smartCEM

Smart connected electro mobility

D4.2 Evaluation criteria and performance indicators

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Table of Content

Abbreviations

Abbreviation	Definition
BAR	City of Barcelona – pilot-site in smartCEM
CIP	Competitiveness and Innovation Framework Programme of the European Commission
CO2	Carbon dioxide
CP	Charging post
DoW	Description of work
eCoMove	Cooperative mobility systems and services for energy efficiency – 7th framework EU-project
EV	Electric Vehicle
FESTA	Field operational test support action – handbook for FOTs
FITS	Finnish National R&D Programme on ITS Infrastructures and Services
FOT	Field Operational Test
GIP	Gipuzkoa/San Sebastian – pilot-site in smartCEM
HB	Hybrid bus
Hyp	Hypothesis
ICT	Information and communication technology
ICT4EVEU	ICT-PSP collaboration project "ICT Services for Electric Vehicle Enhancing the User Experience"
MOBI.Europe	ICT-PSP collaboration project "Integrated and Interoperable ICT Applications for Electro-mobility in Europe"
MOLECULES	ICT-PSP collaboration project "Mobility based on electric connected vehicles in urban and interurban smart. clean environments"
NEW	City of Newcastle – pilot-site in smartCEM
RQ	Research question
SOC	State of charge of the battery
TeleFOT	Field operational tests of aftermarket and nomadic devices in vehicles - 6th framework EU-project
REG	City of Reggio-Emilia – pilot-site in smartCEM
WP	Work Package

List of tables

Executive Summary

The main objective of task 4.2 Evaluation criteria and performance indicators is to prepare and harmonise the data assessment in the pilot-sites. This document provides a description of the evaluation criteria which will be used to evaluate the overall success of the smartCEM project. Five types of evaluation criteria have been specified for smartCEM which will help to determine the progress of the implementations in the pilot-sites, the work-packages, the baseline- and operational-phases of WP4 and, finally, the overall achievements of smartCEM at the end of the project. The indicators have been defined and adapted through harmonisation efforts at project level, where appropriate.

Furthermore, the performance indicators have been specified in more detail through applying and matching the work achieved in the CIP collaboration between the projects smartCEM, ICT4EVEU, MOBI.Europe, and MOLECULES. The adaptation included using three of the four CIP-evaluation categories for the smartCEM performance indicators, i.e. *Environment, Transport & Mobility and User Uptake*. The fourth category - *Economic* – was instead moved to the deployment indicator section as it is derived from performance indicators related to economic aspects. A specific smartCEM category, *Driving Behaviour,* was added for the evaluation of in-vehicle services implemented in smartCEM. Additionally, the four CIP-categories were defined in more detail by first identifying pilot-site specific aspects and then harmonisation of a sub-set of indicators. This approach ensures that special regional aspects are taken into account while ensuring the comparability of the evaluation results through a minimum set of indicators. This process is to be seen as an addition to the FESTA methodology, which has been developed for field-operational-tests (FOT) and needed to be adapted to meet the special needs of a pilot- and demonstration project such as smartCEM.

1. Introduction

The smartCEM project aims at demonstrating ICT-mobility services which have been adapted to support the uptake and deployment of electric vehicles. Four regions have come together to pilot these activities and support a common approach in reaching the smartCEM project goals. These goals are in more detail the following (see also DoW):

1. increasing user acceptance of electric vehicles by at least 15 % due to implementation of smartCEM services
2. evaluate the optimisation of transport efficiency
3. tool development for impact assessment of CO_2 emissions and user acceptance
4. deployment barrier identification
5. support pan-European interoperability
6. enhance adoption of electro mobility in all types of road transport
7. increase integration of new business models
8. provision of lessons-learned from smartCEM services

SmartCEM involves four pilot sites where the newly adapted services are demonstrated and piloted. Thus, it is not a research program with research- and demonstration vehicles (such as in the eCoMove project) nor is it an FOT (for which FESTA-methodology and handbook were developed) where specific functions are tested with participants in real-life situations. Instead, in smartCEM, already existing standalone services are adapted and implemented to meet the demands of electric vehicle usage. These adapted services are afterwards piloted with real users. Based on Bassi (2010), a pilot study is characterised through implementation of an ICT-technology on "a small controlled scale to allow for its full impact, benefits and weaknesses to be evaluated before implementation on a regional or nationwide basis". This includes testing the new implementations with a specifically selected group of users. The keyword is **implementation** in pilot-projects as opposed to research and development in FOT-projects. Based on these assumptions, the evaluation of the smartCEM project has to meet certain demands which are specific to such a pilot project:

1. The **evaluation criteria** do not only focus on the performance of the implemented services, but also on the progress in implementing the services, the activities undertaken for increasing the awareness of potential users and the aspects related to the further deployment of the services and measures to increase the overall uptake of electric vehicles.
2. The **pilot sites** are not equal and implement different use-cases or services. This means that not all evaluation indicators, success criteria and measures can be the same. Harmonisation and comparable measures should still be reached wherever possible.
3. Due to the fact that the services are implemented and tested with **actual users**, the criteria have to be **feasible** and **measurable** during the operation of the services.

4. The expected outcome or the results of a pilot project remain partly open and evaluation criteria and indicators can only be pre-defined to some extent. Many aspects remain **exploratory** due to the nature of a pilot project. The results are meant to support large-scale deployment activities after the end of the project.

Due to these demands, FESTA-methodology was amended and adapted. First of all, five evaluation criteria categories and indicator types were specified for the evaluation of smartCEM. The performance indicators for the evaluation of the implemented services in smartCEM were moreover defined in more detail using a twofold process. On the one hand, identification of **commonalities** which allow comparisons between the sites was targeted. On the other hand, pilot-site specific indicators, which are necessary for successful regional operation, were defined. Therefore, we split performance indicators in two sets:

a. ***Common indicator set:*** which is assessed at all pilot sites, and
b. ***Site-specific indicator set:*** which is specific to the pilot site and only assessed there.

The indicators were created in an iterative manner through discussions with the pilot-sites. In a next step, success criteria and measures were defined. Task 4.3 and deliverable D4.3 will further specify the measures and equations and link them to the sensors for data assessment. Furthermore, the time and circumstances of applying the measures will be stated within the experimental design definition of task 4.3.

This document shows the outcome of the indicator and evaluation criteria definition process. For all evaluation criteria and indicator categories, the common aspects are listed in the subsequent sections. For more detailed lists per pilot sites concerning the progress- and performance indicators, the measures and equations please refer to the lists in the Annex (Annex A: Progress Indicators and Annex B: Success Criteria and Measures).

2. smartCEM project evaluation definitions

Due to the complexity of the smartCEM project, a few definitions are necessary for a common understanding of the activities which were performed. Within the smartCEM project, the following definitions are used (see also Figure 1):

