communication in public transport. There are few projects that were already notified to Integrated Territorial Investment cofinanced by EU Operational Programme such as: construction of new tram lines, buying new public transport vehicles, modernization of roads system, enhancing ITS.

Non-technical actions – policy improvements – single desk for energy retrofitting

Citizens' engagement – citizens's participation for energy efficiency, evaluation of participation process - Hamburg **ICTs Urban Platform – Urban platform, Hamburg cloud – Hamburg Helsinki**

There are no specific plans yet as the issue of urban platform has arisen recently during the smart city group discussions.

4.1.5 How will the financing be of these selected actions? Other programmes are envisaged like ESIF or ERDF funds?

Energy management activities will be financed (if the projects are approved) from the ERDF within Interreg CE Programme. There are national funds such as National Fund for Environment Protection and Regional Fund for Environment Protection that supports the energy efficiency activities. For other tasks possible financing might be: Operational Programme Infrastructure and Environment for 2014-2020; Regional Operational Programme for kujawsko-pomorskie Voivodship for 2014-2020 (RPO WK-P); Programme of development of municipal road infrastructures for 2016-2019 (national budget).

Some of the mentioned investment are foreseen in Integrated Territorial Investment 2014-2020 Programme

4.1.6 Which stakeholders (local, regional or national) are close/engaged to the city to support the city transformation?

- The City of Bydgoszcz including:
    - Integrated Development Department,
    - Municipal Energy Office,
    - IT Department,
    - Investment Department,
    - ZDMiKP – municipal office for roads and public transport,
    - KPEC – municipal district heating company
    - MWiK – municipal water and wastewater company
    - MZK Sp. z o.o. w Bydgoszczy – municipal transport company

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- National government (Ministry of Energy, Ministry of Development, Ministry of Environment, Ministry of Finance),
- National Centre for Research and Development,
- Polish Development Fund,
- National Fund for Environment Protection and Water Management,
- Universities,
- NGO,
- Private sector.

4.2 Selection of smart actions

City of Bydgoszcz analysed the possibility of implementing some of the following actions:

- Smart mobility: electric vehicles (EV), smart EV charging (conventional & PV powered), public transportation (electric/ bio fuel bus & tram);
- Smart lighting systems;
- Smart grids: smart metering, energy storage, development of PV plant, co-generation installations development, district heating & cooling network development; smart water network;
    - Building energy retrofitting and RES integration: residential buildings, public buildings, PV integration with existing buildings
- Citizen involvement - open data platform

After internal discussions and consultations with stakeholders on the possible smart actions implementation, the City of Bydgoszcz decided that the following 5 smart actions, in the field of mobility, city infrastructures and urban platform, would be taken into consideration for implementation (also given in Table 2):

Smart Action 1: MOBILITY – ELECTRIC VEHICLES - e-mobility in Bydgoszcz

Smart Action 2: CITY INFRASTRUCTURES – URBAN RES – PV on public buildings

Smart Action 3: CITY INFRASTRUCTURES – PUBLIC LIGHTING – smart lighting system

Smart Action 4: CITY INFRASTRUCTURES – SMART GRIDS – smart rainwater system

Smart Action 5: URBAN PLATFORM AND ICT DEVELOPMENTS – URBAN PLATFORM – Open data GIS portal

These actions are related to initiatives already in place in Bydgoszcz, some are being already analysed or partially undertaken within other programmes. All actions are complimentary with SEAP and other policies

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focused on sustainable development. They concentrate on city infrastructures of transport, lighting, drainage and public buildings and the ICT (urban platform) action is a cross-cutting implementation covering other infrastructural investments.

Table 3: Selection of smart actions

DISTRICT/BUILDING	CITY INFRASTRUCTURES	MOBILITY	NON-TECHNICAL ACTIONS
Domotics & Smart Controls	Smart Grids	Electric Vehicles	Policy Improvements
	smart water system	e-mobility in Bydgoszcz	
Building Integrated RES	District Heating	Charging Stations	Inovative Businesses
Storage	Public Lighting	Demand mgt: eV ⇔ Grid	Urban Planning
	smart lighting system		
Retrofitting	Urban RES	Urban Freight (Logistics)	Citizens' Engagement
	PV on public buildings		
New Buildings	Thermal Storage	Multi Modality	Staff Exchange
	Electrical Storage	I.T.S	

URBAN PLATFORM AND ICT DEVELOPMENTS	
Urban Platform	IoT
Open data GIS portal	

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5. PESTEL analysis

5.1 Methodology

The purpose of this document is to update the replication plan. It is therefore necessary to analyse the selected actions in an urban context. Thus, one objective is to identify the opportunities and the barriers to the implementation of these actions. This will make it possible to study the feasibility of their implementation, but also to give priority to actions with a favourable context and to raise the barriers for other actions. The actions with a difficult context can then be compared with similar actions set up in partner cities and solutions can be sought to overcome the identified barriers. Use of PESTEL tool in the earliest stage, can be done to meet these objectives.

The objective of the PESTEL analysis is to evaluate the feasibility of each smart action considering the different Political, Economic, Social, Technological, Legal and Environmental implications for each. It consists to assess the strategic viability of the different actions based on a series of questions. The methodology, and specifically these questions come from the STEEP deliverable “D2.3 Guidelines for prioritising interventions” which aims to provide a set of guidelines and principles that can be applied in any city for prioritising interventions regarding energy efficiency.

Figure 7 : PESTEL Analysis

In order to evaluate actions regarding each field it is required to provide evidence regarding the success of this particular intervention to give this a ‘score’. On this Project, as on the STEEP Project, 5 level score is used represented with a specific colour. Performance of a given action is rated from ‘exemplary’ to ‘best

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practice', 'good practice', 'minimum standard' and finally the 'sub-standard'. The higher the environment (incentives or lack of barrier) is favourable to the development of the solution the higher will be the score. In some cases, it may be difficult to understand the question this way, then answer considering that: if the solution and the environment go both towards the same positive direction, then the score is high. The objective of this score is not to assess the performance of the city in overcoming the barriers, but a score to help the decisions about implementing or not a new action and also to prioritise these actions.

Figure 8 : Scoring method inspired from STEEP D2.3

When all selected actions would have been evaluated with PESTEL analysis it would be then possible to prioritise some specific actions. To overcome identified barriers, solutions will be sought from partner's cities. Such inspired solutions will be then added to the replication plan.

5.2 PESTEL Analysis for Smart Action 1 – e-mobility in Bydgoszcz

5.2.1 Short description

This is a complex cross-sectoral action focused on development of electro-mobility in Bydgoszcz. It can be divided into the following sub-actions

a) Electric buses – introduction of electric buses in public transport in Bydgoszcz (purchase of e-buses as well as supporting infrastructure);

b) e-mobility development strategy

c) analysis and implementation of public charging stations network in Bydgoszcz

d) Introduction of electric vehicles in city's fleet

Objectives of this smart action are:

- To increase share of electric vehicles in public transport,
- To increase share of electric vehicles in city's fleet,
- To develop a network of charging points in the city,

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- To promote electromobility in Bydgoszcz.

5.2.2 Political Factors

Stakeholders involved for the operational implementation of the smart-action

Potential stakeholders involved into smart action implementation are:

- The City of Bydgoszcz (Municipal Energy Office, Investment Department),
- MZK Sp. z o.o. w Bydgoszczy – municipal transport company,
- ZDMiKP – municipal office for roads and public transport,
- National government (Ministry of Energy, Ministry of Development, Ministry of Environment, Ministry of Finance),
- National Centre for Research and Development,
- Polish Development Fund,
- National Fund for Environment Protection and Water Management,
- Universities,
- Private sector.

Currently Municipal Energy Office as well as MZK has been involved. City of Bydgoszcz signed an intention letter with the government electromobility initiative for the implementation of electric buses in Bydgoszcz.

⇨ There is a potential for involvement of wide range of **stakeholders** – including government, academia and private sector but currently there hasn't been done much, therefore this item can be evaluated as optimum with a **score of 4 out of 5.**

Existing political support for the implementation of the smart-action

There is a very strong political support for development of electromobility at governmental level. The Ministry of Environment is responsible for development of electromobility in Poland. Wide range of governmental and national institutions are involved (Ministry of Development, Ministry of Environment, Ministry of Finance, National Centre for Research and Development, Polish Development Fund, National Fund for Environment Protection and Water Management). In March 2017 the Programme for development of electromobility has been adopted and the government started working on appropriate legal regulations for electromobility.

At local level there is a consensus that electromobility is a good choice for Bydgoszcz and all actions on the development of electromobility gain support of City Council.

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⇨ The **future proofing** is based on a strong political support of electromobility and wide consensus that it's one of key elements of future urban mobility in Poland. Therefore, it's evaluated with a **score of 4 out of 5.**

5.2.3 Economic Factors

Current and short-term economic context (5 to 10 years) relating to the implementation of the smart-action.

Current economic conditions for the smart action development are not yet favourable. There are very few electric vehicles on the Polish market and still e-vehicles re not popular. However, in coming years due to the government strategy on electromobility it is anticipated that e-mobility will have a significant share in polish car market. So, in the short-term economic context there should be positive environment for this smart action development. Then it will generate more benefits than at the beginning of implementation.

⇨ The economic perspective is currently unfavourable but probably will change in coming 5-10 years, therefore the smart-action and is evaluated with a **score of 2 out of 5.**

Financing mechanisms identified for the implementation of the smart-action

There are diverse funding sources available for the electromobility, currently and in coming years (up to 2020) ERDF offers support for e-mobility projects (under climate change and energy priorities) – these funds are available at regional (Integrated Territorial Investment) and national level. Apart from EU funds, national government supports e-mobility development through research funding (National Centre for Research and Development) and co-financing grants from the National Fund for Environment Protection and Water Management. Also private investors are potentially interested in co-financing of the charging stations network development. However there would be difficulties in funding the initiative if high share of city budget would have to be involved into implantation.

⇨ Due to availability of wide range of co-financing options (EU, national, private) the economic financing is evaluated with a **score of 3 out of 5.**

Local impact resulting from the implementation of the smart-action

Implementation of this smart action would have a very positive impact on local economy. Due to promotion of electromobility and development of public charging stations network there would be new possibilities for business development focused on e-mobility services – this could include development of local innovative companies focused on: infrastructure development (maintenance services), car sales & services, car-sharing, IT services for electromobility (e.g. mobile apps).

