European Commission

Smart Cities
Stakeholder Platform

E-mobility and Power Matching

Key to Innovation Integrated Solution

E-mobility and power matching

Document information

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ABSTRACT

Electro mobility is currently the most important alternative transport technology for urban areas with reduced environmental effects: It is beneficiary in terms of noise and air quality and also in terms of GHG reduction, if the electricity is generated from renewable sources. It can be applied to different transport modes such as passenger cars, light vehicles, buses, e-bikes (pedelecs) and it enables new light vehicle concepts.

Moreover it closely relates to the electricity production, storage and distribution systems and energy buffering. This requires smart technologies to optimally match the power demand for charging E-vehicles with the fluctuating supply of renewable electricity as well as the right location of charging facilities.

The solutions backing this Key Innovation aim to match the transport demand and supply on the one hand (by promoting electric vehicles or bicycles), and the electricity demand for e-mobility and power supply capacity (by promoting smart charging stations and connection with smart grids) at the right place and time on the other hand.

Studies show that beyond many pilot projects one of the main obstacles is the deployment of electro-mobility at a larger scale. This is mainly due to high costs and short lifetime of batteries. However, the business model of battery rental lowers these costs. There are currently several projects on battery ageing behavior.

Focal points therefore should be for the time being and under current conditions on economic and environmental aspects, organisations with (large) vehicle fleets operated regularly but on shorter daily trips such as fleet operators in urban and peri-urban (autonomy range is at the moment 200 km) context (e.g. city logistics, at-home care services for elderly, car-sharing), (charging) infrastructure suppliers, the public sector, and last but not least the users of this innovative individual mobility form.

Picture 1: Charging of small electric (car-sharing) vehicles with renewable electricity (Source: W.Schade)

The projects in this KI, that involve many different stakeholders (citizens, companies, universities, public and private entities) may well be part of a long-term strategy (2050) for urban mobility in Europe focused on “electric vehicles” and the decarbonisation of the transport sector.

INTRODUCTION

The Key Innovations (KIs) are a key output of the Smart Cities Stakeholder Platform. The Platform promotes innovation and is part of the Smart Cities and Communities European Innovation Partnership of the European Union. It aims to accelerate the development and market deployment of energy efficiency and low-carbon technology applications in the urban environment. The emphasis will be on their integration, which is a key challenge particularly for Smart Cities' technologies. The Platform aims to bring together technology providers, financiers and specialists in implementing smart city strategies at local level.

The expert Working Groups of the Platform on Energy Efficiency and Buildings, Energy Supply and Networks as well as Mobility and Transport select from the spectrum of Solution Proposals (SPs) submitted by stakeholders[1] the *most promising and fundamental* solutions to accelerate the development of smart cities. The focus is on specific promising innovations, considered pillars or technical leapfrogs for integrated solutions in smart cities, thus promising, but standalone solutions, will not be developed into key innovation files and toolkits.

Regardless, if an SP will be part or not of a key innovation document, all solution proposals will be published in the Platform and linked to city profiles. The Platform is not an evaluation body and is open to all relevant smart solutions, large or small scale for cities and their inhabitants.

The aim is to promote through the preparation of a detailed document, a guide for cities on the performance of the innovation, including in some cases wider impacts on city life (such as change of behaviour, environment, social inclusion etc.). For each innovation, this key innovation document will describe the methodology to deploy it, including the technical requirements and the necessary framework conditions, such as existing infrastructures, technical expertise, regulatory requirements as well as the financial costs involved. The document aims to promote the adoption of the key technology and to identify barriers to deployment to assist relevant authorities in developing solutions to remove them. The document will list the technology providers as well as information of a number of potential financial sources by the EU and other bodies which have supplied information to the platform.

The information in the Key Innovation documents will become an integral part of the recommendations of the Smart City 10 Year Rolling Agenda document the Platform will draft for the European Commission. This document will highlight identified actions at European level required to promote the adoption of key innovations, such as the removal of regulatory barriers or recommendations on the focus of the Horizon 2020.

It is important to stress that this document is not a set of technical proposal or a full evaluation of the innovation, but aims to assist for cities to identify potential solutions and understand their context and implementation needs. It does not exempt or substitute a detailed cost/benefit analysis and implementation plans for cities that wish to introduce the innovation. The Stakeholder Platform cannot take any responsibility for inaccuracies or missing information or specific problems in the implementation of the proposed Key Innovations or other Solution Proposals.

[1] Solution proposals are published on the web site: www.eu-smartcities.eu/ solution-proposals

Description of a Key Innovation

A key objective of the Smart Cities Stakeholder Platform is to identify Key Innovations (KIs) for the development of Smart Cities. The selection of an SP as KI is based on the following criteria: **applicability, simplicity, affordability**, **usability**, the extent to which it addresses technology integration and if the potential impact is significant. Selected SPs will then be enhanced by the Platform's technical Working Groups (WGs) to develop KIs, adding the following aspects:

- Premises for the technology development and up-take (e.g. problems, what the technology is intended to achieve, other unforeseen benefits for the smart cities);
- Potential integration with other technologies and sectors, including use of ICT;
- If necessary, enhancing the information from the SP on the urban environment in which the technology can be applied;
- Key pre-requisites for the applicability of the key innovation, such as the required enabling environment;
- Instruments and market conditions needed to reach commercial viability.2

KIs will be completed by the technical WGs in collaboration with the Finance WG. This group will analyse the financial needs of the KI as well as their financial viability and bankability. The members of the WG will provide information on funding sources. The result will be published as a Key Innovation Toolkit.

