MAtchUP

D6.2: Review of barriers and solutions to overcome them

WP 6, T 6.2

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[1] PU = Public
PP = Restricted to other programme participants (including the Commission Services)
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CO = Confidential, only for members of the consortium (including the Commission Services)

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0 Abstract

To describe and evaluate the main business models applied within the MAtchUP project, lighthouse cities – with the support of their local technical partners – have identified a set of "action bundles", namely groups of actions that are related among them from a financing point of view (e.g. they are financed under the same programme or funding sources, or one action is able to finance other actions) or because they are jointly interlinked by a specific business model. Overall, **41 action bundles** have been identified (21 by Valencia, 10 by Dresden, 10 by Antalya) on the four project pillars (energy, mobility, ICT, NTA). The key elements of these action bundles and related business models have been collected by means of a **questionnaire survey**, to which MAtchUP lighthouse cities and their local technical partners have participated. The survey was implemented from May 2019 until August 2019.

This Deliverable 6.2 aims to present a set of results from this survey, focusing in particular on 28 action bundles (13 for energy, 11 for mobility, 2 for ICT and 2 for NTA), and is structured as follows:

- **Chapter 2** describes by pillar the key elements of the business models that are connected with action bundles; these elements were identified in D6.1 business model evaluation framework (in particular: target users, asset ownership, value proposition, revenue stream (or other value capture mechanisms), social and environmental benefits generated, city government's role in the action bundle);
- **Chapter 3** presents by pillar the main context factors that partners have identified as needed to implement the action bundles, as well as presents the barriers that hamper a successful implementation of their business model;
- **Chapter 4** includes an overview of the possible solutions to barriers identified by partners.
- **Annexes** display these elements for each action bundle.

Based on the analysis results, different configurations of **asset ownerships** (city-government owned, private-company own, mixed-ownership) and **target users** (focused or broad) characterize the action bundles. The main **value propositions** relate to increasing the efficiency and energy performances of different structures and infrastructures at urban level, improve quality of life across several dimensions, provide new services and stimulate market development. The most common **revenue streams** are associated with the payments of tariffs for specific services, monetary savings from energy savings and increased efficiency for several users, and activation of new markets and business opportunities. The main **social and environmental benefits** expected from these action bundles and their business models relate to GHG reduction, reduction of energy consumption, reduction of air pollutants, plus several additional benefits depending on the specific action categories. The **city government** plays a more focused or wider role according to the different ownership and management configurations.

Looking at the results of the **main context factors, barriers and solutions,** the analysis identified a variety of political-institutional, economic-financial, technological and socio-cultural factors, each one with different relevance across the pillars. The **political-institutional and legislative context** are key determinants of the possible

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business models and approaches that can be adopted. **Governance and cooperation** among actors emerge as needed elements for a successful implementation of smart city solutions. **Technological factors** play a different role according to the pillar and to the maturity of adopted technologies. **Socio-cultural and behavioural factors** interact with all the other elements, to determine the actual results of smart city solutions and ultimately the value delivered.

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1 Introduction

1.1 Purpose and target groups

WP6 of MAtchUP project is focused on exploitation and market deployment as well as on the identification and analysis of innovative business models defined and tested within the project. Specifically, Task 6.2. aims to apply the business model evaluation framework developed in Task 6.1. (D6.1.) to analyse those factors that have a positive and/or negative impact on business models defined by lighthouse cities. To collect the necessary information, a questionnaire survey has been implemented, where lighthouse cities and their technical partners have participated. The questionnaire aimed to retrieve information about the action bundles demonstrated by lighthouse cities and about the main building blocks of their business models.

This deliverable (6.2) in particular aims to:

- describe the key elements of the business models associated with action bundles defined by MAtchUP lighthouse cities;
- analyse context factors needed and barriers to these business models, as emerged from the questionnaire survey;
- highlight possible solutions to overcome these barriers.

1.2 Contribution of partners

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

Partner	Task	Contribution
22- UBIEFE	6.2	Elaboration of questionnaire survey on business models Elaboration of questionnaire results Research activities on smart city business models Overall D6.2 coordination and writing
1-VAL 2-LNV 4-UPV 8-DRE 9-DWG 10-DVB 11-VON 12-FHG 13-TUD 14-ANT 15-SAM 16-DEM 18-TAY	6.2.	MAtchUP lighthouse cities and their local partners took part in the questionnaire survey implemented as part of Task 6.2 activities to collect information about the action bundles and their underlying business model, according to the main building blocks defined in the business model evaluation framework (D6.1.).

Table 1: Contribution from partners

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1.3 Table of acronyms

Acronym	Definition
BM	Business model
BMS	Building management system
EV	Electric vehicle
HVAC	Heating, ventilation, and air conditioning
iMSys	Intelligent metering systems
LED	Light-emitting diode
LFG	Liquefied Flammable Gas
PV	Photovoltaic
RE	Renewable energy
SCTP	Smart City Technology Packages
SHEMS	Smart Home Energy Management Systems
SUMP	Sustainable Urban Mobility Plan

Table 2: Table of acronyms

1.4 Relation to other project activities

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

Partner	Task	Relation to other project activities
UBIEFE	6.1.	Task 6.1. defined the business model evaluation framework and Task 6.2. will apply it to the business models implemented in the project. WP6 performs an in-depth analysis of business models associated with the interventions implemented in the demo-cases by the MAtchUP lighthouse cities, focusing on their key elements, their strengths and weaknesses, success and failure factors.
UBIEFE	5.2.	WP5 will provide the measurement and the evaluation of the business model performances, according to the framework defined in Deliverable 5.2 (Economic Evaluation Framework.
CAR, UBIEFE	1.3.1	Sub-task 1.3.1 defined an approach to characterize the business models associated with SCTPs (Smart City Technology Packages) to be demonstrated in MAtchUP Lighthouse cities and address their bankability.
VAL, DRE, ANT	2.1.2, 3.1.2, 4.1.2	As part of WP2-3-4, these tasks design the financial and business models of LH cities interventions, which are analysed within WP6 activities.

Table 3: Relation to other project activities

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2 Description of key business model elements from MAtchUP's action bundles

As described in Deliverable 6.1, a smart city business model can be defined as the mechanism through which a specific smart city solution (or a combination of interrelated solutions) is able to "create, deliver and capture" private and public (economic, social, environmental) value to society, consistently with the smart city strategy and sustainability goals of the local government[2]. It represents at the same time the way through which smart city solutions are funded and implemented, how they sustain themselves over time, being able to deliver a variety of benefits to several stakeholders.

To describe and evaluate the main business models applied within the MAtchUP project, lighthouse cities – with the support of their local technical partners – have identified a set of "action bundles", namely groups of actions that are related among them from a financing point of view (e.g. they are financed under the same programme or funding sources, or one action is able to finance other actions) or because they are jointly interlinked by a specific business model. Overall, **41 action bundles** have been identified (21 by Valencia, 10 by Dresden, 10 by Antalya). Table 4 below provides an overview of action bundles identified by the cities, categorized according to the main reference pillar (Energy, Mobility, ICT, and Non-Technical Actions).

The following chapter describes for each pillar the **key elements of the business models** that are connected with these action bundles. The discussion is focused on the following elements:

- **target users**
- **asset ownership**
- **value proposition**
- **revenue stream** (or other **value capture mechanisms** in case no revenues are foreseen)
- **social and environmental benefits** generated
- **city government's role** in the action bundle.

These elements are derived from the business model evaluation framework developed in D6.1. They will be used as a basis to identify typologies of business models and to develop a general categorization of business models for smart and sustainable urban transformation, as part of D6.3.deliverable (City business models assessment).

The key elements of these action bundles and related business models have been collected by means of a questionnaire survey, to which MAtchUP lighthouse cities and their local technical partners have participated. The survey was implemented from May 2019 until August 2019. The results of this report refer to the 28 action bundles (13 for energy, 11 for mobility, 2 for ICT and 2 for NTA) whose questionnaires have been collected and it was then possible to document.

[2] This definition was elaborated in D6.1. by MAtchUP partners based on the literature review performed as part of Task 6.1. activities.

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MAtchUP Pillar	Proposed Final name	Valencia		Dresden		Antalya	
Energy	Construction of (private) residential building	VAL_BM-01	Reconstruction of private residential building	DRE_BM-02	Smart tenant new building (District Future House)	ANT_BM-01	New construction of residential building
	Construction of (public) residential building						
	Construction of public terciary building	VAL_BM-03	Reconstruction of public tertiary buildings			ANT_BM-02	New construction of high performance public building
	Retrofitting of private residential buildings	VAL_BM-02	Retrofitting of private residential buildings	DRE_BM-03	Energetic transformation of the real estate		
	Retrofitting of public residential buildings						
	Retrofitting of public tertiary buildings	VAL_BM-04	Retrofitting of public tertiary buildings				
	Building integrated RES in a residential building	VAL_BM-06	Urban RES	DRE_BM-01	Smart tenant existing building		
	Building integrated RES in a tertiary building	VAL_BM-05	Building integrated RES in a tertiary building (Nazaret Sport Centre)				
	Urban scale RES					ANT_BM-04	Solar power plant with storage
						ANT_BM-05	LFG Utilization
	Smart public lighting	VAL_BM-07	Smart lighting	DRE_BM-07	Smart public lighting	ANT_BM-03	Smart public lighting
	Humble lampposts	VAL_BM-08	Humble lampposts				
	Smart controls and domotics in residential building			DRE_BM-05	Smart controls (Building control center)		
	Smart controls and domotics in tertiary building						
	Urban thermal storage						
	Urban electrical storage					ANT_BM-04	Solar power plant with storage
	Building repurposing actions (no BM needed)						
	District heating and cooling (needed BM)						
Mobility	EV cars (private sector)	VAL_BM-10	EV (private sector)	DRE_BM-09	EV for housing sector	ANT_BM-07	E-car
	EV cars (public sector)	VAL_BM-09	EV (public sector)	DRE_BM-08	EV for the public sector		
	EV bus (public sector)					ANT_BM-06	E-bus
	EV bike (public sector)					ANT_BM-08	E-bike
	Demand management/Smart charging	VAL_BM-11	Demand management	DRE_BM-12	Smart charging		
	Last mile logistics	VAL_BM-12	Logistics				
	Multimodality	VAL_BM-13	Multimodality	DRE_BM-11	Intermodal mobility hub	ANT_BM-09	Multimodal hubs
						ANT_BM-10	Intelegant transport system
	ITS for parking management	VAL_BM-14	ITS for parking management				
	Expansion charging infrastructure			DRE_BM-10	Expansion charging infrastructure		
ICT	Use of open data for new business	VAL_BM-15	Use of open data for new business				
	Inputs and Outputs of Urban platform	VAL_BM-16	Inputs and Outputs of Urban platform				
	Internet of Things deployment (posible BM)						
Non-Technical Actions	Employment initiatives	VAL_BM-17	Employment initiatives				
	50/50 Programmes	VAL_BM-18	50/50 Programmes				
	Shared private-public investment models for sustainable energy consumption and circular economy	VAL_BM-19	Shared private-public investment models for sustainable energy consumption and circular economy				
	Prosumer Energy Cooperatives	VAL_BM-20	Prosumer Energy Cooperatives				
	District refurbishment local investment fund (financial instrument)	VAL_BM-21	District refurbishment local investment fund (financial instrument)				

Table 4: Overview of action bundles defined by lighthouse cities in the four project pillars

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2.1 Energy

This pillar includes 13 action bundles from the 3 lighthouse cities (Valencia, Dresden, Antalya) covering different categories: actions targeting buildings (residential or tertiary) - through new constructions or retrofits, with combinations of smart technologies for monitoring and control as well as for lighting, insulation and renewable energy production; actions deploying or testing urban plants for renewable energy production; actions improving or optimizing smart public lighting; actions deploying or testing energy storage.

The main **target users** of energy action bundles depend on their category: citizens (for bundles regarding residential use or provision of new services/public facilities), city government (for bundles regarding tertiary buildings and public services/facilities), or a wide range of users in case of diffused infrastructures like public lighting.

Different configurations characterize the **asset ownership**, where in some bundles a preminent role is played by the city-government (as in the case of ANT_BM-02 “New construction of high performance public building”; in smart lighting action bundles, namely DRE_BM-07 “Smart public lighting”,ANT_BM-03 “Smart public lighting” and VAL_BM_07 smart lighting; and in Antalya’s urban scale RES, namely ANT_BM-04 “Solar power plant with storage” and ANT_BM-05 “LFG Utilization”); and other cases where assets are private-company owned (like DRE_BM-02 “Smart tenant new building (District Future House)”; ANT_BM-01 “New construction of residential building”, DRE_BM-03 “Energetic transformation of the real estate”, DRE_BM-01 “Smart tenant existing building”). In several Valencia action bundles, the asset ownership is mixed, involving the city government, a public company and a private one (VAL_BM-01 “Reconstruction of private residential building”, VAL_BM-02 “Retrofitting of private residential buildings”, VAL_BM-05 “Building integrated RES in a tertiary building (Nazaret Sport Centre)”.