⇨ Such local impact is representative of best practice to the implementation of the smart-action and is evaluated **with a score of 4 out of 5**.

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5.2.4 Social Factors

Impact of the implementation of the smart-action on healthy lifestyles and wellbeing

Development of e-mobility has a positive impact on healthy lifestyle an wellbeing due to the fact that electric vehicles produce less noise and do not emit air pollutants. Possible development of electric carsharing platform as a result of implementation of this action would lead to behavioural change in mobility patterns in the society also positively impacting health and wellbeing.

⇨ This smart-action will improve everyday life of the community and positively influence health and wellbeing – therefore a **score of 4 out of 5.**

Impact of the implementation of the smart-action in equality promotion and community cohesion

This action is neutral in the context of community cohesion. All actions and infrastructure deployed in the framework of this smart action would take into account equal access for all types of individuals, but due to higher cost of electric vehicles (compared to traditional ones) probably the richer part of the society would benefit most from this smart action.

⇨ This action is community cohesion neutral and with a risk of creating privileges for wealthier part of the society, therefore a **score of 2 out of 5.**

5.2.5 Technological Factors

Technologies currently deployed and linked to the smart-action

Electric mobility is developing rapidly and new technologies are market ready every year. In Poland it's still unpopular due to restrictions of car range as well as the cost of e-vehicles. There are currently about 220 electric vehicles registered in the city and only one public charging point available.

⇨ Current state of the infrastructure and technology development in the city is very low making a **score of 1 out of 5.**

Synergy resulting from the implementation of the smart-action

This smart action is well connected to other initiatives in the city in the field of urban mobility. It will not restrict other interventions under development or planned in the city. It's complimentary with other initiatives meeting the objectives of multi-mobility – increased share of public transport, non-motorized transport and other low emission transport modes. Possible synergies are within development of car-sharing schemes, IT apps for mobility, ITS and others.

⇨ Overall because of possible synergies with other initiatives in the transport (mobility) sector the action can be ranked as a good practice standard **making a score of 3 out of 5.**

Effectiveness of the smart-action on the market ("future-proof")

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Electromobility has been already proved to be effective intervention and is rapidly developing in other EU countries. Development of technologies for e-mobility makes this solution more and more viable every year. It is anticipated that the number of electric vehicles will rapidly increase in coming years in Poland due to international trends and national policy of supporting electromobility. Vehicles can be replaced over time in future to more efficient and charging stations are easily adaptable for changes in the technology development.

⇨ Overall the electromobility as a still developing technology can be regarded as a very "future-proof" solution making a **score of 4 out of 5.**

5.2.6 Environment Factors

Impact of the smart-action on GHG emissions

Electromobility is an indirect source of GHG emission. The carbon impact of this action greatly relies on carbon intensity of electricity generation in national grid. Currently Poland has one of the biggest carbon intensity of electricity in EU (ca. 800 kg CO_2/MWh), therefore electric vehicles used in Poland generate on average the same amount of carbon emissions as fossil fuel cars. The carbon intensity of electricity in Poland steadily decreases over recent years making e-mobility more viable in the context of carbon emissions in coming years.

⇨ Due to high carbon intensity of electricity in Poland the use of electric vehicles generate on average the same amount of carbon emissions as fossil fuel cars, therefore a **score of 2 out of 5** has been granted.

Impact of the smart-action on energy consumption

Electric vehicles are more energy efficient than fossil fuel ones (ca. 75% compared to 30% of fossil fuelled cars), but taking into account electricity generation efficiency and T&D losses the numbers are not so favourable for the electric vehicles in Poland. However with increased efficiency of generation in Poland ad utilization of local RES sources the EV are potentially more favourable option in terms of energy consumption.

⇨ EV's are more efficient than fossil fuelled cars, but it largely depends on electricity generation, which in Poland is not very effective. However possibilities exist for the use of locally generated RES electricity leading to high energy efficiency – a **score of 3 out of 5** has been granted.

Impact of the smart-action on air quality, noise and other environmental benefits

EV's are characterised by low noise emission and no direct emissions to the air. It's currently best available transport option in terms of motorized mobility in cities.

⇨ Optimum option for motorized transport due to zero-emission and low noise – a **score 5 out of 5** has been granted.

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5.2.7 Legal Factors

National regulations and policies, potential of policy implementation of local government

Currently there are new regulations regarding electromobility in Poland under development and the City of Bydgoszcz has been actively involved in the consultation process. There are limited possibilities at local scale for regulation and policy development regarding electromobility – all important regulations have to be made at the national level. The city has to implement national regulation on the local level.

⇨ Local authority has limited possibilities of regulations ad policy development regarding the electromobility. All regulations have to be based on national ones. Current legal framework in Poland is changing in favour of EV, so the **score of 3 out of 5** has been granted.

Compliance with existing policies and "future-proofing"

The electromobility is high on EU's mobility agenda as well as in other fields (energy, industry). It's one of the key parts of EU's Strategy for low-emission mobility. The smart action is fully compliant with current and future policy framework and EU regulations.

⇨ As a fully compliant action with EU existing and upcoming regulations a **score of 5 out of 5** has been granted to the action.

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5.2.8 Synthesis of the PESTEL analysis and inspiration from partner cities

Table 4 : PESTEL summary and score for e-mobility in Bydgoszcz

PESTEL Analysis		Main barriers and opportunities	Score
Political	Stakeholders	Involvement of various stakeholders at different level, incl. national government, city administration, universities and private sector.	4
	Future proofing	Wide political consensus, strong governmental support.	4
	Other		
Economic	**Local impact**	New possibilities for business development focused on e-mobility services – this could include development of local innovative companies focused on: infrastructure development (maintenance services), car sales & services, car-sharing, IT services for electromobility (esp. mobile apps).	4
	Financing	Availability of wide range of co-financing options (EU, national, private) restrictions with city budget spending	3
	Economic context	The economic perspective is currently unfavourable but probably will change in coming 5-10 years.	2
Social	**Equality**	This action is community cohesion neutral and with a risk of creating privileges for wealthier part of the society.	2
	Community	This smart-action will improve everyday life of the community and positively influence health and wellbeing, but it does not impact community cohesion	4
	Other		
Technological	**Synergies**	Possible synergies with other initiatives in the transport (mobility) sector	3
	Future proofing	Electromobility as a still developing technology can be regarded as a very “future-proof”	4
	Infrastructure	Current state of the infrastructure and technology development in the city is very low	1
Environmental	**Carbon**	Due to high carbon intensity of electricity in Poland the use of electric vehicles generate on average the same amount of carbon emissions as fossil fuel cars	2
	Energy consumption	EV’s are more efficient than fossil fuelled cars, but it largely depends on electricity generation, which in Poland is not very effective. However possibilities exist for the use of locally generated RES electricity leading to high energy efficiency	3
	Other environmental benefits	Optimum option for motorized transport due to zero-emission and low noise	5
Legal	**Power and Scale**	Local authority has limited possibilities of regulations ad policy development regarding the electromobility. All regulations have to be based on national ones. Current legal framework in Poland is changing in favour of EV	3
	Future Proofing	Fully compliant action with EU existing and upcoming regulations	5
	Other		

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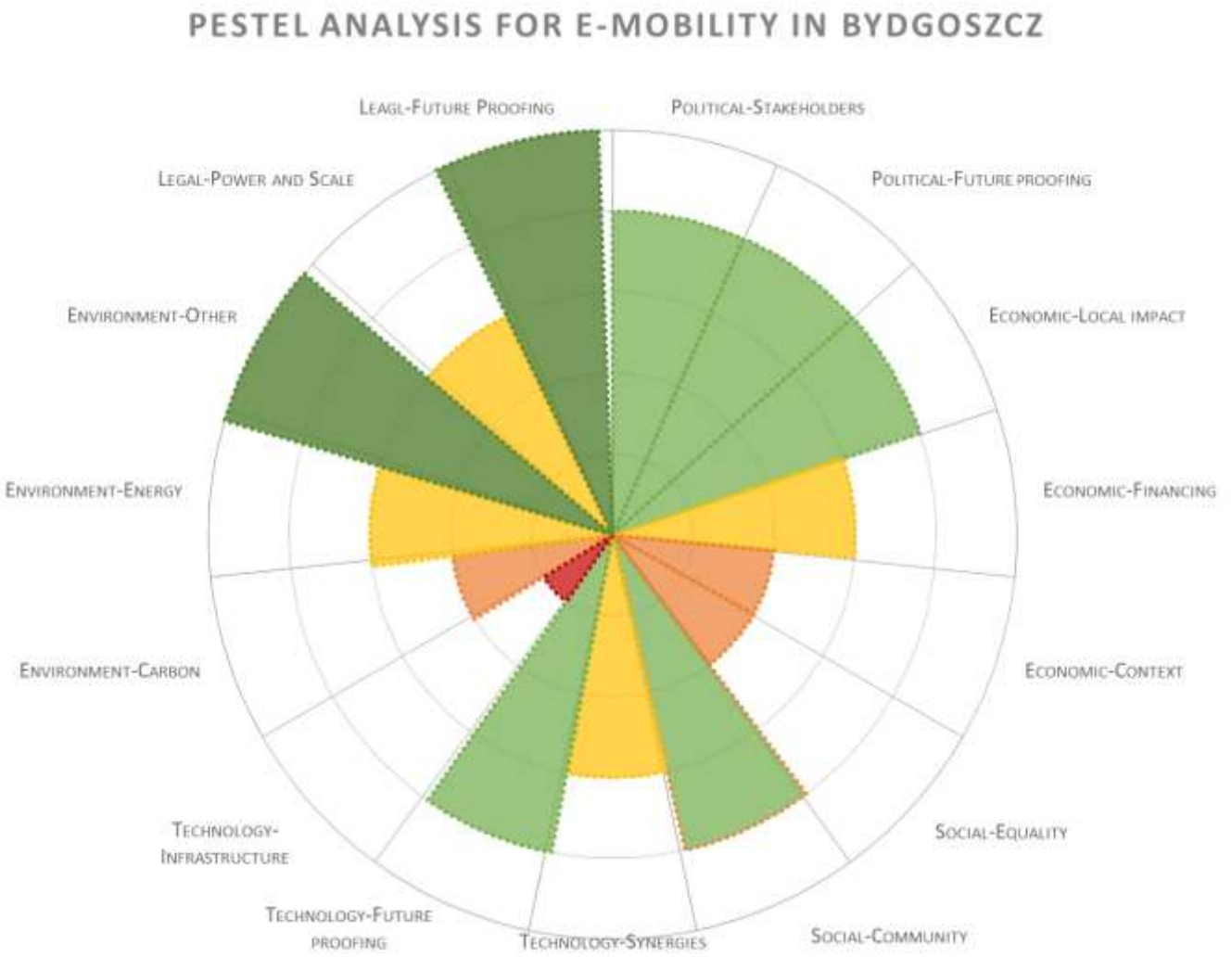

