

PROJECT FINAL REPORT

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² The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

4.1 Final publishable summary report

Executive Summary

The READY4SmartCities project, ICT Roadmap and Data Interoperability for Energy System in Smart Cities, intended to **increase awareness and interoperability** for the adoption of **ICT and semantic technologies in energy systems** to obtain a reduction of energy consumption and CO₂ emissions at **smart city** communities' level relying on ICT-based **RTD and innovation needs** and solutions.

The key objectives of the READY4SmartCities project, as a Coordination and Support Action (CSA), were to:

- 1) **Investigate and identify energy-related vocabularies and ontologies towards dynamic and interoperable Energy Management Systems** that deal with different Smart City aspects;
- 2) **Elaborate a clear set of requirements and guidelines** that facilitate the Smart City community generating, publishing and exploiting their datasets;
- 3) **Support energy data interchange among the Smart City communities (companies, cities, individuals, etc.) through various European-scale actions** towards spanning research, innovation, standards-setting and deployment in Smart Cities;
- 4) **Elaborate a clear vision and produce the corresponding roadmap for the development of ICT for energy systems at the city scale;**
- 5) **Ensure awareness towards a community of experts via dedicated workshops (VoCamp, Summer School, etc.)** in strong collaboration with the **eeSemantic** initiative.

With this background, a backbone of a total of 70 ontologies and 18 datasets were certified, and a set of tools such as **the online catalogues and alignment server** and reference documents such as **guidelines for generating, publishing and exploiting Linked Energy Data** were released and made available by READY4SmartCities project partners for a free usage in supporting open linked data and interoperability for efficient energy systems in smart cities.

Furthermore, the **innovation and research roadmap** was released, consisting of four main domain area sub-roadmaps and one integrating section related to energy data and its usage. The significant domain areas investigated by READY4SmartCities project were: **citizens, building sector, energy sector and municipality level**. Each road map section introduced relevant drivers, needs and requirements, visions, barriers, expected impacts and key stakeholders. Each sector had its own RTD and innovation focus topics, with the description of the general background, state of the art, and suggested RTD and innovation needs identified in the short, medium and long term.

The repeating theme throughout the roadmap was a strong need for broad collaboration, communication and interoperability within various stakeholder networks. This requires standardisation (of data models, data exchange and communication, as well as interfaces and systems themselves) to enable cross-organisational operation.

The close collaboration with the ETSI M2M Smart Appliance working groups, and with the newly formed W3C Linked Building Data Community Group as well as the buildingSMART Linked Data Work Group has been relevant for ensuring the awareness **towards a community of experts** such as **standardisation bodies** and for increasing the overall project success.

Project Context and Objectives

Context

READY4SmartCities operates in a European context where other initiatives are currently running in order to create a common approach on Smart Cities, e.g.:

- EERA Joint Programme for Smart Cities – focused on the development of scientific tools and methods that will enable an intelligent design, planning and operation of the energy system of an entire city in the near future.
- European Innovation Partnership Smart Cities and Communities (EIP) - The partnership proposes to pool resources to support the demonstration of energy, transport and information and communication technologies (ICT) in urban areas.
- European Smart Cities Stakeholder Platform – launched within Smart Cities and Communities EIP it aims to bring together all stakeholders relevant to create an innovation ecosystem for Smart Cities.
- European Member States Initiative Smart Cities – each EU member state is currently developing its own Smart City program following specific national requirements and context.

READY4SmartCities supports and complements these Smart City initiatives by defining a common data framework to support full interoperability among urban energy systems and suggests how ICT could support energy systems in smart cities.

Objectives

READY4SmartCities aimed to bring together relevant stakeholders including engineering specialists, ICT software and equipment providers, RES providers, energy companies (including ESCOs – Energy Service Companies), building and construction sector companies, as well as local and regional authorities and researchers. In co-operation with these stakeholders, the aim was to deliver:

- A new energy data ecosystem that will accommodate cross-domain data (climatic, occupation, pollution, traffic, activity, etc.) and will allow the exploitation of the data at local and global scales; by identifying the set of ontologies relevant to energy-efficiency in Smart Cities and the different requirements and guidelines on how to use (publish and interchange) data described according to these ontologies.
- An holistic and shared vision, allowing feasible step-by-step action plans for city authorities and other relevant stakeholder groups to develop and use of ICT and semantic-based solutions for energy systems in Smart Cities, and thus, leading to reduced energy consumption and CO₂ emissions.

READY4SmartCities project aimed at the following objectives:

- **To investigate and identify energy-related vocabularies and ontologies towards dynamic and interoperable Energy Management Systems (EMS)** that deal with different Smart City aspects. The goal was also targeted to the interoperability of EMS with regards to building complexes, public spaces, neighbourhoods, districts, and eventually Smart Cities. Various ontologies proposed by projects and research groups was analysed and benchmarked in terms of energy efficiency and coverage of interoperability goals;

- **To elaborate a clear set of requirements and guidelines** that will facilitate the Smart City community generating, publishing and exploiting their datasets;
- **To support energy data interchange among the Smart City community (companies, cities, individuals, etc.) through various European-scale actions** towards spanning research, innovation, standards-setting and deployment in Smart Cities. These actions included the organisation of VoCamps, the European Energy Efficiency Data Forum, dissemination and networking workshops for bringing together all involved actors, and a summer school aiming to involve newcomers in the area of energy data interoperability;
- **To create a clear vision of ICT for energy systems of Smart Cities based on extrapolation beyond the state-of-the-art** by envisioning of future scenarios (e.g., design methods, energy management systems, etc.);
- **To create a roadmap suggesting the development and innovation needs of ICTs** towards holistic planning, design, construction and operation of energy systems for Smart Cities. Moreover, specific roles and tangible actions of various stakeholders in this development were also suggested. In detail the topics are:
 - Roadmap suggesting RTD and innovation needs for short, medium and long term;
 - Implementation recommendations for key stakeholders;
 - Assessing, as far as possible in quantified terms, the potential impacts of ICT regarding benefits to various stakeholders and contributions to energy efficiency at the city level.

Work Plan

The work was divided in 4 main technical work packages where the RTD activities were developed, and one additional work package for the management and dissemination.