The main **value propositions** associated with building-related action bundles, as emerged from the questionnaire survey, regard the opportunities linked to the innovative technologies for citizens, which enable energy monitoring and saving, as well as benefits in terms of CO_2 emission reduction and air quality, with a positive impact on quality of life. Emission reduction represents a value also for the city government in term of positive externalities to the overall city. For companies involved in these actions, these action bundles provide testing and business opportunities which help them to achieve a more competitive position in the market. For action bundles regarding renewable energy production and storage, the main value is associated with opportunities for the city government and for the society at large to benefit from increased use of clean energy sources and efficiency optimization. Smart public lighting provides an improved infrastructure with benefits in terms of greater efficiency and reduction of environmental impact.

The main **mechanisms** through which value is captured from these action bundles regard energy and monetary savings, compared to Business as Usual, derived from improved energy performances and improved monitoring. In case of specific energy contract types, like the smart tenant model (DRE_BM-02 “Smart tenant new building”,

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DRE_BM-01 “Smart tenant existing building”), energy consumers have the possibility to request a dedicated tariff for energy use, linked to renewable energy production, which directly provides an economic advantage related to the integration of renewables in the building. For private companies (e.g. real estate developers, building owners), improved performances can be reflected in the rents (in case of tenants) or selling prices (in cases of new constructed flats). In the case of specific incentive tariffs on energy produced from renewable sources, the opportunity to sell energy at a preferential tariff represents a revenue source from these bundles (e.g. in the case of ANT_BM-04 “Solar power plant with storage” and ANT_BM-05 “LFG Utilization”).

In terms of **social and environmental benefits**, the most relevant regard GHG emission reduction, reduction of energy consumption, reduction of local air pollutants, increase of environmental awareness and access to new services and facilities.

Considering the **role of the city government** in the different bundles, it is focused on specific aspects in business models mainly managed by the private companies (like DRE_BM-02 “Smart tenant new building (District Future House)” and DRE_BM-01 “Smart tenant existing building”, where the city government mainly has a communication role, or DRE_BM-03 “Energetic transformation of the real estate” where it has a regulatory and incentive role). In models where the assets are city-government owned, the municipality is involved throughout the different aspects enabling the action bundles. Table 9 in Annex A2 displays the key elements of the underlying business models in the “Energy” pillar.

2.2 Mobility

This pillar includes 11 action bundles from the 3 lighthouse cities (Valencia, Dresden, Antalya), covering different categories: actions deploying electric vehicles (e-cars, e-buses, e-bikes) for private or public use; development and expansion of smart charging infrastructure; development of multimodal hubs to promote integration and use of sustainable mobility transport modes.

The main **target users** of mobility action bundles depend on their category: for e-cars, they may be oriented for use by inhabitants (VAL_BM-10 “EV (private sector)”) or employees of the municipality (ANT_BM-07 “E-car”), or of specific companies (DRE_BM-09 “EV for housing sector”). Action bundles regarding e-buses, e-bikes or multimodal transportation – so with a public use - are oriented for use by citizens, commuters and tourists. Smart charging targets all private and public actors that make use of e-vehicles and need to access the infrastructure to recharge them.

Different configurations characterize the **asset ownership**. For e-cars, ownership by a public company (ANT_BM-07 “E-car”) or a private one (DRE_BM-09 “EV for housing sector”), or by the city government and a private company (VAL_BM-10 “EV (private sector)”) can be found. For e-buses, e-bikes or multimodal transportation – so with a public use, the ownership is mainly of a public company, except for Dresden where assets of the intermobility hub are jointly owned by the city government, a public company and a private company (DRE_BM-11 ”Intermodal mobility hub”). For smart charging and charging infrastructure (both action bundles of Dresden), the asset ownership is mainly private.

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The main **value propositions** for the city-government, citizens and city-users (tourists, commuters) regard the possibility to increase the use of e-vehicles and charging stations, increase their public acceptance and the environmental awareness, support the use of local energy sources, decrease air and noise pollution as well as CO_2 emissions. For road users, the main value is linked to the availability of e-vehicles and charging stations, increased possibility to choose among different transport modes. For action bundles on charging, in particular, the increased availability of charging infrastructure, the improvement of the charging process and reduction of the charging duration represents a benefit for all e-vehicle users.

In Antalya's action bundles, it has been highlighted that the low energy consumption of e-vehicles can lower transport costs and be reflected in the fares (e.g. of public transport) (ANT_BM-07 "E-car", ANT_BM-06 "E-bus", ANT_BM-08 "E-bike"). In Valencia's action bundles, the benefits to households deriving from the optimization of e-vehicles smart charging were mentioned. It enables to reduce energy bills and contributes to optimum household energy management (VAL_BM-10 "EV (private sector)").

For the city government or for private companies, these action bundles provide the possibility to increase the use of e-vehicles in the municipal or company's fleets, as well as managing the fleets and the charging schedules more efficiently and effectively. Intermodal or multimodal hubs enable an efficiency gain as well, since they enable an improved management of different transport modes, reducing operation costs.

For companies, especially in Antalya's action bundles, the possibility to open new market opportunities has been highlighted, since in Turkey there is a limited number of companies that produce e-vehicles or charging stations.

In general, these action bundles have a **strategic role in the overall city's sustainable mobility approach**, since they contribute to implement relevant policy provisions regarding sustainable mobility, favoring integration and promotion of alternative transport modes.

The main **mechanisms** through which value is captured from these action bundles regard energy and monetary savings (e.g. operation costs for city government, city agencies, public transport company, or private companies in case of e-vehicles fleet management, lower transport costs for e-vehicle users), as well as specific tariffs/payments foreseen for the use of the service.

The most relevant **social and environmental benefits** expected from mobility action bundles regard reduction of local air pollutants emissions, reduction of energy consumption, GHG emissions reduction, noise reduction and increase of environmental awareness

Considering the **role of the city government** in the different bundles, it is focused on specific aspects in business models mainly managed by private companies (mainly on communication in DRE_BM-09 "EV for housing sector", communication and diffusion in DRE_BM-10 "Expansion charging infrastructure"). In business models with a city-led or mixed asset ownership, the city government's role covers more widely the different aspects enabling the action bundle. Table 10 in Annex A2 displays the key elements of the underlying business models in the "Mobility" pillar.

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2.3 ICT

This pillar includes 2 action bundles from Valencia which foresee the collection, integration and aggregation of data in the urban platform offering it as open data, and the integration of IoT devices and sensors into the smart city platform and the subsequent data analysis and visualization of relevant indicators in dashboards.

The **target users** of these ICT action bundles are quite broad, since the types of data collected and managed through the urban platform can serve different purposes and be able to deliver services targets to different users, both internal to the city government (city government and city-agencies staff) as well as external (companies, citizens, commuters, tourists), depending on the service provided.

The **asset ownership**.is mainly of the city government, since these bundles rely on a public urban platform.

The main **value propositions** regard the possibility to provide users with a wide range of information about the city and its services, environmental information, traffic, tourism, health. For companies, a specific value is linked to the possibility to use open data to develop new business models and market opportunities. For city government and city agencies there are relevant efficiency opportunities related to improved monitoring and management of the city and city services, as well as the possibility to enable transparency.

The main **revenue streams** are associated with the definition of tariffs to access specific services or apps, however in the case of the two analysed action bundles they have been not been defined yet. **Value is also captured** through the possible energy or monetary savings obtained from the use of provided information (e.g. in traffic or to perform energy efficiency interventions) and access to new or improved services. For the city government, efficiency gains obtained from increased monitoring and control could be detected.

The main **social and environmental benefits** expected from ICT action bundles regard increase of transparency in city government's activities, traffic/road congestion reduction, business generation (e.g. activation of start-ups or innovative businesses) , access to new services, increase of environmental awareness, increased waste management efficiency and increased efficiency in public services.

Considering the **role of the city government** in the different bundles, it is in general quite broad since the actions are connected with the city urban platform. So, the city government has a direct involvement in financing, designing, managing, monitoring and promoting the platform and its services. Table 11 in Annex A2 displays the key elements of the underlying business models in the "ICT" pillar.

2.4 Non-Technical actions

This pillar includes 5 action bundles from Valencia which foresee the development of initiatives supporting employment, social entrepreneurship and social innovation, as well as the pre-feasibility evaluation of a financial scheme (Social Impact Bond)

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fostering a public-private partnership to support sustainable energy actions at urban level.

The **target users** of these NTA action bundles are both the city government and city agencies, but also a wide range of stakeholders that may access the employment and training opportunities (VAL_BM-17 “Employment initiatives”), as well as be interested in the innovative financial instrument (i.e. service providers, donors, social investors) (VAL_BM-19 “Shared private-public investment models for sustainable energy consumption and circular economy”).

The **asset ownership**.is mainly private, since the implementation of these action bundles relies on a private company in collaboration with the municipality.

The main **value propositions** regard for the city government the possibility to develop employment policies based on real needs and data, as well as to increase the efficiency in the sector, fostering also participation. Citizens can obtain a channel to access employment and training opportunities, as well as companies can get in contact with skilled workers. Regarding the Social Impact Bond specifically, the main value proposition is related with an efficiency increase in public services, as well as for companies to access business opportunities and develop their corporate social responsibility policies. Since the Social Impact Bond is mainly targeted to energy poverty measures, there is a direct benefit for citizens interested by these measures.

The main **revenue streams** are associated with the possible tariffs of the service – in case they will be defined in the future (in the project, the employment services are provided for free within VAL_BM-17 “Employment initiatives”), and the associated revenues of the Social Impact Bonds ((VAL_BM-19 “Shared private-public investment models for sustainable energy consumption and circular economy”). However, value is also captured through the improvement of public policies and the creation of training and employment opportunities.

The main **social and environmental benefits** expected from NTA action bundles regard increased efficiency in public services, social inclusion, access to new services, reduction of energy consumption and business generation (e.g. activation of start-ups or innovative businesses).

The **role of the city government** in the two action bundles is mainly communication and diffusion, since it is mainly privately-managed. However, a close collaboration with the city government is foreseen.

Table 12 in Annex A2 displays the key elements of the underlying business models in the “NTA” pillar.

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3 Analysis of context factors and barriers to business models' key elements

Through MAtchUP questionnaire survey, lighthouse cities and their technical partners identified the context factors needed for the action bundle implementation, and the main barriers, which could hamper a successful application of the different business models. Such factors can be of technological, political-institutional, socio-cultural, economic-business type. Chapter 3 describes for each pillar the results obtained from the partners' survey concerning these two aspects. Based on the rating provided by partners in the questionnaire, a spider graph represents the barriers' relevance by pillar and by type. These results will be complemented later in the project by insights deriving from the analysis of smart city cases external to MAtchUP, which will be considered in the next WP6 business model deliverables.

3.1 Energy

Considering the rating provided by partners to the different barriers' typologies[3], economic-financial ones are on average considered as the most relevant ones in the energy pillar, followed by political-institutional barriers and socio-cultural/behavioural ones - almost with equal merit. The technological barriers are considered as the least relevant for this type of action bundle.

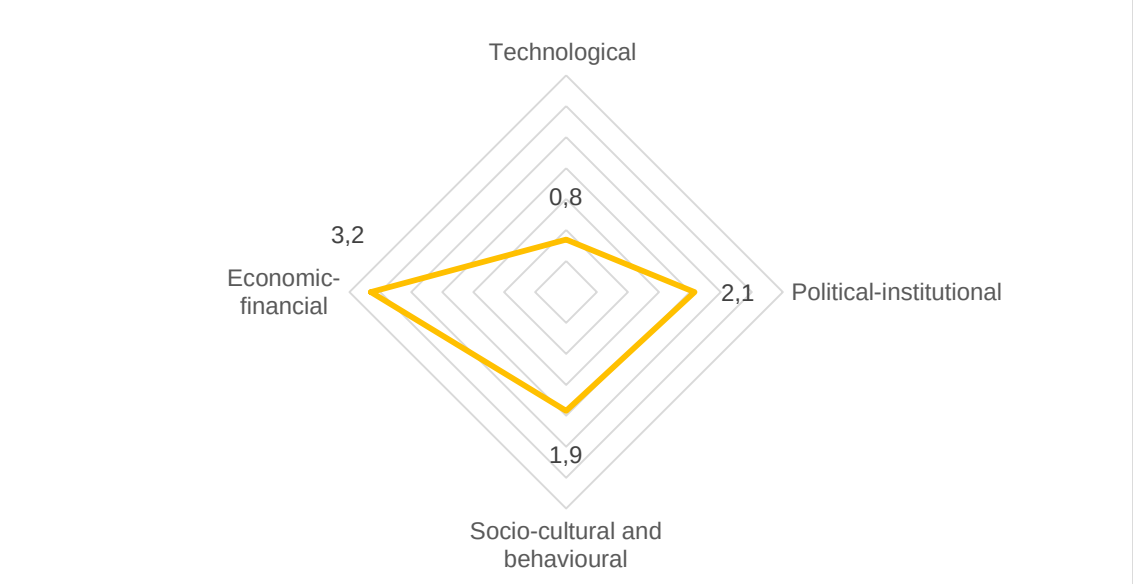

Figure 1: Barriers' relevance in the energy pillar

This is most probably due to the fact that most technologies adopted in these bundles are quite mature and consolidated, whereas there is still lack of effective approaches to

[3] Partners have rated the typologies of barriers on the following scale: not relevant, low relevance, moderate relevance, high relevance, very high relevance. These ratings have been converted into a quantitative scale (0-4)

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secure the appropriate funding for these types of projects, especially when the initial investment needed is high.