Figure 9 : Synthesis of PESTEL analysis for e-mobility in Bydgoszcz

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Table 5 : Solutions to overcome barriers

PESTEL Analysis		Main barriers	Solutions to overcome barriers
Political	Stakeholders	-	
	Future proofing	-	
	Other	-	
Economic	Local impact	-	
	Financing	City budget limitations	High share of co-financing
	Context	-	
Social	Equality	High cost of EV	Carsharing options
	Community	-	
	Other	-	
Technological	**Synergies**	-	
	Future proofing	-	
	Infrastructure	Insufficient infrastructure	Infrastructure development in PPP formula
Environmental	**Carbon**	High CO_2 intensity of electricity	Increased share of RES in the system
	Energy	-	
	Other	-	
Legal	**Power and Scale**	Law obstacles	Law consultation at the national level
	Future Proofing	-	
	Other	-	

5.3 PESTEL Analysis for Smart Action 2 – PV on public buildings

5.3.1 Short description

City of Bydgoszcz Energy Office plans to deploy ca. 30 PV installations on public buildings (schools and office buildings) with a capacity ranging between 5 - 40 kW. In most cases the deployment of the PV will be made within thermal refurbishment of the building. These installations will be designed to cover buildings' electricity demand – most of the modules will be off-grid, but some also will be grid connected, which would allow two-way transfer of the electricity.

Some of the PV installations located on schools will serve as a demonstrative installations including real time monitoring of working conditions and energy production of the installations. The monitoring would be available through mobile app available for students.

Goal of this action is to:

- Provide RES energy supply for municipal buildings – increase energy security;
- Demonstrate feasibility of PV on buildings in the city

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- Educate students on RES.

5.3.2 Political Factors

Stakeholders involved for the operational implementation of the smart-action

Potential stakeholders involved into smart action implementation are:

- The City of Bydgoszcz (Municipal Energy Office, Investment Department),
- Public schools (students).

⇨ This action does not involve many different stakeholders, however it will engage students therefore it is assessed with a **score of 3 out of 5.**

Existing political support for the implementation of the smart-action

Use of PV technology on buildings is perceived neutrally by national government – there is no special political support and no obstacles for this kind of technology. However regional authority supports PV in funding policy of the regional programmes.

At local level there is a general support for investment in PV on municipal buildings and all investment projects on the development of PV gain support of City Council.

⇨ The **future proofing** is based on a good political support PV especially at regional and local levels. Therefore it's evaluated with a **score of 3 out of 5.**

5.3.3 Economic Factors

Current and short-term economic context (5 to 10 years) relating to the implementation of the smart-action.

Current economic conditions for the smart action development are favourable. The cost of PV has been steadily decreasing over recent years and the RoI can be at very attractive levels even in Polish climate conditions. Maintenance cost is very low for building integrated PV – overall investment in PV is economically feasible for local administration when the EU funds are involved. Due to market development trends it is anticipated that in coming years CAPEX and OPEX for the PV will continue to decrease.

⇨ The economic perspective is currently very good and will continue in coming 5-10 years, therefore the smart-action and is evaluated with a **score of 4 out of 5.**

Financing mechanisms identified for the implementation of the smart-action

There are funding sources available for the PV, currently and in coming years (up to 2020) ERDF offers support for e-mobility projects (under climate change and energy priorities) – these funds are available at regional (Integrated Territorial Investment) and national level. Apart from EU funds, national government supports e-mobility development through research funding (National Centre for Research and Development) and co-financing grants from the National Fund for Environment Protection and Water Management. Also

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private investors are potentially interested in co-financing of the charging stations network development. However there would be difficulties in funding the initiative if high share of city budget would have to be involved into implantation.

⇨ Due to availability of wide range of co-financing options (EU, national, private) the economic financing is evaluated with a **score of 3 out of 5.**

Local impact resulting from the implementation of the smart-action

Implementation of this smart action will have a small scale, positive impact on local economy. Due to promotion and demonstration of PV there is anticipated increased private investment in RES in the city. This would lead to increased revenue of local companies in PV business.

⇨ Scale of the local impact is limited to a specific group of existing companies – it is evaluated with a **score of 2 out of 5.**

5.3.4 Social Factors

Impact of the implementation of the smart-action on healthy lifestyles and wellbeing

Development of PV on public buildings has a very small positive impact on healthy lifestyle an wellbeing, mainly due to RES promotion activities carried out within project.

⇨ This smart-action will just slightly improve everyday life of the community and positively influence health and wellbeing – therefore a **score of 2 out of 5.**

Impact of the implementation of the smart-action in equality promotion and community cohesion

This action is neutral in the context of community cohesion. All actions and infrastructure deployed in the framework of this smart action would take into account equal access for all types of individuals.

⇨ This action is community cohesion neutral, therefore a **score of 3 out of 5.**

5.3.5 Technological Factors

Technologies currently deployed and linked to the smart-action

PV is widely used in EU and in Poland its market share steadily increases. This solution has been already tested by the City of Bydgoszcz on public buildings, as well as on special demonstration building - Demonstration Center of Renewable Energy Sources in Bydgoszcz. The building intended for schooling – didactic function auditorium located in the vicinity of the Mechanical School Complex No. 2. Demonstration and reference building. It shows good practices in energy-saving and passive solutions in building as well as renewables.

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The City Energy Office and Investment Department has required skills and know-how for the implementation of wide scale PV project. Buildings which will be included in the project will mostly undergo a thermal refurbishment.

⇨ Current state of the infrastructure and technology development in the city is adequate to the project making a **score of 3 out of 5.**

Synergy resulting from the implementation of the smart-action

This smart action is well connected to other initiatives in the city in the field of building improvement. It will not restrict other interventions under development or planned in the city. It's complimentary with other initiatives meeting the objectives of energy efficiency – especially thermal refurbishment of buildings. Possible synergies result from the demonstration aspects of the project – it is anticipated that investment in PV in private sector will increase.

⇨ Overall because of possible synergies with other initiatives in the buildings sector the action can be ranked as a good practice standard making a **score of 3 out of 5.**

Effectiveness of the smart-action on the market ("future-proof")

PV has been already proved to be effective intervention and is rapidly developing in other EU countries. Lifetime of the PV installations is about 25 years, with a steady slightly decreasing electricity output making it effective and future-proof solution. However it is not easily adaptable to changing technical requirements.

⇨ Overall the PV as well developed and tested technology can be regarded as effective and "future-proof" investment making a **score of 4 out of 5**.

5.3.6 Environment Factors

Impact of the smart-action on GHG emissions

PV is very effective in reducing GHG emission. The carbon impact of this action greatly relies on carbon intensity of electricity generation in national grid. Currently Poland has one of the biggest carbon intensity of electricity in EU (ca. 800 kg CO_2/MWh), therefore electric PV used in Poland generate high GHG reductions.

⇨ Due to high carbon intensity of electricity in Poland the use of PV reduces on average 800 kg CO2 per MWh generated, therefore a **score of 5 out of 5** has been granted.

Impact of the smart-action on energy consumption

PV generates electricity locally from RES allowing reduction of fossil energy use. Because of low overall efficiency of electricity generation in Poland (ca. 35%) and high T&D losses PV has a very big impact on reduction of fossil fuel energy consumption.

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⇨ PV allows for local generation of local RES electricity, making savings on fossil fuel energy – especially in Poland it has high impact on energy efficiency – a **score of 5 out of** 5 has been granted.

Impact of the smart-action on air quality, noise and other environmental benefits

PV is characterised by no noise emission and no direct emissions to the air. It's currently one of the best available RES option in cities.

⇨ Optimum option for RES electricity generation in cities due to zero-emission – a **score 5 out of 5** has been granted.

5.3.7 Legal Factors

National regulations and policies, potential of policy implementation of local government

National regulations regarding RES development are implemented in Poland and are generally accordant with EU regulations, however Polish RES law does not favour small-scale installations. The installations have to be limited in size to avoid specific bureaucratic regulations during investment process and operation. There are limited possibilities at local scale for regulation and policy development regarding RES – all important regulations have to be made at the national level. The city has to implement national regulation on the local level.

⇨ Local authority has limited possibilities of regulations and policy development regarding the PV. All regulations have to be based on national ones. Current legal framework in Poland does not favour small-scale PV, so the **score of 2 out of 5** has been granted.

Compliance with existing policies and "future-proofing"

Renewable energy is one of the goals of EU climate and energy policy The smart action is fully compliant with current and future policy framework and EU regulations.