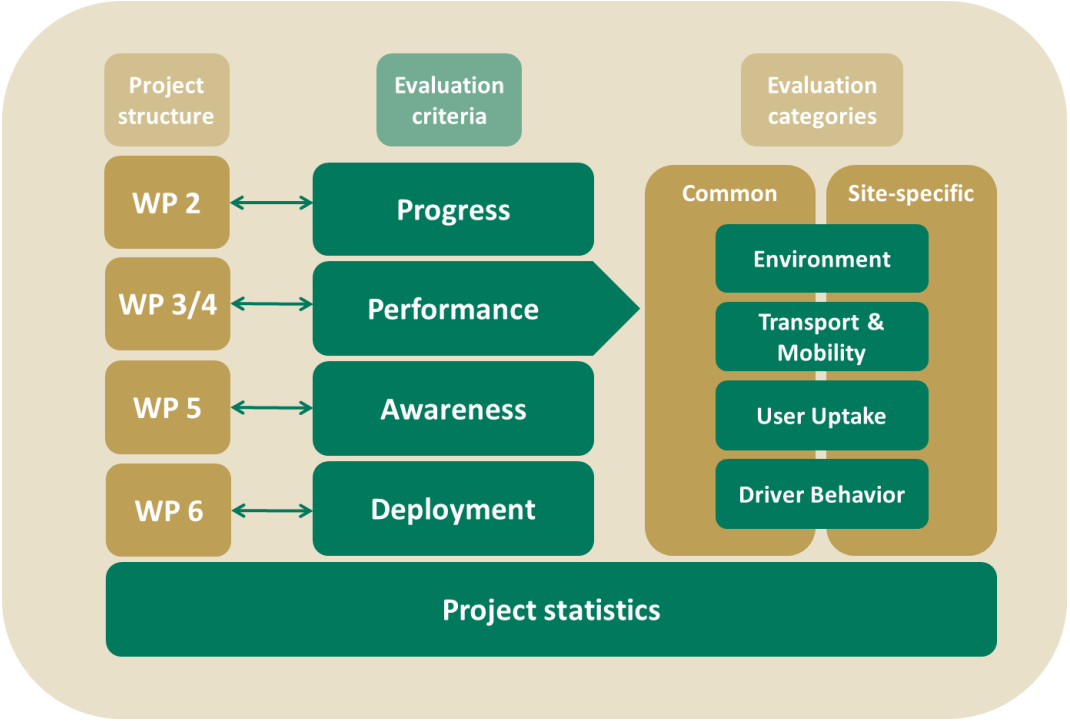

Figure 1: Relationship of smartCEM evaluation definitions

Evaluation criteria: Are based on the smartCEM project goals and are used to determine the overall success of the smartCEM project. Five types of evaluation criteria have been defined for the evaluation of the smartCEM project (see also DOW):

1. **Progress:** the progress of the implemented services at each pilot-site is assessed on a monthly basis and is mainly related to the activities of WP2 – implementation. Within this document, the commonalities of the originally proposed indicators are presented.
2. **Performance:** the services implemented in WP2 are piloted in the operational phase and their performance is evaluated in WP4 based on research questions and hypotheses (based on FESTA approach).
3. **Awareness:** in WP5 – dissemination - several activities are performed which are aimed at increasing the public awareness of ICT-services for electric vehicles. An updated and enhanced collection of indicators is presented in this document.

4. **Deployment:** the viability, sustainability and scalability of the implemented services after the end of the project are estimated and evaluated in WP6. For the definition of deployment indicators related to the economic viability, performance indicators are used and translated into economic values in WP4. Further deployment indicators will be developed and used in WP6 at a later stage in the project.
5. **Project:** These are statistics which are relevant for the overall project evaluation after the end of the duration of smartCEM. They are not linked to a specific goal achievement or research question but contribute to the overall evaluation of the success of smartCEM.

Evaluation categories: are used to group the indicators. The categories are based or rather adapted based on already existing work in other projects or programmes, e.g. TeleFOT, FESTA, FITS. They were also defined on the CIP-level but were further modified to meet the specifics of the smartCEM project. The changes were deleting the *Economic* category and moving it to the deployment indicator section. Furthermore, a category named *Driving Behaviour* was added for the evaluation of services which are online, in-vehicle applications. The following list includes all evaluation categories for the performance indicators for smartCEM:

Environment: this category focusses on the environmental impacts due to the transportation system and other traffic participants. Examples are carbon emissions due to charging events. The carbon emission calculations will additionally take into account the energy mix of the area.

Transport & Mobility: specifies road users' attitudes, opinions and choices concerning travel behaviour such as trip decisions, choice of mode of transport, choice of route or the travel time, travel delays, vehicle speeds and traffic density.

User Uptake: is defined as how drivers make use of the smartCEM services, invest in them, trust and accept them (see also TeleFOT D4.7.1). User uptake is hereby specifically related to aspects of usefulness and satisfaction with the services (see van der Laan et al., 1997). Additionally, aspects of usability/user experience (see Brook, 1996; Laugwitz et al., 2008) are relevant influences on user uptake as well as trust in the impact and functionality of the services and willingness-to-pay (see Kulmala et al., 2002). Subjective evaluations of safety could also be summarised in this category.

Driver Behaviour: this category is related to changes in individual driving behaviour, such as acceleration and braking behaviour. These indicators could be used to contribute to an objective safety assessment.

Indicator: Is a parameter to measure whether goals have been met. It is the operationalisation for the empirical measurement of the evaluation criteria. Please also refer to the definition from D4.1: "Something that provides an

indication about the status of system, project, etc., i.e. a “tool” used to measure or evaluate if smartCEM services and the project itself have been developed properly, and the objectives of the smartCEM project have been achieved”.

Measure: Indicators use the input from one or more measures which are combined or aggregated. Several indicators can use the same measures, which itself can be derived from varying sensors (see FESTA-handbook). One indicator can also consist of several measures. This document reports on measures and equations in more detail in the Annex.

Performance indicator: can be defined as a percentage, index, rate or absolute value and is used to evaluate the performance or the impact of a system, function or service (see also FESTA-handbook and Tarry et al., 2008).

Success criteria: Are defined as a reference to determine whether the goals have been achieved. They are defined based on existing knowledge, experience or expert judgment. They can be specific, such as a certain absolute value or percentage or be more imprecise, such as the direction of an outcome or a hypothesis. They are included in the detailed tables in the Annex.

In order to understand the definition of the performance indicators and the relationship to the smartCEM services, it is necessary to shortly summarise the implementations of the services and the specifics of the pilot-sites.

3. Services and pilot sites

Five electromobility services will be implemented in the smartCEM project. The following definitions are meant to describe the specific adaptations for EV-usage that are foreseen. For more details please refer to the WP2 deliverables, e.g. D2.2 (Platform Architecture).

1. *EV-navigation:* Navigation is optimised based on the state of charge (SOC) of the battery, driving style, typography and available charging stations.
2. *EV-sharing:* This service includes vehicle booking and payment through collection and monitoring of vehicle data.
3. *EV-trip management:* A multimodal journey planning service including EV-sharing as an additional mode of transport.
4. *EV-efficient driving:* Based on driving style and vehicle usage the service provides recommendations for energy-efficiency optimisation to the driver. This service might be implemented online (in-vehicle service, dynamic) and offline (web-service or nomadic device, static).
5. *EV-charging station management:* This service will integrate functions related to station operation, station energy management, power supplier status, range estimator, charging point booking, payment and scheduling.

Each pilot-site might thereby modify some aspects of the described services to meet the specific demands of the site while implementing the core functionality of the services. There are four pilot-sites in the smartCEM project:

1. Barcelona: In this pilot-site 45 electric motorcycles will be used through the EV-sharing service. Within the city of Barcelona, 234 charging locations are existent.
2. Gipuzkoa/SanSebastian: This pilot-site covers one hybrid bus and 30 electric vehicles using EV-sharing. There are 33 available charging points in the region.
3. Newcastle: This pilot-site provides 10 drivers of electric cars for individual use. The city and surroundings have currently over 600 charging points which will increase to 1.300 by the end of smartCEM.
4. Reggio-Emilia: 10 electric vehicles will be run in this test-site through EV-sharing.

The next sections of this deliverable will present the indicators which have been specified for the evaluation criteria categories.

4. Progress indicators

As described in the DoW, Progress indicators are related to the implementation phase of the project, specifically the completion of the integration and adaptation of all components necessary for the relevant pilot sites, as well as operation (undertaking of trials and collection of measurements in the pilot sites). They address WP2 – Implementation and WP3 – Pilot operation.

Updated on a monthly basis, progress indicators are specific for each test site (see Annex A: Progress Indicators). Besides these specifics, the commonalities of the progress indicators are shown in Table 1:

Table 1: Common progress indicators.