- WP2 Energy Efficiency Data Interoperability: this WP, led by AEC3, that run in parallel with WP3, aimed at identifying the knowledge and data resources, available or needed, that support Energy Management System interoperability. These resources include: i) ontologies, vocabularies and standards, ii) relevant datasets, and iii) ontology alignments and data links.
- WP3 Interoperability of Energy Measurement and Validation: this WP, led by EMP, that run in parallel with WP2, aimed at identifying the knowledge and data resources, available or needed, that support Energy Measurement and Validation interoperability. These resources include: i) ontologies, vocabularies and standards, ii) relevant datasets, and iii) ontology alignments and data links.
- WP4 Requirements and guidelines for energy data management: this WP, led by UPM, aimed at providing a clear set of requirements and guidelines that support energy data management (data generation, data publication, data exploitation, and also data protection) and take into account the Linked Data principles and technologies and the specific characteristics of the energy domain.
- WP5 Framework and Vision of ICT for Energy Systems in Smart Cities: this WP, led by VTT, aimed at releasing the innovation and research roadmap suggesting the future RTD and innovation needs for ICTs supporting energy systems in smart cities. The innovation and research roadmap proposed the development and innovation activities for ICTs enabling holistic design, planning and operation of energy systems in smart cities in short, medium and long. Additionally, synergies with other ICT systems for smart cities were considered.

S&T Results

The project has fully achieved the intended result by releasing a set of tools (catalogues and alignment server) and reference **guidelines for generating, publishing and exploiting Linked Energy Data** for a free usage in supporting open linked data and interoperability for efficient energy systems in smart cities as well as an **innovation and research roadmap** that proposes development and innovation activities for ICTs enabling holistic design, planning and operation of energy systems in smart cities in short, medium and long term. The achievements of each Work package and the key deliverables are described in the following paragraphs.

WP1 Community Creation and Dissemination (CSTB)

D1.2 Community Description - rev1, 2, and 3

Intent: to set up the basis for the definition and the support of the “community of communities”.

Highlights: In the READY4SmartCities project the community is not only an audience for project results dissemination but was actively involved in project activities as the main input and feedback provider. READY4SmartCities brought together different stakeholders representing different sectors already separately active on smart city innovation activities. Therefore instead of a single community READY4SmartCities was aiming to create a “community of communities”. A methodology for community building and management has been depicted; different targeted networks were specified, taking in particular into account relevant active EU projects as well as SAB members as main network representatives, and in addition also others were considered like for instance standardization bodies (ETSI, M2M, W3C). During the second year the involvement of non-expert and user-centric practical mind-set stakeholders was put in place to actively support the development of the new smart city data ecosystem.



Figure 1: Participants of the 1st Summer School on Smart Cities and Linked Open Data

WP2 Energy Efficiency Data Interoperability (AEC3)

D2.1 Strategy for Energy Management System Interoperability

Intent: definition of the boundaries within the Energy Management system domain is represented as well as the identification of the stakeholders that are active in the domain.

Highlights: presentation of a concrete set of methods for collecting, identifying, assessing, and publishing the different resources that enable such interoperability (ontologies, datasets and alignments) (Figure 2 and Figure 3).

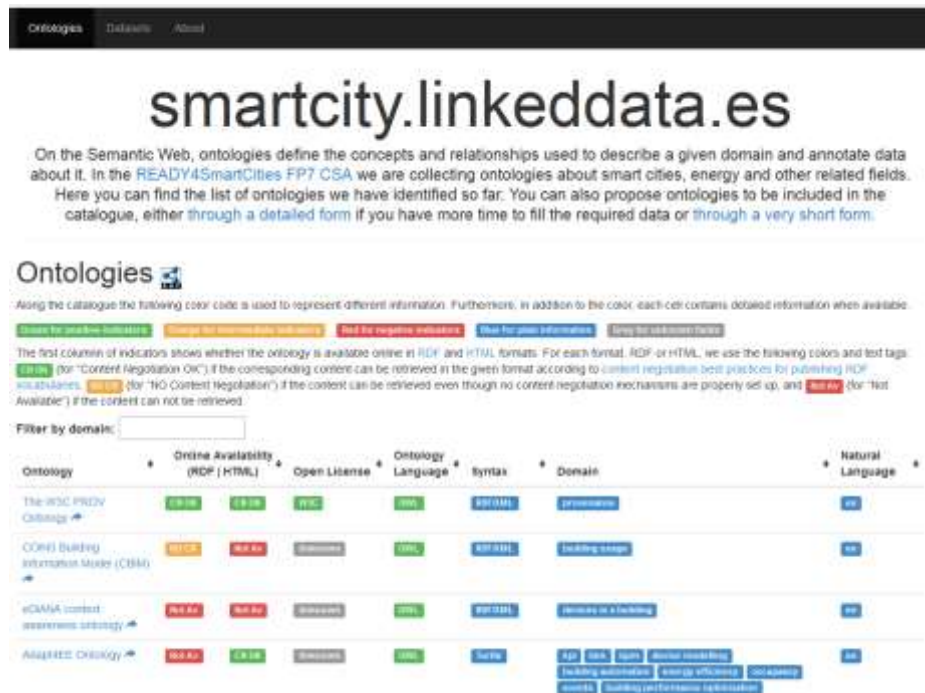


Figure 2: Screenshot of the Ontology catalogue.

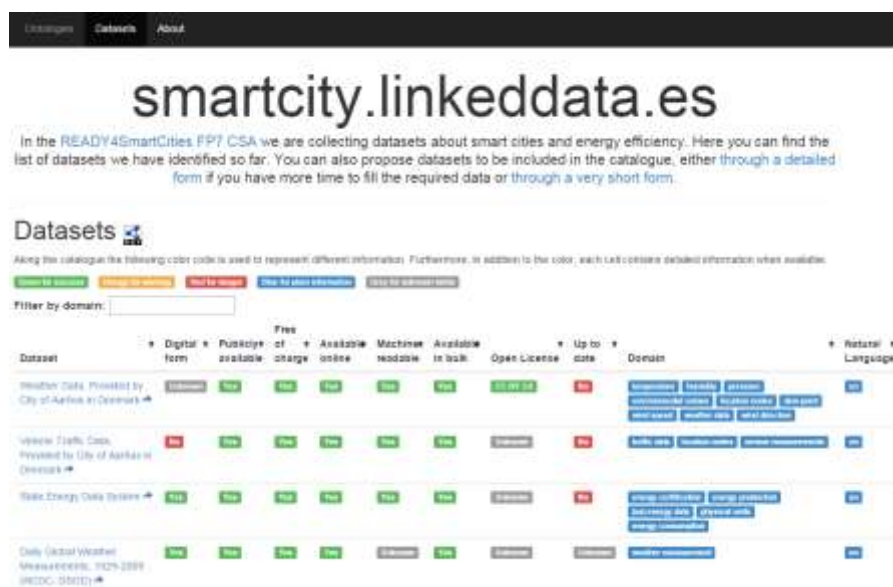


Figure 3: Screenshot of the Dataset catalogue

D2.2 Ontologies and datasets for Energy Management System Interoperability

Intent: to identify the knowledge and data resources that support interoperability for energy management systems.