⇨ As a fully compliant action with EU existing and upcoming regulations a **score of 5 out of 5** has been granted to the action.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.3.8 Synthesis of the PESTEL analysis and inspiration from partner cities

Table 6 : PESTEL summary and score for PV on public buildings

PESTEL Analysis		Main barriers and opportunities	Score
Political	Stakeholders	This action does not involve many different stakeholders, however it will engage students	3
	Future proofing	good political support PV especially at regional and local levels	4
	Other		
Economic	**Local impact**	Scale of the local impact is limited to a specific group of existing companies	2
	Financing	Availability of wide range of co-financing options (EU, national); restrictive state aid regulations when using co-financing	3
	Economic context	The economic perspective is currently very good and will continue in coming 5-10 years	4
Social	**Equality**	This action is community cohesion neutral	3
	Community	This smart-action will just slightly improve everyday life of the community and positively influence health and wellbeing	2
	Other		
Technological	**Synergies**	Possible synergies with other initiatives in the buildings sector the action can be ranked as a good practice standard	3
	Future proofing	PV as well developed and tested technology can be regarded as effective and “future-proof” investment	4
	Infrastructure	Current state of the infrastructure and technology development in the city is adequate to the project	3
Environmental	**Carbon**	Due to high carbon intensity of electricity in Poland the use of PV reduces on average 800 kg CO2 per MWh generated	5
	Energy consumption	PV allows for local generation of local RES electricity, making savings on fossil fuel energy – especially in Poland it has high impact on energy efficiency	5
	Other environmental benefits	Optimum option for RES electricity generation in cities due to zero-emission	5
Legal	**Power and Scale**	Local authority has limited possibilities of regulations and policy development regarding the PV. All regulations have to be based on national ones. Current legal framework in Poland does not favour small-scale PV	2
	Future Proofing	Fully compliant action with EU existing and upcoming regulations	5
	Other		

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

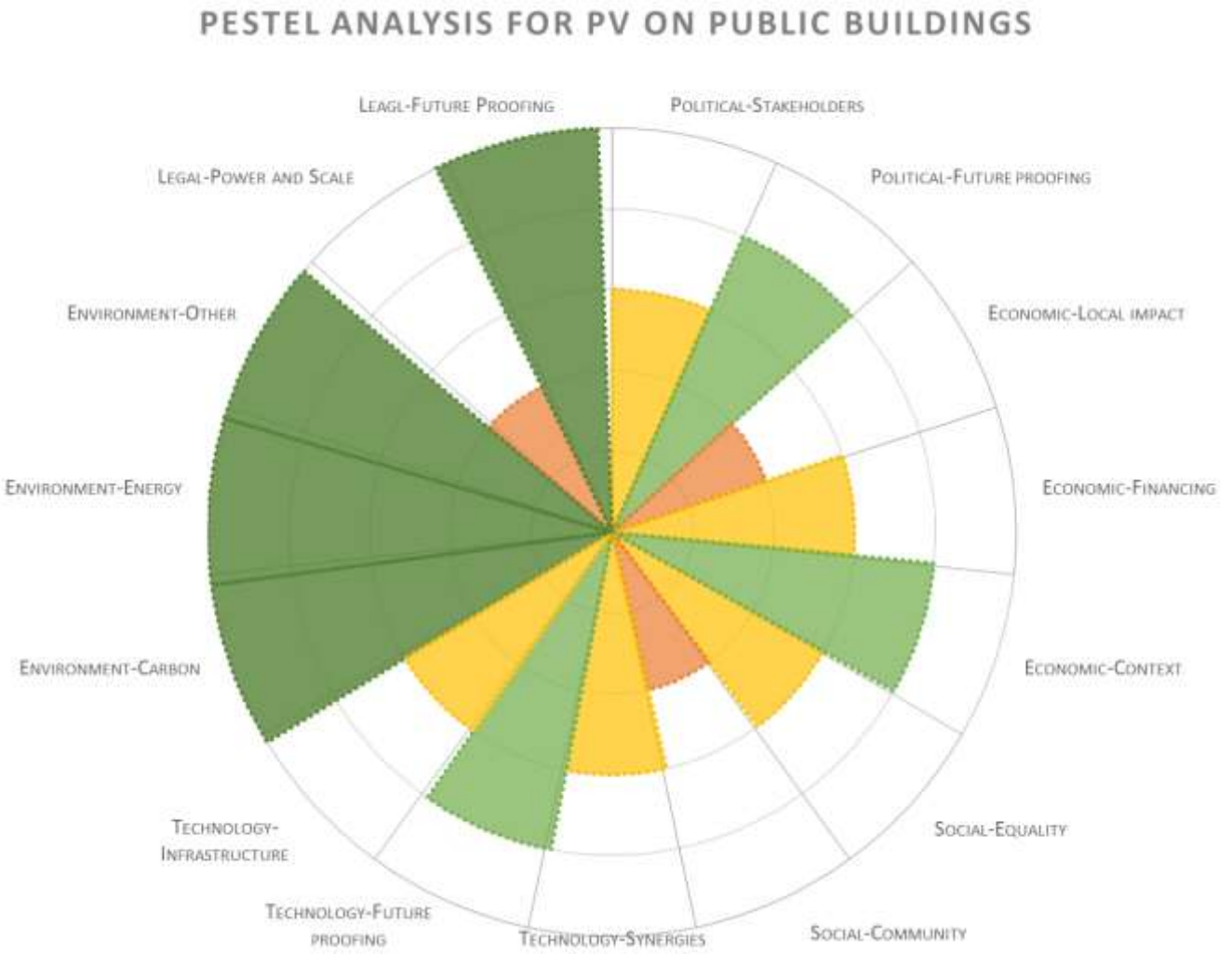

Figure 10 : Synthesis of PESTEL analysis for PV on public buildings

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table 7 : Solutions to overcome barriers

PESTEL Analysis		Main barriers	Solutions to overcome barriers
Political	Stakeholders	-	
	Future proofing	-	
	Other	-	
Economic	Local impact	Limited economic impact	Procurement encouraging share of local companies in the works
	Financing	City budget limitations	High share of co-financing
	Context	-	
Social	Equality	-	
	Community	-	
	Other	-	
Technological	**Synergies**	-	
	Future proofing	-	
	Infrastructure	Building limitations	Specific design of PV
Environmental	**Carbon**	-	
	Energy	-	
	Other	-	
Legal	**Power and Scale**	Law obstacles	Law consultation at the national level
	Future Proofing	-	
	Other	-	

5.4 PESTEL Analysis for Smart Action 3 – smart lighting system

5.4.1 Short description

Bydgoszcz city lighting has only been partially modernized over recent years. This is due to complicated ownership situation – large part of the lighting (ca. 80%) is owned and managed by the energy operator company and the city cannot do any investment on this part of lighting. However Bydgoszcz plans to take control over this part of lighting system in coming years. On the municipally owned lighting there has already been investment made in the smart lighting: 7309 lamps has been modernized (LED lighting) and steering system has been implemented at the cost of ca. 5M EUR.

Smart lighting system in Bydgoszcz project will cover:

- modernization of old lighting (implementation of LED lighting system),

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- enhancement of smart steering of public lighting (telematics, smart controls),
- citizens' application for notification on emergencies and damages.

Objectives of this smart action are:

- To increase energy efficiency of public lighting,
- To increase public safety,
- To decrease maintenance cost of public lighting,

5.4.2 Political Factors

Stakeholders involved for the operational implementation of the smart-action

Potential stakeholders involved into smart action implementation are:

- The City of Bydgoszcz (Municipal Energy Office, Investment Department),
- ZDMiKP – municipal office for roads and public transport,
- ENEA Oświetlenie sp. z o.o. – private company, owner of large part of lighting in Bydgoszcz,
- citizens

⇨ This action involve public (municipal) and private stakeholders as well as citizens therefore it is assessed with a **score of 3 out of 5.**

Existing political support for the implementation of the smart-action

There is no special support at the national level for this type of action and as the ENEA Operator is a state owned company there may even be obstacle made for ownership changes in the lighting system managed by ENEA (the company makes profit on the lighting system).

Al local level there is a consensus that lighting should be modernized and managed completely by the city itself, but there is lack of strong political will to change existing status-quo mainly due to large investment needed to take ownership from the ENEA. But provided that funding will be available for such actions there will be support from the City Council for this action – support will probably increase over time.

⇨ The **future proofing** is based on a weak, but growing political support at local level and possible obstacles from the national government. Therefore it's evaluated with a **score of 2 out of 5.**

5.4.3 Economic Factors

Current and short-term economic context (5 to 10 years) relating to the implementation of the smart-action.

Current economic conditions for the smart action development are becoming more favourable over recent years. The LED lighting technology is developing rapidly decreasing investment cost over time. Efficient

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

LED lighting and smart control decreases maintenance cost of lighting system making the investment economically viable. Obligations related to the energy efficiency (energy efficiency directive) for the energy companies (ENEA) will probably make them more willing for ownership changes or modernization of the lighting system in upcoming years.

⇨ The economic perspective is currently favourable and change to even more favourable in coming 5-10 years, therefore the smart-action and is evaluated with a **score of 3 out of 5.**

Financing mechanisms identified for the implementation of the smart-action

There are some funding sources available for the modernization of the lighting including smart lighting systems. Currently and in coming years (up to 2020) ERDF offers support for this type of projects (under climate change and energy priorities) – these funds are available at regional (Integrated Territorial Investment) and national level. Apart from EU funds, these type of investment can be made also in the ESCO formula. However there would be difficulties in obtaining funding to take ownership of the complete lighting system from the ENEA company.

⇨ There are available co-financing options (EU, national, ESCO) however large amount of funding would be required for ownership change – therefore the action is evaluated with a **score of 3 out of 5.**

Local impact resulting from the implementation of the smart-action

Implementation of this smart action will have a neutral impact on local economy.

⇨ Neutral impact on local economy – evaluated with **a score of 2 out of 5**.

5.4.4 Social Factors

Impact of the implementation of the smart-action on healthy lifestyles and wellbeing

Lighting system modernization and smart lighting systems would improve general public wellbeing – better lighting would increase public safety (traffic and general safety during night-time). LED lighting offers more natural and eye-friendly lighting for humans. The control of lighting intensity through smart controls will also affect general wellbeing of citizens (dimmed light in low traffic night hours would offer better night time conditions for citizens living along the streets).

⇨ This smart-action will improve everyday life of the community and positively influence wellbeing through increased public safety – therefore a **score of 4 out of 5.**

Impact of the implementation of the smart-action in equality promotion and community cohesion

This action is neutral in the context of community cohesion. All actions and infrastructure deployed in the framework of this smart action offers equal access for all types of individuals.

⇨ This action is community cohesion neutral, therefore **a score of 3 out of 5**.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.4.5 Technological Factors

Technologies currently deployed and linked to the smart-action

Currently Bydgoszcz city lighting consists of old sodium lamps and new LED lamps. In 2015 a smart lighting project has already been finished – the city modernized over 7 thousand lights and implemented smart control system for the lighting – but it covered only part of the city's lighting system. The steering system currently in place offers: light intensity management, damage control, remote control over lighting.