Indicator No.	Progress indicator	Progress	Progress per site			
			BAR	GIP	NEW	REG
PRO_COM_1	# EVs	Year 1	45	19	44[1]	-
		Year 2	45	24	44	10
		Year 3	45	30	44	10
PRO_COM_2	# charging points	Year 1	137	22	200	-
		Year 2	137	27		13
		Year 3	137	33	1300	24
PRO_COM_3	EV-navigation service implementation status	Year 1	30%	30%	30%	-
		Year 2	70%	70%	70%	100%
		Year 3	-	-	-	-
PRO_COM_4	EV-efficient driving service implementation status	Year 1	30%	30%	30%	-
		Year 2	70%	70%	70%	100%
		Year 3	-	-	-	-
PRO_COM_5	EV-trip management service implementation status	Year 1	-	30%	-	-
		Year 2	-	70%	-	100%
		Year 3	-	-	-	-
PRO_COM_6	EV-sharing service implementation	Year 1	30%	30%	-	-

[1] In Newcastle there will be 44 electric vehicles which will be used by 10 vehicles drivers throughout the smartCEM project.

	status	Year 2	70%	70%	-	100%
		Year 3	-	-	-	-
PRO_COM_7	Data collection on energy consumption	Year 1	-	-	-	-
		Year 2	x	x	x	x
		Year 3	-	-	x	-
PRO_COM_8	Data collection on # of users	Year 1	-	-	-	-
		Year 2	x	x	10	x
		Year 3	-	-	10	-

5. Performance indicators

For the performance indicators, the generation approach was following the FESTA methodology, i.e. research questions related to the specified use-cases were identified, hypotheses defined which are linked to the research questions and performance indicators and measures derived. They are linked to the evaluation categories which have been agreed on in the CIP collaboration work: Environment, Transport and Mobility, User Uptake and additionally, Driver Behaviour. Economic aspects are targeted in the deployment section.

The matching process for the indicator sets to the research questions was twofold: on the one hand the indicators were selected and adapted top-down, based on previous research in other areas and research projects. On the other hand, a bottom-up approach, based on the use-cases and implemented services at each pilot site, was used. Through discussions with the pilot site leaders and the other members of the project, sets of indicators were identified. These sets reflect the current status of knowledge of the project partners which will be the basis for the evaluation analyses. Since there does not exist a vast amount of experience on ICT-usage in the context of electric vehicles from other research or demonstration projects as well as in the single pilot-site locations, the final evaluation indicators might still be different from these initial lists.

For the performance indicators, the research questions, hypotheses and indicators for each of the four evaluation categories are shown which are common for all pilot-sites as well as the site-specific aspects. The process for this development was that each pilot-site specified their set of indicators based on their specific regional goals and implementations. During a next iteration, commonalities between the pilot-sites were identified and names and definitions for the indicators harmonised. This led to the common indicator tables as well as the site-specific indicator tables.

5.1. Common Performance indicators

The following section presents the outcome of the harmonisation process between the pilot-sites concerning the performance indicators for each evaluation category. Firstly, the common research questions and hypotheses for each category are presented. Afterwards, the related indicators and services per pilot-site are marked.

For more detailed descriptions, the definition of the success criteria, measures and equations per pilot-site, please refer to Annex B: Success Criteria and Measures.

5.1.1. Environment

1. **Research Question:** Do smartCEM services change the amount of CO_2 emission?
   Hypothesis: SmartCEM services will reduce the amount of CO_2 emission.
2. **Research Question:** Do smartCEM services change energy consumption?
   Hypothesis: SmartCEM services will reduce energy consumption.
3. **Research Question:** Do smartCEM services change the SOC of the battery?
   Hypothesis: SmartCEM services will reduce the number of run-out of battery events.
4. **Research Question:** Do smartCEM services change the temporal characteristic of the charging behaviour?
   Hypothesis: SmartCEM services will optimise temporal charging (increase in number of off-peak charging events).
5. **Research Question:** Do smartCEM services change the regional characteristic of the charging behaviour?
   Hypothesis: SmartCEM service will optimise regional charging.

Table 2: Specification of the performance indicators for the category environment.

RQ/ Hyp No.	Performance indicator	Applicable per service / Site			
		BAR	New	REG	GIP
1	Average energy consumption	EV-efficient driving	EV-efficient driving / EV navigation	EV-efficient Driving/EV-navigation	EV-efficient driving
2	Average CO_2 emissions	EV-sharing	EV-efficient driving	EV-sharing	EV-sharing
3	Number of run-out of battery events	EV-sharing	EV-efficient driving/ EV navigation	EV-efficient driving/ EV navigation	EV-navigation
4	Number of off-peak charging events		EV-efficient driving	EV-efficient driving	EV-charging station management
5	Charging event distribution		EV-navigation	EV-navigation	EV-navigation

5.1.2. Transport and mobility

1. **Research Question:** Do smartCEM services change the number of trips?
   Hypothesis: SmartCEM services will increase the number of trips per day.

Table 3: Specification of the performance indicators for the category transport and mobility.

RQ/ Hyp No.	Performance indicator	Applicable per service / Site			
		BAR	New	REG	GIP
1	Average number of trips per day per vehicle	EV-sharing	EV-charging station management		EV-sharing

5.1.3. User uptake

1. **Research Question:** What is the acceptance level of smartCEM services?
   Hypothesis: SmartCEM services will be highly accepted.
2. **Research Question:** What is the acceptance level of electric vehicles?
   Hypothesis: The user acceptance of electric vehicles will increase due to the implementation of smartCEM services.
3. **Research Question:** What is the willingness to pay level for smartCEM services?
   Hypothesis: SmartCEM services willingness to pay level will be high.
4. **Research Question:** What is the willingness to pay level for electric vehicles/ motorcycles/ services?
   Hypothesis: The willingness to pay level for electric vehicles/ motorcycles/ services will be high/ increase due to smartCEM services.
5. **Research Question:** What is the impact of smartCEM services on range anxiety?
   Hypothesis: Range anxiety level will be low/ will decrease due to smartCEM services.

Table 4: Specification of the performance indicators for the category user uptake.

RQ/ Hyp No.	Indicator	Applicable per service / Site			
		BAR	New	REG	GIP
1	Average user acceptance score	(open) EV-sharing	EV-efficient driving / EV-navigation	EV-efficient driving / EV-navigation /	EV-sharing/ EV-efficient driving / EV-navigation

RQ/ Hyp No.	Indicator	Applicable per service / Site			
		BAR	New	REG	GIP
				EV-sharing	/ EV-trip management
2	General user acceptance score electric vehicles	Scooters	Electric cars	Electric cars	Electric cars
3	Average willingness-to-pay score	(open) EV-sharing	EV-navigation / EV-efficient driving	EV-efficient driving / EV-navigation	EV-sharing/ EV-efficient driving / EV-navigation / EV-trip management
4	General willingness to pay score for electric vehicles	Scooters	Electric cars	Electric cars	Electric cars
5	Average range-anxiety score	EV-sharing	EV-navigation	EV-efficient driving / EV-navigation / EV-sharing	EV-sharing

5.1.4. Driver behaviour

1. **Research Question:** Do smartCEM services change the speed/ acceleration profile of the driver?
   Hypothesis: The smartCEM services will make the speed/ acceleration profile smoother.
2. **Research Question:** Do smartCEM services change the amount of generated energy?
   Hypothesis: SmartCEM services will increase the amount of generated energy.

Table 5: Specification of the performance indicators for the driver behaviour category.

RQ/Hyp No.	Indicator	Applicable per service / Site			
		BAR	New	REG	GIP
1	Speed/ acceleration profile	EV-efficient driving		EV-efficient driving	EV-efficient driving
2	Average amount of generated energy		EV-efficient driving	EV-efficient driving	EV-efficient driving

5.2. Site-specific performance indicators[2]

There are also some site-specific indicators which are presented in the following tables for each pilot site.

5.2.1. Pilot-site specific indicators for Barcelona

1. **Research Question:** What is the impact of incentivising trips (as part of the open EV-sharing implementation) on the number of complied trips?
   Hypothesis: Users will comply with the modification of his/her initial route when incentivised.

Table 6: Site-specific performance indicators for Barcelona.