The Toolkits thus provide practical solutions that can create an enabling environment for the application and replication of key innovations in a smart city.

[2] This includes a description of the main EU support instruments, such as the Risk Sharing Financing Facility

1. Presentation of the Key Innovation

Submitted to the platform at date (Innovation maturity)	Body(ies) submitting the proposal(s):	IP right holders:	Problem addressed	City (ies)	Parties or stakeholders involved:
1. 'beAgueda' - the electrical bicycle of Agueda					
11 Sept 2012 (Best Practice)	Gil Nadais **Municipality of Agueda (P)**	Municipality of Agueda (P)	Implementing environment-tally friendly and energy efficient means of transport	Águeda	Municipality; Private companies: Orbita, Miralago, Ubiwere, Ponto.C, MicroIo); Private citizens/population; Schools/ students, University of Aveiro
2. Integration of electric vehicles and energy infrastructure					
29 Sept 2012 (Project Idea)	Roberto Baldessari **NEC Europe Ltd.**	Some large IT and grid operators might have IPRs, depending on the exact algorithm	Integrating transport and energy management system for optimized EV-charging	EU Projects PowerUP, SmartCEM, Mobility2.0	EV fleet operator or service provider (e.g. logistics vans, EV car sharing or subscription-based service), grid operator, charging station operator
3. KATE: Personal Mobility Assitant					
20 Sept 2012 (Pilot Project)	Don Guikink **TNO** Netherlands	TNO and some of its partners	Traffic congestion	Assen	Private and public parties, service providers (XL-websolutions, ModelIT), urban traffic management centers, fleet operators, etc.
4. Smart charging infrastructure					
15 Oct. 2012 (Best Practice)	Pierre Clasquin **G2Mobility**	G2Mobility	Large scale deployment of electrical vehicle		Private and public parties as well as research centers involved.

5. ICT solution to enable efficient car-sharing services (including EVs)					
21 Dec. 2012 (Best Practice)	Ana Herrera **GMV**	GMV	Urban mobility efficiency (Car Sharing Systems)	Madrid	public sector, private car-sharing companies, , technology provider, public transport companies
6. EV charging stations located in railway stations supplied by regnerative break supplied electricity					
17 Jan 2013 (Best Practice: Demonstra-tion Project)	José Ignacio Pradas-Poveda **Schneider Electric**	Several European engineering companies own related IPR, including associated companies to SERCOBE	Sustainable electro-mobility	Málaga (Spain)	Private sector (ADIF, Ingeteam, Andelsa, Green Power Tech, Isofoton, MP Sistemas), research institutions (Instituto Andaluz de Tecnología, Universities of Malaga and Seville)

1.1 Description of the innovation and rationale for selection

All SPs have been selected based on the following evaluation grid:

	Evaluation Criteria (Score: 1 to 5)	Weight
1. Impact over GHG emissions		25%
1,1	CO_2 reduction,	
1,2	Increasing share of renewables,	
1,3	Increasing energy efficiency	
2. Economic issues/ cost-benefit-ratio		25%
2,1	Affordability (mobility costs for end users)	
2,2	Economic viability (period for return of capital)	
3. Smartness of Innovation		25%
3,1	Innovative nature/ progress to the state-of-the-art	
3,2	Integration into the urban transport system, handling existing (infra-) structures	
4. Potential for market uptake and replication/ customers experience		25%
4,1	Potential for scale-up and replication	
4,2	Barriers to market entry (e.g. vendor lock-in or non-interoperable protocols and rules)	
4,3	stakeholders involvement/ consumers attractiveness (e.g. user-friendliness of the technology)	
Total Score		

The result of the evaluation by all WG members of the SPs selected for this KI was as follows (scale = 1 (lowest effect) to 5 (highest effect)):

criteria	SP#1	SP#2	SP#3	SP#4	SP#5	SP#6
1	3,33	3,67	3,33	3,53	2,97	3,76
2	3,5	3	3,50	2,92	3,46	2,5
3	3	4,5	3	2,88	2,83	3,23
4	4	3,67	4	2,86	2,97	2,73
total	**3,46**	**3,71**	**3,46**	**3,05**	**3,06**	**3,05**

Electro mobility is the currently available key alternative transport technology for urban areas, offering multiple benefits in terms of: CO_2 reduction, air quality, and noise. Transport modes include: passenger cars, light delivery vehicles, buses, e-bikes, and possibly new light vehicle concepts. Moreover, it closely relates to the electricity production and distribution system, requiring smart technologies to optimally match the power demand for charging E-vehicles in space and time. The challenges are basically twofold, the capacity problems and the energy sources.

The first challenge can be illustrated by the example that the electricity demand of and average household will approximately double, if they will start to drive about 15,000 km per year with an EV. Therefore concepts are required to give incentives towards charging during off peak hours with intelligent systems. The second challenge is the energy source – a recent study showed that the environmental balance of electro mobility largely depend on the fuel for the electricity production.[3]Key stakeholders involve: citizens and visitors, fleet operators, logistic companies, local governments, urban traffic management centers, power grid operators; and in addition the industrial suppliers of: vehicles, (charging) infrastructure, and software to optimize supply, demand and billing. Furthermore the issue enables new business models.