Highlights: collection of retrieved and identified ontologies and datasets; the recording process of ontologies and datasets consists of: i) definition of the ontology catalogue, ii) definition of the dataset catalogue, iii) implementation of the alignment catalogue as an alignment server sharing alignments on the web, vi) ontology alignments and data links; extraction of the collected ontologies and datasets related to energy management systems.

D2.3 Ontologies and datasets for Energy Management System Interoperability v2

Intent: to identify and assess alignments, both in terms of ontology alignment and data interlinking that support interoperability for energy management systems.

Highlights: Links from the dataset catalogue to the ontology catalogue have been created and included in the web portal. In addition the ontology, dataset and alignment catalogues have been connected in the following way: i) connection from the ontology pages to the alignment server and vice-versa, and ii) connection from the dataset pages to the ontologies within the catalogue and outside.

WP3 Interoperability of Energy Measurement and Validation (EMP)

D3.1 Strategy for Energy Measurement and Validation Interoperability

Intent: definition of the boundaries within the Energy Measurement and Validation domain is represented as well as the identification of the stakeholders that are active in the domain.

Highlights: presentation of a concrete set of methods for collecting, identifying, assessing, and publishing the different resources that enable such interoperability (ontologies, datasets and alignments).

D3.2 Ontologies and datasets for Energy Measurement and Validation Interoperability v1

Intent: to identify the knowledge and data resources that support interoperability for energy measurement and validation.

Highlights: collection of retrieved and identified ontologies and datasets (Figure 4); the recoding process of ontologies and datasets consists of: i) definition of the ontology catalogue, ii) definition of the dataset catalogue, iii) implementation of the alignment catalogue as an alignment server sharing alignments on the web, vi) ontology alignments and data links; extraction of the collected ontologies and datasets relating to energy measurement and validation.

Name	INERTIA Ontology dataset instance
Author and License	Peter Kostelnik (peter.kostelnik@gmail.com), Creative Commons Attribution-NonCommercial 2.0 Generic (CC BY-NC 2.0)
URL	http://www.inertia-project.eu/inertia/files/document/ontologies/dataset-iti-building.n3
Description	Complete ontology instance used in 2nd year project review. Dataset describes whole location context for pilot building together with device equipment. More specifically, the data selected to be published comprise of a set of event-based data collected during one representative day from the multi-sensorial infrastructure deployed at the main INERTIA project's pilot site (a tertiary building with offices and a kitchen at CERTH premises in Thessaloniki, Greece).
Scope (Domain)	Location context, models of devices, consumption data, environmental data, occupancy model
Use cases (Motivation, Relevance)	The dataset example which is publicly available can be utilized as a simple instantiation for the INERTIA ontology. ¹ In general, the data produced during the whole pilot implementation in CERTH premises include real-time and event-based information about distributed energy resources (DERs) consumption behaviour, environmental conditions inside and outside the pilot (temperature, humidity etc.), applied and automated control actions in the DERs as well as building occupants, and group-based and individual detection (RFID-Radio Frequency Identification detection system). The event-based data are recorded towards optimal and automated decision making in real-time without compromising users needs and comfort.
Statistics	The event-based dataset selected provides a representative example of events generated during one day: 2014-12-03. The dataset contains 97507 sensor events (environmental sensors, power consumption sensors, device actuators, etc.) available as semantic information.
Questions	-

Figure 4: Example of recorded dataset

D3.3 Ontologies and datasets for Energy Measurement and Validation Interoperability v2

Intent: to identify and assess alignments, both in terms of ontology alignment and data interlinking that support interoperability for energy measurement and validation interoperability.

Highlights: Links from the dataset catalogue to the ontology catalogue have been created and included in the web portal. In addition the ontology, dataset and alignment catalogues have been connected in the following way: i) connection from the ontology pages to the alignment server and vice-versa (Figure 5), and ii) connection from the dataset pages to the ontologies within the catalogue and outside.

Alignment server commands

- Available alignments
- Load alignments
- Find alignment
- Match ontologies
- Trim alignment
- Invert alignment
- Store alignment
- Render alignment
- Translate query
- Evaluate alignment
- Compare alignment
- Ontology networks
- Server management

Alignment server

Available alignments

Onto1:

Onto2:

- <http://al4sc.inrialpes.fr/alid/1401809057321/6445>
- <http://al4sc.inrialpes.fr/alid/1401809057318/9838>
- <http://al4sc.inrialpes.fr/alid/1401809057317/146>
- <http://al4sc.inrialpes.fr/alid/1401809057313/4148>
- <http://al4sc.inrialpes.fr/alid/1401809057316/1045>
- <http://al4sc.inrialpes.fr/alid/1401809057319/513>
- <http://al4sc.inrialpes.fr/alid/1401809057320/2329>
- <http://al4sc.inrialpes.fr/alid/1401809057311/3806>
- <http://al4sc.inrialpes.fr/alid/1401809057314/7657>
- <http://al4sc.inrialpes.fr/alid/1401809057317/2124>
- <http://al4sc.inrialpes.fr/alid/1401809057313/4392>
- <http://al4sc.inrialpes.fr/alid/1401809057318/3472>
- <http://al4sc.inrialpes.fr/alid/1401809057318/2473>
- <http://al4sc.inrialpes.fr/alid/1401809057320/6662>
- <http://al4sc.inrialpes.fr/alid/1401809057317/4944>
- <http://al4sc.inrialpes.fr/alid/1401809057313/5697>

Alignment server

Figure 5: Alignment Server functionalities

WP4 Requirements and guidelines for energy data management (UPM)

D4.1 Requirements and guidelines for energy data generation

Intent: to enable a new energy data ecosystem that supports the interoperability and exploitation of data by adopting Semantic Web standards and technologies.

Highlights: requirements and a set of guidelines for the generation of Linked Data in the energy domain, derived and developed from a survey conducted with various stakeholders. These guidelines help organizations in the energy domain from both public and private sectors in generating Linked Data from already-existing data, by providing detailed descriptions of each task in the generation process (Figure 6).