⇨ Smart action's solutions has already been partially implemented and tested in the city but most part still requires improvement - **a score of 3 out of 5**.

Synergy resulting from the implementation of the smart-action

This smart action can be linked with initiatives in the mobility sector – especially it has synergies with the ITS which has been already implemented in the city. Improved lighting would improve overall traffic safety and smart controls of the lighting can be integrated with ITS management..

⇨ The smart action has synergies with other mobility sector initiatives, especially ITS – a good standard with **a score of 3 out of 5.**

Effectiveness of the smart-action on the market ("future-proof")

The LED lighting technology and smart controls of lighting systems are currently state of the art technology offering best effectiveness in terms of energy efficiency and investment efficiency. Currently there are no changes in the lighting systems foreseen in coming years and the smart control system can be easily upgraded if needed.

⇨ Overall this is a most efficient currently available technology and also "future-proof" solution making a **score of 5 out of 5**.

5.4.6 Environment Factors

LED lighting is very effective in reducing GHG emission (due to decrease in electricity consumption). The carbon impact of this action greatly relies on carbon intensity of electricity generation in national grid. Currently Poland has one of the biggest carbon intensity of electricity in EU (ca. 800 kg CO_2/MWh), therefore electricity saved through lighting generates large GHG reductions. Already implemented actions in the city lighting of Bydgoszcz allowed for the reduction of 2449 tonnes of CO_2 (per year).

⇨ Due to high carbon intensity of electricity in Poland the use of LED lighting greatly reduces CO_2 emissions, therefore **a score of 4 out of 5** has been granted.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Impact of the smart-action on energy consumption

LED lighting with smart controls is very energy efficient lighting technology and has a very big impact on reduction of fossil fuel energy consumption. Already implemented actions in the city lighting of Bydgoszcz allowed for the reduction of 2752 MWh of electricity (per year).

⇨ Smart LED lighting allows for high energy savings compared to sodium lighting – a **score of 5 out of 5** has been granted.

Impact of the smart-action on air quality, noise and other environmental benefits

LED lighting with smart controls reduces light pollution in the city and also offers better lighting conditions (more natural light) improving the cityscape.

⇨ Reduction of light pollution and improvement of cityscape – a **score 4 out of 5** has been granted

5.4.7 Legal Factors

National regulations and policies, potential of policy implementation of local government

There are limitations and specific obligations for the local authorities in Poland regarding the management of city lighting. Basically the city can do anything with owned lighting however for the part of the public lighting system owned by energy companies (ENEA in this case) the city has to pay but is not allowed to do any investment. Also the PPP law is difficult in Poland making this type of investment a difficult and complicated ones.

⇨ Local authority has limited possibilities of actions in the current regulations and policy framework, so the **score of 2 out of 5** has been granted.

Compliance with existing policies and “future-proofing”

LED lighting complies with energy efficiency policy of the EU - one of the goals of EU climate and energy policy The smart action is fully compliant with current and future policy framework and EU regulations.

⇨ As a fully compliant action with EU existing and upcoming regulations **a score of 5 out of 5** has been granted to the action.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.4.8 Synthesis of the PESTEL analysis and inspiration from partner cities

Table 8 : PESTEL summary and score for smart lighting system

PESTEL Analysis		Main barriers and opportunities	Score
Political	Stakeholders	This action involve public (municipal) and private stakeholders as well as citizens	3
	Future proofing	Weak, but growing political support at local level and possible obstacles from the national government	2
	Other		
Economic	**Local impact**	Neutral impact on local economy	2
	Financing	Availability of co-financing options (EU, national, ESCO) however large amount of funding would be required for ownership change	3
	Economic context	The economic perspective is currently favourable and change to even more favourable in coming 5-10 years	3
Social	**Equality**	This action is community cohesion neutral	3
	Community	This smart-action will improve everyday life of the community and positively influence wellbeing through increased public safety	4
	Other		
Technological	**Synergies**	Synergies with other mobility sector initiatives, especially ITS	3
	Future proofing	Most efficient currently available technology and also “future-proof”	5
	Infrastructure	Current state of the infrastructure and technology development in the city is adequate to the project	3
Environmental	**Carbon**	Due to high carbon intensity of electricity in Poland the use of LED lighting greatly reduces CO2 emissions	4
	Energy consumption	Smart LED lighting allows for high energy savings compared to sodium lighting	5
	Other environmental benefits	Reduction of light pollution and improvement of cityscape	4
Legal	**Power and Scale**	Local authority has limited possibilities of actions in the current regulations and policy framework	2
	Future Proofing	Fully compliant action with EU existing and upcoming regulations	5
	Other		

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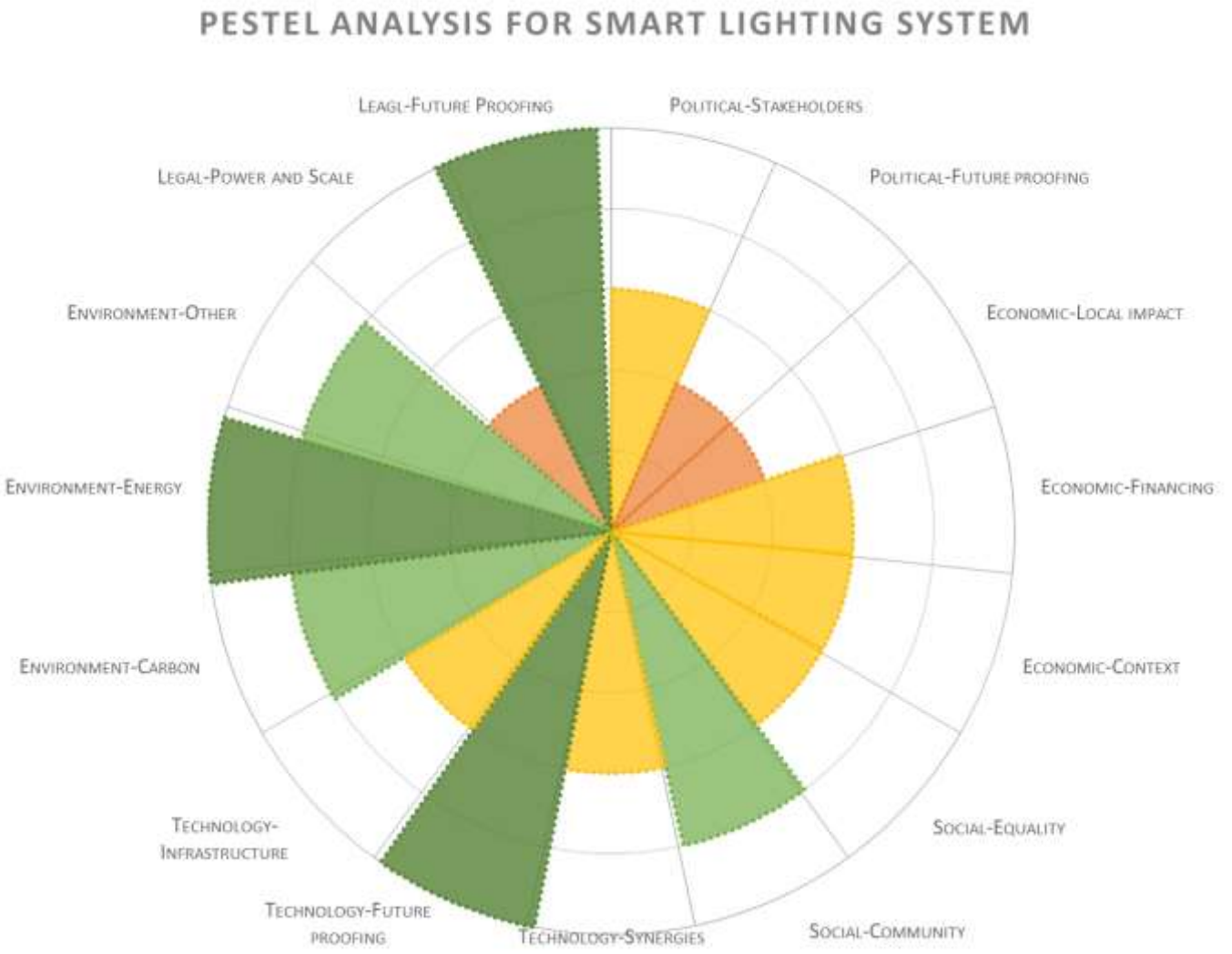

Figure 11 : Synthesis of PESTEL analysis for smart lighting system

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table 9 : Solutions to overcome barriers

PESTEL Analysis		Main barriers	Solutions to overcome barriers
Political	Stakeholders	-	
	Future proofing	Weak political support	Lobbying at local level (showing possible benefits)
	Other	-	
Economic	Local impact	Limited economic impact	Procurement encouraging share of local companies in the works
	Financing	City budget limitations	High share of co-financing
	Context	-	
Social	Equality	-	
	Community	-	
	Other	-	
Technological	**Synergies**	-	
	Future proofing	-	
	Infrastructure	-	
Environmental	**Carbon**	**-**	
	Energy	**-**	
	Other	-	
Legal	**Power and Scale**	Ownership issues	Negotiations with stakeholders
	Future Proofing	-	
	Other	-	

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.5 PESTEL Analysis for Smart Action 4 – smart rainwater system

5.5.1 Short description

This project covers the rainwater drainage system in the city – a complete modernization of the system together with smart management system for drainage management. The goal of the project is to fit the drainage system to current and future land use pattern and prevent flooding from heavy rainfall. The project consist of two main parts:

1) Modernization and expansion of rainwater drainage system (ca. 104 km of drainage system).
2) Retention potential increase and management (ca. 36,900 m^3 of water retention capacity).

The drainage system will be adapted to current and anticipated future weather change increasing overall city resilience to climate change. The retention part of the project focuses on blue-green architecture – new lakes, green areas, polders.

For the management of the drainage system a smart control network will be implemented, allowing for real-time management of the drainage network (e.g. pumping stations) as well as retention control.