The six Solution Proposals presented above address the thematic field of "E-mobility and power matching". They offer solutions to match

1. mobility/ transport demand and supply and
2. electricity demand for vehicle charging and the power supply capacity in space and time.

Optimising both issues require smart (software) solutions that need to be widely applicable and affordable. The suggested solutions cover the following issues:

- Innovation in charging of electric vehicles (at home, at destination, in car parks, at work and along the way), e.g. fast/slow charging, battery swapping, reducing range anxiety (see SP # 4). An innovative pilot project in Malaga is to use the regenerative braking system embedded in rail rolling stock as a source for charge electric vehicles and therefore locate them in railway stations (see SP # 6).
- Innovation in the energy management that is needed for e-mobility, not only in terms of capacity but also meaning a smart usage of electricity (See SP # 2, which provides up to the minute infos by sensors and congestion alarm). This relates to the innovation / extension of the powermatching technologies that have been developed and that are a huge opportunity to make a big leap forward in energy management/awareness (and therefore smarter usage).
- Innovation in related services around e-mobility, such as 'mobility matching' (demand and supply for mobility). This not only focuses on the generation and storage of energy needed for mobility, but deals with smart information handling about availability of mobility options (e.g. shared e-Bikes such as the best practice example of Agueda, SP # 1). Technologies such as KATE (mobility matching tool, SP # 3) are currently being developed and tested. Important are ICT solutions to provide a smart organisation of the procedure of car sharing services including the specific needs of EV as it is best Practice in Madrid (SP # 5).

[3] Schubert, Doll, Wietschel: Externe Effekte von Elektro- und Verbrennungsfahrzeugen im Vergleich, 2011

The European Commission has a long history of supporting research, technological development, and demonstration for alternative fuels and propulsion systems (including bio-fuels, electromobility and hydrogen for transport) through its Research Framework Programmes. Examples of projects or initiative are the European Green Car Initiative, Green eMotion, FR-EVUE (Freight), EBSF (European Bus system of the Future) and the setup of a European Electromobility Obervatory (EEO).

1.2 Deployment status

Between March and November 2012 a review of the Action Plan on Urban Mobility has been undertaken, R&D on low and zero emission mobility being one of the 20 actions. Part of the review was a launching a questionnaire among stakeholders across Europe. Regarding renewable energy sources and e-mobility it was concluded that on the positive side was mentioned:

- the uptake of industrial applications in R&D programmes;
- improved awareness of industry regarding renewable sources;
- good positioning of the EC for standards will lead to efficiency;
- different programs lead to usable results (however the effect of the Clean Vehicles Directive is unclear);
- the positive effects of demonstration projects: unique experience, concrete results and a contribution to mass market uptake;
- the positive contributions of the CIVITAS programme;

On the negative side it was mentioned that:

- only pilot schemes have been supported, uptake by the public unknown
- € 5 billion investment in EGCI resulted in 'only'8700 BEV registered
- Too much focus on cars, electrified public transport and electric 2-wheelers neglected (exception CIVITAS).

On 24 January 2013, the European Commission launched a clean fuel strategy for Europe[1]. The main aims of the package of measures are to ensure common standards in the EU member states and overcome barriers to the use of clean vehicles and alternative fuels. A proposal for a "Directive on the deployment of alternative fuels infrastructure" aims at ensuring the build-up of alternative fuel infrastructure and the implementation of common technical specifications for this infrastructure in the Union. Its objective is to facilitate the work of market forces and contribute with this initiative to economic growth in Europe.

The main measures proposed in the so-called Clean Power for Transport Package, of relevance to urban transport, concern recharging points for electric vehicles, the development of a Hydrogen network and refueling with Liquefied (LNG) and Compressed (CNG) Natural Gas.

The situation for electric charging points varies greatly across the EU. The leading countries are Germany, France, the Netherlands, Spain and the UK. Under the proposal, a minimum number of recharging points will be required by each Member State by 2020, 10% of which should be publicly accessible. This number is based on the number of electric vehicles planned in each of the Member States. The required number per country, as well as the current stance, is available in the table below. The aim is to put in place a critical mass of charging points so that companies will mass produce the cars at reasonable prices. The number of publicly accessible recharging points is 10% of the total number of recharging points.

Table: Electric charging Points/vehicles per Member State

[1] Source: http://europa.eu/rapid/press-release_MEMO-13-24_en.htm and http://europa.eu/rapid/press-release_IP-13-40_en.htm?locale=en#PR_metaPressRelease_bottom
and http://ec.europa.eu/transport/themes/urban/cpt/index_en.htm

Members States	Existing infrastructure (charging points) 2011	Proposed targets of publicly accessible infrastructure by 2020[4]	Member States' plans for No. of electric vehicles for 2020
Austria	489	12,000	250,000
Belgium	188	21,000	-
Bulgaria	1	7,000	-
Cyprus	-	2,000	-
Czech Republic	23	13,000	-
Germany	1,937	150,000	1,000,000
Denmark	280	5,000	200,000
Estonia	2	1,000	-
Greece	3	13,000	-
Finland	1	7,000	-
France	1,600	97,000	2,000,000
Hungary	7	7,000	-
Ireland	640	2,000	350,000
Italy	1,350	125,000	130,000 (by 2015)
Lithuania	-	4,000	-
Luxembourg	7	1,000	40,000
Latvia	1	2,000	-
Malta	-	1,000	-
Netherlands	1,700	32,000	200,000
Poland	27	46,000	-
Portugal	1,350	12,000	200,000
Romania	1	10,000	-
Spain	1,356	82,000	2,500,000
Slovakia	3	4,000	-
Slovenia	80	3,000	14,000
Sweden	-	14,000	600,000
UK	703	122,000	1,550,000

A common EU wide plug is also an essential element for the roll out of electric vehicles. Currently, there are two main different types of charging points in Europe. This could lead to a situation where a car that travels from France to Germany cannot be refueled. The EC proposes to have common standards for electric charging points across Europe designed and implemented by December 2015 to ensure that electric cars can circulate freely across the EU. To end uncertainty in the market, the Commission has announced the use of the "Type 2" plug as the common standard for the whole of Europe.