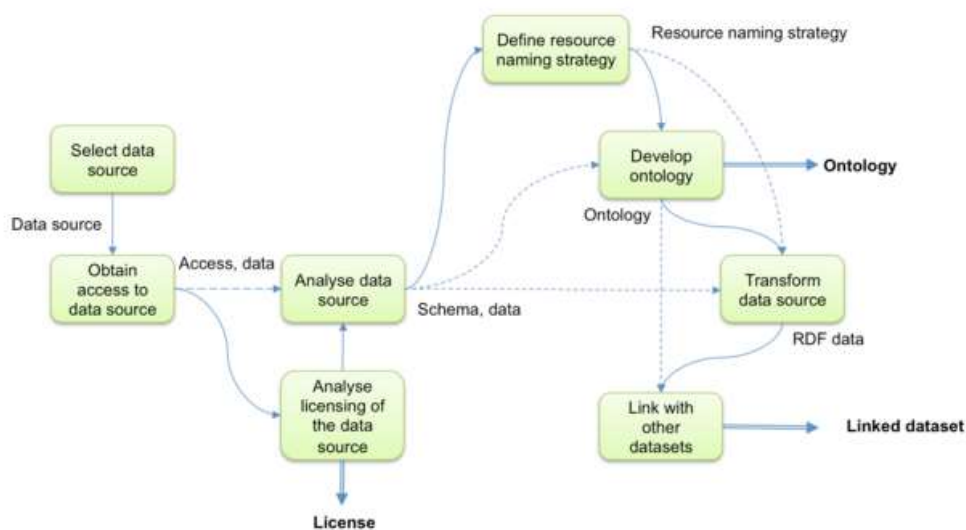


Figure 6: Steps for Linked Data generation

D4.2 Requirements and guidelines for energy data publication

Intent: to present a set of guidelines for Linked Data publication on the Web in the energy domain.

Highlights: the defined and assessed guidelines help public and private organizations in the energy domain in publishing Linked Data from already-existing data, by providing detailed descriptions of each task in the publication process (Figure 7).

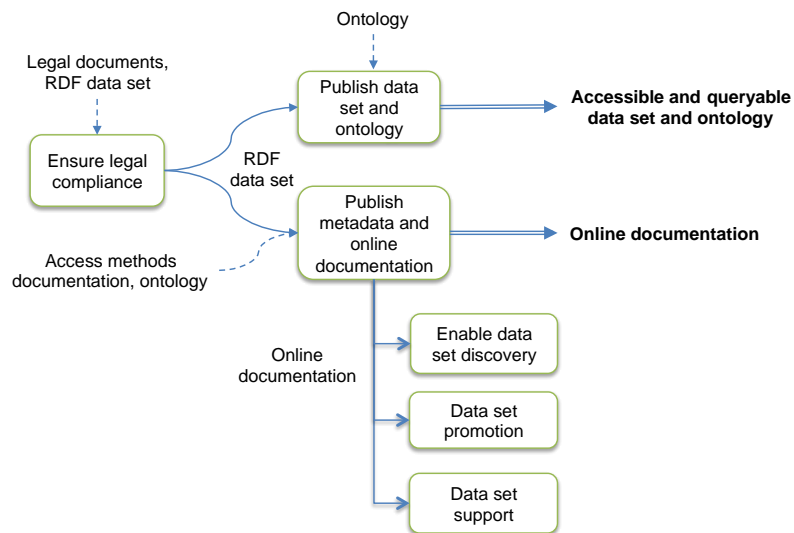


Figure 7: Steps for Linked Data publication

D4.3 Requirements and guidelines for energy data exploitation

Intent: to present a set of guidelines for Linked Data exploitation in the energy domain.

Highlights: the defined and assessed guidelines help public and private organizations in the energy domain in publishing Linked Data from already-existing data, by providing detailed descriptions of each task in the exploitation process (Figure 8).

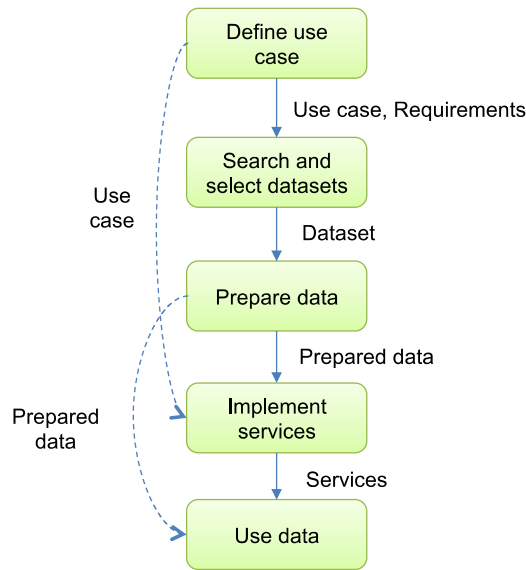


Figure 8: Steps for Linked Data exploitation

WP5 Framework and Vision of ICT for Energy Systems in Smart Cities (VTT)

D5.1 Conceptual framework and methodology

Intent: definition of the conceptual framework and methodology” as basis for the elaboration of a vision and a roadmap for ICT supporting energy systems in smart cities.

Highlights: a common terminology of key concepts for energy systems in smart cities in order to bridge the different units of measurement, languages, practices and terminologies used by each of the concerned sectors; a plan describing how to integrate results from WPs 1, 2, 3 and 4 into WP5 – and correspondingly – provide guidance to those WPs regarding the expected content and format of their results; a taxonomy/classification of RTDI (research, technology development and innovation) topics.

D5.2 Vision of Energy system in Smart Cities

Intent: extrapolation beyond the state-of-the-art by envisioning future scenarios stating the development needs for energy systems of smart cities and especially on how ICT is enabling it.

Highlights: a vision for ICT supporting energy systems in smart cities was presented as a set of visionary scenarios, which describe foreseen and desirable developments and innovations as well as best practices and opportunities for a widespread knowledge transfer appearing in the horizon of the next 10 years and beyond (Figure 9).



Figure 9: Vision for the READY4SmarCities roadmap

D5.4 Implementation recommendations

Intent: to suggest the actions and roles for the key stakeholders in the development of optimized energy systems in smart cities.