RQ/Hyp No.	Performance indicator	Service
1	Percentage of complied trips (due to incentives) = Percentage of trips in which the user accepted a modification in his initial trip preferences for a cheaper fare	EV-sharing

5.2.2. Pilot-site specific indicators for Gipuzkoa

1. **Research Question:** Do smartCEM services reduce the fuel consumption of the hybrid bus (HB)?
   Hypothesis: SmartCEM services will reduce the fuel consumption of the HB.
2. **Research Question:** Do smartCEM services reduce the CO_2 emissions produced by fuel consumption of the HB?
   Hypothesis: SmartCEM services will reduce the CO_2 emissions produced by fuel consumption of the HB.
3. **Research Question:** What is the willingness-to-pay level for a transport card for multimodal transport service?
   Hypothesis: The willingness-to-pay level will be high for a ticket from the multimodal transport service.
4. **Research Question:** Does EV-efficient driving lead to eco-friendly driving behaviour?
   Hypothesis: EV-efficient driving will increase the rate-of use.

[2] At the moment, Reggio-Emilia pilot-site does not have pilot-site specific indicators.

Table 7: Site-specific performance indicator for Gipuzkoa.

RQ/ Hyp No.	Indicator	Service
1	Amount of fuel consumed for hybrid bus	EV-efficient driving
2	CO_2 emissions for hybrid bus	EV-efficient driving
3	Average willingness-to-pay score for a transport card combining carsharing with public transport	EV-trip management (multimodal)
4	Rate of use = number of instructions followed for car- and hybrid bus driver	EV-efficient driving

5.2.3. Pilot-site specific indicators for Newcastle

1. **Research Question:** Do smartCEM services change drivers' confidence to take longer trips?
   Hypothesis: SmartCEM services will increase drivers' confidence to take longer trips.

Table 8: Site-specific performance indicator for Newcastle.

RQ/Hyp No.	Indicator	Service
1	Average confidence score for longer trips	EV-navigation

6. Awareness indicators

Awareness indicators are used to evaluate the public awareness of the project and are therefore linked to the dissemination activities in WP5 (for more details see also deliverable D5.1).

The following table shows the common awareness indicators and the overall success criteria which smartCEM would like to achieve.

Table 9: List of awareness indicators.

Nr.	Awareness indicator	Success Criteria	Measure
1	Scientific impact	5 articles in scientific journals / specialised press	Total number of publications until the end of the smartCEM project
2	Published results on websites	At least 50 different website publishing smartCEM results (all websites)	Total number of publications at the end of the project
3	Newsletter	SmartCEM newsletter twice a year	Total number of newsletters at the end of the project
4	Leaflets	4 leaflets: 250 of each distributed	Total number of leaflets
5	Mobility event organisation	At least one event per pilot site over the duration of the project	Number of mobility event organisation per year and per test-site
6	Media awareness	50 local media articles / 10 National media articles per country	Total number at the end of the project
7	Number of project contacts	300 registrations on www.smartcem-project.eu	Total number of subscribers at the end of the project
8	Website visits	At least 250 unique visitors per quarter (www.smartcem-project.eu)	Total number of website visits every quarter
9	Number of people attending events	At least 100 registrations for each of the events	Total number of people attending event at the end of the project

7. Deployment indicators

Deployment indicators are defined to evaluate the viability, sustainability and scalability of the smartCEM services after the end of the project. They are on the one hand translations of performance indicators into monetary benefits. On the other hand they are aspects related to further deployment of the smartCEM services and therefore related to interoperability, commonality and sustainability. These aspects will be assessed and further defined in a later stage of the project within WP6 for the identification of deployment enablers and barriers.

The following list shows the economic translation of some of the performance indicators (see section 5) and project statistics (see section 8) which are necessary for the cost-benefit-analysis to be performed in WP6:

Table 10: List of deployment indicators.

Nr.	Deployment indicator	Measure
1	Average expected profit - CO_2 emissions	Total accumulated profit calculated in € over a specified time period (e.g. 0.5 years) based on the performance indicator of CO_2 emission reduction.
2	Average expected profit - fuel consumption	Total accumulated profit calculated in € over a specified time period (e.g. 0.5 years) based on the performance indicator of fuel saving.
3	Average expected profit - time savings	Total accumulated profit calculated in € over a specified time period (e.g. 0.5 years) based on the performance indicator of time savings.
4	Average expected profit – charging events	Total accumulated profit calculated in € over a specified time period (e.g. 1 month) generated by the number of EV chargings at the charging spots.
5	Average expected profit - rentals	Total accumulated profit calculated in € over a specified time period (e.g. 1 month) generated by the number of EV rentals.
6	Average expected profit - single users	Total accumulated profit calculated in € over a specified time period (e.g. 1 month) generated by single users (not registered as frequent users) of EV rentals.
7	Average expected profit - subscribed users	Total accumulated profit calculated in € over a specified time period (e.g. 1 month) generated by registered frequent users users of EV rentals.

8. Project statistics - project indicators

The smartCEM project indicators are statistics relevant for the final assessment of the project's impacts:

Table 11: List of project indicators

Nr.	Project indicator	Measure
1	Number of electric vehicles	Number of electric vehicles in each pilot site - number of EVs in the respective city and per city population
2	Number of charging points	Total number of active charging points available - number of charging posts per km driven in each city.
3	Overall usage	Total number of hours that electric vehicles have been used (km driven).
4	Number of users	Total number of subscribed and single-users – total number of subscribed and single- EV users per city population in 1 year.
5	Number of charging processes	Total number of charging events (number of events and hours of charging).
6	kwh charged	Total amount of charged energy - provided by back-office logging.
7	Alternative energy charged	Relative amount of alternative energy charged (based on energy-mix and time-of-charging)
8	km travelled	Total distance of km travelled with EV s in km.
9	Penetration of EV-navigation application	Total number of purchased EV-navigation applications
10	Total number of users	Total number of users that have been exposed to the smartCEM services.
11	Questionnaire return rate	Total number of filled out questionnaires/focus group sessions.
12	Focus groups attendance	Total number of participants attending the focus groups and number of focus group sessions.
13	CP breakdowns	Total number of times that a charging post is out of order.
14	Number of help requests	Total number of complaints arriving at help desk assessed via data-logger from help desk -split into business/after business hours.

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Annex A: Progress Indicators

A.1 Barcelona progress indicators

Indicator No.	Relating to which project objective / expected result	Method of measurement	Project execution indicator	Expected progress		
				Yr1	Yr2	Yr3
PRO_BCN_1	Implementation in the BARCELONA pilot site: *delivery*	ACASA–will monitor the delivery status from Motorcycle makers and report on the progress (added up per year)	# EV Scooter	45	45	45
			# charging station	137	137	137
PRO_ BCN_2	Specifications BARCELONA pilot site	CREAFUTUR will define specifications and requirements (technical, functional)	EV-efficient driving	-		
			EV-sharing (Scooters)	-		
		ACASA will define specifications and requirements (technical, functional)	EV-navigation	-		
PRO_ BCN_3	Implementation in the BARCELONA pilot site: *adaptation*	CREAFUTUR will be adapting the services and report on the progress	EV-efficient driving	30%	70%	-
			EV-sharing (Scooters)	30%	70%	-
PRO_ BCN_4	Implementation in the BARCELONA pilot site: *adaptation*	ACASA will be adapting the services and report on the progress	EV-navigation	30%	70%	
PRO_ BCN_5	Operation tests in the BARCELONA pilot site: *baseline and functional operation*	IDIADA will monitor the operation works and report on the progress	- Energy consumption	-	9m	-
			- CO_2 equivalent emissions	-	9m	-
PRO_ BCN_6	Operation tests in the BARCELONA pilot site: baseline and functional operation	CREAFUTUR will monitor the operation works and report on the progress	- # users (expected 200)	-	9m	-
			- # trips per day per vehicle (expected 4)	-	9m	-
			- %#of incentivized trips per (expected 20%)	-	9m	-