According to the Commission, Member States will be able to implement these changes without necessarily involving public spending if they use the wide range of measures available to mobilise private investment. At the same time, EU support is already available from TEN-T funds, cohesion and structural funds.

However, these figures show that beyond all these local pilot projects the dissemination and the establishment of electro mobility at a larger scale could not be reached yet. One approach to overcome these obstacles is to involve large logistic organisations such as the French post within the InfiniDRIVE (SP # 5).

The deployment status in the cities involved is as follows:

Malaga is committed with becoming an urban living lab for e-mobility further beyond the achievements of the Malaga Smart City project: this SP enables promoters to integrate in one single area a two-fold concept: first, renewable energies (PV, micro-wind) with smart charging; secondly, energy efficiency in railway transport (regenerative braking).

[4] http://europa.eu/rapid/press-release_IP-13-40_en.htm?locale=en#footnote-1

The pilot project beÁgueda – electrical bicycle of **Agueda** is founded on the idea to combine sustainable daily mobility with supporting the local economy, as well as on the important cooperation between the Municipal Authority, the company from Águeda producing the electrical bicycle, and the citizens, ultimate users of the system. The use of shared e- bicycles in Águeda is a novel experience, not only because of the free use of e- bikes in a territory with steep slopes (causing severe constraints on mobility and sociability between the Historical Centre and the Upper Areas of the city), but also because of the software managing the system, based on new information and communication technologies (WIMAX), but also because it is an alternative form of energy efficient mobility, charged by renewable energy, with reduced environmental impacts and, as such, more sustainable. The awareness of the individual citizen, citizen groups, companies and organisations, students, schools and other to pilot project beÁgueda - electric bicycle of Águeda allowed to have, in just 2 years of the project, more than nearly a 4000 uses of the e-bicycles, and more than 18000km driven in Agueda. In a query, users highlighted the following capabilities: ease of travel in steep terrain, travel in comfort and speed, and transportation of people with reduced mobility due to reduced effort. The feedback from users has allowed the company to improve certain aspects of the bicycle itself, so that it could best serve the citizen in the city of Águeda.

Nowadays and as future initiatives, the project team is developing other projects, such as an innovative parking and sharing system for smart bikes, using the WiMAX network installed in the municipality.

In 2013 the city **Assen** is transformed to the “Sensor City” and will be used as a large scale test environment for the Sensor City Mobility project[5]. Within the project hundreds of people will use the Personal Mobility Apps (like Congestion Alarm and Travel Alarm) on the KATE platform to plan their journey. Goals of the project are: free testing travel services and contribution to a better traffic flow, reduced CO_2 emission and improved road safety,

The Sensor City Mobility project is part of the Sensor City project[6] Within the project the (smart) city Assen will be equipped with an extensive network of sensors that can be used to develop different complex sensor systems and services and different smart city related topics (including mobility).

1.3 Technical feasibility and viability

Present status:

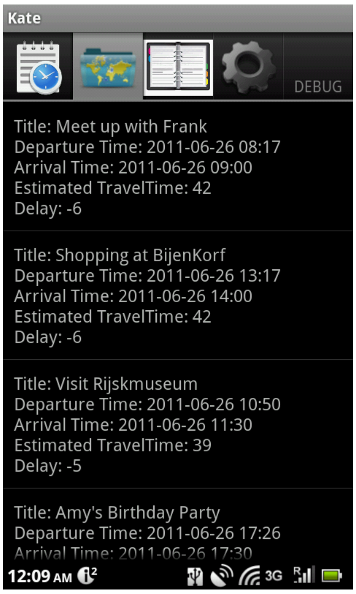
In just 2 years of the project pf SP #1, with just 10 e-bikes and one park, more than 160 users used the e-bike about 4,000 times, and travelled more than 18,000km in Agueda. In a query, users highlighted the following capabilities: ease of travel in steep terrain, travel in comfort and speed, and transportation of people with reduced mobility due to reduced effort. The feedback from users has allowed the company to improve certain aspects of the bicycle itself, so that it could best serve the citizen in the city of Águeda.

SP #2 is about multi-criteria optimization of EV routing and charging scheduling. The idea is to assign charging station slots to EVs taking into account multiple criteria like the route-to-destination, the local load on the grid and the real-time traffic situation. Especially for EV quick charging, the load on the energy distribution networks must be taken into account. Some EU projects are looking at some aspects of this (ICT STREP PowerUP, PSP CIP Pilot SmartCEM, Green Cars STREP Mobility2.0 and others). Some pilots exist around the world, e.g. the Swedish ELVIIS project. A truly city-driven pilot of a reasonable scale does not exist yet.