Highlights: A summary of the suggested implementation recommendations is shown in Figure 10. The efficient knowledge transfer between the stakeholders is essential. Thus, the interoperability and related ICT technologies enable different energy networks and systems to be optimally operated in the context of a smart city.

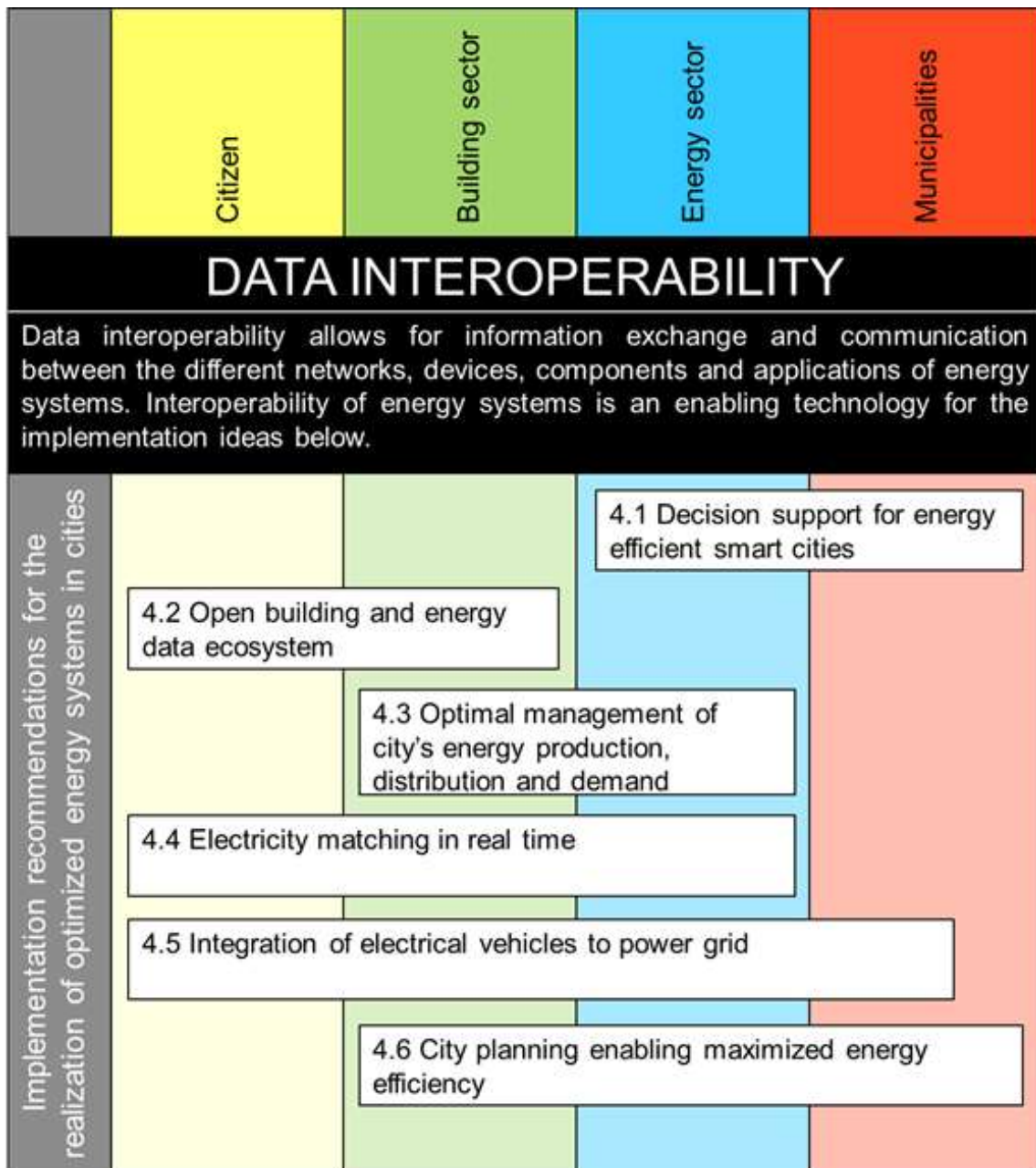


Figure 10: The implementation recommendation topics as suggested in D5.4

D5.5 Impact assessment

Intent: to describe the impacts of the actions, and therefore necessary ICT components and processes, which enable to plan and operate cities energy systems efficiently and in a sustainable manner.

Highlights: an evaluation of the impacts of the actions suggested in the roadmap for citizens, and building, energy, and municipality sectors.

D5.6 Innovation and Research Roadmap

Intent: Suggest innovation and research roadmap for ICTs supporting energy systems in smart cities.

Highlights: the final innovation and research roadmap suggests research and technical development and innovation activities in short, medium and long term as well as development and innovation of ICTs for holistic design, planning and operation of energy systems in smart cities. In addition, synergies with other ICT systems for smart cities are considered.