Economic circumstances at national level may affect in a significant way investments and the related business models. For example, Turkey has experienced for many years a constantly expanding economy, but lately the economic instability, recession, economic austerity measures and exchange rate fluctuation have affected energy investments. Economic growth has driven a high demand in primary energy, which stimulated an increase in energy production from renewable energy sources, but there is still the issue to import most of the energy supply needed to cover the required demand. At the same time, there has been an increasing social demand in energy consumption. This financial crisis and exchange rate fluctuation in Turkey - particularly in the last two years - have hampered investment on PV installation. Even if the Central Government gives incentives regarding the solar panels, there are insufficient central and local government subsidies and incentives when compared with other EU countries.

The **legislative and political context** are indeed important factors for the implementation of action bundles in the energy pillar, since they define the possibility to adopt specific tariff models according to the legislation in place and to the boundaries defined for each mechanism, as well as they provide political backup and support to testing innovative models. In Germany, the recently adopted “Renewable Energy Sources Act” has enabled the possibility to transfer the electricity generated by the own photovoltaic systems installed in their rooftops to the respective homes of their tenants, and through the “Tenant Electricity Act”, tenants will also have received cost benefits produced by renewable energies. In Turkey, the Central Government promotes and provides incentives to solar energy using domestic modules. At local level, Antalya’s government political will to invest in solid waste management was backed by the consideration about its reliability and the possibility to postpone energy generation that characterizes this energy production source.

The political level can represent a barrier in case of **lack of political will** or **lack of technology knowledge** about specific smart city solutions. In Turkey for example, most of the policy makers lack of knowledge about solar power production technology, which leads to inadequate local policies on the subject. There is also **low local awareness regarding European and international financial organisations and agencies** such as EBRD, EİB and World Bank, which hampers the possibility to access relevant financing opportunities.

At governance level, in case several actors are involved in the bundle implementation, an **effective cooperation** between them is envisaged as necessary, for example in the case of Dresden’s District Future House the cooperation between the energy supplier, the real estate company and the building owners.

For business models that involve residents and building users, **tenants’ acceptance and participation** are key elements to the model (like in the smart tenant one: DRE_BM-02 “Smart tenant new building”, DRE_BM-01 “Smart tenant existing building”). In Antalya, solar thermal panels and collectors that supply heat water are significantly popular. Therefore, socio-cultural acceptance of solar power plants is

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relatively easier and it marks a positive attitude towards supporting climate change actions.

Building users should be aware of the opportunities and benefits related to smart technologies adopted in their homes, as well as be informed about their functioning and potential implications. In the case of Dresden, for example, tenants in fact have to accept intelligent monitoring and control technologies within their apartments and the whole building to enable this model. A further issue may be **data privacy**, in case it is perceived as critical by inhabitants whose data are recorded. The same is valid also for users of public buildings, where the issue of **building users' awareness and participation** is also relevant. In Antalya, for example, a new high performance public building is being developed. Since it will serve the public and should function by all segments of the society, it is necessary to inform them about the features of the building and encourage its use, also in terms of setting an example for buildings where environmental approaches and renewable energy systems are applied.

Despite the technological barriers being perceived as the least relevant by partners, **specific technical location factors** should be carefully taken into account, since they play a role in the design, implementation and financing of these action bundles. For example in Valencia's building integrated RES in a tertiary building (Nazaret Sport Centre), several technical conditions are necessary to be able to implement and test this combination of RES sources, namely: the selected site needs to have an available sewerage network, as well as floor space for geothermal proves and clear roof area for PV modules. Moreover, a HVAC system must be deployed and thermal and electric demand should be considerably high.

For several bundles, since these types of smart solutions are highly integrated among them, it would be important for the city government to ensure their **integration** not only at building level, but also at **city-level** into the urban infrastructure.

Finally, specific operational barriers may be encountered, for example in the case of Dresden's District Future House the **billability** issue, which requires appropriate procedures to ensure the correct billing operations.

Table 13 in Annex A3 displays the main context factors, barriers and solutions for action bundles in the "Energy" pillar.

3.2 Mobility

Considering the rating provided by partners to the different barriers' typologies, political-institutional ones are on average considered as the most relevant in the mobility pillar, followed closely by economic-financial and technological ones. Socio-cultural barriers are considered as the least relevant for this type of action bundles.

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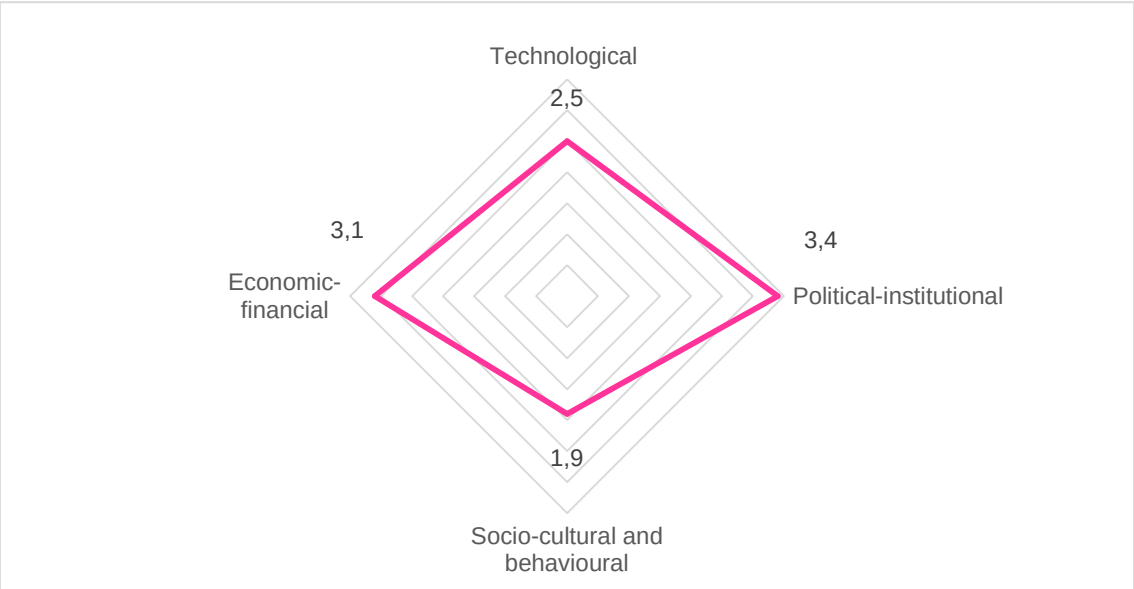

Figure 2: Barriers' relevance in the mobility pillar

Political-institutional factors are related to the overall city's **sustainable mobility strategy and investment choices** on sustainable mobility infrastructure in the city, which can also be influenced by **national-level policy and national funds** available. A low acceptance of the city's SUMP within the public sector may act as a barrier to these action bundles. The presence of **internal capacities** and considering these investments as a **priority** are a relevant context factor condition. The **public administration commitment** speeds up the tendering process for infrastructure procurement. In Antalya, after the municipal elections the Antalya Metropolitan Municipality started to be governed by a **different political party**. Although the mayor and his administration are very interested in the project, time is needed for the new government to become fully aware of the ongoing projects, therefore it is needed to establish a close dialogue with the new administration. Overall, the **identification of the key stakeholders** that should be involved and a good **cooperation between them and the city administration** is necessary to fully implement the mobility projects in the city context.

Considering the **economic-financial** aspects, the **high cost of owning and installing the e-vehicle infrastructure** may represent a relevant barrier to the city government, depending on the availability of funds in the city. Specific economic circumstances like the **exchange rate fluctuation** in Turkey affects the price and therefore the purchase of e-vehicles and charging stations, as well as their maintenance and management costs. For Dresden, it was mentioned the possibility of **low client's willingness to invest** in electric charging stations in an **uncertain market for EVs.**

Furthermore, commercial charging is in competition with domestic charging, since EV drivers may be reluctant to pay the high costs of public charging equipment when charging at home is easy and significantly less expensive. Therefore, the presence of **incentive mechanisms** seems to be a context factor needed for overcoming this barrier. A further element which is relevant for Turkey is the **lack of companies that**

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produce e-vehicles and charging stations in the country. This makes it more difficult to determine the most economic and quality (optimum) e-vehicle and e-vehicle charging stations to be deployed in the city.

Technological barriers mainly relate with possible **bottlenecks in the delivery of new vehicles and monitoring equipment,** as well as the need to identify **suitable locations.** For charging infrastructure, there is need to ensure a **network-suitable integration** as well as obtaining the **permissions from the city** for charging points in public spaces.

The **monitoring issue and lack of data on e-vehicle use** is seen as a barrier throughout all Antalya's mobility action bundles, since it hampers the possibility to carry out effective demand management. For Dresden, **data privacy and security of data** acquired through charging was also mentioned as a possible issue.

Looking at **socio-cultural** aspects, the **willingness to buy and use e-vehicles** are important factors, as well as the need to shift behaviours from use of private motorized modes to sustainable modes, contributing also to an improvement in traffic conditions. In Antalya a relevant role is played by the **climate**. Since it is quite hot, the possibility to use e-bikes for cycling – which implies less effort - is a good opportunity to replace the use of private cars, therefore for this action bundle there seems to be a good acceptance.

Table 14 in Annex A3 displays the main context factors, barriers and solutions for action bundles in the "Mobility" pillar.

3.3 ICT

Considering the rating provided by partners to the different barriers' typologies[4], technological ones – followed by political-institutional – are on average considered as more relevant in the ICT pillar, followed closely socio-cultural and behavioural ones. Economic-financial barriers are rated as the least relevant ones.

[4] It should be noted that this rating refers to two action bundles.

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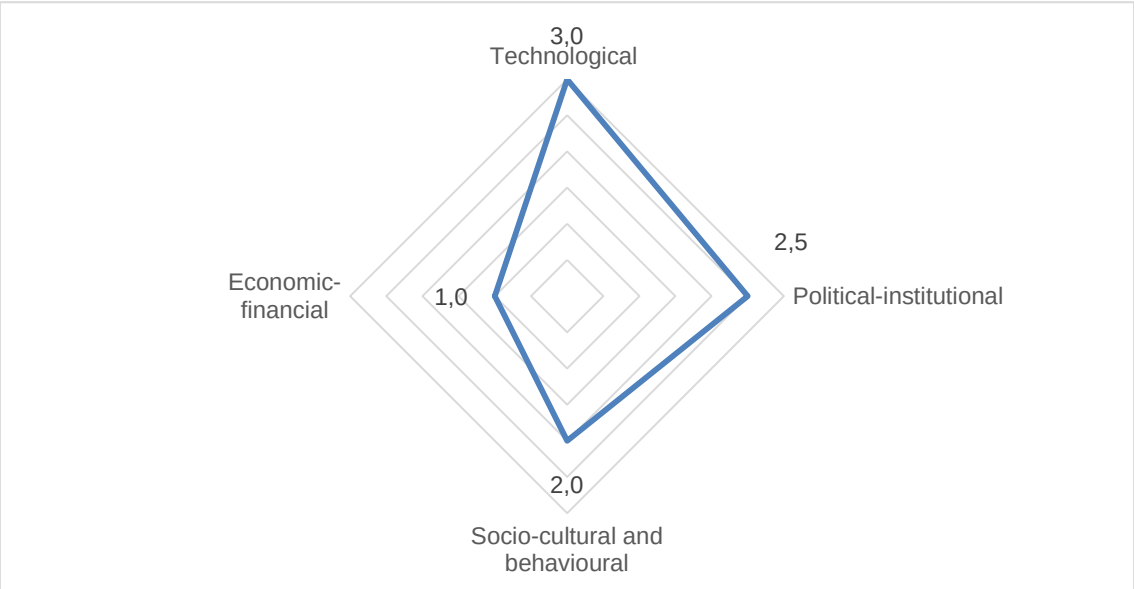

Figure 3: Barriers' relevance in the ICT pillar

This is due to the fact that the base of these action bundles is technological, related to the **availability of the urban platform**, the possibility related to open data management and – for actions regarding sensors – to the **availability of devices and software to collect and visualize the data**. Relevant technological aspects in the development of ICT action bundles may refer also to the types of available ICT skills inside the city government; the integration with legacy systems already operating; as well as the issue of data integration from disparate sources, which needs to be managed and organized.