[5] Source: https://www.sensorcitymobility.nl/

[6] Source: http://www.sensorcity.nl/

For SP #3 the Personal Mobility Assistant applications (Congestion Alarm and Travel Alarm) will be used in the large scale test in Assen this year within the Sensor City Mobility project. The Apps will be used by approximately 750 user to plan their journeys. The Apps will be valuable for the users as it will provide insight in traffic behaviour and the dynamic start and end locations. The Apps can be used for both travelling by car (Congestion Alarm App), journeys via public transport or combined travels by car and public transport (Travel Alarm App). The applications will give personalised travel advise based current location and destination (retrieved from personal calendar information), real-time traffic information (eg. retrieved form sensors loops and camera's), data gathered from other users and travel time predictions based on combined data. Moreover the underlying KATE platform can be used to improve traffic management as it will provide the necessary dynamic information on travel behaviour of the users of the Apps.



Example interface of Personal Mobility Assitant KATE application with travel time estimates based on personal calendar appointments and real time travel info.

SP #6 is under tests with preliminary satisfactory results for the regenerative braking system. Located in Malaga (Spain) as urban living lab for e-mobility the results will require additional time in combination with other R&D projects. In particular, ZEM2All will provide an outstanding base of over 250 EVs for fast smart charging. Such amount of EVs at simultaneous charging will demand extreme conditions to the grid, so that SP

<u>Emerging solution for smart cities:</u>

In regard to SP #1it is intended that with beÁgueda the territory continues to be a leader in the sector of "two wheels" industry but, in the twenty-first century, for innovation and the challenge the Municipal Authority presents to the citizens, so that they (re)learn how to ride a bicycle and discover again, in a sustainable way, the city and the municipality. With the potential to be accepted as a case study in terms of sustainable mobility, which means it can be replicated in other towns, cities and countries, beÁgueda seems to have already given the first steps in this direction since it was regarded as one of the best actions to promote local sustainability and reduction in CO2 emissions, a European prize awarded by EnergyCities. The Municipal Authority maintains the prospects of continuing the beÁgueda project to promote cycling, particularly the electric bike as a mode of sustainable transport for journeys in the city and territory. Nevertheless, there is still much work to do, and one you can expect the future expansion of the beÁgueda network, among other aspects, a wide dissemination of the project and its results, the implementation of the Strategy for Sustainable Mobility of Águeda, the work with groups and local authorities to support the promotion of local and regional sustainable mobility. Effort will also be made to ensure the complementarity of the e-bike travel vs. other transportation, envisaging the setting up of new infrastructures to support a more sustainable mobility, e.g. energy efficient, with reduced environmental impact, socially integrated in an inter-and intra-generational way, and to develop the local economy.

The management system of beAgueda, also allows the manager of the project to, at any time and from anywhere, with Internet access, access the system and perform any necessary operation, such as, activation of user cards, cancellation of user cards, change the user information, lock / unlock e- bikes, monitor the parks, among other tasks. By accessing the surveillance cameras installed in the central station it is also possible to see live online the park and surrounding area. A new project is also been tested with BikeEmotion, where the e-bikes can be traced via GPS System, and with a simple internet access by i-Phone or iPad, or other similar technology, you can rent an e-bike available, see it's status (full battery or not). All of the routes remain registed and available for consult only for each user and globally only for the project manager:

favourite routes, places more visited, among other data can be obtained and treated for several purposes.

SP #2 core ideas are technically feasible, as demonstrated by some EU projects. The impact of this technology depends on the penetration of electric vehicles. Given that cities promote EVs for environmental reasons, we can expect a growth in EV usage in some cities, despite the still low market-driven demand. Therefore, SP #2 will play an important role in the efficient integration of EVs with power grids.

In SP #3 the KATE platform is intended as framework providing generic functionalities that can be used to create innovative mobility services. The Personal Mobility Assistant application called “Congestion Alarm” (in Dutch “FileAlarm”) is the first application developed on top of the KATE platform. The KATE platform comprises a number of modules to predict travel times and travel patterns, an agenda (including appointment retrieval functionality), a database containing travel profiles, surveys, serious games and more. The platform provides a mechanism to disclose open mobility data within the smart city and is intended for the development many different smart city services. TNO is currently upgrading the platform to facilitate 500.000 users and is incorporating the functionality into applications of 3rd parties. Furthermore TNO has plans to provide functionality towards logistic companies to support them in making more accurate predictions on travel time and thereby reduce uncertainties within the logistic process,

Similarly to the KATE platform, TNO is also working on smart grid related platform, such as the Power Matcher and Heat Matcher, which also disclose and use specific sensor data. These platforms disclose energy data to a service layer in which energy application are executed, In this case the disclosure platform is specifically used for balancing of energy demand and supply. Within the Grid4Vehicles project [1] TNO applied the PowerMatcher platform for the smart charging of Electric Vehicles. In the ultimate smart city of the future the different disclosure platforms (or parts of these platforms) could be combined and integrated into a single urban platform allowing trans-sectoral service development which for example combine mobility and energy data to be used in a single smart city service.

SP #6 consists of practical use of advanced power electronics applied to both smart charging and RES integration. The energy efficiency measures implied by the application of regenerative braking systems in specific transformer substations have commonly taken place in light railways and metros, so there is long pathway for technological improvement and this SP #6 will be an important hint.

1.4 Financial analysis

This section presents an initial financial evaluation, based on the estimations of the solution providers.

The review of the Action Plan, described above, also showed that green cars are still very expensive, so that they are not cost/ beneficial for ordinary drivers. Moreover the depreciation rates are too high (batteries).