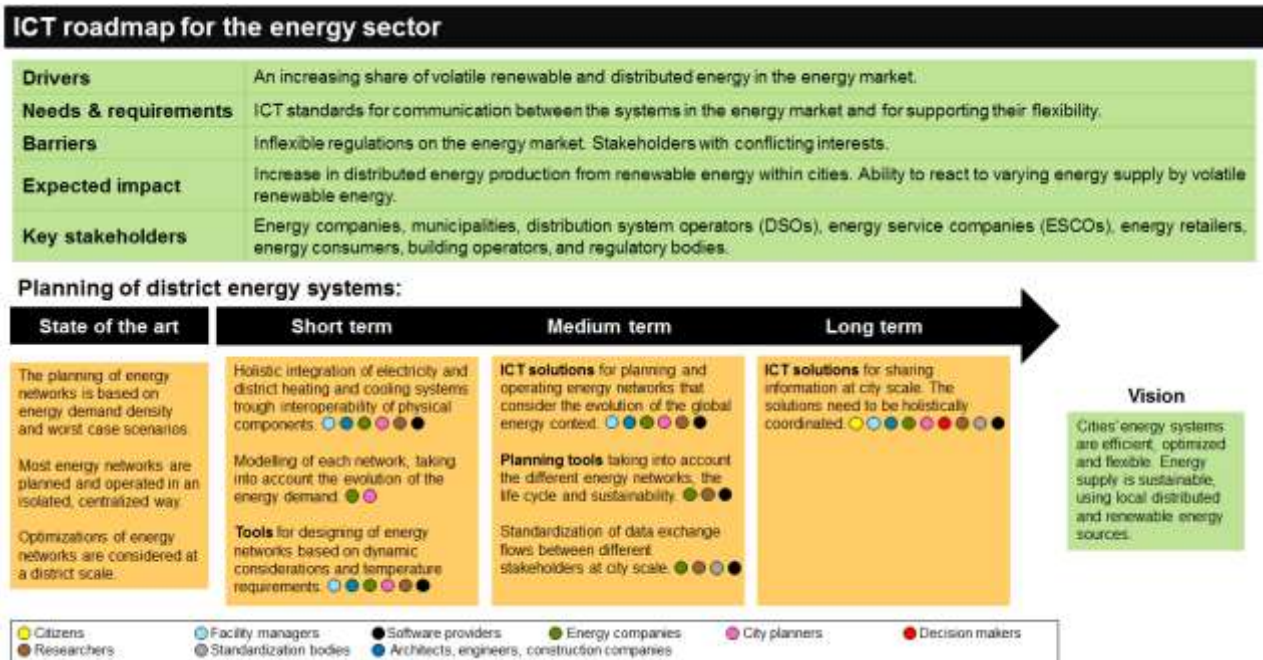


Figure 11: Example of a roadmap section for energy sector

Potential Impact

European countries and cities are increasingly adding to their agendas targets to improve sustainability. Also the image of the city as a forerunner and smart city supports the business environment and attracts companies to the city. Opportunities are seen for improving energy efficiency via integration and linking of different energy systems. ICT literacy of people and emerging technologies such as Open Data and Internet of Things offer new opportunities for wide engagement of citizens, municipalities, and in overall for the system integration.

Within this background READY4SmartCities has demonstrated the capacity to:

- Define **consolidated strategies** for identifying the available knowledge and data resources that support the interoperability of energy management systems and energy measurement and validation;
- Release reliable, efficient, and open tools for the: i) **collection of ontologies and datasets** through a special online catalogue capable to collected and recorded resource in a **standardised way**, and ii) **collection of alignments** through an alignment server capable to identify and document links and alignments among the identified ontologies and datasets;
- Develop and release a set of **reference guidelines** capable to cover the whole life cycle of generating, publishing and exploiting Linked Data for smart cities;
- Suggest to the European Commission the future RTD and innovation needs for ICTs supporting energy systems in smart cities through the tailored **innovation and research roadmap**.

Quantifiable and significant reduction of energy consumption and CO₂ emissions achieved through ICT

As a coordination and support action, READY4SmartCities is contributing the European Smart Cities field development by providing guidelines and support for energy data interoperability. The roadmap suggest development needs that support the transition to an energy-efficient low carbon economy through the establishment and more efficient use of smart grid, smart metering, building and construction modelling and simulation technologies, and hence, contributing to the reduction of energy consumption and CO₂ emissions in the long term.

READY4SmartCities shortens the gaps currently present in some Smart Cities platform and initiative by putting the key pillars for generating a new smart city data ecosystem based on Web standards. The barriers (both technical and related to data privacy and security) that may be faced by people (e.g., companies, municipalities, citizens) interested in publishing or using energy open data could be now overcome exploiting the set of tools (i.e. catalogues and guidelines) developed in the project and made available for a free usage to supporting open linked data and interoperability development for efficient energy systems in smart cities.

Adoption of ICT by city authorities

European cities, in order to become “a smart city”, have a strong need for broad collaboration, communication and interoperability within various stakeholder networks. This requires standardisation (of

data models, data exchange, interfaces and systems themselves) to enable the cross-organisational operation.

READY4SmartCities will make and impact identifying the key concepts in the inter-related domains, mainly ICT, energy, buildings and cities suggesting terms and definitions for these concepts. This terminology is used as a common language by the community already active in the framework of Smart Cities in communication with technical stakeholders.

The READY4SmartCities’ **innovation and research roadmap** has multiple goals. Among others, it aimed to increase citizens’ involvement and their active role in the daily operation, use and decision making related to energy aspects. On the building side, the energy performance of the Buildings Directive adopted by EC drives buildings to become (nearly) zero energy buildings that are actually active prosumers, which both use energy efficiently and also produce renewable energy on-site. The vision is that buildings are connected objects optimised to balance their energy behaviour to maximise the comfort of inhabitants and to act as energy providers when required by external actors of the energy systems. This again requires among others the smart use of data, which means data acquisition, data storage, and data profiling from the building environment but also from other domains (energy grids, transportation systems, weather and urban activities at large). Through the new smart city data ecosystem set in the context of the project, READY4SmartCities will generate an impact for this profiling activity: interoperability is ensured at different levels (physical level: the sensors, actuators, and acquisition systems are connected to each other, and communication protocols, data structures and semantics are shared).

Roadmap section	RTD and innovation focus topics
Citizen	<ul style="list-style-type: none"> • Participation to building design • User behaviour and decision support for energy efficient living and working
Building sector	<ul style="list-style-type: none"> • Planning of buildings • Planning and implementation of building renovation • Controlling energy performance of buildings • Building energy performance validation and management
Energy sector	<ul style="list-style-type: none"> • Planning of district energy system • Demand side management • District electricity management • District heating and cooling management • Cities’ energy performance validation and management • Energy trading and brokering
Municipalities	<ul style="list-style-type: none"> • Electrical vehicles integration to cities’ energy systems • City planning enabling maximized energy efficiency
Energy data	<ul style="list-style-type: none"> • Development and harmonization of energy data models • Open energy data, ecosystems and regulations • Smarter use of energy data

Figure 12: A summary of the roadmap sector topics

Finally, the close collaboration with the ETSI M2M Smart Appliance working groups, and with the newly formed W3C Linked Building Data Community Group as well as the buildingSMART Linked Data Work Group represents the main impact generated by READY4SmartCities project for ensuring the awareness **towards a community of experts** such as **standardisation bodies** and for facilitating the activities carried out by the European Commission.