5.5.2 Political Factors

Stakeholders involved for the operational implementation of the smart-action

Potential stakeholders involved into smart action implementation are:

- The City of Bydgoszcz,
- MWiK – municipal water works company,
- ZDMiKP – municipal office for roads and public transport,
- National Fund for Environment Protection and Water Management,
- RZGW – regional water management authority
- Research institutions.

⇨ Involvement of wide range of **stakeholders** – including research institutions can be evaluated as optimum with a **score of 4 out of 5.**

Existing political support for the implementation of the smart-action

There is a very strong political support for this type of action at local level because of past problems with water drainage during heavy rainfall. The support is not likely to change due to high interest in the society within the project realization. At national level there is also support for this type of actions and the National Fund for Environment Protection and Water Management has in its priorities financing of such initiatives.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

⇨ The **future proofing** is based on a strong political will at local level to implement this action. Therefore it's evaluated with a **score of 4 out of 5.**

5.5.3 Economic Factors

Current and short-term economic context (5 to 10 years) relating to the implementation of the smart-action.

Currently the rainwater system is in very bad condition leading to requires high amount of investment. If the action hasn't been undertaken it would lead to high economic cost of maintaining inefficient drainage system as well as economic losses due to heavy rainfall. Implementation will lead to reduced maintenance cost and will provide net benefits for the whole city. However on the downside there is large investment cost for this action (ca. 50M EUR).

⇨ The economic perspective is favourable in coming 5-10 years but the investment cost ids very high, therefore the smart-action and is evaluated with a **score of 3 out of 5.**

Financing mechanisms identified for the implementation of the smart-action

There are some funding sources available for this type of investment – the city has already applied for co-financing grant from the National Fund for Environment Protection and Water Management (60% of co-financing). Large amount of funding is still required from the city budget.

⇨ The project has a co-financing from national sources but still high budget spending is required – action is evaluated with a **score of 4 out of 5.**

Local impact resulting from the implementation of the smart-action

Implementation of this smart action will have a slightly positive impact on local economy due to increased resiliency of the city to extreme weather events (heavy rainfall).

⇨ Positive impact on local economy through increased resilience – evaluated with **a score of 3 out of 5**.

5.5.4 Social Factors

Impact of the implementation of the smart-action on healthy lifestyles and wellbeing

Improvement of rainwater drainage system will lead to better living conditions and increased resilience of the city to the extreme weather events. This will lead to increased public security – improving wellbeing. Smart drainage management system (rainwater retention) with green-blue infrastructure and reuse of rainwater will lead to more healthy lifestyles of the citizens also benefitting wellbeing.

⇨ This smart-action will improve public safety and everyday life of the community and positively influence health and wellbeing – therefore a **score of 4 out of 5.**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Impact of the implementation of the smart-action in equality promotion and community cohesion

This action is should increase community cohesion through development of the green-blue infrastructure (smart rainwater retention system). It will increase accessibility of green spaces in the city for all types of individuals.

⇨ This action is community cohesion positive, therefore **a score of 3 out of 5**.

5.5.5 Technological Factors

Technologies currently deployed and linked to the smart-action

Currently the rainwater drainage system is in very bad condition and requires modernization to meet current demand for rainwater runoff. It is also not fit to current climate conditions. There are limited smart control systems implemented in the existing system.

⇨ The infrastructure needs complex upgrading - **a score of 1 out of 5**.

Synergy resulting from the implementation of the smart-action

This smart has synergies with other smart grid developments in the city. The waterworks company (MWiK) has already implemented a partial smart control system for water system and plans to implement in the future smart metering. Through increased resilience all smart systems in the city will possibly benefit in the future. This intervention will not restrict other initiatives in the city.

⇨ This intervention has some synergies with other smart cities initiatives and increases smart city's systems resilience to climate change - a good practice standard making **a score of 3 out of 5.**

Effectiveness of the smart-action on the market ("future-proof")

This action has been designed as a future-proof because it take into account climate change. It increases adaptability to climate change – builds city's resilience. The technology to be implemented is market available and efficient.

⇨ This intervention is designed as a "future-proof" and efficient solution making **a score of 4 out of 5.**

5.5.6 Environment Factors

Impact of the smart-action on GHG emissions

The project will have a minimal impact on GHG emission reductions – due to limited water use (the rainwater will be reused) and increased system efficiency it will lead to small GHG reduction.

⇨ Small impact on GHG reduction, therefore **a score of 2 out of 5** has been granted.

Impact of the smart-action on energy consumption

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Due to better management the project will lead to increase in overall energy performance of the drainage system, allowing some energy savings.

⇨ Some energy savings possible as a result of increased system efficiency – a **score of 3 out of 5** has been granted.

Impact of the smart-action on air quality, noise and other environmental benefits

Reuse of rainwater will have a positive impact on environment, also introduction of the green-blue infrastructure in the city will lead to improved environment in the city. The action also positively impacts water systems and ecosystems in the city.

⇨ High positive impact on environment (water reuse, green infrastructures, water systems, ecosystems) – exemplary action **a score 5 out of 5** has been granted.

5.5.7 Legal Factors

National regulations and policies, potential of policy implementation of local government

All necessary regulations for the project implementation are already available at the national level. The city is not restricted by law and has the ability to fully implement the action.

⇨ Current legal framework allows implementation of the action, so the **score of 3 out of 5** has been granted.

Compliance with existing policies and “future-proofing”

The smart action is fully compliant with current and future EU policy framework on water management and adaptation to climate change.

⇨ As a fully compliant action with EU existing and upcoming regulations **a score of 5 out of 5** has been granted to the action.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.5.8 Synthesis of the PESTEL analysis and inspiration from partner cities

Table 10 : PESTEL summary and score for smart rainwater system

PESTEL Analysis		Main barriers and opportunities	Score
Political	Stakeholders	Involvement of wide range of stakeholders – including research institutions	4
	Future proofing	strong political will at local level to implement this action	4
	Other		
Economic	**Local impact**	Positive impact on local economy through increased resilience	3
	Financing	The project has a co-financing from national sources but still high budget spending is required	4
	Economic context	Economic perspective is favourable in coming 5-10 years but the investment cost ids very high	3
Social	**Equality**	The action is community cohesion positive	3
	Community	This smart-action will improve public safety and everyday life of the community and positively influence health and wellbeing	4
	Other		
Technological	**Synergies**	Some synergies with other smart cities initiatives and increases smart city's systems resilience to climate change	3
	Future proofing	Intervention is designed as a "future-proof" and efficient solution	4
	Infrastructure	The infrastructure needs complex upgrading	1
Environmental	**Carbon**	Small impact on GHG reduction	2
	Energy consumption	Some energy savings possible as a result of increased system efficiency	3
	Other environmental benefits	High positive impact on environment (water reuse, green infrastructures, water systems, ecosystems)	5
Legal	**Power and Scale**	Current legal framework allows implementation of the action	3
	Future Proofing	Fully compliant action with EU existing and upcoming regulations	5
	Other		

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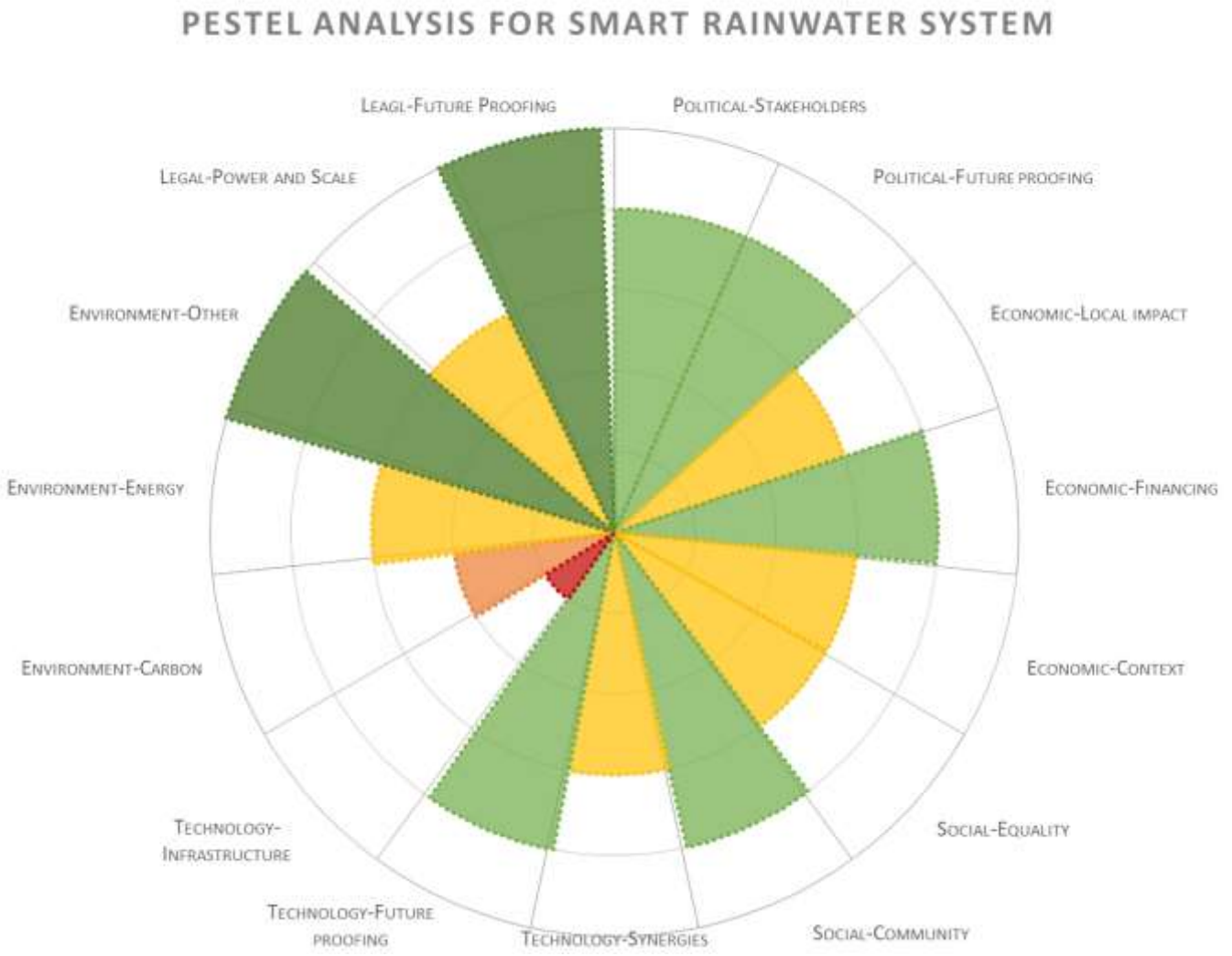