A.2 Gipuzkoa Progress indicators

Indicator No.	Relating to which project objective / expected result	Method of measurement	Project execution indicator	Expected progress		
				Yr1	Yr2	Yr3
PRO_GIP_1	Implementation in the GIPUZKOA pilot site: delivery	TECNALIA will monitor the delivery status and report on the progress, of EV carsharing at DSS and GPI; as well as the hybrid bus from CTSS (added up per year).	# EV carsharing vehicles	19	24	30
			# charging positions	22	27	33
			# hybrid bus	1	1	1
PRO_GIP_2	Specifications GIPUZKOA pilot site	TECNALIA will define specifications and requirements (technical, functional)	EV-navigation	100%	-	-
			EV-efficient driving	100%	-	-
			EV-trip management	100%	-	-
			EV-sharing	100%	-	-
PRO_GIP_3	Implementation in the GIPUZKOA pilot site: adaptation	ENNERA will be adapting the services and report on the progress %	EV-navigation	30%	70%	-
			EV-efficient driving	30%	70%	-
			EV-trip management	30%	70%	-
			EV-sharing	30%	70%	-
PRO_GIP_4	Implementation in the GIPUZKOA pilot site: integration and verification	ENNERA will be integrating and verifying adapted services (backoffice/OBU) and report on the progress %	Integration and verification: EV carsharing at backoffice and OBU	-	100%	-
PRO_GIP_5	Implementation in the GIPUZKOA pilot site: integration and verification	CTSS will be integrating and verifying adapted services (backoffice/OBU) and report on the progress	Integration and verification: hybrid bus at backoffice and OBU	-	100%	-
PRO_GIP_6	Operation tests in the GIPUZKOA pilot site: baseline and functional operation	ENNERA will monitor the operation works during baseline and report on the progress	Baseline and functional operation data collection EV carsharing:			
			- Energy consumption	-	9m	-
			- CO2 emission	-	9m	-
			- Range travelled	-	9m	-
			- # users	-	9m	-
PRO_GIP_7	Operation tests in the GIPUZKOA pilot site: baseline and functional operation	CTSS will monitor the operation works during baseline and report on the progress	Baseline and functional operation data collection hybrid public transport:			
			- Energy consumption	-	9m	-
			- Fuel consumption	-	9m	-
			- CO2 emission	-	9m	-
PRO_GIP_8	Operation tests in the GIPUZKOA pilot site: baseline and functional operation	TECNALIA will monitor the operation works during baseline and report on the progress	Baseline and functional operation data collection EV carsharing:			
			- User acceptance	-	9m	-
			- User experience	-	9m	-

A.3 Newcastle Progress indicators

Indicator No.	Relating to which project objective / expected result	Method of measurement	Project execution indicator	Expected progress		
				Y1	Y2	Y3
PRO_NEW_1	Implementation in NEWCASTLE pilot site: *delivery*	GCOL will monitor the delivery status and report on the progress (added up per year)	# charging positions	200	700	1300
PRO_NEW_2	Implementation in NEWCASTLE pilot site: *delivery*	UNEW will monitor the delivery status and report on the progress (added up per year)	# of EV drivers	10	10	10
PRO_NEW_3	Implementation in NEWCASTLE pilot site: *delivery*	GCOL will monitor the working status and report on the maintenance	# functioning charging points	95%	95%	95%
PRO_NEW_4	Specification NEWCASTLE pilot site	UNEW will define specifications and requirements (technical, functional)	EV-navigation	100%	-	-
			EV-charging station management	100%	-	-
			EV-trip management	100%	-	-
			EV-eco driving HMI	100%	-	-
PRO_NEW_5	Implementation in the NEWCASTLE pilot site: *adaptation*	UNEW will be adapting the services and report on the progress	EV-navigation	30%	70%	-
			EV-charging station management	30%	70%	-
			EV-trip management	30%	70%	-
			EV-eco driving HMI	30%	70%	-
PRO_NEW_6	Implementation in NEWCASTLE pilot site: *integration and verification*	UNEW will be integrating and verifying adapted services (backoffice/OBU) and report on PROGRESS	Integration and verification EV Carsharing at backoffice and OBU	-	1	-
PRO_NEW_7	Operation in the NEWCASTLE pilot site: *baseline and functional operation*	UNEW will monitor the operation works during baseline and functional operation and report on the progress	Energy consumption	-	X	X
			CO_2 emissions	-	X	X
			Range travelled (4000 km/yr)	-	X	X
			# Users	-	X	X

A.4 Reggio-Emilia progress indicators

Indicator No	Related to which project objective/ expected result	Measurement method	Project execution indicator	Expected progress		
				Yr 1	Yr 2	Yr 3
PRO_REG_1	Implementation in the Reggio Emilia test site: ecarsharing	UNIMORE will monitor the status and report on the progress	# EVs	-	10	10
			# mini vans	-	1	1
			# charging stations	-	14	23
PRO_ REG_2	Implementation in the Reggio Emilia pilot site: adaptation	CRF and UNIMORE will analyze and develop services adaptation for OEM OBU (vans) and nomadic and report on the progress	EV-trip management	-	-	-
			EV-car sharing	-	100%	-
			EV-navigation	-	100%	-
			EV-efficient driving	-	100%	-
			EV-charging station management	-	-	-
PRO_ REG_3	Implementation in the Reggio Emilia pilot site: integration	UNIMORE will monitor development of adapted services (backoffice) and report on the progress	Integration: EV-sharing at backoffice	-	100%	-
PRO_ REG_4	Implementation in the Reggio Emilia pilot site: baseline and functional operation	UNIMORE will monitor the operation works during baseline and functional operation and report on the progress	Baseline data collection on EV-sharing			
			- Energy consumption	-	9m	-
			- Fuel consumption	-	9m	-
			- Range travelled	-	9m	-
			# of users	-	20	-
			- User acceptance	-	9m	-
			- User experience	-	9m	-

Annex B: Success Criteria and Measures

B1 Success Criteria and Measures for Barcelona

Performance Indicators Evaluation Category	Research Question	Hypothesis	Success Criteria	Indicator ID	Indicator Name	Required measures		Equation
1) Environment *2) Transport & mobility* *3) User uptake* *4) Driver behaviour*				*Performance Indicator (PI)* *Newcastle: NEW* *Gipuzkoa: GIP* *Barcelona: BCN* *Reggio-Emilia: REG*		REQ ME_ID	REQ ME Name	
Environment	Does the EV-efficient driving service (post trip) contribute to reduce energy consumption (battery discharge) and thus CO_2-equivalent emissions?	The EV-efficient driving service will contribute to reduce energy consumption of e-scooters	Energy consumption reduction > 5%	PI_BCN_1	Average energy consumption (scooter)	REQ_ME-301	State of charge of the battery initial	"=(SOC final - SOC initial)/Distance travelled)"
						REQ_ME-302	State of charge of the battery final	
						REQ_ME-107	Travelled distance	
Environment	Does the open EV-sharing service contribute to	Using an EV + the combination of features of	The CO_2 emissions of with the open EV-sharing	PI_BCN_2	Average CO_2 emissions (scootersharing)	REQ_ME-403	Energy consumption per day	"=CO_2 - emission tool calculation "
						REQ_ME-	Date	

	reducing CO_2-emissions?	the open EV-sharing scheme will contribute to reduce the amount of CO_2 emission.	service will be < than without.			102		
						REQ_ME-101	Time of the day	
						REQ_ME-405	Energy mix	
Environment	Does the open EV-sharing scheme influence the SOC of the battery?	The implemented demand management service will contribute to reduce the number of run-out of battery events.	Average daily number of run-out of battery events will be 0 < x < 0.3 for the whole fleet (45 electric scooters)	PI_BCN_3	Number of run-out of battery events	REQ_ME-303	Number of run-out of battery events	"number of run-out battery events/sum of total number of complied trips per day) *100"
						REQ_ME-112	Number of complied trips per day	
Transport & mobility	Does the open EV-sharing scheme increase the electric scooter usage rate?	The possibility to pick-up and drop-off the e-scooters anywhere will increase the daily usage rate of the e-scooters.	Average number of trips (per day / vehicle) > 4	PI_BCN_4	Average number of trips per day per vehicle	REQ_ME-118	Number of trips	"=(Total sum of number of trips/ Number of days)"
						REQ_ME-106	Number of days	
						REQ_ME_252	Vehicle ID	
User uptake	What is the acceptance level of the open EV-sharing scheme?	The open EV-sharing scheme will be highly accepted.	User acceptance scores for the open EV-sharing scheme will be > than the middle of the rating	PI_BCN_5	Average user acceptance scores	REQ_ME-611	User acceptance scores	"=(sum of acceptance scores/number of scores)/number of participants"
						REQ_ME-601	Number of scores	
						REQ_ME-001	Number of participants	