Related to these aspects is the **political will** to purse an open data policy, which leads to the choice of collecting data and making them available. The socio-cultural aspects mainly regard the **acceptance by users** to monitor certain devices or habits and the adoption of sensors, because of privacy reasons.

Table 15 in Annex A3 displays the main context factors, barriers and solutions for action bundles in the "ICT" pillar.

3.4 Non-Technical actions

Considering the rating provided by partners to the different barriers' typologies[5], political-institutional ones are on average considered as more relevant in the NTA pillar, followed by economic-financial barriers and socio-cultural ones. Given the scope of these actions, technological barriers are not considered relevant for these bundles.

[5] It should be noted that this rating refers to two action bundles.

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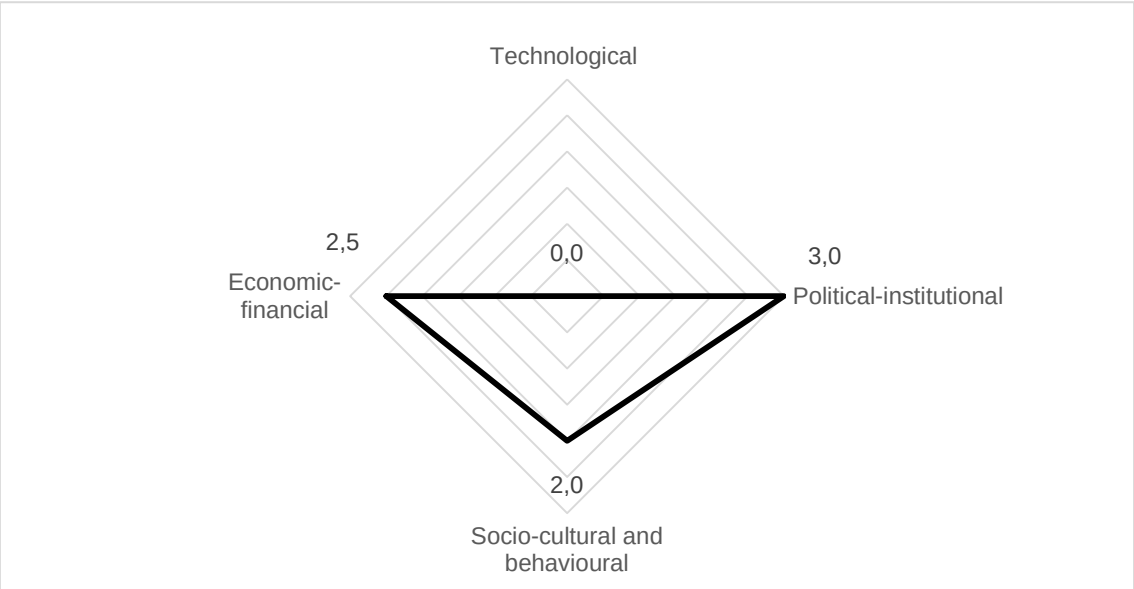

Figure 4: Barriers' relevance in the NTA pillar

Political-institutional barriers in the NTA pillar are related to the presence of **political support** to these initiatives and to such innovative financial schemes, as well as the availability to foresee **public incentives or grants** to promote measures connected with them. In general, a **reluctance of public administrations to engage in Public-Private Partnerships** as innovative way to carry out the actions was detected. For employment initiatives, the **identification and involvement of all relevant stakeholders** at territorial level is necessary to effectively implement the programme, with a participation of technical and non-technical partners. The economic-financial barriers are related to the **lack of resources** to implement these programmes and – as mentioned before – the reluctance to seek a collaboration from the private sector. Regarding the socio-cultural aspects, a **lack of knowledge by citizens** on sustainable energy and circular economy issues has still been identified, which needs to be overcome with dedicated information means and training.

Table 16 in Annex A3 displays the main context factors, barriers and solutions for action bundles in the “NTA” pillar.

3.5 Cross-cutting analysis of key factors for smart city business model development

The analysis of MAtchUP action bundles has highlighted a set of context factors needed for implementation and success, as well as potential barriers that can obstacle an effective deployment of the solutions and their business models.

Political will and commitment at the different government levels (from the national to the municipal one) sets the strategic orientation of smart city policies (e.g. on building’s energy performances, retrofit policies, sustainable mobility, open data and ICT

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deployment, as well as on non-technical initiatives), and drives the decision to invest or support smart solutions at city level. The **regulatory and legislative contexts** define the boundaries of innovative models that can be adopted and can hinder or promote innovation, according to the defined boundaries. **Governance** of smart city solutions, which requires effective **coordination mechanisms and cooperation** within the **city government** and externally with stakeholders involved, including the overall **value chain** of a smart city solution, has been identified as a relevant success factor of smart city business models (EC, 2016). However, **silos** in public authorities but also in some companies of the value chain may act as barriers to this collaboration.

Economic-financial aspects are key elements that should be considered. Securing the appropriate funding is a critical aspect, especially when the initial **investment** needed or the associated **risks** are high (EC, 2013). **Budgetary constraints** can affect both local governments, as well as the technological players (e.g. small innovative companies and start-ups), and require to find the appropriate funding and financing instruments (EC, 2016). The reluctance of public authorities to engage in collaboration with the private sector may be a barrier to developing Public Private Partnerships, which could provide alternative solutions to financial constraints. In some cases, local governments **lack knowledge** about the different financial organizations and opportunities that could be available.

Looking at the technological aspects, these are quite specific of the different solutions and require to take also specific **technical location factors** into account. However a relevant aspect which emerges from MAtchUP and also from literature on the topic is the need to consider the **overall integration** of the smart city solution into the overall city-level infrastructure, to provide for greater efficiency and synergies, and not only limiting to a specific building or street or project.

Finally, considering socio-cultural aspects, **citizens' and city-users' awareness and acceptance** of the smart city solutions are key factors and enablers of their business models. Without people participation and involvement, these solutions are not able to work and deploy their overall effect and benefits. Despite the increase of public debate on smart cities, the **knowledge** about the benefits connected with smart cities in terms of improvement of quality of life, lower resource consumption, and increased efficiency of public services is not yet widely spread. For specific technologies which involve data collection and monitoring, **data privacy** is a relevant topic which should be addressed and clearly communicated to involved users, to inform them adequately about benefits and implication of data management. Specific issues related to **potential digital divide,** due to socio-economic characteristics, should be known and dealt with in smart city policies. Indeed ICT should promote further participation opportunities rather than hampering them (CDP, 2013).

From a cultural perspective, it is also important to consider the **knowledge level of public administrations** about the different smart city technologies and their competences on the subject, to enable their effective deployment into city-strategies.

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4 Preliminary review of possible solutions to barriers identified by partners

Through MAtchUP questionnaire survey, lighthouse cities and their technical partners suggested a range of possible solutions which could contribute to overcome the main barriers they have identified in the development of business models in their action bundles. The following paragraphs describe for each pillar these suggestions according to the different typologies of barriers. These results represent a starting point for the next steps of the project and next WP6 deliverables, where proposals about innovative business model design and the optimization of existing business models will be outlined.

4.1 Energy

For addressing economic-financial barriers, partners from Valencia and Antalya in particular suggested the identification of **new financial models or alternative financial instruments**. It is often recalled in smart cities literature the need to involve private actors into financing instruments, since an effective scale-up of smart city solutions cannot take place relying on public finance alone (EIP-SCC, 2018). In the survey, it was noted by Dresden partners that rising energy costs will represent a key driver for the further uptake of these solutions, which will more evidently show their benefits to households, such as in the case of buildings' action bundles.

The **legislative and political context** is a key determinant of policies and actions that can be deployed in smart cities, throughout all the energy action bundles (e.g. in terms of regulations, standards, incentive schemes). Several partners underlined these aspects, and it was suggested by Dresden partners that **legislative adaptations** could be required to create further flexibility or new boundaries in the mechanisms enabling the adoption of smart city solutions. Furthermore, the enforcement of **environmental taxes** (like a carbon tax) could act as a lever to these bundles.

For barriers regarding tenants' acceptance and participation, it is was underlined - in particular in Dresden buildings' action bundles, the importance to **provide adequate information** about the product and the contract to tenants, and to well define and clearly communicate the **financial advantage** achievable through this model. Similarly, for actions involving residential and public buildings in Antalya, it was recalled to the role of communication with building users and information to citizens to encourage the use of a public space and inform them about the specific smart characteristics.

For data privacy issues, which were mentioned as a relevant topic in particular by Dresden partners, it was suggested to deploy appropriate tools for data privacy provision, including to draw a **data management plan** and obtain an **agreement of customers** to implement the monitoring, as in the case of DRE_BM-01 "Smart tenant existing building" and DRE_BM-02 "Smart tenant new building".

For billability, which was identified as well as issue in the same Dresden action bundles, the main solution suggested was to develop **new procedures in internal billing systems.**

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Considering the **scope of change** to successfully implement action bundles and their business models in the energy pillar, on average partners have rated that a **moderate socio-cultural and regulatory-legislative** change, and a **small technological** change are needed (see Figure 5)[6].

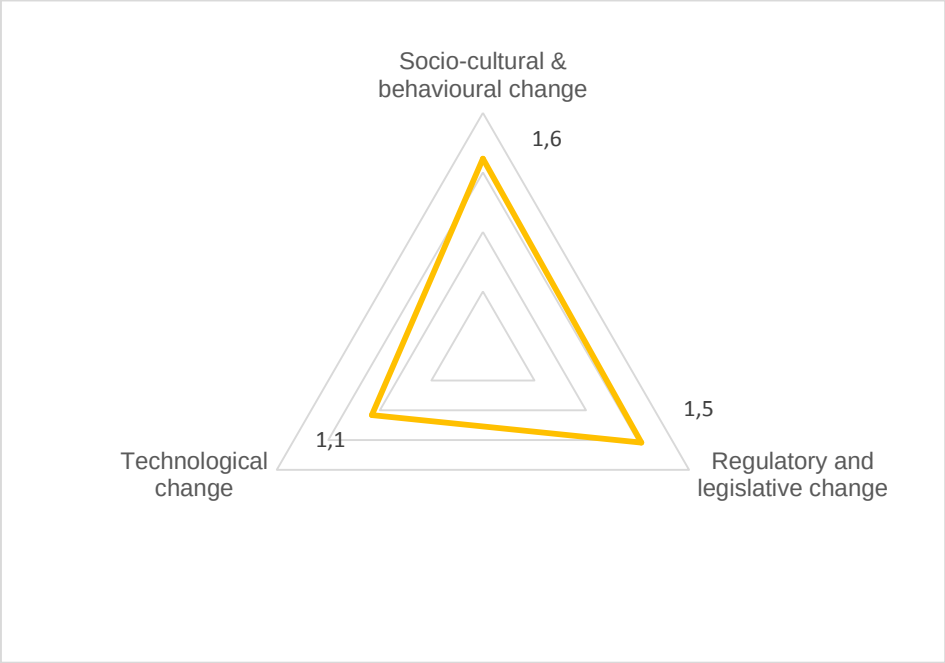

Figure 5: Rating of change required to successfully implement BM in the energy pillar

4.2 Mobility

For the political and institutional barriers identified by partners in the mobility sector, possible solutions are considered to be the **dialogue and good cooperation mechanisms** between the involved actors and the different public institutions. In Antalya for example a change of city government took place recently, which requires that partners involved in the smart city solutions meet with the new city management to discuss the implementation of the smart city projects. For Dresden, the coordination aspect was mentioned in particular for DRE_BM-10 “Expansion charging infrastructure” bundle, where a good cooperation with the responsible part of the city administration is required.

Economic-financial aspects mentioned in particular in Antalya, linked to the specific economic situation, need a **planning of the municipality’s budget** use as well as the identification of relevant **funding instruments to be leveraged**, including national and EU funding. The identification of national subsidies or funding sources of the European

[6] Partners have rated the change needed on the following scale: no change required, small, moderate, significant and very significant. These ratings have been converted into a quantitative scale (0-4)

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Union was also recalled by Dresden partners for the contribution to the action bundle economic feasibility.

For socio-cultural barriers and resistance the role of dedicated **informative campaigns** was recalled by Dresden, as well as **incentive mechanisms** by Valencia and Antalya partners, to promote e-vehicle purchase, use and charging. In the case of Turkey, for example, since the government receives a high tax on vehicle purchases, it was proposed to **lower the tax for e-vehicles** in order to promote them.

Considering the **scope of change** to successfully implement action bundles and their business models in the mobility pillar, on average partners have rated that a **significant technological** change**,** as well as a moderate regulatory-legislative and socio-cultural change, are needed (see Figure 6).