Estimated timescale:

For SP #3 the initial Apps are currently deployed in the pilot in Assen, but could also be commercialised in the very short term. TNO is trying to get commercial parties involved to create and launch mobility applications on the KATE platform.

SP #4 is being deployed in pilot cities (Paris, Nantes, Nice, Grenoble) chosen for their being representatives of versatile geographic and climatic profiles. SP #4 started in 2011, in 2012 most of the smart charging infrastructure were deployed and the experimentations started in 2013. SP #4 is expected to be finished in 2014 T1. The smart charging solutions are already commercialized and sold to private customers.

[1] Source: http://www.g4v.eu/

Example of some key timetable aspects:

Some of the main key timetables aspects of SP #1 – the electrical bicycle of Agueda where: Initial project design and testing: the “Test to implement” phase allowed the evaluation of potential users and conditions. With the users opinion the implementation strategy was outlined, with a proper planning and financing system, in order to promote a suitable respond to their needs of mobility and also to prepare the city to a safe travel of the cyclist. Also during the planning of the project there was a closed involvement with some private and public entities (e.g. Orbita, Miralago, LNEC, among others). An important aspect must also be referred has beAgueda has already been promoted and presented in several public events and seminars of mobility. New technological developments and partnerships are been tested in order to improve and expand the project. Miralago is certified by the ISO 9001.

The return of the investment will depend on the fees that may be applied to users through a monthly/annuity fee, or other.

A key aspect for the SP #3 timetable is the interest of commercial or public entities to develop and use KATE based mobility services.

For SP #4 key learning are to be found during both deployment and experimentations. Considering this aspect, 2013, the year of experimentations, is the most important. In 2014, a report gathering the key learning, but also recommendation and best practice will be delivered and disclose to the public.

Key Risks:

There are no negative risks identified for SP#1 (despite the user accidents that can occur). If the slopes are not a problem in a territory, the e-bike allows to faster travel in every place where e-bike system is implemented. With a long term usage the batteries might need to be replaced.

For SP #3 there are no key risks involved. It is however very important to ensure collected data and performed estimations on this data is as accurate as possible, Inaccurate estimation will have negative impact on the service and the acceptance of the end user.

No key risks observed so far for SP #4. There could be obstacles to the adoption of electric vehicle but SP #4 also works on the human aspect and delivers a close follow up with eco-driving training.

Scale of financing required:

The SP #1 required an initial investment of 22.000,00 euros: 10 e-bikes, the parking structure and the management system and platform.

Regarding SP #2, providing the requested information requires a city-specific analysis and study.

As basic functionality provided by the SP #3 KATE platform can be reused by the different applications, the investment needed for new applications is relatively small. The initial investment for the project was substantial (needed for initial development of the framework and implementation of the central platform). The plan is to earn this investment back via the launch multiple services sold to different commercial parties. For cities that want to use KATE based services, optional investments can be performed in sensor network to improve precision of travel predictions. For new services no new platform investments are needed as the developments will mostly be limited to the development of the Android App itself. The Apps will reuse the generic functionality from the KATE Android framework and its related central KATE data platform and connected sensor network of joining cities.

SP #4 is a 9 081 957 € Research and Development project, with 3 563 720 € of subsidies from the French Environment and Energy Management Agency. SP #4 pilots deployments are located in four major French cities and involved public and private organisations as well as research centers.

The timescale for SP #6 is a three-year-long R&D project implemented in Malaga city and part of the province, including the first step for industrial design and engineering of the equipment and test facilities (12 months). Experimental tasks cover two years.
The risk analysis of the project does not include the regulatory framework. In Spain DSOs are obliged to acquire the electricity supplied to the grid from regenerative braking systems as energy efficiency facilities. However, the conditions, i.e. quality of signal, frequency and voltage, among other parameters, refer only to technical aspects. Economic feasibility is more controversial in accordance with current financial terms of the regulation. By introducing energy storage technologies it is expected that both technical and economic feasibilities of SP #6 will improve.

1.5 Suitable city context

The key innovation is suitable for mid/large city already engaged in eMobility. Ideally they already have good contacts to power grid operators and traffic management centers. It requires a strong involvement of the citizens as end users, by means of their smartphones and openness to new forms of (electric) mobility.

SP #3 can provide multiple services aimed at specific transportation means or multi model travel assistance in and around the city. The mobility functionality can also be easily incorporated in other services in which mobility assistance is only a part of the solution. By this new or existing services can be enriched with real time travel support.

SP #4 involve two main influential actors: one is the French Electricity Grid (ERDF) and the other one is the French Post Office (La Poste). Being a power grid operator, ERDF is naturally committed in the development of eMobility. And the French Post office is well known for their long commitment with new electric means of mobility which started in the early Twenties (1901). Moreover, the French government has assigned La Poste the task of gathering major companies interested in purchasing numerous electric vehicle (known as the “Groupement UGAP”): amongst other companies and organizations, La Poste and ERDF purchase on their own more than 13 000 electric vehicles. Both companies belong to the everyday life of French cities thus acting as ambassadors of electric mobility. SP # also aims at gathering users’ feedback about their use of electric vehicles and also tends to solve any impediments that may occur with the charging of electric vehicles.

SP #6 provides an innovative approach to eMobility by combining two means of transport in crowded urban areas: EV and railway. This may include either commuters from the periphery of hinterland, or long distance travelers hiring an EV. Malaga is committed to become a reference as urban living lab for eMobility projects.