			scale.					
User uptake	What is the acceptance level of electric motorcycles?	The user acceptance of electric motorcycles will increase due to the implementation of EV-open sharing scheme.	User acceptance score of electric motorcycles will increase by > 15%.	PI_BCN_6	General user acceptance score (electric motorcycles)	REQ_ME-603 REQ_ME-601 REQ_ME-001	General user acceptance score Number of scores Number of participants	"=(sum of acceptance scores/number of scores)/number of participants* 100 and comparison with baseline"
User uptake	What is the willingness to pay level for the open EV-sharing scheme?	The open EV-sharing scheme will be highly accepted.	Willingness to pay scores for the open EV-sharing scheme will be > than without.	PI_BCN_7	Average willingness to pay score (scooter sharing)	REQ ME_ID 612 REQ_ME-601 REQ_ME-001	Willingness-to-pay scores Number of scores Number of participants	"=(sum of willingness to pay scores/number of scores)/number of participants"
User uptake	What is the willingness to pay level for electric scooters?	The willingness to pay level for electric scooters will be high.	Willingness to pay for electric scooters with open EV-sharing will be > than without.	PI_BCN_8	General willingness-to-pay	REQ_ME-604 REQ_ME-601 REQ_ME-001	General willingness-to-pay scores Number of scores Number of participants	"=(sum of willingness to pay scores/number of scores)/number of participants"
User uptake	What is the impact of the EV-sharing service on range anxiety	Range anxiety level will be low due to the EV-sharing service.	Reduction of 70% (at least) in the range anxiety score after using	PI_BCN_9	Average range-anxiety score	REQ_ME-602 REQ_ME-601	Range anxiety scores Number of scores	"=(sum of range anxiety scores/number of

			smartCEM services			REQ_ME-001	Number of participants	scores)/number of participants"
User uptake	What is the impact of incentivising trips (as part of the open EV-sharing implementation) on the number of complied trips?	Users will comply to the modification of his/her initial route when incentivised	Percentage of complied trips (because of incentivise) at least 20%	PI_BCN_10	Percentage of complied trips (due to incentives)	REQ_ME-111	Number of incentivised trips per day (user changed his initial preferences)	"=(Daily number of incentivised trips/total number of complied trips per day)*100"
						REQ_ME-112	Number of complied trips per day (incentivized or not)	
Driver behaviour	Does the EV-efficient driving service change the speed/ acceleration profile?	The EV-efficient driving service will make the speed/ acceleration profile smoother.	Acceleration profiles will be smoother with EV-efficient driving than without.	PI_BCN_11	Speed/acceleration profile per user	REQ_ME-712	Instant acceleration	Graph interpretation on acceleration out of defined range; position coordinates collected on a 1 sec basis
						REQ_ME-713	Reference acceleration limits	

B2 Success Criteria and Measures for Gipuzkoa

Performance Indicators Evaluation Category	Research Question	Hypothesis	Success Criteria	Indicator ID	Indicator Name	Required measures		Equation
1) Environment *2) Transport & mobility* *3) User uptake* *4) Driver behaviour*				*Performance Indicator (PI)* *Newcastle: NEW* *Gipuzkoa: GIP* *Barcelona: BCN* *Reggio-Emilia: REG*		REQ ME_ID	REQ ME Name	
Environment	Does the EV-efficient driving service contribute to reduce energy consumption?	The EV-efficient driving service will reduce energy consumption.	The energy consumption reduction is estimated to be > 5%	PI_GIP_1	Average energy consumption (carsharing)	REQ_ME-403 REQ_ME-107	Energy consumption per day Travelled distance	"=(kWh consumed*100/km driven)"
Environment	Does the EV-sharing service contribute	The EV-sharing service will contribute	The CO_2 emission (due to energy generation)	PI_GIP_2	Average CO_2 emissions (carsharing)	REQ_ME-403	Energy consumption per day	"= CO_2 -emission tool calculation"

	to reduce the CO_2 emissions produced by energy generation ?	to reduce the CO_2 emissions, emitted during the energy generation	reduction is estimated to be > 10%			REQ_ME-102	Date	
						REQ_ME-101	Time of the day	
						REQ_ME-405	Energy mix	
Environment	Does the EV-efficient driving service contribute to reduce the fuel consumption of the hybrid bus?	The EV-efficient driving service will contribute to reduce the fuel consumption of the hybrid bus	The amount of fuel consumption reduction due to EV-efficient driving is > than without.	PI_GIP_3	Amount of fuel consumed for hybrid bus	REQ_ME-204	Fuel consumption per route	"=liters consumed *100/Travelled distance (per route)"
						REQ_ME-107	Travelled distance	
Environment	Does the EV-efficient driving service contribute to reduce the CO_2 emissions produced by fuel consumption?	The EV-efficient driving service will contribute to reduce the CO_2 emissions derived from fuel consumption	The amount of CO_2 emission reduction (due to fuel consumption) using EV-efficient driving is > than without.	PI_GIP_4	CO_2 emissions for hybrid bus	PI_GIP_3	Fuel consumption per route	"= vehicle specifications"
						REQ_ME-107	Travelled distance	

Environment	Does the EV-navigation service change the SOC of the battery?	The EV-navigation service will contribute to reduce the number of run-out of battery events.	The run-out battery events is estimated to be > 30%	PI_GIP_5	Number of run-out of battery events	REQ_ME-303	Number of run-out of battery events	"= (number of run-out battery events/sum of total number of complied trips per day) *100"
						REQ_ME-112	Number of complied trips per day	
Environment	Does the EV-charging station management service change the temporal characteristic of the charging behaviour?	The EV-charging station management service will optimise temporal charging (increase in number of off-peak charging events).	The number of off-peak charging events will be > with EV-charging station management than without.	PI_ GIP_6	Number of off-peak charging events	REQ_ME-505	Charging post ID	"=number of start/end charging events per time of day per charging post per peak- and off-peak time"
						REQ_ME-102	Date	
						REQ_ME-502	Starting time charging event	
						REQ_ME-507	Peak-time	
Environment	Does the EV-navigation service change the regional characteristic of the charging behaviour?	The EV-navigation service will optimise regional charging (number of charging events per charging post will decrease,	The ratio of charging post usage/events per charging posts when using EV-navigation will be< than without EV-navigation.	PI_GIP_7	Charging event distribution	REQ_ME-505	Charging post ID	"=number of charging events per day/ number of charging posts per date“
						REQ_ME-506	charging transaction ID	
						REQ_ME-102	Date	

		while the overall number of charging events will stay the same).						
Transport & mobility	Does the EV-sharing service change the number of trips/ users?	The EV-sharing service will increase the number of trips.	The number of trips with EV-sharing will be > than without.	PI_GIP_8	Average number of trips per day per vehicle	REQ_ME-118	Number of trips	"=(Total sum of number of trips per day/ Number of days)"
						REQ_ME-106	Number of days	
						REQ_ME_252	Vehicle ID	
User uptake	What is the acceptance level of EV-sharing, EV-trip management, EV-efficient driving and EV-navigation services?	SmartCEM services will be highly accepted.	60% of the participants, will give a positive answer (acceptance score > than the middle of the rating scale)	PI_GIP_9	Average user acceptance scores	REQ_ME-611	User acceptance scores	"=(sum of acceptance scores/number of scores)/number of participants"
						REQ_ME-601	Number of scores	
						REQ_ME-001	Number of participants	
User uptake	What is the acceptance level of electric	The user acceptance of electric vehicles will	User acceptance score of electric cars	PI_GIP_10	General user acceptance score (for electric cars)	REQ_ME-603	General user acceptance score for electric cars	"=(sum of acceptance scores/number of scores)/number of