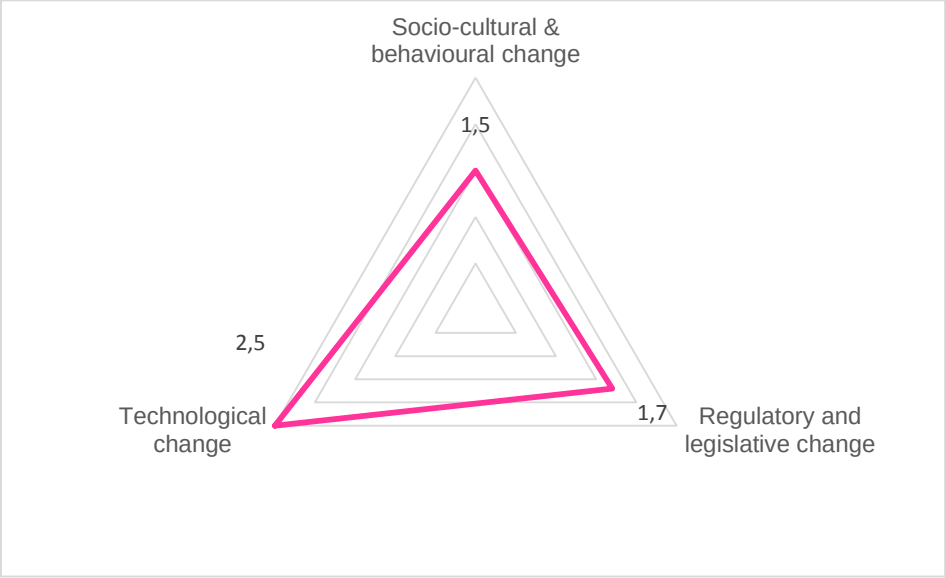

Figure 6: Rating of change required to successfully implement BM in the mobility pillar

4.3 ICT

For ICT action bundles, the results are limited to two examples from Valencia, regarding the use of open data for new business and inputs/outputs of the urban platform. As solution to identified technological barriers, it was recalled the role of maintaining an updated and scalable urban platform, since the technological aspect is the key enabler of both action bundles. For socio-cultural aspects, **dedicated informative campaigns** about the benefits achievable from sensoring and monitoring have been suggested as important means in achieving users' acceptance.

Considering the **scope of change** to successfully implement action bundles and their business models in the ICT pillar, on average partners have rated that a **moderate technological and socio-cultural change** are needed, as well as a s**mall regulatory and legislative** change (see Figure 7).

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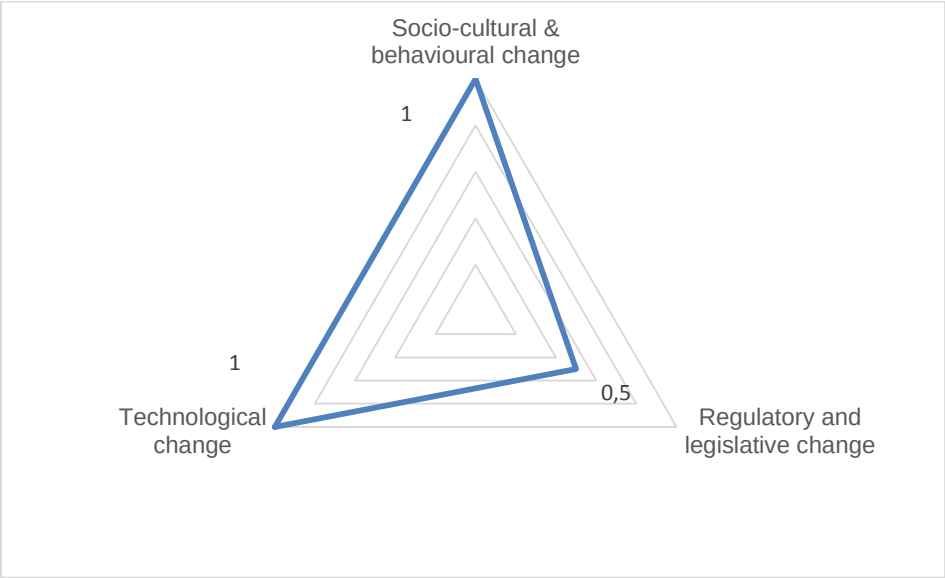

Figure 7: Rating of change required to successfully implement BM in the ICT pillar

4.4 NTA

For NTA action bundles, the results are limited to two examples from Valencia, regarding employment initiatives and the definition of shared private-public investment models for sustainable energy consumption and circular economy. In particular, for employment initiatives, **public-private partnership schemes** were mentioned as possible solutions to political-institutional and economic barriers, since they could increase the flexibility for the deployment of the action. PPP also represents a key constituent aspect of the shared model for sustainable energy consumption.

For employment initiatives it was underlined the role of **coordination among city agencies,** which can leverage potential synergies and thus reduce the need of additional resources.

Regarding the Social Impact Bond, it was suggested to **involve the city government and relevant stakeholders in the design** of the scheme, as well as rely on **experts' assessment and support** in order to provide a solid base and increase the consistency with stakeholders' needs.

Considering the **scope of change** to successfully implement action bundles and their business models in the NTA pillar, on average partners have rated that a **moderate socio-cultural and regulatory-legislative change** are needed, whereas a technological change is not required (see Figure 8).

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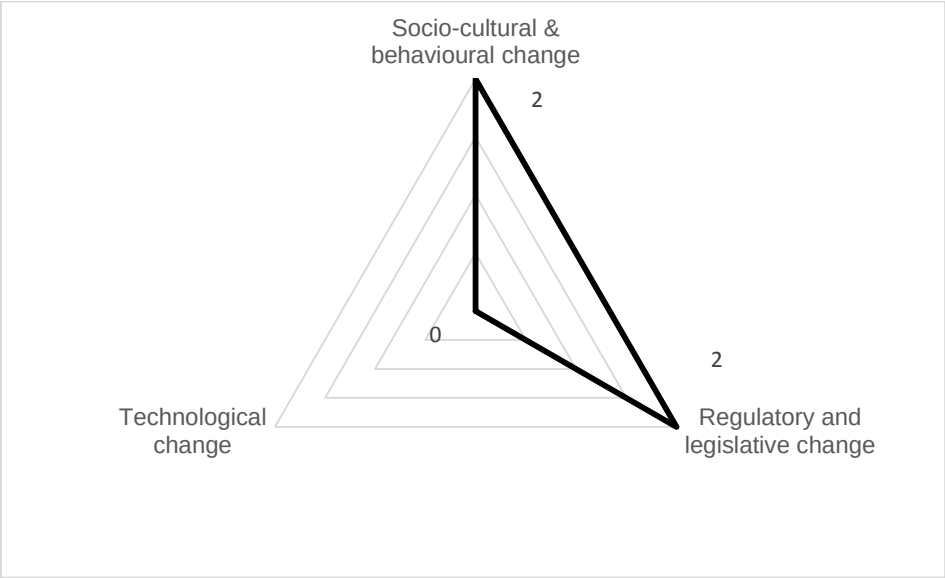

Figure 8: Rating of change required to successfully implement BM in the NTA pillar

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5 Conclusions

MAtchUP lighthouse cities have identified a set of action bundles (namely groups of smart city actions interrelated from a financing or business model point of view) as unit of analysis, to define and assess the relevant business models that are being applied in the project. Based on the 28 **results of a questionnaire survey** that involved lighthouse cities and their technical partners, this deliverable (6.2.) describes the main elements of these business models and analyses the main context factors, barriers and solutions which according to partners are the most relevant ones.

Based on the analysis results, different configurations of **asset ownerships** (city-government owned, private-company own, mixed-ownership) and **target users** (focused or broad) characterize the action bundles. The main **value propositions** relate to increasing the efficiency and energy performances of different structures and infrastructures at urban level, improve quality of life across several dimensions, provide new services and stimulate market development. The most common **revenue streams** are associated with the payments of tariffs for specific services, monetary savings from energy savings and increased efficiency for several users, and activation of new markets and business opportunities. The main **social and environmental benefits** expected from these action bundles and their business models relate to GHG reduction, reduction of energy consumption, reduction of air pollutants, plus several additional benefits depending on the specific action categories. The **city government** plays a more focused or wider role according to the different ownership and management configurations.

Looking at the results of the **main context factors, barriers and solutions,** the analysis identified a variety of political-institutional, economic-financial, technological and socio-cultural factors, each one with different relevance across the pillars. The **political-institutional and legislative context** are key determinants of the possible business models and approaches that can be adopted. **Governance and cooperation** among actors emerge as needed elements for a successful implementation of smart city solutions. **Technological factors** play a different role according to the pillar and to the maturity of adopted technologies. **Socio-cultural and behavioural factors** interact with all the other elements, to determine the actual results of smart city solutions and ultimately the value delivered.

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Annex A1. Action bundles' overview

Categ.	Action bundle name	Action bundle overview
Construction of (private) residential building	VAL_BM-01 Reconstruction of private residential building	
	DRE_BM-02 Smart tenant new building (District Future House)	Within the newly built house with a total of 15 apartments for rent, innovative energy supply solutions will be implemented for an increase of innovative and smart living. Innovative technology that is used includes a rooftop solar PV; an electricity storage unit; sensors; smart meters/ smart meter gateway / iMSys to allow for monitoring, hierarchic energy management and control. To increase the awareness regarding private energy consumption within the housing sector, a smart info screen will be placed outside the building. Showing detailed information about the current energy demand and production will work as a starting point for further smart tenant activities and concepts.
	ANT_BM-01 New construction of residential building	Located in the Kepez Santral District, the action bundle focuses on 4 residential building blocks that will be newly built with a total area of approximately 20,000 m2 conditioned area and 264 flats. The building blocks are designed to achieve a B energy rating through insulation, low u value glazing and energy efficient lighting. The low energy demand will be further managed through smart controls and meters (Building management systems). This will introduction new technologies such as smart control calorimeters, smart control sensors (humidity, heat, water leakage etc.) smart control domotics (home alarm, smart door locks, movement sensors, smart lighting and smart switches etc.) to apartment and dwellers compared to the baseline. The Domestic Hot Water system will be heated with Solar Collectors increasing the use of Renwable energy share in energy consumption.

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Construction of public tertiary building	ANT_BM-02 New construction of high performance public building	A selected public building will benefit from use of PV system which will generate renewable electricity. The electricity will be used to cover lighting demand as well as charging systems for e-bus e car and e bike. Some of the electricity will be stored for system flexibility.
Retrofitting of private residential buildings	VAL_BM-02 Retrofitting of private residential buildings	V4 (400 Smart meters for buildings) V5 (Next generation of 150 smart controllers at the building level) V6 (Retrofitting of 548 private houses (536 private + 12 public) V12 (Solar thermal integration) V28 (Smart home energy management system (SHEMS)
	DRE_BM-03 Energetic transformation of the real estate	The buildings will be retrofitted according to current energy consumption and saving standards. Current windows and doors will be replaced by elements meeting the standards of KfW program-152 and facades and roofs will be insulated using a thermal insulation system also according to the requirements of KfW program-152 (KfW-Effizienzhaus). • Insulation of top floor ceiling and cellar ceiling • Hydraulic balancing of the heating system • Substitution of the windows with triple glazing and a heat transition coefficient of 0,7 W/m²K • Staircase vitrification Decreased energy consumption based on the retrofit measures and generation from action PV new-built (Action 4) will be taken into account in the heating system design (Action 17). A charging pole (Action 22) will be included for e-mobility. This will lead to a reduction of the heating systems dimension compared to the current status together with lower energy consumption and thus a CO2-reduction.

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Building integrated RES in a residential building	DRE_BM-01 Smart tenant existing building	Tenants are allowed to use the generated energy from on-site renewable energy sources (here rooftop solar photovoltaic) themselves. The intelligent linkage of photovoltaic decouples production and consumption and increases the autonomy of the building and the district. Moreover, a consumption-oriented expansion of renewable energy sources is thus promoted. Providing information for tenants and power producers about feed-in, consumption levels or efficiency is a main aspect of the smart tenant model. Therefore, according to the availability in the German market of this systems, the buildings will be equipped with intelligent metering systems (iMSys), consisting of modern measuring equipment and a smart meter gateway, which collects, stores and transmits the date to AMPs.
Building integrated RES in a tertiary building	VAL_BM-05 Building integrated RES in a tertiary building (Nazaret Sport Centre)	The action bundle includes on the one hand the integration of several renewable technologies (geothermal, PV and sewerage energy recovery) and in the other hand, the installation of a smart energy management system. The main objective is to enhance the utilization of renewable energy sources rather than conventional ones that are currently used in the Sport Centre. This would help to promote clean energy generation as well as contribute to decarbonisation. Moreover, a smart system will be put into operation in order to manage the energy flows in the facilities.
Urban scale RES	ANT_BM-04 Solar power plant with storage	The action involves integration of Solar Power Plant with a total of 5 MWp to the city infrastructure. The electricity generated will be mostly used to power irrigation pumps within the city. The electricity generated during daytime will be mostly stored in battery groups [action 12]. The stored electricity will be used to power irrigation pumps where the demand is at dawn, when the electricity generation from PV system is low. The power plant is estimated to generate approximately 7,500 MWh/yr and reduce carbon emission around 3,680 tCO2/yr. Linked with [Action 10], a district electricity storage system (based on batteries) will be integrated in the city to store the electricity generated by the PV Power Plant. The battery group is planned to reach to a total storage capacity of 720 kWh through installation of 300 units.