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4.2 Use and dissemination of foreground

Section A (public)

A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers ³ (if available)	Is/Will open access ⁴ provided to this publication?
1	<i>Introduction to top-level contents of catalogued vocabularies and future strategies</i>	<i>Asunción Gómez Pérez, Raúl García-Castro, María Poveda Villalón, and Filip Radulovic</i>	<i>I-Know 2014</i>		<i>UPM</i>	<i>Austria</i>	<i>2014</i>			Yes
2	<i>Building an ontology catalogue for smart cities</i>	<i>Asunción Gómez Pérez, Raúl García-Castro, María Poveda Villalón, and Filip Radulovic</i>	<i>ECPPM 2014</i>		<i>UPM</i>	<i>Austria</i>	<i>2014</i>			Yes
3	<i>ICT Road MAP for Supporting Energy Systems in Smart Cities</i>	<i>Mari Sepponen, Bruno Fiès, and Raúl García-Castro</i>	<i>40th IAHS Sustainable Housing Construction, conference proceedings</i>		<i>VTT, CSTB, UPM</i>	<i>Portugal</i>	<i>2014</i>			No
4	<i>Interoperable Energy Systems – Research and Innovation Strategy for ICT</i>	<i>Mari Hukkalainen, Elina Grahn, Bruno Fiès, Andrea Cavallaro, and Matthias Weise</i>	<i>Sustainable Places 2015, conference proceedings</i>		<i>VTT, CSTB, DAPP, AEC3</i>	<i>Italy</i>	<i>2015</i>	<i>181-189</i>	http://sustainable-places.eu/wp-content/uploads/2015/11/Proceedings-SP2015_compressed.pdf	Yes

³ A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).

⁴ Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

A2: LIST OF DISSEMINATION ACTIVITIES

NO.	Type of activities ⁵	Main leader	Title	Date/Period	Place	Type of audience ⁶	Size of audience	Countries addressed
1	Presentation	UPM and INRIA	4th VoCamp on "Integrating multiple domains and scales"	13-14 February 2014	Barcelona / Spain	Scientific Community & Academic	30 to 35 attendees	EU28
2	Presentation	UPM	5th VoCamp on Device & Sensor Ontologies	20-21 May 2014	Sankt Augustin / Germany	Scientific Community & Academic	20 Attendees	EU28
3	Presentation	UPM & AEC3	6th VoCamp on Linked Data in Architecture and Construction	20-27 May 2014	Espoo / Finland	Scientific Community & Academic	30 Attendees	EU28
4	Workshop	CSTB	ECTP	17-19 June 2014	Brussels Belgium /	Industry & Academic	150 Attendees	EU28
5	Poster	CSTB	ECTP	17-19 June 2014	Brussels Belgium /	Industry & Academic	150 Attendees	EU28
6	Workshop	UPM	I-Know 2014	16-19 September 2014	Graz / Austria	Scientific Community, Industry & Academic	n.a.	EU28
7	Conference	CSTB, AEC3, POLITO, and UPM	ECPPM 2014	17-19 September 2014	Vienna Austria /	Scientific Community, Industry & Academic	150 Attendees	EU28
8	Poster	CSTB	ECPPM 2014	17-19 September 2014	Vienna Austria /	Scientific Community, Industry & Academic	150 Attendees	EU28
9	Workshop	ALL	Sustainable Places 2014	1-3 October 2014	Nice / France	Scientific Community,	150 Attendees	EU28

⁵ A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

⁶ A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).

A2: LIST OF DISSEMINATION ACTIVITIES

NO.	Type of activities ⁵	Main leader	Title	Date/Period	Place	Type of audience ⁶	Size of audience	Countries addressed
						<i>Industry & Academic</i>		
10	<i>Fair</i>	<i>AIT</i>	<i>SmartCity Expo</i>	<i>18-20 November 2014</i>	<i>Barcelona / Spain</i>	<i>Scientific Community, Industry, Civil Society, Policy makers & Academic</i>	<i>n.a.</i>	<i>EU28</i>
11	<i>Congress</i>	<i>VTT</i>	<i>40th IAHS Sustainable Housing Construction</i>	<i>15-19 December 2014</i>	<i>Funchal / Portugal</i>	<i>Scientific Community, Industry & Academic</i>	<i>300 Attendees</i>	<i>37 countries Worldwide</i>
12	<i>Paper</i>	<i>VTT</i>	<i>40th IAHS Sustainable Housing Construction</i>	<i>15-19 December 2014</i>	<i>Funchal / Portugal</i>	<i>Scientific Community, Industry & Academic</i>	<i>300 Attendees</i>	<i>37 countries Worldwide</i>
13	<i>Workshop</i>	<i>DAPP, UPM, and AIT</i>	<i>7th VoCamp on "Energy measurement data in municipalities"</i>	<i>22-23 April 2015</i>	<i>Vienna / Austria</i>	<i>Scientific Community & Academic</i>	<i>25 Attendees</i>	<i>EU28</i>
14	<i>School</i>	<i>UPM, INRIA, and CETH/ITI</i>	<i>1st Summer School on Smart Cities and Linked Open Data (LD4SC-15)</i>	<i>7-12 June 2015</i>	<i>Madrid / Spain</i>	<i>Scientific Community, Industry, Civil Society, and Academic</i>	<i>27 Attendees</i>	<i>EU28</i>
15	<i>Workshop</i>	<i>DAPP, CSTB, INRIA, AEC3, and CETH/ITI</i>	<i>8th VoCamp on "Supporting open linked data and interoperability for efficient energy systems in smart cities"</i>	<i>14-15 September 2015</i>	<i>Genova / Italy</i>	<i>Scientific Community, Industry & Academic</i>	<i>20 Attendees</i>	<i>EU28</i>
16	<i>Workshop</i>	<i>DAPP</i>	<i>Sustainable Places 2015</i>	<i>16-17 September 2015</i>	<i>Savona / Italy</i>	<i>Scientific Community, Industry, Civil Society, Policy makers & Academic</i>	<i>150 Attendees</i>	<i>EU28</i>

A2: LIST OF DISSEMINATION ACTIVITIES

NO.	Type of activities ⁵	Main leader	Title	Date/Period	Place	Type of audience ⁶	Size of audience	Countries addressed
17	Presentation	DAPP, VTT, CSTB	Sustainable Places 2015	16-17 September 2015	Savona / Italy	Scientific Community, Industry, Civil Society, Policy makers & Academic	150 Attendees	EU28
18	Paper	VTT, DAPP, CSTB, and AEC3	Sustainable Places 2015	16-17 September 2015	Savona / Italy	Scientific Community, Industry, Civil Society, Policy makers & Academic	150 Attendees	EU28

4.3 Report on societal implications

A General Information *(completed automatically when Grant Agreement number is entered.)*

Grant Agreement Number: 608711

Title of Project: ICT Roadmap and Data Interoperability for Energy System in Smart Cities