	vehicles?	increase due to the implementation of smartCEM services.	will increase by > 15%.			REQ_ME-601	Number of scores	participants*100 and comparison with baseline"
						REQ_ME-001	Number of participants	
User uptake	What is the willingness to pay level for EV-navigation, EV-efficient driving and EV-sharing services?	The willingness to pay level for EV-navigation, EV-efficient and EV-sharing services will be high.	The average willingness-to-pay score will be > with EV-navigation, EV-efficient driving and EV-sharing than without.	PI_GIP_11	Average willingness-to-pay score	REQ ME_ID_612	Willingness-to-pay scores	"=(sum of willingness to pay scores/number of scores)/number of participants"
						REQ_ME-601	Number of scores	
						REQ_ME-001	Number of participants	
User uptake	What is the willingness -to-pay level for the trip management service?	The willingness-to-pay level will be high.	The willingness to pay for the transport card will be > with EV-trip management than without.	PI_GIP_12	Average willingness-to-pay score (for a transport card combining carsharing with public transport)	REQ ME_ID 18	Willingness-to-pay scores	"=(sum of willingness to pay scores/number of scores)/number of participants"
						REQ_ME-601	Number of scores	
						REQ_ME-001	Number of participants	
User uptake	What is the willingness to pay level for electric vehicles?	The willingness to pay level for electric vehicles will be high due to the implementat	Willingness - to –pay for electric vehicles will be > with EV-sharing than without.	PI_GIP_13	General willingness to pay	ME_604	General willingness to pay scores	"=(sum of willingness to pay scores/number of scores)/number of participants*100 and comparison with baseline"
						REQ_ME-601	Number of scores	
						REQ_ME-001	Number of participants	

		ion of smartCEM services.						
User uptake	What is the impact of the EV-sharing service on range anxiety?	Range anxiety level will decrease due to the EV-sharing service.	A reduction of 10% of range anxiety after using EV-sharing service.	PI_GIP_14	Average range-anxiety score	REQ_ME_ME_602	Range anxiety scores	"=(sum of range anxiety scores/number of scores)/number of participants"
						REQ_ME-601	Number of scores	
						REQ_ME-001	Number of participants	
Driver behaviour	Does the EV-efficient driving service change the speed/ acceleration profile?	The EV-Efficient driving service will make the speed/ acceleration profile smoother.	Acceleration profiles will be smoother with EV-efficient driving than without.	PI_GIP_15	Speed/Acceleration profile per EV user	REQ_ME-714	Instant speed	Graph: Speed (km/h) vs. Travelled distance (km)
						REQ_ME-107	Travelled distance	
Driver behaviour	Does the EV-efficient driving service lead to eco-friendly driving behaviour?	The EV-efficient driving service will increase the rate-of use.	The rate of use (compliance) will be higher at the end of operational phase than at the beginning.	PI_GIP_16	Rate of use = number of instructions followed for car- and hybrid bus driver	REQ_ME-702	Number of instructions given	"=(instructions followed/intructions given)*100"
						REQ_ME-701	Number of instructions followed by EV and hybrid bus driver	

Driver behaviour	Does the EV-efficient driving service change the amount of generated energy?	The EV-efficient driving service will increase the amount of generated energy.	The amount of generated energy using EV-efficient driving will be > than without.	PI_GIP_17	Average amount of generated energy	REQ_ME-402 REQ_ME-107	Regenerated energy Travelled distance	"=(sum of regenerated energy in kWh/km driven)"

B3 Success Criteria and Measures for Newcastle

Performance Indicator Evaluation Category	Research Question	Hypothesis	Success Criteria	Indicator ID	Indicator Name	Required measures		Equation
1) Environment *2) Transport & mobility* *3) User uptake* *4) Driver behaviour*				*Performance Indicator (PI)* *Newcastle: NEW* *Gipuzkoa: GIP* *Barcelona: BCN* *Reggio-Emilia: REG*		REQ ME_ID	REQ ME Name	
Environment	Do EV-efficient driving and EV-navigation services change energy consumption ?	EV-efficient driving and EV-navigation service will reduce energy consumption on EV	The average energy consumption will be < 19.8 kWh.	PI_NEW_1	Average energy consumption	REQ_ME-403	Energy consumption per day	"=(kWh consumed*100/km driven) per user"
						REQ_ME-107	Travelled distance	

Environment	Does the EV-efficient driving service contribute to reduce the amount of CO_2 emissions?	The EV-efficient driving service will contribute to reduce the CO_2 emissions.	The CO_2 emission (due to energy generation) reduction is estimated to be > 10%	PI_NEW_2	Average CO_2 emissions	REQ_ME -107	Energy consumption	" CO_2 - emission tool calculation "
						REQ_ME -102	Date	
						REQ_ME -101	Time of day	
						REQ_ME -405	Energy mix	
Environment	Do EV-efficient driving and EV-navigation service change the SOC of the battery?	The EV-efficient driving and EV-navigation service will contribute to reduce the number of run-out of battery events.	Number of run-out-of battery events will be <2 per month	PI_NEW_3	Number of run-out-of-battery events	REQ_ME -303	Number of run-out of battery events	"= (number of run-out battery events/sum of total number of complied trips per day) *100"
						REQ_ME -112	Number of complied trips per day	
Environment	Does the EV-efficient driving service (e.g. including advice on the usage of other in-vehicle components) change the temporal characteristics of the charging behaviour?	The EV-efficient driving service will optimise the temporal charging (increase in number of off-peak charging events).	Increase in 0ff-peak charging events for private users will be >20%	PI_NEW_4	Number of off-peak charging events	REQ_ME -505	Charging post ID	"=number of start/end charging events per time of day per charging post per peak- and off-peak time"
						REQ_ME -102	Date	
						REQ_ME -502	Starting time of charging event	
						REQ_ME -501	End time of charging event	
						REQ_ME -101	Time of day	
						REQ_ME _507	Peak-time	

Environment	Does the EV-navigation service change the regional characteristics of the charging behaviour?	The EV-navigation service will optimise regional charging (number of charging events per charging post will decrease, while the overall number of charging events will stay the same).	The ratio of charging post usage/events per charging posts when using EV-navigation will be< than without EV-navigation.	PI_NEW_5	Charging event distribution	REQ_ME-505	Charging post ID	"=number of charging events per day"/ number of charging posts per date"
						REQ_ME-506	Charging transaction ID	
						REQ_ME-102	Date	
Transport & mobility	Does the EV charging station management service (i.e. range estimator) change the number of trips?	The EV charging station management service will increase the number of trips.	The average number of trips will be > 4.41	PI_NEW_6	Average number of trips per day per vehicle	REQ_ME-118	Number of trips	"=(Total sum of number of trips per day/ Number of days)"
						REQ-ME_ID-106	Number of days	
						REQ_ME_252	Vehicle ID	
User uptake	Does the EV-navigation service change drivers' confidence to take longer trips?	The EV-navigation service will increase drivers' confidence to take longer trips.	The average confidence score will be > than the middle of rating scale	PI_NEW_7	Average confidence score for longer trips.	REQ_ME-607	Confidence scores for longer trips	"=(sum of confidence scores/number of scores)/number of participants "
						REQ_ME-601	Number of scores	
						REQ_ME-001	Number of scores	
User uptake	What is the	Range anxiety will be low due to the	The average range-anxiety score will be < than the	PI_NEW_8	Average range-anxiety score	REQ_ME-602	Range anxiety scores	"=(sum of range anxiety