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	ANT_BM-05 LFG Utilization	The project activity involves the installation of the LFG collection technology for the purpose of electricity generation in Kızıllı Waste Management Site in Antalya. Waste management site receives 3000 tons/day of waste which releases methane of approx. 235,000 tCO2e/yr. In order to dispose the waste, avoid emission and minimize the amount of oxygen going into the waste, the landfills will be covered with a 60 cm thick clay layer. On top of the clay layer, a 10 cm thick sand layer, a 30 cm thick soil and a 15 cm thick top soil layer will be laid out for erosion control and plant growth. The LFG collection system consists of vertical wells drilled into the landfill with horizontal piping to transfer the LFG. The LFG collected from the wells are gathered at several manifolds where each incoming gas pipe is coupled to system to measure the flow rate, gas concentrations, and the calorific value of the LFG to effectively monitor and optimize the well operating conditions. The gas collection system also includes a LFG storage unit. The main use of LFG is to combust it within the gas engines coupled with generators to generate electricity. The gas engines are specifically designed for LFG applications. The electricity generated is delivered to the Turkish National Grid via 34.5 kV transmission line. The system will generate approximately 52,600 MWh/yr renewable electricity and reduce 26,300 tCO2e/yr.
Smart public lighting	DRE_BM-07 Smart public lighting	Smart public lighting is proving to be a compelling starting point for most smart city initiatives around the world. The motivation is the energy savings gained by replacing traditional luminaires with low-power LEDs and implementing urban micro-renewables, but the further benefits enabled through connectivity and control. Networked street lighting, in which data and services are integrated in Dresden Urban platform, delivers additional energy savings, reduced maintenance costs, improved safety and security. Integration with other smart city and smart grid projects yields yet greater potential. Inside MAtchUP 40 conventional street lamps will be switched to LED with Intelligent Auto-Dimming Lighting.
	ANT_BM-03 Smart public lighting	350 LED integrated street lighting systems will be deployed to a selected area within Kepez Santral District. The use of LED will result in an estimated 40% energy efficiency. Also, the lighting system will be coupled with an intelligent communication system allowing smart control for further efficiency.

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Smart controls and domotics in residential building	DRE_BM-05 Smart controls (Building control center)	5 schools, 6 children's day care facilities and 1 administrative building, all of them located in Dresden's high-performance district Johannstadt, will be connected to a Central Building Control Center (CBCC), which although currently being constructed in another Dresden district, will allow increasing the effective energy management of the selected 12 public Johannstadt buildings. This increment will be obtained through the permanent timely adaptation of the building heating and ventilation systems with the current internal and external climatic conditions, exhausting the existing energy savings potential. All data acquired by the CBCC will be integrated into the Dresden Urban Platform and will be released as Open Data

Table 5: Overview of action bundles in the energy pillar

Categ.	Action bundle name	Action bundle overview
EV cars (private sector)	VAL_BM-10 EV (private sector)	This action bundle deals with the deployment of new charging points of electric vehicles and its integration, management and monitoring in a system that includes: • Fleet Management System - ICT system to manage all the public charging stations, integrated as a vertical service over the VLCi platform, which will provide fleet managers of electric vehicles and to city managers, smart management of charging points, as well as planning capabilities. • Billing and roaming - will provide schemas that will be also integrated into VLCi platform. Booking services - that allow to combine EVs and charging points.
	DRE_BM-09 EV for housing sector	Acquisition of new e-vehicles, in order to reduce CO2 emissions and particulate pollution within the city. These vehicles will be fully monitored to determine an optimal use of charging infrastructure and to predict in advance the expected electrical load needed in the evening. In relation the measured data will also be integrated into the Urban Platform for further use.

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	ANT_BM-07 E-car	In the scope of the action, 20 e-vehicles for municipality fleet and 5 e-vehicle charging stations will be purchased by Antalya Metropolitan Municipality (ANT) in order to use in the existing car fleet in the city of Antalya. This action will contribute the utilization of e-Buses as a smart and new technology vehicle in Antalya and Turkey. Hence smart city transformation of the Antalya will continue with the utilization and management of e-vehicles. Additionally, this action bundle will contribute to e-vehicle users' sustainable strategic plan for environmental friendly smart city transformation and utilization. This action will also provide new smart technology on sustainable mobility. These e-vehicles and charging stations data will be fully monitored and integrated into the Antalya urban platform in order to extract aggregated data to evaluate the sustainability to evaluate the sustainability by using smart city solutions.
EV bus (public sector)	ANT_BM-06 E-bus	In the scope of the action bundle, 2 e-Buses, 2 e-Bus charging stations will be purchased by Antalya Metropolitan Municipality (ANT) in order to use in the existing bus fleet in the city of Antalya connected with demo area (kepez santral). This action will contribute the utilization of e-Buses as a smart and new technology vehicle in Antalya and Turkey. Hence smart city transformation of the Antalya will continue with the utilization and management of e-Vehicles. Additionally, this action bundle will contribute to transportation authorities' sustainable strategic plan for environmental friendly smart city transformation and utilization on public vehicles. This action will also provide new smart technology on sustainable mobility. These e-Buses and charging stations will be fully monitored and integrated into the Antalya urban platform in order to extract aggregated data to evaluate the sustainability by using smart city solutions.
EV bike (public sector)	ANT_BM-08 E-bike	In the scope of the action, 30 e-Bikes for municipality fleet and 5 e-Bike charging stations will be purchased by Antalya Metropolitan Municipality (ANT) in order to use in the public transport in the city of Antalya. This action will contribute the utilization of e-Bikes as a smart and new technology vehicle in Antalya and Turkey. Hence, smart city transformation of the Antalya will continue with the utilization and management of e-Bikes. Additionally, this action bundle will contribute to e-vehicle users' sustainable strategic plan for environmental friendly smart city transformation and utilization. This action will also provide specifications of the new services on sustainable mobility. These e-Bikes and charging stations data will be fully monitored and integrated into the Antalya urban platform in order to extract aggregated data to evaluate the sustainability by using smart city solutions.

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Demand management/Smart charging	DRE_BM-12 Smart charging	A broad market penetration of e-mobility requires a demand-oriented charging infrastructure with easy access and billing systems for the users as well as the integration into local energy systems and networks. Therefore, the charging stations will be equipped with intelligent measuring systems that enable the interconnection to decentral nodes of the local distribution grid and thus allow for a smart management of the charging infrastructure. Grid bottlenecks that will become a challenge in urban areas can be reduced or even avoided via the integration of battery storage systems. Charging requests of e-vehicles are predicted. A modular platform enables customer-specific Apps with individual business models.
Multimodality	DRE_BM-11 Intermodal mobility hub	A network of intermodal mobility hubs connecting public transport, carsharing and bikesharing and public charging infrastructure will be established for enhancing the use of shared mobility and electric cars. The establishment of mobility hub is required for an easier access to the sharing products. Therefore, innovative solutions have to be developed that simplify the access and payment of the offers and enable a seamless "shared mobility" of public transport, bikesharing, carsharing and electric charging. As intermodal services are offered by various operators with different access conditions, many access difficulties for intermodal users occur. These difficulties shall be reduced by the development of an integrated access application for booking and billing for all services together. A corporate design of the mobility hub will make it easier to identify the mobility hub and the services and to show the very important combination between the digital access via the multimodal app and the local services. User needs and expectations for the mobility hub and the intermodal app will be discussed and analyzed for a customer friendly concept. Both cost and modal effects will be evaluated and further optimized to attract new users. Construction planning and design-studies will be made for 5 specific locations in Dresden-Johannstadt: Straßburger Platz, Fetscherplatz, Bönischplatz, Güntzplatz and Blasewitzer/Fetscherstraße. Based on those results, 1 Intermodal mobility hub will be selected and implemented within the MAtchUP project.

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	ANT_BM-09 Multimodal hubs	In the scope of the action, 2 multimodal hubs will be applied in Antalya. The application of 2 multimodal hubs will increase the capability of the city in terms of sustainable mobility. 2 multimodal hubs will allow the shift between sustainable public transports such as e-Buses and e-Bikes, including EV chargers (using new smart city services). With the help of this multimodal planning and determined route, transportation connection between demo area and city center will be supplied by integrating new, sustainable and different transportation modes. This action will contribute the utilization of different transportation modes as a smart and new technology vehicle in Antalya and Turkey. Hence smart city transformation of the Antalya will continue with the utilization and management of different modes. Additionally, this action bundle will contribute to planners' sustainable strategic plan for environmental friendly smart city transformation and utilization. This action will also provide specifications of the new services and smart solutions on sustainable mobility.
	ANT_BM-10 Intelligent transport system	In this action, Intelligent Transport System will be implemented into the Antalya urban platform with the objective of providing citizens with a service for last mile delivery by means of shifting between rail and e-Bikes. This service will also allow the shifting between fossil fuel vehicles towards e-Bikes. In this way, the action will contribute to the reduction of energy consumption by reducing the use of fossil vehicles, noise levels, pollution and traffic congestion. This action bundle also treats the integration of a shift station where citizens would be capable of shifting between light rail public transport, e-Bike station (including the chargers) and bus transport stations and it provides sustainable mobility to the citizens.
Expansion charging infrastructure	DRE_BM-10 Expansion charging infrastructure	Build-up and operation of new charging infrastructure. The increased number of charging points increases the mobility potential for electric vehicles in the city.

Table 6: Overview of action bundles in the mobility pillar

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

Categ.	Action bundle name	Action bundle overview
Use of open data for new business	VAL_BM-15 Use of open data for new business	The process of collecting, integrating and aggregating data in the urban platform and offering it as open data will enable enhanced services to citizens and allow local SMEs and start-ups to offer new services/launch innovative apps based on data made available through the platform.
Inputs and Outputs of Urban platform	VAL_BM-16 Inputs and Outputs of Urban platform	This action bundle deals with the integration of IoT devices and sensors into the VLCi smart city platform and the subsequent data analysis and visualization of relevant indicators in dashboards.

Table 7: Overview of action bundles in the ICT pillar

Categ.	Action bundle name	Action bundle overview
Employment initiatives	VAL_BM-17 Employment initiatives	Repository of initiatives for the promotion of employment, social entrepreneurship and social innovation in smart cities environment, including recommendations and pathways for replicability. Training activities (conferences, workshops, speed presentations) and related materials.
Shared private-public investment models for sustainable energy consumption and circular economy	VAL_BM-19 Shared private-public investment models for sustainable energy consumption and circular economy	Pre-feasibility study of the deployment of a Social Impact Bond financial scheme applied to actions addressed to the mitigation of energy poverty. The SIBs are an outcome based innovative financial scheme. Due to its complexity, the final product of the action will be a pre-feasibility study, together with training and awareness raising activities addressed to the city government , city agencies and interested stakeholders .

Table 8: Overview of action bundles in the NTA pillar

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

Annex A2. Key elements of business models per pillar

Categ.	Action bundle name	Target user	Asset ownership	Value proposition	Revenue streams/value capture	City government's role
Construction of (private) residential building	VAL_BM-01 Reconstruction of private residential building	Citizens	City government Public company Private company	For city government/citizens: improve the quality of life of groups of citizens through energy efficiency measures and the integration of new technologies For involved companies: create opportunities to provide their products and services in valuable and representative contexts.	For citizens: energy and monetary savings For involved companies: business opportunities	• Finance • Design • Management • Regulation • Economic incentive • Monitoring • Communication • Diffusion
	DRE_BM-02 Smart tenant new building (District Future House)	Citizens	Private company	For city government: reduce CO_2 emissions and thereby improve the air quality within the city. For citizens: opportunity to use new technologies and test new products, enabling more control over their energy consumption and therefore saving money For involved companies: possibility to test the new products and technologies in a real life environment, as well as new business models.	For citizens: energy and monetary savings For companies: apartments' rent contracts and roof-rent (for the building owner); smart energy contracts (for the energy supplier)	• Communication
	ANT_BM-01 New construction of residential	Citizens	Private company Property	For city government: development of a role model smart district For citizens: the decreased demand for energy and smart BMS applications, will increase the	For citizens: energy and monetary savings For companies:	• Finance • Design • Management • Regulation

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	building		owners	quality of indoor conditions and decrease the energy use leading to lowered energy bills. For companies: implementation of high performance interventions	selling of high-performance apartments	• Economic incentive • Monitoring • Communication • Diffusion
Construction of public tertiary building	ANT_BM-02 New construction of high performance public building	City government	City government	For the city government: new public facilities For city agencies: new services For citizens: access to new services and increase in urban quality For commuters: the use of renewable energy in e-vehicles will provide a sustainable and clean transportation method.	For city government: energy and monetary savings	• Finance • Design • Management • Regulation • Economic incentive • Monitoring • Communication • Diffusion
Retrofitting of private residential buildings	VAL_BM-02 Retrofitting of private residential buildings	Citizens	City government Public company Private company	For the city government/citizens: quality of life improvement for groups of citizens through energy efficiency measures, improvement of their houses and integration of new technologies For involved companies: create opportunities to provide their products and services in valuable and representative contexts.	For citizens: energy and monetary savings	• Management
	DRE_BM-03 Energetic transformation of the real estate	Citizens	Private company	For citizens: improved townscape For companies: commissions	For citizens: monetary savings (combination of energy efficiency, fire protection and design) For companies: possible rent increase to cover the investment costs, meeting	• Regulation • Economic incentive