2. EXPECTED IMPACTS

Generally the advantage of electric mobility in terms of energy efficiency and GHG emissions depends on the energy source used to produce the electricity. Some national governments require that additional electricity demand has to be met preliminary by regenerative energy sources (e.g. the 'national development plan electric mobility' in Germany).

2.1 Energy supplied or savings expected

SP #2 allows to balance the EV load on the power network and reduces waiting time at charging stations. A scenario-specific analysis is needed in order to quantify the savings.

SP #3 can help to reduce traffic congestion in and around the city and thereby save on energy consumption and reduce CO_2 emission. With multi-modal travel support the KATE based applications can also stimulate the usage of public transport, which will also have a positive impact on energy consumption and CO_2 emission.

SP #6 offers significant energy savings. With regard to regenerative braking systems the initial results have reached 8%, as electricity is self-consumed in the operations of railways. By implementing energy storage technologies, the efficiency is expected to be increased up to 15-20%.

2.2 Expected impact on GHG emissions

As for SP #1, with 16000km travelled, estimate a total of 2,5 ton of CO_2 emissions savings is estimated,

The impact of the application of SP #6 will depend on the level of EVs and railways. Further tests are necessary for accountability in accordance with international measurement standards.

One of the goals of travel assistance application of the KATE platform of SP #3 is to reduce traffic congestions. This will result in reduction CO_2 emissions and other pollution caused by traffic jams and congestions. The exact amount of reductions will greatly depend on the acceptance and usage of given applications, the infrastructure of the involved city and the impact on the behaviour of its citizens (eg. usage of cars and public transport in and around the city),

2.3 Interfaces with other technologies/ transport modes

The second challenge described in 1.1 addresses an important cross sectoral issue.

- SP#1: E-bikes are charged using renewable energy sources - photovoltaic panels, and the communication system and management uses some of the most recent technologies such as WiMax system, GPS for tracing the e-bike and a platform that allows to draw the main routes used by the e-bike user. By accessing the internet (Smartphone, I Pad, or other) the user can see where it is an e-bike available, the status, and ultimately it can order it (this last system is only available in one e-bike has still is been tested).
- Innovation in the energy management that is needed for e-mobility, not only in terms of capacity but also meaning a smart usage of electricity (See SP # 2). This relates to the innovation / extension of the powermatching technologies that have been developed and that are a huge opportunity to make a big leap forward in energy management/awareness (and therefore smarter usage).

- One of the most important challenges for SP #3 is the adoption and acceptance by the user of the provided personal mobility services. The users therefore have to be persuaded to actually uses the provided services to plan his/her journey. Initiatives like (temporary) free usage of the services or incorporation in other services can stimulate usage and prove the benefits to the end users.
- The technologies involved in SP #6 a big challenge for innovative power electronics, such as integration of RES, regenerative braking, smart charging and electricity storage.

2.4 Waste generation

SP#1: There is no waste generated by the usage of the e-bike per year. When the batteries of the e-bike end their life cycle, or even the e-bike needs to be replaced because is no longer with the quality required to move in the city, this will generate waste, but we predict to value these residues

SP #6 implies a minimum amount of waste.

2.5 Wider potential benefits for cities

SP#1: There are several benefits expected for example to local economy it is expected the development of the “two wheels” cluster in Águeda, the creation of new dynamics in bicycle trade and business, the reduction of costs with daily commuting, new stores will open. Some social benefits for the cities improvement of the cultural identity (has people learn to better now their cities and what the cities have to offer), collective appreciation, it promotes mobility for all, and improves the quality of life in the city. As for the environment the cities will register the reduction in the emission of GEG and noise, an increase in energy efficiency and the reduction in the use of natural resources.

The platform provided by SP #3 can be further extended in the future (eg. combined with Power Matching platform[7] from the energy sector or similar data disclosure platform from other sectors) to create a generic urban platform, which will allow the development of trans-sectoral services. These new services can make optimal usage of data, functionality and resources from the different sectors and by this possibly create totally new markets and businesses which make use of these optimizations. This will eventually lead to more efficient and self-sufficient smart cities.

Replicability of SP #6 is relatively simple, as local parameters do not affect the application of the technologies under development. At different scales of population and complexity of means of transportation, Malaga is committed to serve as test platform for emobility, and SP #6 is one of the basic elements of the local political strategy. Other municipalities from all over Europe will benefit of the experimental results achieved in Malaga.

2.6 Other expected impacts

SP#1: The development of the project will allow the integration of a sustainable city development strategy, predicted within the signature of the Aalborg commitments and the implementation of a Local Agenda 21. Due to this process, the municipality signed the Covenant of Mayors pledging to implement solutions that contribute not only to reduce the emission of greenhouse gases, especially CO2, but to increase energy efficiency. A smart governance and planning of the city, will allow the implementation of more sustainable modes improving the urban sustainable mobility, but also improving some others aspects of living and enjoining the city. Also due to the technology associated, there are some impacts expected on smart citizens.

[7] Source: http://www.powermatcher.net

Usage of the services from SP #3 will result in smarter mobility for the citizens of the city. By reduce traffic congestion and make travelling more efficient it will contribute to the improved quality of living in the city.