Figure 12 : Synthesis of PESTEL analysis for smart rainwater system

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table 11 : Solutions to overcome barriers

PESTEL Analysis		Main barriers	Solutions to overcome barriers
Political	Stakeholders	-	
	Future proofing	-	
	Other	-	
Economic	Local impact	-	
	Financing	City budget limitations	High share of co-financing
	Context	-	
Social	Equality	-	
	Community	-	
	Other	-	
Technological	**Synergies**	-	
	Future proofing	-	
	Infrastructure	Poor state of infrastructure	Redevelopment works within project
Environmental	**Carbon**	-	
	Energy	-	
	Other	-	
Legal	**Power and Scale**	-	
	Future Proofing	-	
	Other	-	

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.6 PESTEL Analysis for Smart Action 5 – Open data GIS portal

5.6.1 Short description

City of Bydgoszcz currently does not have any open data portal available for citizens. Existing portals (city main site, public information site and other services) do not allow open data access however they provide valuable information. Especially the ITS portal (http://www.its.bydgoszcz.pl/) is packed with useful information from the traffic management system (over two thousand sensors located in the city). Also there is no spatial information portal made publicly available (GIS portal) with information from the city.

The concept of open data GIS portal covers the existing gap between available digital resources in the city and access to them through the web. Open data portal will make publicly available:

- Spatial information (cadastre, address points, spatial planning etc.) – available through online GIS viewer as well as through WMS/WMTS servers,
- Air quality information,
- Environmental information,
- Public transport data (API),
- ITS data (it is already available to online viewing but if possible it should be made available through API),

Also other relevant information which could be made available – it will be analysed which data are ready for making publicly available. To involve citizens in the project there would be hackathon-like contest organized for new products/services based on open data.

5.6.2 Political Factors

Stakeholders involved for the operational implementation of the smart-action

Potential stakeholders involved into smart action implementation are:

- The City of Bydgoszcz (all departments),
- MZK Sp. z o.o. w Bydgoszczy – municipal transport company,
- ZDMiKP – municipal office for roads and public transport,
- Universities,
- NGO,
- Private sector,
- Citizens.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

⇨ There is a potential for involvement of wide range of **stakeholders** – including, academia, NGO, citizens and private sector, therefore this item can be evaluated as optimum with a **score of 4 out of 5.**

Existing political support for the implementation of the smart-action

The open data policy is still unpopular within government structures and there is not much support for the open data policy in Poland. There are very few open data initiatives in polish cities right now. Also at local level there are issues regarding problems anticipated from like: additional work, cost, data protection issues etc. However, with a growing popularity of mobile services and digitalization of the society and government, the support for open data access will grow in coming years.

⇨ There is currently low interest of national and local government in open data but it will probably grow in coming years. Due to low support the action is evaluated with a **score of 2 out of 5.**

5.6.3 Economic Factors

Current and short-term economic context (5 to 10 years) relating to the implementation of the smart-action.

Open data is becoming more popular over recent years. Although the administration in Poland (at all levels) publish data online, there are still issues with open access. All legally binding documents and national statistics are ready for open access but problem is with more specific data – regarding for example environmental data (access to this type of data is possible, but they're not readily available on the Internet).

Global trends show that every year more and more public data providers publish them online in the open data format (http://opendatabarometer.org/3rdedition/report). Also from the society there is rising pressure for open data access from public institutions.

⇨ The economic perspective is changing positively but current context is rather at the minimum standard, therefore the smart-action and is evaluated with a **score of 2 out of 5.**

Financing mechanisms identified for the implementation of the smart-action

There are some funding sources available for ITC, currently and in coming years (up to 2020) ERDF offers some support for IT projects – these funds are available at regional (Integrated Territorial Investment) and national level. There is small interest in private investors co-financing. This action would require city's own financial resources.

⇨ Some co-financing options (EU) are possible, but probably it would require city's own financial resources - the economic financing is evaluated with a **score of 2 out of 5.**

Local impact resulting from the implementation of the smart-action

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Implementation of this smart action would have a very positive impact on local economy. Availability of public data in open access can catalyse local citizens' initiatives and provide business and academia useful resources for further reuse. There is high potential in mobile apps development which would base on open data access from city's resources. Great example of such initiatives is London's TfL. Research by Deloitte shows that the release of open data by TfL is generating annual economic benefits and savings of up to £130m a year (https://tfl.gov.uk/info-for/open-data-users/open-data-policy). It is anticipated that this kind of impact would have been also seen in Bydgoszcz, but of course in not such a big scale.

⇨ The potential of this smart action to influence local economy is very big, and is evaluated with a **score of 4 out of 5**.

5.6.4 Social Factors

Impact of the implementation of the smart-action on healthy lifestyles and wellbeing

Publicly available data from the city resources can be easily adapted for applications focused on healthy lifestyles and wellbeing creating positive impact on the society. Availability of the data also directly affects wellbeing of the citizens as they would spend less resources on acquiring data from the city.

⇨ This smart-action will slightly improve everyday life of the community and positively influence health and wellbeing – therefore a **score of 3 out of 5.**

Impact of the implementation of the smart-action in equality promotion and community cohesion

This action is positive in the context of community cohesion. Open data platform allows for equal access for all types of individuals especially for people with disabilities.

⇨ This action is community cohesion and discrimination positive allowing for easy open access to data for everyone, therefore **a score of 4 out of 5**.

5.6.5 Technological Factors

Technologies currently deployed and linked to the smart-action

There are already available digital resources in city's administration, which are partly accessible through the Internet. Intelligent transport system portal (http://its.bydgoszcz.pl/) already provides a lot of valuable data, but not in open access format. City public information page also provides public information (http://bip.um.bydgoszcz.pl) but it's not easily accessible. There are many other databases available in the Municipal Office as well as in municipal units. However these data should be first analysed in the context of possibility of making it publicly available in open access. The IT infrastructure of the city is good and does not require additional investment.

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⇨ Availability of public data in digital format is good, but there availability for open access have to be analysed making **a score of 3 out of 5**.

Synergy resulting from the implementation of the smart-action

This smart action have synergies with initiatives in the city in all field where public data is available. It will not restrict other interventions under development or planned in the city. It's complimentary with other smart initiatives to be undertaken in Bydgoszcz – e.g. e-mobility data could be published through this portal. Also city planning could benefit from the products prepared by citizens from open data.

⇨ This action has synergies with other smart initiatives to be undertaken - the action can be ranked as a best practice standard making **a score of 4 out of 5.**

Effectiveness of the smart-action on the market ("future-proof")

Open data is becoming a standard for publishing public data. Open data is used more and more every year (http://opendatabarometer.org/3rdedition/report), so this type of open data platform would be very future proof. However if standards for open data access change there would be changes needed to implement in the platform.

⇨ Open data portal with API access can be regarded as a very "future-proof" solution making **a score of 4 out of 5.**

5.6.6 Environment Factors

Impact of the smart-action on GHG emissions

The solution will have indirect positive impact on the environment by possibly decreasing CO_2 emissions, but it's difficult to estimate the impact.

⇨ Indirect positive impact on CO_2 emission reductions, therefore **a score of 2 out of 5** has been granted.

Impact of the smart-action on energy consumption

The solution will have indirect positive impact on the environment by possibly reducing energy use, but it's difficult to estimate the impact.

⇨ Indirect positive impact on energy consumption (reduction), therefore **a score of 2 out of 5** has been granted.

Impact of the smart-action on air quality, noise and other environmental benefits

The solution will have indirect positive impact on the environment (noise, emissions, townscape etc.), but it's difficult to estimate the impact.

⇨ Indirect positive impact on the environment, therefore **a score of 2 out of 5** has been granted.

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5.6.7 Legal Factors

National regulations and policies, potential of policy implementation of local government

Regarding making public data available online in open access there are some legal issues, especially connected with data protection, intellectual property rights and personal identification data. Therefore before making datasets available they have to undergo specific legal analysis. Some of the data would have to be made available with specific restrictions on reuse.

⇨ There are restrictions resulting from intellectual property rights and personal data protection, making open access complicated - so the **score of 3 out of 5** has been granted.

Compliance with existing policies and "future-proofing"

This action is compliant with EU policy of open data and data reuse. In 2012 the EU ODP (https://data.europa.eu) was set up following European Commission Decision 2011/833/EU on the reuse of Commission documents. The Commission encourages all EU institutions to make their data publicly available whenever possible.

⇨ As a fully compliant action with EU existing and upcoming regulations **a score of 5 out of 5** has been granted to the action.