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					the environmental standards, required by government	
Building integrated RES in a residential building	DRE_BM-01 Smart tenant existing building	Citizens Other companies	Private company	For the city government: this smart city solution reduces CO_2 emissions and thereby helps to improve the air quality within the city. For citizens: the building tenants will be able to use the electricity generated by renewable energy sources in the building (here rooftop solar photovoltaic). They have more control over their energy consumption and energy costs. Also they will benefit from the more detailed information about consumption, electricity generation etc. and they will be able to test the new technologies. For involved companies: they will implement their results in other buildings to increase the number of tenants that can use the new technologies, therefore a competitive advantage is created over other market participants	For citizens: energy and monetary savings For companies: business opportunities, competitive advantage	• Communication
Building integrated RES in a tertiary building	VAL_BM-05 Building integrated RES in a tertiary building (Nazaret Sport Centre)	City government Citizens	City government Public company Private company	For the city government: The action bundle is an excellent opportunity to promote the utilization of renewable energy sources to satisfy (partially) both thermal and electricity demand of a Sport Centre. Apart from reducing costs in energy bills, the results of the demonstrator will be publicly disseminated in order to spread good energy practices. For citizens: they will be the final target users of the solutions provided. They might benefit from some discount on fees and be responsible for clean energy utilization.	For city government: energy and monetary savings; learning from testing For citizens: fees reduction For companies: business opportunities	• Finance • Design • Management • Monitoring • Communication • Diffusion

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				For companies: Several companies are an important part of the action bundle. They are responsible for the design of the different technology systems (geothermal, PV and sewerage energy recovery, smart energy management system) as well as the construction and integration process.		
Urban scale RES	ANT_BM-04 Solar power plant with storage	City government Citizens	City government	For the city government: By this action bundle city government will promote and increase usage of renewable energy as an alternative for conventional fuels as well as contribute emission reduction in the city. Moreover, in accordance with the applicable law and regulations, any excess energy can be sold to the grid from a guaranteed tariff of 13.3 USDcent/kWh base price for increasing fiscal benefits to the city government. For citizens: Reduction of energy cost, Currently, 25% of energy demand irrigation cooperatives covered by solar power plant and ANT aims to supply 100% of the energy demand from solar power.	For city government: energy selling For citizens: monetary savings	• Finance • Design • Management • Monitoring • Diffusion
	ANT_BM-05 LFG Utilization	Citizens	City government	For the city government: In accordance with the applicable law and regulations, generated electricity can be sold to the grid from a guaranteed tariff of 13.3 USDcent/kWh base price. For citizens: Energy generated from LFG power plant will be distributed to for free in order to reduce energy costs of citizens.	For city government: energy selling For citizens: monetary savings	• Design • Management • Regulation • Diffusion
Smart public lighting	DRE_BM-07 Smart public lighting	Citizens	City government		For city government: energy and monetary savings	• Finance • Design • Management • Monitoring

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	ANT_BM-03 Smart public lighting	City government, City agencies, Citizens, Commuters, Tourists, Utility companies, Other companies	City government	For the city government: Smart lighting Infrastructure and energy efficiency; The use of led will provide an efficient and sustainable light source For city agencies: Smart lighting Infrastructure and energy efficiency For citizens/tourists/commuters/companies: Smart infrastructure	For city government: energy and monetary savings	• Finance • Design • Management • Regulation • Economic incentive • Monitoring • Communication
Smart controls and domotics in residential building	DRE_BM-05 Smart controls (Building control center)	City government	City government	For the city government: energy and monetary savings; CO_2 emissions decrease For citizens: emissions decrease	For city government: energy and monetary savings	• Finance • Design • Management • Monitoring • Communication • Diffusion
Urban electrical storage	ANT_BM-04 Solar power plant with storage	City government Citizens	City government	For city government: by this action bundle city government will promote and increase usage of renewable energy as an alternative for conventional fuels as well as contribute emission reduction in the city. Moreover, in accordance with the applicable law and regulations, any excess energy can be sold to the grid from a guaranteed tariff of 13.3 USDcent/kWh base price for increasing fiscal benefits to the city government. For citizens: Reduction of energy cost, Currently, 25% of energy demand irrigation cooperatives covered by solar power plant and ANT aims to supply 100% of the energy demand from solar power.	For city government: energy selling For citizens: monetary savings	• Finance • Design • Management • Monitoring • Diffusion

Table 9: Key elements of business models in the energy pillar

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

Categ.	Action bundle name	Target user	Asset ownership	Value proposition	Revenue streams/value capture	City government's role
EV cars (private sector)	VAL_BM-10 EV (private sector)	City agencies Citizens Commuters	City government Private company	For the city government/citizens: realization of public EV charging infrastructure For citizens: optimization of EVs smart charging, reducing energy billing and contributing therefore to the optimum household energy management. For companies: optimization of EVs smart charging, reducing energy billing; planning and control of charging schedule of all EVs of a fleet.	Tariffs	• Finance • Design • Regulation • Monitoring • Communication • Diffusion
	DRE_BM-09 EV for housing sector	Citizens Other companies	Private company	For the city government: decrease of CO_2 and NOx-emissions and of fine dust pollution within the city For citizens: facilitation of access and possibility to use e-vehicles For companies: this solution provides new EV's for housing companies/ their craftsmen. With the optimization of charging infrastructure, the use of e-vehicles will be more attractive, measured data will be used for scientific use and further development of batteries and charging infrastructure.	Tariffs	• Communication
	ANT_BM-07 E-car	Citizens Commuters Tourists	Public company	For the city government/city agencies: - increase the utilization of e-vehicles in municipality fleet; - increase the public acceptance of e-vehicles in daily utilization		• Finance • Design • Management • Regulation • Economic incentive

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				- increase the sustainability use of e-vehicles and charging stations - increase the environmental awareness for e-vehicles - increase the transportation authorities' strategic plan for e-vehicle utilization - increase the utilization of e-vehicles and their charging stations - increase the increased use of local energy sources - increase the utilization of local energy source and air quality For citizens/commuters: better air quality; reduction of noise pollution; lower transport costs For companies: new markets		• Monitoring • Communication
EV bus (public sector)	ANT_BM-06 E-bus	Citizens Commuters Tourists	Public company	For the city government/city agencies: - increase the transportation authorities' strategic plan on e-Buses and charging stations - increase the sustainability use of e-Bus and charging stations - provide specifications of the new services on sustainable mobility - increase the utilization of e-Busses in public transportation - increase environmental awareness - increase e-Bus and charging station utilization and management experience - increase the utilization of local energy		• Finance • Design • Management • Regulation • Economic incentive • Monitoring • Communication

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				source and air quality For citizens/commuters/tourists: better air quality; reduction of noise pollution; lower transport costs For companies: new markets Other stakeholders: opportunities to use, monitor and analyze e-vehicles and charging station technology effects in the city transportation.		
EV bike (public sector)	ANT_BM-08 E-bike	Citizens Commuters Tourists	Public company	For the city government/city agencies: - increase the utilization of e-Bikes in public transportation - increase the public acceptance of e-Bikes in daily utilization - increase the sustainability use of e-Bikes - increase the environmental awareness for e-Bikes - increase the transportation authorities' strategic plan for e-Bike utilization - increase the utilization of e-Bikes and their charging stations - increase the increased use of local energy sources - increase the utilization of local energy source and air quality For citizens/commuters/tourists: reduction in noise levels, pollution and traffic congestion; lower transport costs; access to cheap and sustainable transport mode to visit the city		• Finance • Design • Management • Regulation • Economic incentive • Monitoring • Communication

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				For companies: new markets Other stakeholders: opportunities to use, monitor and analyze e-Bikes and charging station technology effects in the city transportation and sightseeing purposes		
Demand management/Smart charging	DRE_BM-12 Smart charging	City agencies Citizens Commuters Tourists Utility companies Other companies	Private company	For city government: improvement of the reliability of the charging infrastructure and the energy grid within the city. For citizens/commuters/companies/other stakeholders: improvement of the charging process and reduction of the charging duration for citizens/ for companies with an e-vehicle fleet/for other stakeholders that use e-vehicles.	Tariff	• Management • Monitoring • Communication • Diffusion
Multimodality	DRE_BM-11 Intermodal mobility hub	Citizens Commuters Tourists	City government Public company Private company	For city government/citizens/commuters/tourists: reduction of car traffic, increase of public transport use and ecologic means of transport		• Regulation • Communication
	ANT_BM-09 Multimodal hubs	Citizens Commuters Tourists	Public company	For city government: - increase the mix-use of different forms of multimodality - increase the transportation authorities' strategic plan for multimodal hubs - increase the investments for sustainable		• Finance • Design • Management • Regulation • Economic incentive • Monitoring • Communication

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				public transports - increase the utilization of local energy source and air quality - reduce public transportation operation costs - reduce the amount of recreational places instead of building car parks - reduce the fossil energy demand For city agencies: increase multimodal transport system utilization and their technologies; increase awareness of different transportation modes; monitor their performances For citizens/commuters/tourists: reduction in noise levels, pollution and traffic congestion; lower travel times and cost; better air quality and emission reduction. For companies: new markets		
	ANT_BM-10 Intelligent transport system	Citizens Commuters Tourists	Public company	For the city government: - increase the capability of the city in terms of mobility - increase the transportation authorities' strategic plan for the integration of e-bikes and light rail - increase the utilization all e-vehicle types (Including e-buses and e-bikes) by supplying quality charging systems and effective operation and management for the multimodal hubs - increase the investments for sustainable		• Finance • Design • Management • Regulation • Economic incentive • Monitoring • Communication

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				public transports - reduce public transportation operation costs - increase the shift between sustainable public transports such as e-Bikes and existing light rail - reduce the utilization of mobility in the daily journeys - provide optimum travel time by using e-bikes and light rail integration For city agencies: increase multimodal transport system utilization and their technologies; increase awareness of different transportation modes; monitor their performances For citizens/commuters/tourists: reduction in noise levels, pollution and traffic congestion; lower travel times and cost; better air quality and emission reduction. For companies: new markets		
Expansion charging infrastructure	DRE_BM-10 Expansion charging infrastructure	Citizens Commuters Tourists Other companies	Private company	For the city government: CO_2 , NOx, fine dust-reduction and better air quality For citizens/commuters/tourists/companies: access to charging stations, increase of e-mobility use		• Communication • Diffusion

Table 10: Key elements of business models in the mobility pillar

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

Categ.	Action bundle name	Target user	Asset ownership	Value proposition	Revenue streams/value capture	City government's role
Use of open data for new business	VAL_BM-15 Use of open data for new business	City government City agencies Citizens Commuters Tourists Utility companies Other companies	City government	For city government: provide more information to the citizens about the city, the city services, environmental concerns, etc. and also satisfy the needs of transparency. For city agencies: offer datasets as open data and consume data in order to improve services or create new ones. For citizens: they will be provided with more information about the city, not only new services, but also interesting data about the daily life in the city, building information, health, traffic, etc. For commuters: obtain valuable information from open datasets or open APIs that offer information in real-time about traffic congestion and weather conditions. For tourists: benefit from open information available on the portal, whether directly by means of checking tourism information like monuments, landmarks, etc., or by means of touristic applications that draw information from the available open datasets. For companies: explore and discover new business models using this new datasets and APIs. For any other stakeholders: from neighbourhood associations or non-profit organizations to entrepreneurs and other city or national government that may find in the city open data a source of information for any activity.	Tariffs for use of the service Development of new apps Access to new services	Design Management Monitoring Communication Diffusion
Inputs and Outputs of Urban	VAL_BM-16 Inputs and Outputs of	City government City	City government	For the city government: will obtain information from the sensored interventions and this will evolve into new analysis reports and diagnosis and more control over the city.	Tariffs for use of the service Development of new	Design Management

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platform	Urban platform	agencies Citizens Commuters Tourists Utility companies Other companies		For city agencies: could benefit from the information obtained from the sensors in order to improve their services or create new ones. For citizens: This action bundle also refers to the integration of measurements from citizens sensors into the urban platform in order to improve their daily life by means of energy consumption studies, efficiency recommendations, etc. For commuters: Inputs from means of transport and multimodal hubs will be aggregated and offered in dashboards. Also traffic and weather alerts are inputs for the urban platform to offer advanced information to commuters. For tourists: Some data regarding transportation and aggregated inputs from different means of transport and multimodal hubs could be very useful for improving the mobility of tourists and their experience. For companies: New outputs can entail an innovative opportunity for companies and entrepreneurs. Companies may find new business model through agreements with the city council to inject interesting data into the platform.	apps Access to new services	Economic incentive Monitoring Communication Diffusion