As a complement to SP #6, Municipality of Malaga is implementing support actions to stimulate more rationale use of cars, and a higher penetration of EVs is fostered. Intelligent Traffic Systems have also been deployed in different areas of the city. In combination with outreach measures related to smart grids, a more rational electricity consumption is also expected.

3. ADDITIONAL REQUIREMENTS ON DEPLOYMENT

This section presents the requirements for wider deployment of the innovation. It indicates any potential barriers or risks facing wider deployment or replication elsewhere.

3.1 Governance and regulation

For SP #3 there are some aspects of data ownership and privacy to take into account. It should for example be made clear to the user that some of the personal data will be used for travel predictions and user should be asked for confirmation for usage of the data. Within the project data should be kept anonimous where possible to prevent misuse of the data,

On the other side openness of data from public environments should be encouraged in order to better support mobility services, like foreseen on the KATE platform, and thereby create an effective, efficient and smart city.

SP #6 is led by ADIF, the state-owned entity responsible for managing the railway infrastructure. Endesa as DSO in dominant position in the region of Malaga (Andalusia, Spain) plays also a key role for the smart charging tasks.

3.2 Stakeholders to involve

This section identifies the different stakeholder that need to be mobilised to successfully introduce the technology in the urban area, such as households, specific professional bodies, corporations, specific authorities (transport authority), etc

Stakeholder	Role/ how to be involved
Mayors/ politicians	Should be convinced by the concept of eMobility and financially support necessary infrastructure investment. Politicians should use EV in public showing a good example.
City administration	Should work as facilitator in the development of eMobility projects; can promote partnerships; The responsible bodies for sustainable mobility and energy need to be involved (in Malaga for instance: Council for innovation, local agency for energy
Private car-sharing companies	important stakeholders to integrate EV in their fleet.
Bike-sharing organisations	Could offer e-bikes for renting
inhabitants	Can be involved testing the e-bikes and the system solutions, in order to evaluate and suggest improvement in the city planning and also in the rules of usage of the e-bike. Inhabitants should also be stimulated to personal mobility assist applications in order to reduce and better plan required travel time.
Service Providers	Service providers can create smart / personal mobility assistance application and/or integrate smart mobility functionality in new or existing services as part of the overall functionality using

	KATE platform from SP #3.
Public transport companies	Public transport companies can make use of personal mobility assistant applications (SP #3) to better inform their customers and for example provide a smart alternative in different multi-mode travelling scenarios.
Police / traffic management	Police and traffic management centres could make use of real time travel information of SP #3 (from sensors and user application) to better predict and control traffic flows.
Financial institutions	Can create programs to finance private institutions and citizens to acquire more sustainable means of transport such as e-bikes.

3.3 Supporting infrastructure required

To provide real benefits via SP #3 to the citizens, the city must provide an extensive sensor infrastructure and provide the generated (open) data to KATE like platforms in order to supply real time travel information on which travel predictions can be made. Alternative indirect mechanisms, like data generated by smartphones and other devices, can also be used to create data collection on which predictions and travelling patterns can be derived.

SP #6 requires expensive equipment to be extensively deployed. Even though a significant number of EVs is expected to get advantage of the charging infrastructure involved in SP #6, the impact on current grid is far from being influential or critical to compromise the whole operations of DSO.

3.4 Alignment of administrative levels involved

Implementation of KI’s in cities will be supported by funding mechanisms and other (policy) incentives at different administrative levels: city, national and EU. However, some initial interviews on the challenges that cities face during the roll out of sustainable mobility projects indicate that the supporting frameworks at the city, national and EU-level are not always optimal aligned. This is especially evidenced by the preliminary evaluation of several urban electro-mobility initiatives.

City officials indicate that successful implementation of sustainable mobility initiatives requires a highly flexible tailor-made approach; especially through cooperation with local key-stakeholders. This approach involves flexibility of implementation trajectories regarding: timing of roll-out, adjusting overall project size, as well as the possibility to involve (new) public and/or private partners. In contrast, national and EU administration levels typically aim to develop longer term policy frameworks that need to be uniform and shaped in a verifiable format, thereby limiting flexibility. The challenge for future incentivizing frameworks is to bridge the gap between the need for local flexibility and the aim for long term uniform and verifiable policies at the higher administrative levels.

4. POTENTIAL FUNDING SOURCES

The Finance Group of the Stakeholder Platform has prepared documents on funding models and the use of EU Funding instruments, either from the EU budget or from the European Investment Bank. The documents are freely downloadable from the Stakeholder Platform's website.

- For funding models please refer to the **"Financing models for Smart Cities"** guidance document.
- For EU supported funding instruments please refer to the guidance document on **"Using EU Funding mechanisms for Smart Cities"**.

This section presents specific recommendations for financing models and potential sources suitable for this KI.

4.1 Financing models suitable for the innovation

The most evident business model of SP #6 requires a critical mass of EVs circulating in the urban area of Malaga. However, the number of EVs is far from reaching a figure implying any chance for a fair return on investment. The targets designed for deployment of EV charging infrastructure in the draft Directive seem difficult to be achieved.

This KI will need considerable public support for testing and wider deployment to attract critical masses of users.

4.2 Specific sources of funding for the KI

SP #6 among other R&D projects implemented in Malaga (Andalusia, Spain) are co-funded by EU funds; Structural Funds (ERDF). Complementary projects and measures have been funded by national R&D programmes (CENIT, INNPACTO, CDTI).

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...brings together people, industry and authorities from across Europe to make our cities more energy efficient, better to live in and growth-friendly.

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