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5.6.8 Synthesis of the PESTEL analysis and inspiration from partner cities

Table 12 : PESTEL summary and score for Open data GIS portal

PESTEL Analysis		Main barriers and opportunities	Score
Political	Stakeholders	There is a potential for involvement of wide range of stakeholders – including, academia, NGO, citizens and private sector	4
	Future proofing	There is currently low interest of national and local government in open data but it will probably grow in coming years.	2
	Other		
Economic	**Local impact**	Availability of public data in open access can catalyse local citizens' initiatives and provide business and academia useful resources. There is high potential in mobile apps development	4
	Financing	Some co-financing options (EU) are possible, but probably it would require city's own financial resources	2
	Economic context	Economic perspective is changing positively but current context is rather at the minimum standard	2
Social	**Equality**	This action is community cohesion and discrimination positive allowing for easy open access to data for everyone	4
	Community	This smart-action will slightly improve everyday life of the community and positively influence health and wellbeing	3
	Other		
Technological	**Synergies**	This action has synergies with other smart initiatives to be undertaken	4
	Future proofing	Open data portal with API access can be regarded as a very "future-proof"	4
	Infrastructure	Availability of public data in digital format is good, but there availability for open access have to be analysed	3
Environmental	**Carbon**	Indirect positive impact on CO_2 emission reductions	2
	Energy consumption	Indirect positive impact on energy consumption (reduction)	2
	Other environmental benefits	Indirect positive impact on the environment	2
Legal	**Power and Scale**	There are restrictions resulting from intellectual property rights and personal data protection, making open access complicated	3
	Future Proofing	Fully compliant action with EU existing and upcoming regulations	5
	Other		

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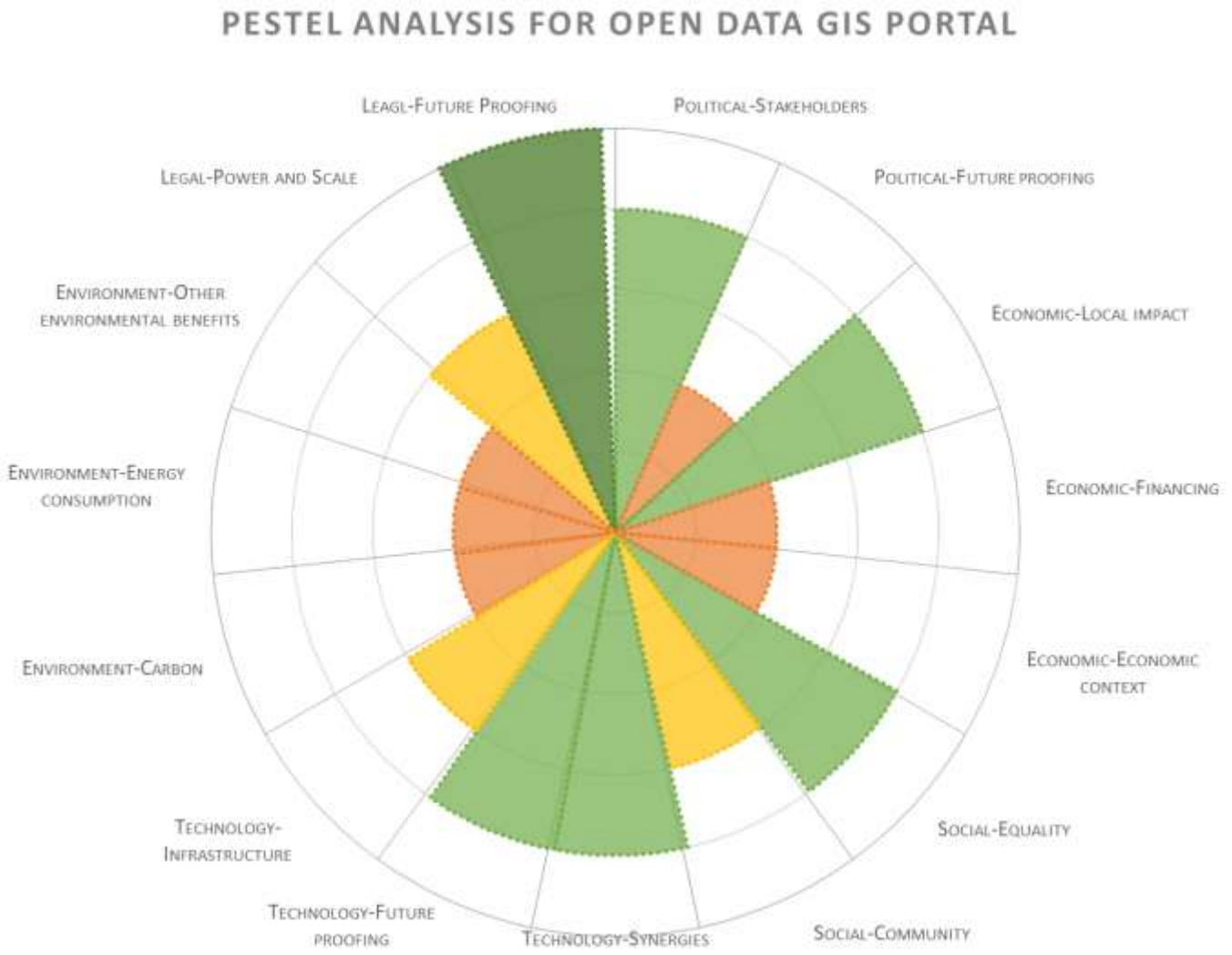

Figure 13 : Synthesis of PESTEL analysis for open data GIS portal

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Table 13 : Solutions to overcome barriers

PESTEL Analysis		Main barriers	Solutions to overcome barriers
Political	Stakeholders	-	
	Future proofing	Low interest of public authorities	Advocating and promoting OD access
	Other	-	
Economic	Local impact	-	
	Financing	City budget limitations, limited co-financing options	High share of co-financing, PPP
	Context	-	
Social	Equality	-	
	Community	-	
	Other	-	
Technological	**Synergies**	-	
	Future proofing	-	
	Infrastructure	-	
Environmental	**Carbon**	-	
	Energy	-	
	Other	-	
Legal	**Power and Scale**	Law issues (data protection, intellectual property rights)	Careful data selection, limitations for some datasets; anonymization of personal data
	Future Proofing	-	
	Other	-	

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6. Conclusions

In this Deliverable, the City of Bydgoszcz, a follower city in the mySMARTlife project, has analysed current baseline for taking smart actions. This analysis covered the following thematic areas:

- General overview,
- Socio-economic characteristics,
- Environmental characteristics,
- Governance characteristics,
- Citizens engagement,
- Transportation,
- Energy supply,
- Urban infrastructure.

Following the indicators scheme provided for partner cities within the project, the City of Bydgoszcz was able to provide values for most of metrics in use within the project framework. The metrics which were possible to provide values provided valuable feedback to the city on its current state compared to other cities in the project. Metrics which were not provided would have to be monitored in the future.

After the deep analysis carried out during the development of this deliverable, the City of Bydgoszcz has summarized in the following table its strengths and weaknesses.

Table 14: Strengths and weaknesses of Bydgoszcz

STRENGTHS
Well-developed climate and energy policy : the city is Covenant of Mayors Signatory (since 2011), has set 20%+ CO_2 reduction target,
High economic performance : relatively higher than average GDP in Poland and rapid economic development (steady increase in GDP and budget spending)
Low unemployment rate : a lot of different industries operate in the city (traditional ones and ne ones), with well developing ITC sector,
Successes in urban regeneration : redevelopment of brownfield urban spaces**,** exemplary projects carried out in the city centre;
Well-developed district heating network : supply heat to large part of households in the city,
Well-developed public transport system with extension possibilities,
Available local energy sources : renewable and fossil

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WEAKNESSES
Air pollution : especially in winter time high concentrations of PM occur, the city has to carry out air protection programme,
High congestion : large share of private car traffic in the modal split,
Ageing population: high dependency ratio.
Relatively high CO_2 emissions per capita : resulting mainly from transport and electricity use – high carbon intensity of electricity with increasing emissions in transport sector year-to-year,
Low RES share in energy mix of the city.
Weak digital governance : no open data platforms available in the city

The baseline assessment provided solid ground for taking new initiatives which may contribute to the city transformation. Taking into account current state of the city and the development of the Lighthouse cities in the project, Bydgoszcz analysed possible smart actions to be undertaken in coming years. All actions included in the updated preliminary replication plan have been considered, but for further implementation analysis, after internal discussions and consultations with stakeholders the City of Bydgoszcz decided that the 5 smart actions, in the field of mobility, city infrastructures and urban platform, would be taken into consideration for implementation. These selected actions have been analysed in the PESTEL analysis framework, according to the common methodology provided in the project.

At the stage of PESTEL analysis the following units have been engaged: Integrated Development Department (various units within the department), Energy management Office, Investment Department, IT Department, MWiK (municipal water and wastewater company), KPEC (municipal district heating company), ZDMiKP (municipal office for roads and public transport). Detailed analysis has been described in the section 5 of this Deliverable.

In the field of mobility the development of electric vehicles in a broad context of electromobility has been selected as a very perspective option. The PESTEL analysis found this action very favourable in terms of political, technological and environmental aspects. This is specially a future-proof smart action which would make City of Bydgoszcz ready for future challenges in the mobility. This smart action is costly but has a high potential of co-financing from various level stakeholders.

City infrastructure development would take into account smart actions focused on: PV on public buildings, smart lighting system and smart rainwater system. All these actions would help Bydgoszcz increase resilience by mitigating and adapting to climate change. All three actions have a very positive environmental impact, good economic context and solid technological base. Political support for them is rather strong and there are possibilities of co-financing implementation of these actions. Future-proofing of these actions is also positive. The PESTEL analysis is in favour of all three of these actions.

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The last analysed with PESTEL action was a cross-cutting urban platform development – an open data GIS portal. As it appeared it would be most challenging of these actions mainly due to weaker political support, lower score in economic analysis and least score in the environmental section. However this is a technology driven project focused on increasing of transparency and citizen engagement in the city governance. It is also a cross-sectoral project which would enhance and integrate other smart actions implemented in the city.

For all actions main drivers important for implementation are the political support and economic factors (impact, financing). Also legal background plays a very important role as it is in large part independent from the city administration.

It is important to have in mind that there are also other limitations for the smart action implementation like limited human resources, time restrictions and municipal budget limitations. This is the reason that Bydgoszcz cannot guarantee implementation of the actions in the described above scope. However there is strong political will to implement smart solutions in all areas of city performance.

Overall all smart actions selected by the City of Bydgoszcz contribute to the following mySMARTLife project objectives:

a) Transforming current cities into more sustainable places where smart people and smart economy become reality.

b) Making cities more environmentally friendly by reducing CO2 emissions and increasing the use of renewable energy sources.

c) Making cities more inclusive and allowing a high quality of life.

d) Increasing the digitalization of the cities thanks to the urban platforms.

Bydgoszcz is currently working on the development of new development strategy which will focus on smart city development initiatives. The baseline assessment with PESTEL would be a good point in the discussion about future strategy. City of Bydgoszcz has ambitions to become one of national exemplary for smart city transformation and will seek for the solutions to gain such a label. In that perspective the PESTEL analysis unveils the first layer of action context, while the next steps should reveal more detailed profile of every action.

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