Table 11: Key elements of business models in the ICT pillar

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

Categ.	Action bundle name	Target user	Asset ownership	Value proposition	Revenue streams/value capture	City government's role
Employment initiatives	VAL_BM-17 Employment initiatives	City government City agencies Citizens Other companies Non-Governmental associations	Private company	For the city government: strengthened synergies among city agencies, and with key stakeholders from the quadruple helix (non-governmental associations and citizens; schools and universities; companies): efficiency of public services, participatory approach. Development of public policies based on real needs. For city agencies: strengthened synergies and efficiency. For citizens: public policies based on real needs. Awareness on business opportunities. Training. For companies: awareness on business opportunities. Identification of skilled workers. For other stakeholders: awareness on good practices for non-governmental associations.	The service is provided for free under the project. Training delivery Employment opportunities	Communication Diffusion
Shared private-public investment models for sustainable energy consumption and circular economy	VAL_BM-19 Shared private-public investment models for sustainable energy consumption and circular economy	City government City agencies Interested stakeholders (service providers; donors/social investors)	Private company	For the city government/city agencies: enhanced efficiency of public services based on proven interventions and outcome assessment For citizens: enhanced and evidenced-based better quality public services. For companies: Business opportunities for social entrepreneurs (social services providers) and impact evaluators. For other stakeholders: Corporate Social Responsibility for big companies (donors, investors).	Results of the Social Impact Bond Energy poverty mitigation Training delivery	Communication Diffusion

Table 12: Key elements of business models in the NTA pillar

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Annex A3. Context factors, barriers and solutions in each pillar

Categ.	Action bundle name	Context factors	Barriers	Solutions
Construction of (private) residential building	VAL_BM-01 Reconstruction of private residential building	All technological, political-institutional, socio-cultural and economic-business factors are needed in order to success because of the complex internal and external relationships and the great number of external factors influencing this type of actions.	- political decisions - financial models applied	
	DRE_BM-02 Smart tenant new building (District Future House)	- acceptance and participation of tenants - cooperation between energy supplier, real estate company and building owner - financial advantages for the tenant - depending on the country-specific legislature	- capacity dependencies - billability - specific, technical location factors - legislative boundary conditions - acceptance by the tenants - data privacy	- capacity dependencies → expand capacities - billability → development of new procedures in internal billing systems (SAP) - legislative boundary conditions → legislative adaptations - acceptance by the tenants → financial advantages for the tenant, information about the product - data privacy → needs a data management plan and agreement of the customers
	ANT_BM-01 New construction of residential building	- integration of renewable energy and smart city solutions into not only the building scale but also to existing city infrastructure, led by the local authorities/municipality;	- economic circumstances or fluctuations at national level or for the contractor financing the intervention could affect the successful application of the business model	- alternative financing instruments - local politics - internal communication with the building users

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Construction of public tertiary building	ANT_BM-02 New construction of high performance public building	- integration of renewable energy and smart city solutions into not only the building scale but also to existing city infrastructure, led by the local authorities/municipality; - social integration and participation	- possible delays in tendering and procurement processes, due to the fact that the model is fully financed by municipality	- alternative financing instruments - local politics - information, integration and participation of the public, to encourage the use of this public place
Retrofitting of private residential buildings	VAL_BM-02 Retrofitting of private residential buildings	All technological, political-institutional, socio-cultural and economic-business factors are needed in order to success because of the complex internal and external relationships and the great number of external factors influencing this type of actions.	- political decisions - financial models applied	
	DRE_BM-03 Energetic transformation of the real estate	tenant acceptance	- governmental regulatories - resistance of tenants	- CO_2 tax - rising energy costs

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Building integrated RES in a residential building	DRE_BM-01 Smart tenant existing building	- acceptance and participation of tenants - cooperation between energy supplier, real estate company and building owner - financial advantages for the tenant - depending on the country-specific legislature	- capacity dependencies - billability - specific, technical location factors - legislative boundary conditions - acceptance by the tenants - data privacy	- capacity dependencies → expand capacities - billability → development of new procedures in internal billing systems (SAP) - legislative boundary conditions → legislative adaptations - acceptance by the tenants → financial advantages for the tenant, information about the product - data privacy → needs a data management plan and agreement of the customers
Building integrated RES in a tertiary building	VAL_BM-05 Building integrated RES in a tertiary building (Nazaret Sport Centre)	- need to consider different financial solutions, since initial investment needed is very large - political-institutional support - availability of sewerage network, floor space for geothermal proves and clear roof area for PV modules - deployment of a HVAC system - high thermal and electric demand	- lack of technical conditions (see context factors) - high initial investment	- look for new alternative financing methods - modular designs in order to reduce costs
Urban scale RES/ Urban electrical storage	ANT_BM-04 Solar power plant with storage	- good socio-cultural acceptance and positive attitude towards solar power plants - increasing social demand in energy consumption	- renewable energy production not able to cover high energy demand (import needs); - financial crisis and exchange rate fluctuation particularly in the last two years in Turkey hamper investment on	- alternative financing instruments - local politics

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		- increased primary energy demand driven by economic growth - promotion of solar energy by the Central Government through incentives	PV installation - insufficient central and local government subsidies - lack of technology knowledge among most of the policy makers, leading to inadequate local politics on solar power plant implementation - low local awareness regarding European and international financial organisations and agencies	
	ANT_BM-05 LFG Utilization	- city government's political will to invest in solid waste management, given its reliability for energy production and storage possibility for demand-side load management in smart grid applications	- economic instability, recession and exchange rate fluctuation in Turkey and, more precisely, in Antalya. - economic austerity measures by the central government on its bodies, which ultimately decreased the direct investment.	- alternative financing instruments - local politics
Smart public lighting	DRE_BM-07 Smart public lighting	acceptance	management cost	reliability
	ANT_BM-03 Smart public lighting	- presence of a strong network of interconnected lightning system, including smart city applications such as EV charging, digital signage and communication, environmental monitoring, supported ICT applications.	- possible delays in tendering and procurement processes, due to the fact that the model is fully financed by municipality	- alternative financing instruments - local politics

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Smart controls and domotics in residential building	DRE_BM-05 Smart controls (Building control center)	Political will	Limited public funds	- ambitious political targets, formulated in city strategy, with budgets backing the realization of these goals

Table 13: Context factors, barriers and solutions in the energy pillar

Categ.	Action bundle name	Context factors	Barriers	Solutions
EV cars (private sector)	VAL_BM-10 EV (private sector)	- public administration commitment - need to identify key stakeholders to be involved - informative campaigns to citizens about EV use	- high cost of owning and installing charging infrastructure, which strongly depends also of availability for funds in the city. - competition with home charging (which is easier and less expensive)	Incentivation policies to promote this service among citizens
	DRE_BM-09 EV for housing sector	- Willingness to buy e-vehicles - SUMP	- internal capacities and priorities - low acceptance of the SUMP within the public sector - bottlenecks in the delivery of new vehicles - bottleneck in the delivery of monitoring equipment - development of legislative boundary condition - Possibly low utilization rate of e-vehicles - Data privacy	- Possibly low utilization rate of e-vehicles → make the use more attractive - Data privacy → needs a data management plan and agreement of the users

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	ANT_BM-07 E-car	- political will - incentives	- limited number of companies that produce e-vehicles and e-vehicle charging stations in Turkey - determination of the most economic and quality (optimum) e-vehicle and e-vehicle charging stations - political changes in the city government (needs time to be fully aware of the project) - lack of data about e-vehicles and their use, which hampers demand management - exchange rate fluctuation, which affects the prices of e-vehicles and charging stations maintenance and management cost.	- need to meet with new management team of Antalya municipality - develop a national policy for e-vehicles - lower the purchase tax applied to e-vehicles
EV bus (public sector)	ANT_BM-06 E-bus	- successful e-bus application as stimulus for nation-wide policy development	- limited number of companies that produce e-vehicles and e-vehicle charging stations in Turkey - determination of the most economic and quality (optimum) e-Bus and e-Bus charging stations - political changes in the city government (needs time to be fully aware of the project) - lack of data about e-Bus and their use, which hampers demand management	- need to meet with new management team of Antalya municipality, to discuss the implementation of vehicle tracking systems in all public transport

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			- exchange rate fluctuation, which affects the prices of e-Bus and charging stations maintenance and management cost.	
EV bike (public sector)	ANT_BM-08 E-bike	- good comfort, which is important for biking given the climate - demand management to decrease use of private motorized vehicles	- limited number of companies that produce e-Bikes and e-Bike charging stations in Turkey - determination of the most economic and quality (optimum) e-Bikes and charging stations - political changes in the city government (needs time to be fully aware of the project) - lack of data about e-Bikes and their use, which hampers demand management - exchange rate fluctuation, which affects the prices of e-Bikes and charging stations maintenance and management cost.	- need to meet with new management team of Antalya municipality - need to upgrade the municipality's budget to prevent negative effects of high exchange rates
Demand management/Smart charging	DRE_BM-12 Smart charging	- sufficient number of charging stations for e-vehicles - Market availability of certified SMGW in Germany	- internal capacities and priorities - economic feasibility - specific, technical location factors - development of legislative framework, especially data security issues - market mechanisms still in development	- economic feasibility → usage of national subsidies or funding sources of the European Union

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Multimodality	DRE_BM-11 Intermodal mobility hub	- good locations - changes in mobility behaviour (public transport & bicycle vs. car)	- no optimal locations - no acceptance by users - poor infrastructures for cycling in the rest of the city ...	
	ANT_BM-09 Multimodal hubs	- integration between modes, to be achieved by using intelligent transportation systems technology.	- limited number of companies that produce e-vehicles and e-vehicle charging stations in Turkey - determination of the most economic and quality (optimum) e-vehicle and e-vehicle charging stations - political changes in the city government (needs time to be fully aware of the project) - lack of data about e-vehicles and their use, which hampers demand management - exchange rate fluctuation, which affects the prices of e-vehicles and charging stations maintenance and management cost.	- need to meet with new management team of Antalya municipality
	ANT_BM-10 Intelligent transport system	- Antalya Metropolitan Municipality's will to supply the intelligent transport system structure and operation cost	- limited number of companies that produce e-vehicles and e-vehicle charging stations in Turkey - determination of the most economic and quality (optimum) e-vehicle and e-vehicle charging stations	

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			- political changes in the city government (needs time to be fully aware of the project) - lack of data about e-vehicles and their use, which hampers demand management - exchange rate fluctuation, which affects the prices of e-vehicles and charging stations maintenance and management cost.	
Expansion charging infrastructure	DRE_BM-10 Expansion charging infrastructure	- network-suitable integration of charging infrastructure - permissions from the city for charging points in public places	- client's willingness to invest in electric charging stations in a uncertain market for EV's - approval capability and location finding - Internal capacities and priorities - Specific, technical location factors - development of legislative framework conditions - market mechanisms still in development	- client's willingness to invest in electric charging stations in a uncertain market for EV's → marketing and knowledge transfer via website, leaflets.. - approval capability and location finding → a good cooperation with the responsible part of the city administration is necessary

Table 14: Context factors, barriers and solutions in the mobility pillar

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Categ.	Action bundle name	Context factors	Barriers	Solutions
Use of open data for new business	VAL_BM-15 Use of open data for new business	The base of this business model is technological. Once the technology is ready, there is a strong influence of political-institutional factors to promote the use of open data.	The lack of open data or the lack of determination of collecting data and making it openly available.	The maintenance of an up-to-date and scalable urban platform is needed to deal with technological issues and the adoption of citizen-centred policies, which should be based on transparency and openness.
Inputs and Outputs of Urban platform	VAL_BM-16 Inputs and Outputs of Urban platform	The main context factors needed are technological because new devices and software have to be developed to collect and visualize data. Additionally, there is a light socio-cultural influence in the success of the application of this business model since people need to be used to living among sensors and being monitored.	Rejection to monitor certain areas or devices or habits because of privacy issues or any other reason.	Consciousness-raising campaigns about the benefits of monitoring and sensoring, and the favourable results that they may have in the citizens daily life.

Table 15: Context factors, barriers and solutions in the ICT pillar

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Categ.	Action bundle name	Context factors	Barriers	Solutions
Employment initiatives	VAL_BM-17 Employment initiatives	- involvement of all relevant stakeholders at the territorial level. - participation of technical and non-technical partners of the project - wide and targeted dissemination of materials and about events / training activities.	Lack of resources and leadership for replication.	- coordination among city agencies in order to identify potential synergies and thus reduce the need of additional resources. - Public-private partnership schemes to ensure the needed flexibility in the deployment of the action.
Shared private-public investment models for sustainable energy consumption and circular economy	VAL_BM-19 Shared private-public investment models for sustainable energy consumption and circular economy	- political support by means of public helps/grants to promote the use of RES	- lack of knowledge within citizens - reluctance of public administrations to innovate and engage in PPPs	- involvement of the city government and relevant stakeholders in the design - experts' assessment and support

Table 16: Context factors, barriers and solutions in NTA pillar

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