	impact of the EV-navigation service (Eco-advices) on range anxiety ?	EV-navigation service (Eco-advices).	middle of the rating scale.			REQ_ME-601 REQ_ME-001	Number of scores Number of participants	scores/number of scores)/number of participants "
User uptake	What is the acceptance level of the EV-navigation and EV-efficient driving services?	The EV-navigation/ EV-efficient driving services will be highly accepted.	The average user acceptance score will be >than the middle of the rating scale	PI_NEW_9	Average user acceptance scores	REQ_ME-611 REQ_ME-601 REQ_ME-001	User acceptance scores Number of scores Number of participants	"=(sum of user acceptance scores/number of scores)/number of participants "
User uptake	What is the acceptance level of electric vehicles?	The user acceptance of electric vehicles will increase due to the implementation of smartCEM services.	User acceptance score of electric cars will increase by > 15%.	PI_NEW_10	General user acceptance score (for electric cars)	REQ_ME-603 REQ_ME-601 REQ_ME-001	General user acceptance score for electric cars Number of scores Number of participants	"=(sum of acceptance scores/number of scores)/number of participants *100 and comparison with baseline"
User uptake	What is the willingness to pay level for EV-navigation and EV-efficient	The willingness to pay level for EV-navigation and EV-efficient driving services will be high.	The average Willingness-to-pay score will be > than the middle of rating scale	PI_NEW_11	Average willingness-to-pay score	REQ_ME-612 REQ_ME-601	Willingness to pay scores Number of scores	"=(sum of average willingness-to-pay items/number of scores) / number of

	driving services?					REQ_ME-001	Number of participants	participants "
User uptake	What is the willingness to pay level for electric vehicles?	Willingness-to-pay will be high.	The average Willingness-to-pay score will be > than the middle of rating scale	PI_NEW_12	General willingness to pay	ME_604	General willingness to pay scores	"=(sum of willingness to pay scores/number of scores)/number of participants *100 and comparison with baseline"
						REQ_ME-601	Number of scores	
						REQ_ME-001	Number of participants	
Driver behaviour	Does the EV-efficient driving service change the amount of generated energy?	The EV-efficient driving service will increase the amount of generated energy.	The amount of generated energy using EV-efficient driving will be > than without.	PI_NEW_13	Average amount of generated energy	REQ_ME-402	Regenerated energy	"=(sum of regenerated energy in kWh/km driven)"
						REQ_ME-107	Travelled distance	

B4 Success Criteria and Measures for Reggio-Emilia

Evaluation Category	Research Question	Hypothesis	Success Criteria	Indicator ID	Indicator Name	Required measures		Equation
1) Environment *2) Transport & mobility* *3) User uptake* *4) Driver behaviour*				*Performance Indicator (PI)* *Newcastle: NEW* *Gipuzkoa: GIP* *Barcelona: BCN* *Reggio-Emilia: REG*		REQ ME_ID	REQ ME Name	
Environment	Do EV-efficient driving and EV-navigation services contribute to reduce the energy consumption ?	The EV-efficient driving and EV-navigation services will contribute to reduce energy consumption.	The energy consumption reduction is estimated to be > 5%	PI_REG_1	Average energy consumption	REQ_ME-403 REQ_ME-107	Energy consumption per day Travelled distance	"=(kWh consumed*100/km driven)"
Environment	Does the EV-sharing service contribute to reduce	The EV-sharing service will contribute to reduce the CO_2 emissions, emitted	The CO_2 emission (due to energy generation) reduction is estimated to be >	PI_REG_2	Average CO_2 emissions (carsharing)	REQ_ME-403 REQ_ME-102	Energy consumption per day Date	"= CO_2 - emission tool calculation" calculation"

	the CO_2 emissions produced by energy generation?	during the energy generation	10%			REQ_ME-101 REQ_ME-405	Time of the day Energy mix	
Environment	Does the EV-sharing service change the SOC of the battery?	The EV-sharing service will contribute to reduce the number of run-out of battery events.	Average daily number of run-out of battery events will be 0 for the whole fleet.	PI_REG_3	Number of run-out of battery events	REQ_ME-112 REQ_ME-303	Number of complied trips per day Number of run-out of battery events per day	"=(Number of trips/number of run-out of battery)"
Environment	Does the EV-efficient driving service change the temporal characteristic of the charging behavior?	The EV-efficient driving service will optimise temporal charging (increase in number of off-peak charging events).	The number of off-peak charging events using EV-efficient driving will be > than without.	PI_REG_4	Number of off-peak charging events	REQ_ME-505 REQ_ME-502 REQ_ME-501 REQ_ME-101 REQ_ME-507	Charging post ID Starting time charging event End time charging event Time of day Peak-time	"=number of start/end charging events per time of day per charging post per peak- and off-peak time"
Environment	Does the EV-navigation service change the regional characteristi	The EV-navigation service will optimise regional charging (number of charging events per charging post	The ratio of charging post usage/events per charging posts using EV-navigation will be	PI_REG_5	Charging distribution	REQ_ME-505	Charging post ID	"=number of charging events per day"/ number of charging

	c of the charging behaviour?	will decrease, while the overall number of charging events will stay the same).	> than without EV-navigation.			REQ_ME-506	Charging transaction ID	posts
						REQ_ME-102	Date	
User uptake	What is the impact of EV-efficient driving, EV-navigation, and EV-sharing services on range anxiety ?	Range anxiety level will decrease due to smartCEM services.	A reduction of 10% of range anxiety after using smartCEM services	PI_REG_6	Average range anxiety score	REQ_ME-602	Range anxiety scores	"=(sum of range anxiety scores/number of scores)/number of participants"
						REQ_ME-601	Number of scores	
						REQ_ME-001	Number of participants	
User uptake	What is the acceptance level of EV-efficient driving, EV-navigation and EV-sharing services?	SmartCEM services will be highly accepted.	The average user acceptance score will be >than the middle of the rating scale	PI_REG_7	Average user acceptance scores	REQ_ME-603	User acceptance scores for smartCEM services	"=(sum of acceptance scores/number of scores)/number of participants"
						REQ_ME-601	Number of scores	
						REQ_ME-001	Number of participants	
User uptake	What is the acceptance level of electric vehicles?	The user acceptance of electric vehicles will increase due to the implementation of smartCEM services.	User acceptance score of electric cars will increase by > 15%.	PI_REG_8	General user acceptance score (for electric cars)	REQ_ME-603	General user acceptance score for electric cars	"=(sum of acceptance scores/number of scores)/number of participants*
						REQ_ME-601	Number of scores	
						REQ_ME-	Number of	

						001	participants	100 and comparison with baseline"
User uptake	What is the willingness to pay level for EV-efficient driving and EV-navigation services?	The willingness to pay level for EV-efficient driving and EV-navigation services will be high.	The average Willingness-to-pay score will be > than the middle of rating scale	PI_REG_9	Average willingness to pay score	REQ_ME-604 REQ_ME-601 REQ_ME-001	Willingness-to-pay scores Number of scores Number of participants	"=(sum of willingness to pay scores/number of scores)/number of participants"
User uptake	What is the willingness to pay level for electric vehicles?	Willingness-to-pay will be high.	The average Willingness-to-pay score will be > than the middle of rating scale	PI_REG_10	General willingness to pay	ME_604 REQ_ME-601 REQ_ME-001	General willingness to pay scores Number of scores Number of participants	"=(sum of willingness to pay scores/number of scores)/number of participants* 100 and comparison with baseline"
Driver behaviour	Does the EV-efficient driving service change the amount of generated energy?	The EV-efficient driving service will increase the amount of generated energy.	The amount of generated energy using EV-efficient driving will be > than without.	PI_REG_11	Average amount of generated energy	REQ_ME-402 REQ_ME-103	Regenerated energy per trip Starting time of trip	"=average regenerated energy per trip/ trip duration"

Driver behaviour	Does the EV-efficient driving service change the speed/ acceleration profile?	The EV-efficient driving service will make the speed/ acceleration profile smoother.	Acceleration profiles will be smoother with EV-efficient driving than without.	PI_REG_12	Speed/Acceleration profile per EV user	REQ_ME-714	Instant speed	Graph: Speed (km/h) vs. Travelled distance (km)
						REQ_ME-107	Travelled distance	