Name and Title of Coordinator: Andrea Cavallaro

B Ethics

<p>1. Did your project undergo an Ethics Review (and/or Screening)?</p> <ul style="list-style-type: none"> • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? <p>Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 'Work Progress and Achievements'</p>	No
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<p>2. Please indicate whether your project involved any of the following issues (tick box) :</p>	YES
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RESEARCH ON HUMANS

- | | |
|---|--|
| • Did the project involve children? | |
| • Did the project involve patients? | |
| • Did the project involve persons not able to give consent? | |
| • Did the project involve adult healthy volunteers? | |
| • Did the project involve Human genetic material? | |
| • Did the project involve Human biological samples? | |
| • Did the project involve Human data collection? | |

RESEARCH ON HUMAN EMBRYO/FOETUS

- | | |
|---|--|
| • Did the project involve Human Embryos? | |
| • Did the project involve Human Foetal Tissue / Cells? | |
| • Did the project involve Human Embryonic Stem Cells (hESCs)? | |
| • Did the project on human Embryonic Stem Cells involve cells in culture? | |
| • Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos? | |

PRIVACY

- | | |
|---|--|
| • Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)? | |
| • Did the project involve tracking the location or observation of people? | |

RESEARCH ON ANIMALS

- | | |
|---|--|
| • Did the project involve research on animals? | |
| • Were those animals transgenic small laboratory animals? | |
| • Were those animals transgenic farm animals? | |
| • Were those animals cloned farm animals? | |
| • Were those animals non-human primates? | |

RESEARCH INVOLVING DEVELOPING COUNTRIES

- | | |
|---|--|
| • Did the project involve the use of local resources (genetic, animal, plant etc)? | |
| • Was the project of benefit to local community (capacity building, access to healthcare, education etc)? | |

DUAL USE

• Research having direct military use	<i>No</i>
• Research having the potential for terrorist abuse	

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	3	4
Work package leaders	2	4
Experienced researchers (i.e. PhD holders)	1	2
PhD Students	2	3
Other	12	27

4. How many additional researchers (in companies and universities) were recruited specifically for this project?

Of which, indicate the number of men:

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project? Yes No

6. Which of the following actions did you carry out and how effective were they?

- | | Not at all
effective | Very
effective |
|---|-------------------------|-------------------|
| <input type="checkbox"/> Design and implement an equal opportunity policy | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| <input type="checkbox"/> Set targets to achieve a gender balance in the workforce | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| <input type="checkbox"/> Organise conferences and workshops on gender | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| <input type="checkbox"/> Actions to improve work-life balance | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| <input type="radio"/> Other: <input style="width: 200px;" type="text"/> | | |

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

Yes- please specify

No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

Yes- please specify

No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

Yes- please specify

No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

Main discipline⁷: Engineering and technology

Associated discipline⁷: ICT, and energy system Associated discipline⁷:

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? (if 'No', go to Question 14) Yes No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

No

Yes- in determining what research should be performed

Yes - in implementing the research

Yes, in communicating /disseminating / using the results of the project

⁷ Insert number from list below (Frascati Manual).

13c If Yes, at which level? <input type="radio"/> Local / regional levels <input type="radio"/> National level <input checked="" type="radio"/> European level <input type="radio"/> International level		
H Use and dissemination		
14. How many Articles were published/accepted for publication in peer-reviewed journals?		
To how many of these is open access⁸ provided?		
How many of these are published in open access journals?		
How many of these are published in open repositories?		
To how many of these is open access not provided?		
Please check all applicable reasons for not providing open access:		
<input type="checkbox"/> publisher's licensing agreement would not permit publishing in a repository <input type="checkbox"/> no suitable repository available <input type="checkbox"/> no suitable open access journal available <input type="checkbox"/> no funds available to publish in an open access journal <input type="checkbox"/> lack of time and resources <input type="checkbox"/> lack of information on open access <input type="checkbox"/> other ⁹ :		
15. How many new patent applications ('priority filings') have been made? <i>("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).</i>		
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	
	Registered design	
	Other	
17. How many spin-off companies were created / are planned as a direct result of the project?		
<i>Indicate the approximate number of additional jobs in these companies:</i>		
18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:		
<input type="checkbox"/> Increase in employment, or <input type="checkbox"/> Safeguard employment, or <input type="checkbox"/> Decrease in employment, <input type="checkbox"/> Difficult to estimate / not possible to quantify	<input type="checkbox"/> In small & medium-sized enterprises <input type="checkbox"/> In large companies <input type="checkbox"/> None of the above / not relevant to the project	
19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (FTE = one person working fulltime for a year) jobs:	<i>Indicate figure:</i>	

⁸ Open Access is defined as free of charge access for anyone via Internet.

⁹ For instance: classification for security project.

Difficult to estimate / not possible to quantify	<input type="checkbox"/>
I Media and Communication to the general public	
20. As part of the project, were any of the beneficiaries professionals in communication or media relations?	
<input type="radio"/> Yes	<input checked="" type="radio"/> No
21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?	
<input checked="" type="radio"/> Yes	<input type="radio"/> No
22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?	
<input type="checkbox"/> Press Release <input type="checkbox"/> Media briefing <input type="checkbox"/> TV coverage / report <input type="checkbox"/> Radio coverage / report <input checked="" type="checkbox"/> Brochures /posters / flyers <input type="checkbox"/> DVD /Film /Multimedia	<input type="checkbox"/> Coverage in specialist press <input type="checkbox"/> Coverage in general (non-specialist) press <input type="checkbox"/> Coverage in national press <input type="checkbox"/> Coverage in international press <input checked="" type="checkbox"/> Website for the general public / internet <input checked="" type="checkbox"/> Event targeting general public (festival, conference, exhibition, science café)
23 In which languages are the information products for the general public produced?	
<input type="checkbox"/> Language of the coordinator <input type="checkbox"/> Other language(s)	<input checked="" type="checkbox"/> English

Question F-10: Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

- 1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]
- 1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)
- 1.3 Chemical sciences (chemistry, other allied subjects)
- 1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)
- 1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2. ENGINEERING AND TECHNOLOGY

- 2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)
- 2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]
- 2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as

geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

- 3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immuno-haematology, clinical chemistry, clinical microbiology, pathology)
- 3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)
- 3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

- 4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)
- 4.2 Veterinary medicine

5. SOCIAL SCIENCES

- 5.1 Psychology
- 5.2 Economics
- 5.3 Educational sciences (education and training and other allied subjects)
- 5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary, methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

- 6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)
- 6.2 Languages and literature (ancient and modern)
- 6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]